Change in Operations Application

South Middleback Range Mining Area

Miscellaneous Purposes Licence 32 (new activity)

15 August 2024



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This document has been commissioned by SIMEC Mining and prepared by JBS&G Australia Pty Ltd.

Declaration of Accuracy

This document has been prepared to fulfil the requirement under Regulation 84 (1)(b) of the *Mining Regulations 2020,* determining the minimum information required to be provided in a Change in Operations Review application.

Accountable Manager Review

I, **Chris Smyth**, have taken the following steps to review the information in this Change in Operations Application to ensure its accuracy:

- Implementing an audit process against the terms of reference to ensure the minimum requirements have been addressed
- An internal process for review, endorsement or sign off by senior management or executive
- independent peer review by a suitably qualified and experienced consultant
- internal peer review by a suitably qualified and experienced company employee.

Name	Position	Signature	Date
Chris Smyth	Group Manager – Environment, Regulatory and Stakeholder		15 August 2024

Declaration for the purposes of Regulation 84 of the *Mining Regulations 2020*

I declare that OneSteel Manufacturing Pty Limited has taken reasonable steps to review the information in this Change in Operations Application to ensure its accuracy.

Name	Position	Signature	Date
Sanjay Bhartia	Attorney pursuant to power of attorney dated 8 December 2023		15 August 2024

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1. Introduction

SIMEC Mining through its legal entity, OneSteel Manufacturing Pty Limited (OneSteel) is the holder of several mining assets in the South Middleback Range (SMR) Mining Area, including Miscellaneous Purposes Licence 32 (MPL32). The main current use of MPL32 is the road connecting SMR operations to the Lincoln Highway.

SIMEC Mining is seeking approval for a Change in Operations (CiO) for MPL32 to:

- change the authorised operations; and
- change the terms and conditions of the tenement.

Any reference to SIMEC Mining or SIMEC is deemed to be a reference to the holder and operator of the SMR mining operations, OneSteel.

1.1 Context

A Change in Operations (CiO) application must comply with Section 56(R)(b)(i) of the *Mining Act 1971* (Mining Act) (SA) and Regulations 55 and 56 of the *Mining Regulations 2020* (Mining Regulations) (SA) as well as with Terms of Reference (TOR) 025 (Change in Operations Application) (MD025) (Department for Energy and Mining, 2020). Additional guidance regarding changes to an operational mine are included in both Ministerial Guideline 35 (MG35) (Applying for a Change in Operations) (Department for Energy and Mining, 2023) and Ministerial Guideline 2b (MG2b) Section 12 (Assessment of Proposed Changes to an Operation).

Both MG35 and MG2b require that a proponent complete a self-assessment for each proposed CiO. The significance level of that assessment determines the need to provide the assessment to the Department for Energy and Mining (DEM) for further consideration and acceptance or approval.

This application applies to MPL32, part of SIMEC's SMR mining area and provides a self-assessment against existing approval conditions regarding the construction, operation and ultimate rehabilitation of a waste rock dump expansion, new topsoil stockpile and access road re-alignment, which is required to support the Magnetite Expansion Project Stage 1 (MEP1, the Project).

The structure of this document follows the sections detailed in Table 1-1.

Table 1-1: Structure of Change in Operations application

Section	Description
2	Details the required changes to authorised operations
3.1	Details the assessment against existing MPL conditions
3.2	Details a preliminary environmental impact assessment review and assessment against existing Outcomes and Measurement Criteria
3.3	Details SIMEC's reasonable prospect of access to land for proposed MPL32 activities
3.4	Details stakeholder consultation which has been undertaken in support of the proposed changes
4	Summarises the proposed change in operations

1.2 Operational status

The SMR mining area operates in accordance with a Program for Environment Protection and Rehabilitation (PEPR), currently MPEPR2023/026 (WPC-243 Rev 1), approved by DEM on 19 September 2023.

1.3 Self-Assessment process

SIMEC has completed a self-assessment to determine the significance level of the proposed CiO against the scope (including terms and conditions) of MPL32 and the corresponding PEPR (WPC-243 Rev 1) in accordance with the requirements of Section 12 of MG2b.

Reference has been made to MD025 and MG35 for specific requirements and the relevant form to be submitted to support this CiO. The requirements for the self-assessment are:

"An application for a change in operations under Part 8B Division 7 of the Mining Act 1971 must:

- *comply with section 56R of the Mining Act 1971, regulation 55 of the Mining Regulations 2020 and any determinations set out in the Terms of Reference 025;*
- *be accompanied by a declaration of accuracy that complies with regulation 84 of the Mining Regulations 2020;*
- *be accompanied by a statement in accordance with regulation 55(1)(c) of the Mining Regulations 2020; and*
- *be accompanied by the relevant application fee.*

To determine the significance of any proposed change, the self-assessment should cover the following decision process:

- *Is the proposed change outside of the scope of, or inconsistent with, the operations that were approved in the Mining Lease Proposal (MLP)? This does not just include the change itself but also secondary aspects, such as water and energy use, land clearance etc.*
- *Is the proposed change inconsistent with (i.e. a material alteration) the operations that were approved in the current PEPR? As above, this includes secondary aspects.*
- *Does the change result in new, or significantly greater, environmental impacts that were not assessed within the original MLP?*
- *Would the change result in a non-compliance with the tenement lease terms and conditions?*
- *Would the change reduce our ability to meet the approved Environmental Outcomes relevant to the tenement/operation/mining area, or would the change require introduction of an "essential" control to meet the outcomes that itself would require a Leading Indicator?*
- *Does the change require new native vegetation clearance?"*

2. Change in Proposed Operations

2.1 Site details and tenure

General site details for the SMR are presented in Table 2-1.

Table 2-1: Site and Tenement Details

Aspect	Description	
Mine operation	South Middleback Range Mining Area	
General location	Approximately 50 km south-east of Whyalla	
Mine operator	OneSteel Manufacturing Pty Limited	
Tenement	Miscellaneous Purposes Licence 32	
Holder	OneSteel Manufacturing Pty Limited	**Expiry Date**: 14/07/2030

2.2 Description of proposed Changes in Operations

2.2.1 Objectives

Changes to the current authorised operations for MPL32 are required to support MEP1.

MEP1 objectives include:

- to increase total magnetite concentrate production;
- as hematite reserves deplete, transition to increase magnetite production to supply the Whyalla Steelworks into the future and for export;
- to produce a high-grade product with direct reduction quality, enabling low carbon iron and steel production – demand driven by emerging green steel and hydrogen markets and associated steel making technology, Electric Arc Furnaces;
- upgrades to the concentrator process enabling utilisation of ore that was considered waste, extending the life of mine; and
- introduction of new technology to reduce SIMEC's carbon emissions per tonne of iron ore produced.

The objective of this Change in Operations is to enable waste rock and topsoil to be stored within MPL 32, as well as any associated monitoring infrastructure (such as monitoring wells) to support as required.

Details of the required changes are detailed in Section 2.2.3 and 2.2.4.

2.2.2 Overarching MEP1 approvals

Table 2-2 outlines the main components of MEP1 and the overarching approvals already in place, together with the four key approval documents required to implement the Project. The four key approvals documents are:

- CiO (southern WRD) (this document);

- MEP1 Stage 1 PEPR (including processing upgrades and Mag TSF embankment raise 9);
- CiO (Iron Knight in pit tailings); and
- MEP1 Stage 2 PEPR (incorporating Iron Knight in pit tailings).

Table 2-2: Approval status of MEP1 major components

Component	Approval Status
Existing mine pit to 20m RL	Approved and underway
Existing Concentrator	Approved, built and in operation
Mag Tailings Storage Facility (TSF) up to Raise 8	Approved, built and in operation
Transmission line	Approved, built and in operation
Slurry and return water pipeline to Whyalla	Approved, built and in operation
Flotation	Primary approval (ML) in place. Incorporation into Stage 1 PEPR.
DLIMS	Primary approval (ML) in place. Incorporation into Stage 1 PEPR.
Northern Waste Rock Dump	Approved
Southern Waste Rock Dump	Primary approval (MLs and MPLs) in place. Change in Operations (this document) and subsequent incorporation into Stage 1 PEPR.
MagTSF Raise 9	Primary approval (MPL) in place. Incorporation into Stage 1 PEPR.
Expanded mine pit	Primary approval (MLs) in place. Incorporation into Stage 1 PEPR.
Iron Knight in-pit tailings	Primary approval (ML) in place. Change in Operations, and subsequent incorporation into a Stage 2 PEPR.

2.2.3 Background

The SMR mining region includes Iron Duke, Iron Magnet, Iron Duchess North and South, Iron Knight North and South, Iron Chieftain, Cooks North (including Cooks North West) and associated processing, all of which operate in accordance with MPEPR2023/026 (WPC-243 Rev 1).

Since 2007, SIMEC Mining has operated its SMR magnetite concentrator, processing magnetite ores from its Iron Magnet pit situated at the southern end of the Middleback Ranges. This ore mix incorporates various geological types of magnetite, primarily magnetite carbonate (MTC) and magnetite silica ores (MTS), with MTC being the predominant feed type into the existing concentrator. This feed blending strategy enables the concentrator to achieve a nominal 35% to 40% mass recovery, producing a concentrate with a silica content of 4% to 4.5%, meeting the Whyalla Steelworks blast furnace (BF) specifications.

The existing life of mine (LOM) plan, sustaining the current ore blending and processing strategy, is projected to conclude by the end of 2027, coinciding with the depletion of the current magnet pit. While there are possibilities for pit extensions, these require a shift in ore composition from carbonate to predominantly siliceous MTS ore.

As such, SIMEC are proposing to extend into the Duchess South pit as part of MEP1 which is set to increase silica levels, leading to a reduced mass recovery rate at 32% compared with the 35% to 40% from the current mining operation. To address this, the existing concentrator, which is currently equipped to produce 2.2 million tonnes per annum (Mtpa) at BF-grade concentrate, will require an upgrade. As the ore feed transitions from MTC to MTS, the increased silica content poses a variety of processing challenges. These upgrades primarily consist of the addition of upfront dry low intensity magnetic separation (DLIMS) to upgrade the feed, increased wet magnetic separation and grinding capacity in parallel with the current concentrator (debottlenecking) and the addition of a final reverse flotation stage to produce the high-grade product.

MEP1 will increase total magnetite concentration production rate from 2.2 to 2.5 Mtpa.

The MEP1 mine pit extension and processing upgrades will be reflected within an updated PEPR to be submitted to the DEM for review.

The changes relevant to this CiO are specific to those on MPL32 only, as detailed in Section 0.

Currently, MPL32 is authorised only for the provision of an access track from the Lincoln Highway to the mine site.

Table 2-3 outlines relevant property titles contained within the boundaries of MPL32.

Table 2-3: Land titles and tenure

Tenement	Title Reference	Land Tenure
MPL32	CR 6059/799	Crown Record
	CT 6057/546	Freehold

2.2.4 Detailed description of the change

Waste rock storage is not currently a licenced activity on MPL32. This Change in Operations seeks to add this to the Licence conditions, as well as topsoil storage and other minor ancillary infrastructure to support the mining operation.

The information provided within this Change in Operations is intended to be utilised to update the current SMR PEPR (MPEPR2023/026), in a revision which describes the activities proposed as part of MEP1.

Waste rock produced by MEP1 will be partly accommodated in the existing and approved northern and southern Waste Rock Dumps (WRD) on MPL34, MPL72, MPL135, ML 4717, ML 2714, ML 2715, ML 2716, ML 4720, ML 4721, ML 2648 and ML 4722. However, to provide the required capacity to accommodate the additional material generated by MEP1, the southern WRD requires expansion outside of its existing approved capacity (as described in MPEPR2023/026).

The expansion of the southern WRD will see it grow into MPL32. A consequence of the expansion is that it will increase vegetation clearance, reduce the setback to the Lincoln Highway by approximately 370 m and require the existing access road on MPL32 to be realigned to the south and west of the WRD.

Additionally, a new topsoil stockpile is proposed to support MEP1.

MPL32's current authorised operations are for the construction and use of an access road from the Lincoln Highway to the mine site, and as such are not sufficient for the works required to support MEP1. As such, the purpose of this CiO is to allow for the expansion of the WRD (including associated access and surface water drainage infrastructure), a realignment of the main site access road and establishment of a topsoil stockpile into MPL32.

The proposed extent of the southern WRD, access road realignment and topsoil stockpile are shown in Figure 2-1.

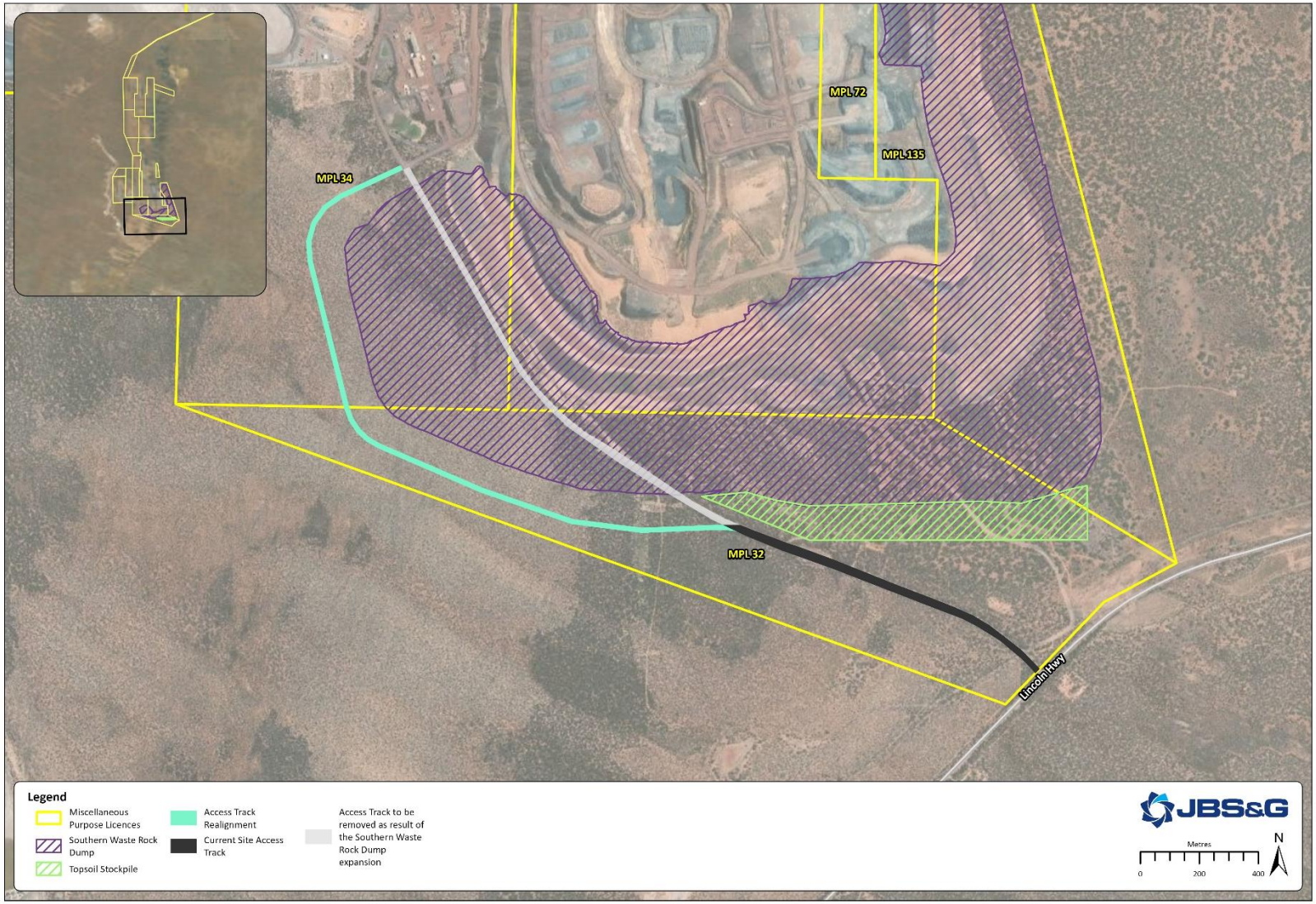


Figure 2-1: MEP1 features proposed within MPL32

Spatial Reference: GDA2020 MGA Zone 53; **Author:** rtandon; **Date:** 25/07/2024
Client: SIMEC; **Job Number:** 6622904

Figure 2-1: MEP1 features proposed within MPL32

2.2.4.1 Southern WRD

The proposed, expanded southern WRD is designed to have a capacity of 64 Mm³ (measured as Bank Cubic Metre (BCM)) over approximately 20 years – see Figure 2-2. This equates to approximately 172 Mwmt. The overall strip ratio is 1.12:1 (waste t: ore t) for the total mineable quantity within the ultimate proposed MEP1 pit. The method of placement is via conventional 140 t class rear-dump trucks and conventional paddock dumping.

Waste rock volumes are based on the current MEP1 Ore Resources and Duchess South Mineral Resources (included in Appendix B).

The production schedule has waste material defined by non-acid forming (NAF) and potentially acid forming (PAF) as provided in the mining block model (refer section below for geochemical assessment). Waste movement by NAF and PAF is presented in Figure 2-3. PAF material is encountered throughout the schedule. Placement of PAF material requires special care as it needs to be fully encapsulated with NAF material. All PAF material in the schedule is to be hauled to the south dump.

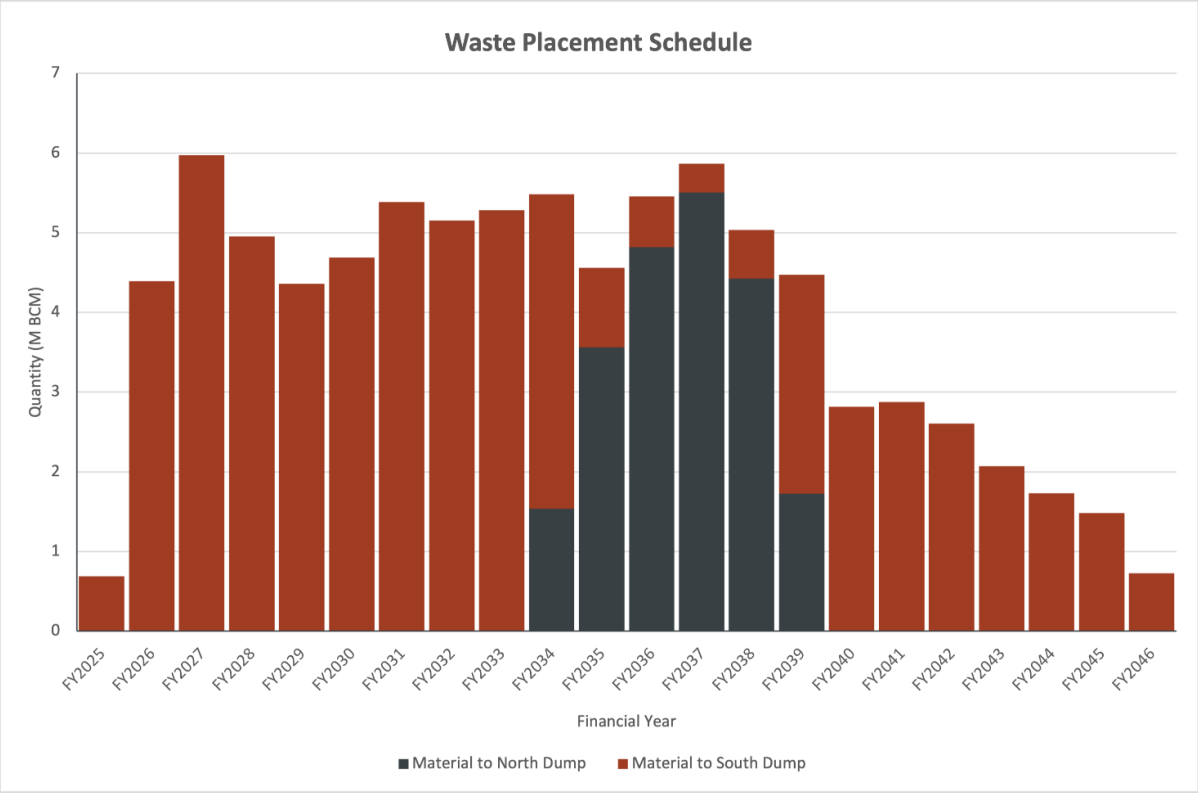


Figure 2-2: Waste placement schedule for MEP1

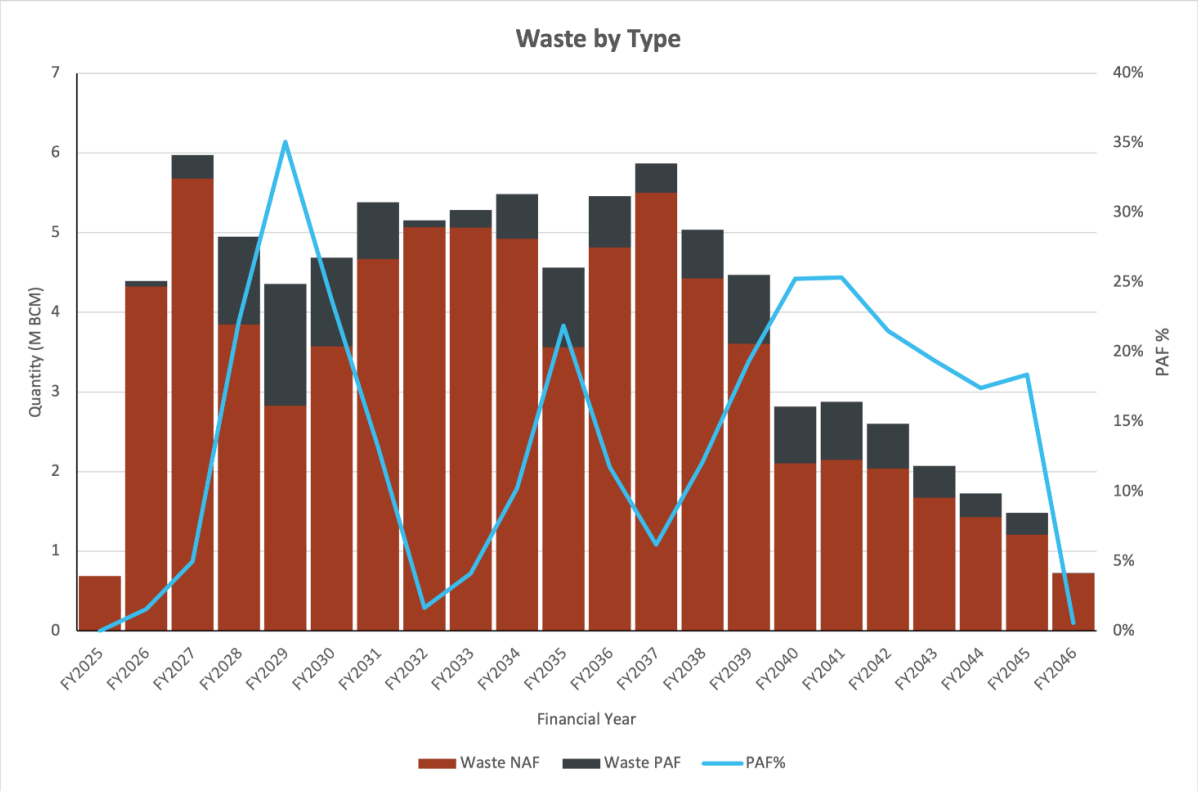


Figure 2-3: NAF/PAF waste movement

The expanded southern WRD design parameters, including berm widths, batter angles and haul road widths and gradients, is summarised in Table 2-4. Potential Acid Forming (PAF) containment design parameters are also included in Table 2-3.

Table 2-4: Southern WRD design parameters

Description	Units	Value
Berm width at closure	m	10
As-tipped batter angle	°	37
Rehab batter profile	°	10-20
Inert waste foundation height for Potential Acid Forming (PAF) storage	m	5
Inert waste capping width/lateral for PAF storage, batters	m	20
Inert waste capping height/vertical for PAF storage, flat	m	5
Ramp width	m	36
Ramp gradient	%	10

Both PAF and NAF material will be placed within the southern WRD. Key stages of WRD development, and proposed placement of PAF and NAF material are shown in the figures below. In these figures:

- light blue, dark blue, yellow, and red are mine staging for MEP1*;
- for the northern* and southern WRDs:
  - beige is PAF waste material; and
  - pink is NAF waste material.

These figures also show the access track realignment (blue line) and topsoil stockpile (green polygon).

It is planned for the WRD to expand into MPL32 by approximately Financial Year (FY) 2026, as shown in the figures below (Figure 2-4).

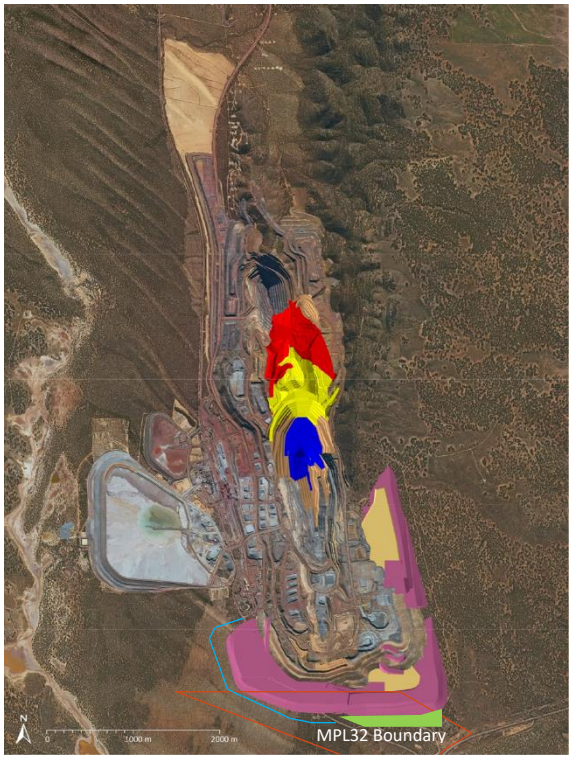
***note that the northern WRD (approved) and MEP1 mine pit does not form part of this Change in Operations application, but information has been included for context and completeness.**



Schedule start February FY-2025



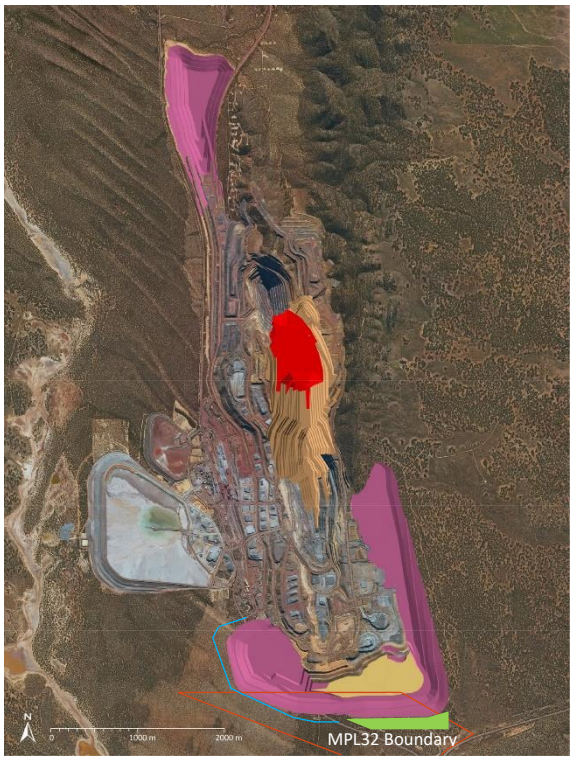
Pit development at end of FY-2026



Pit development at end of FY-2029



Pit development at end of FY-2033



Pit development at end of FY-2038



Pit development at end of FY-2046

Figure 2-4: Proposed stages for the southern WRD

PAF Geochemistry

A geochemical assessment has been included in Appendix D6. Table 2-5 outlines the geochemical sampling and characterisation program.

Table 2-5: Geochemical sampling and characterisation

Stage 1		Stage 2	
Drilling Campaign 2020-21		Drilling Campaign 2023-24	
Samples selected from resource estimation assay program		Combination of fresh samples (99) selected from new drillholes and Stage 1 samples with high sulfur content material (167)	
Acid Neutralisation Capacity (ANC)	978	ANC	266
Total-S (drilling database)	978	Total-S (drilling database) - Sulfur speciation – sulfide CRS	266 265
Multi-elements	401	Net Acid Generation (NAG)	266

A Net Potential Ratio classification (based on ANC and Total-Sulfur) of ore and waste rock samples showed that 77% of tests were NAF, 11% of tests were PAF and 12% of tests were uncertain. Further AMIRA classification indicated that dominant waste rock types Amphibolite (AMP) and Basal Sequence (BSQ) samples were typically PAF. AMP and BSQ materials comprise 28.8 % of the rock to be extracted for MEP1.

PAF and AMD Management

In addition to the PAF storage parameters in Table 2-3, PAF storage areas have been designed with the following criteria:

- PAF material is tipped in 5 m lifts; and
- accesses to PAF storage areas are designed such that they are separate to NAF storage areas, which allows PAF and NAF construction to occur at different rates.

Throughout operations, sufficient NAF will be stockpiled to ensure the volume is readily available to cover the PAF storage areas once filled (refer Figure 2-3 for PAF/NAF waste movement schedule).

At the end of mine life, all PAF material is capped with NAF material per design (Table 2-3), such that there is no PAF material exposed. The LOM is scheduled in such a way that this is achievable. Figure 2-7 shows cross sections of the PAF storage areas after capping is completed, where PAF material is shown in dark grey and NAF material is shown in blue.

Material characterisation will be ongoing until mining commences and throughout operation. This information will be used to validate the findings of the geochemical studies and update the block model and the mining schedule. It will also be used to address geochemical characterisation knowledge gaps such as saline and metalliferous drainage and potentially long-term kinetic work to assist in planning for closure.

During operation, the sampling, analysis and quality program (SAQP) should consider:

- standard sampling frequency of one sample per ~400 m^3;
- standard analysis to include total-S, ANC and NAG pH; and
- complement the standard analysis with pH1:2 and EC1:2 (solid:liquid ratio), saline and metalliferous drainage.



Figure 2-5 - WRD Designs

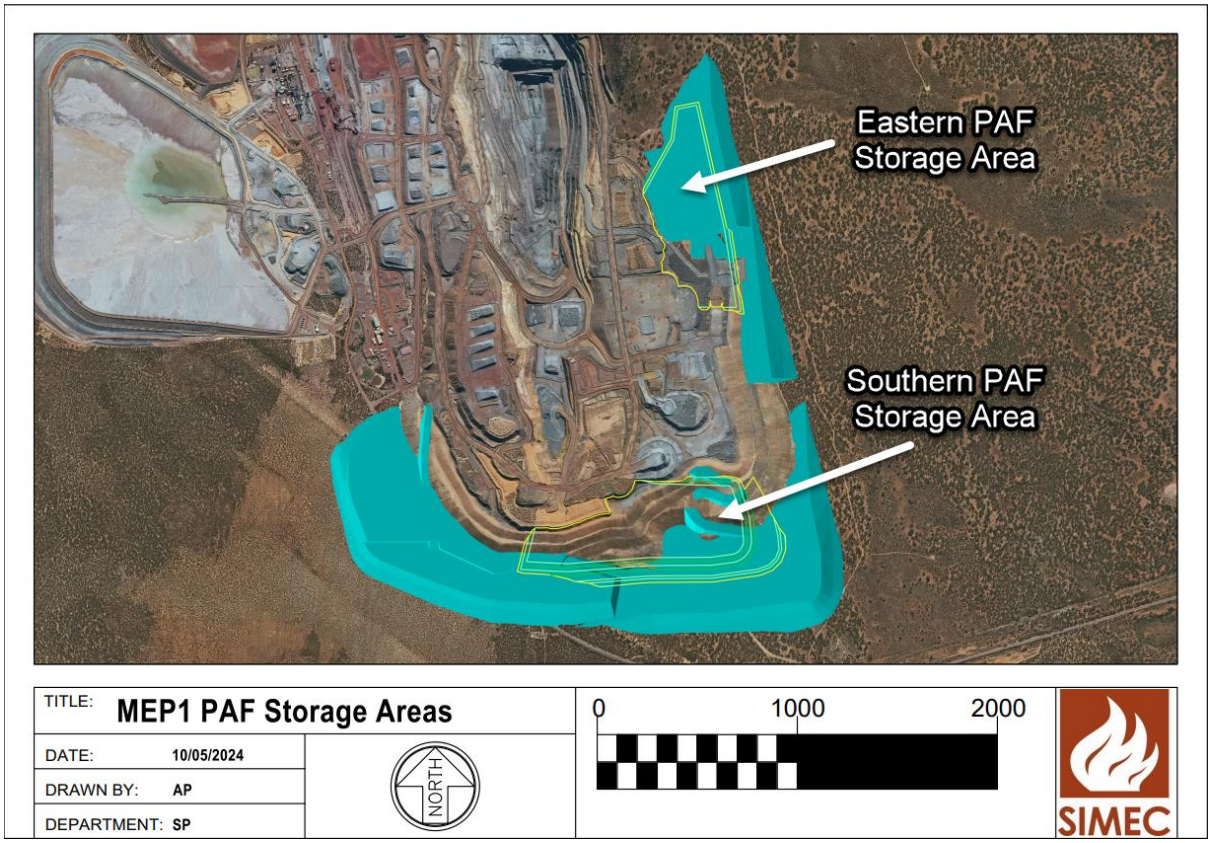


Figure 2-6 - PAF Storage Areas

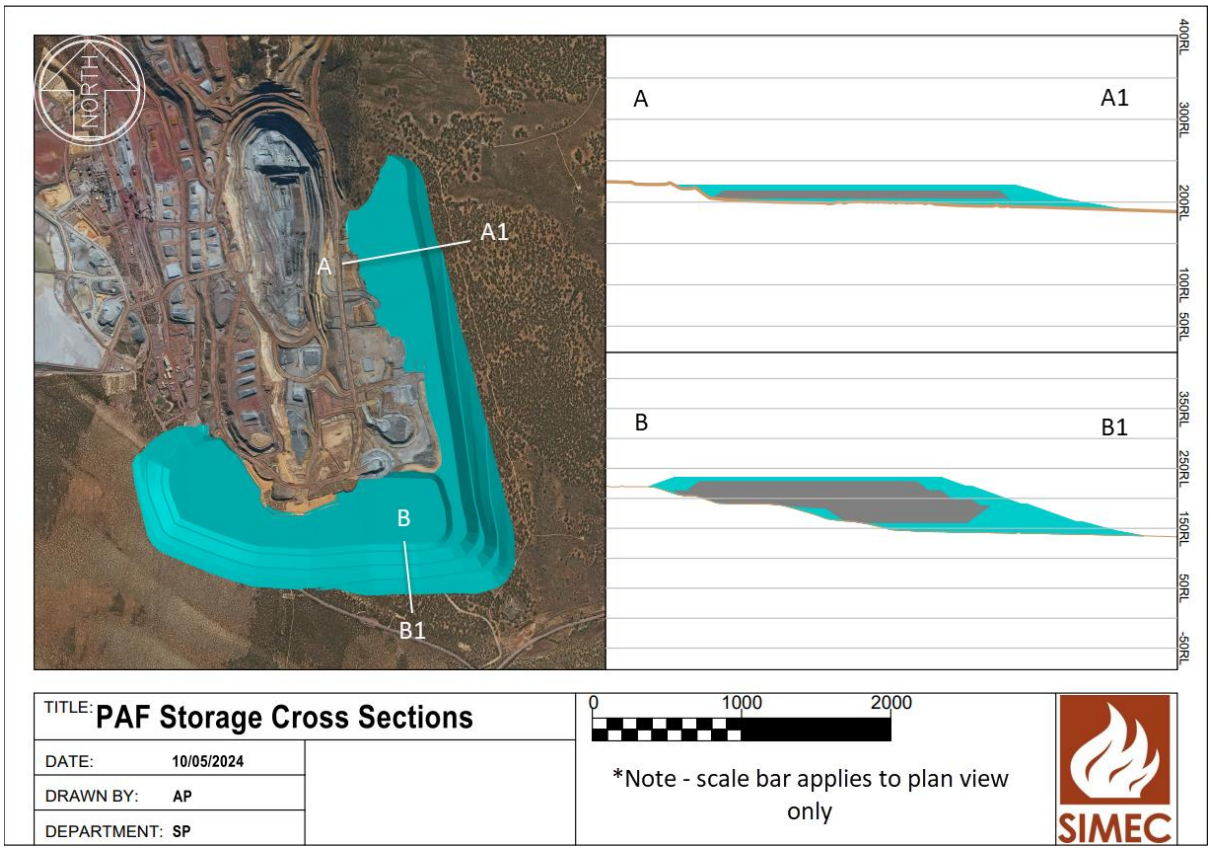


Figure 2-7 - PAF Storage Cross Sections

Long term stability analysis (geotechnical stability, weathering and erosion control)

Waste rock from the MEP1 mining area is hauled to one of 2 WRDs, either the northern or southern WRD. The design capacity of the WRDs is sufficient to store the quantity of waste rock expected from MEP1. Figure 2-8 presents a birds-eye view of the location of the MEP1 WRDs.

As noted, the southern WRD is a southern expansion of an existing WRD at SMR. Reprofiled slopes are as steep as 20° for the upper lifts or as shallow as 10° for the lower lifts. Reprofiled slopes are 30 m high and are separated by 10 m berms. At its highest point, this WRD is 100 m above nearby ground level. A typical cross section at its highest point is presented in Figure 2-9.

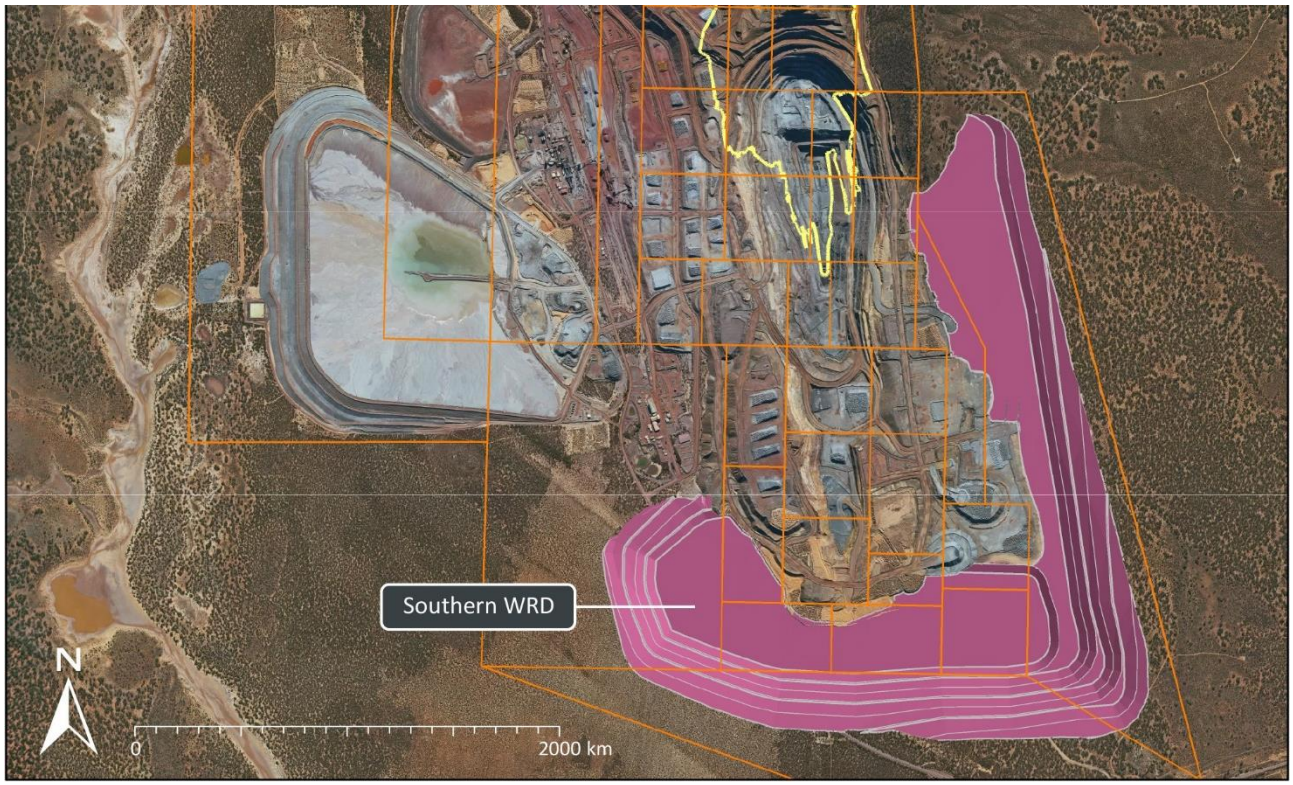


Figure 2-8: MEP1 WRD locations with tenement boundaries shown in orange.

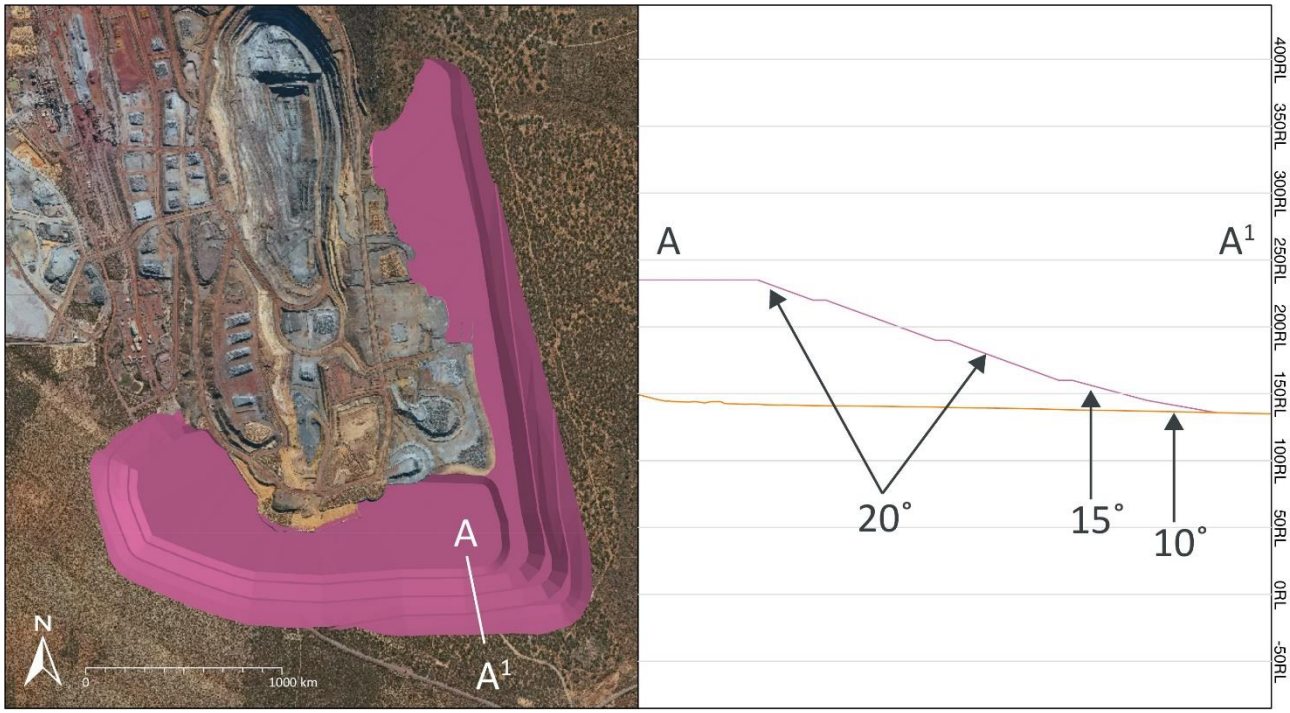


Figure 2-9: MEP1 southern WRD detail and cross section

As with the existing approved WRDs in the SMR, design profiles, features and finishes have been developed through a combination of engaging independent experts, making observations of historical WRDs previously established in these mining regions, and commissioning studies and trials on variations of regolith and armouring materials. Stable SMR WRD designs reference the following observations and learnings:

- A review of as-built WRD structures within SIMEC's SMR was completed by Mining Plus in 2011. The review identified a high level of stability in historical dumps over 50 years old at the natural rill angle of 37°. These WRDs remain stable, even at substantially high 30-40 m faces as evidenced in the historical WRD profiles in the Iron Knob and Iron Baron operations.
    - The southern WRD parameters for as-tipped waste dumps are 37° faces at 30 m high.
- Mining Plus 2011, determined the development of the waste rock dump designs for all WRDs to be constructed after that time. The WRD designs incorporated specific landform slope angles and cover requirements (for higher WRDs) on lower slopes at 10°, mid slopes at 15° and upper slopes at 20°.
    - The southern WRD rehabilitated landform applies a concave batter of 10° – 15° for the lower face, with 20° batters on the upper slopes.
- Cross ripping or seed boxing of faces helps retain water runoff and assists in vegetation regrowth, reducing erosion and loss of topsoil.
    - This will occur on the southern WRD when the dump is being reshaped to a closure landform.

Factor of Safety

A conservative Factor of Safety (FOS) analysis has been undertaken by Peter O'Bryan and Associates which included the following parameters:

- reshaped slopes on the WRD based on 30 m high, 20° face angle batters;
- separated by berms from 10 m to ~50 m wide (typically 10m or 20m);
- an ultimate WRD heights of 135 m to 165 m; and
- resultant overall slope angles for re-shaped WRD are therefore ≤ 15°.

Utilising these parameters, the proposed slope configurations are assessed to be adequately stable.

Limit equilibrium analysis of WRD slope stability indicates that re-shaped slopes will be stable in the long term, with FOS of ~ 2.1 under static loading with dry conditions. FOS under seismic surcharge remain adequate at ≥ 1.65 (under 0.08g lateral acceleration) and ≥ 1.39 (0.15g acceleration) (Peter O'Bryan and Associates, 2023).

Should the WRD become water-saturated to 30 m above the base, under 0.15g disturbance the FOS is 1.24, which is acceptable under this high magnitude transient surcharge. *"Saturation to this extent is inferred unlikely"* (Peter O'Bryan and Associates, 2023) as modelling of infiltration through the proposed WRD found there may be a rise in the groundwater head of 18 m (for the worst-case scenario), compared to a pre-construction groundwater level of around 50 m bgl (see section 3.2.7).

Revised Universal Soil Loss Equation

For the purpose of catchment planning, topsoil, spoil and disturbance areas are to be classified based on estimated annual soil loss due to erosion. The estimated soil loss rate shall be calculated using the Revised Universal Soil Loss Equation (RUSLE).

The RUSLE method of estimating annual soil loss due to erosion is documented in IECA (2008). The annual soil loss due to erosion is calculated as:

$$A = R \times K \times LS \times C \times P$$

Where:

A = annual soil loss due to erosion (t/ha/yr);

R = rainfall erosivity factor;

K = soil erodibility factor;

LS = topographic factor derived from slope length and slope gradient;

C = cover and management factor; and

P = erosion control practice factor.

Based on the standard parameters for the southern WRD, the soil loss rate is approximately 144 m^3/ha/year. This has been taken into consideration when planning surface water management structures.

Seepage Assessment / Water movement through WRD

In order to assess potential rainfall infiltration into the southern WRDs, a seepage assessment has been undertaken. This has been detailed in section 3.2.7.

Surface water / Hydrology

A hydrology assessment has been undertaken by HydroBalance on the proposed southern WRD (refer Appendix D1).

The southern WRD will adopt three main features of erosion and sediment control in regard to surface water management to effectively manage sediment and erosion:

1. Drainage control
    - prevention or reduction of soil erosion caused by concentrated flows and appropriate management and separation of the movement of diverted and surface water through the area of concern.
2. Erosion control
    - prevention or minimisation of soil erosion (from dispersive, nondispersive or competent material) caused by rain drop impact and exacerbated overland flow on disturbed surfaces.
3. Sediment control
    - trapping or retention of sediment either moving along the land surface, contained within runoff (i.e. from up-slope erosion) or from windborne particles.

The locations and number of sediment control infrastructure provided in this CiO is conceptual only. Details of sizing and placement of sediment control infrastructure will be finalised during detailed design of the WRD.

The proposed sediment drainage system consists of the following elements:

- toe drains/bunds;
- slope berms;
- drop structures/rock chutes; and
- sediment dams.

The proposed drain dimensions and expected hydraulic parameters for a 10% AEP design event are presented in Table 2-6 and Figure 2-10. Proposed sediment dam specifications have been detailed in Appendix D1 and are summarised in Table 2-7.

More information on the conceptual design of toe drains/bunds, contour berms, drop structures and sediment dam construction are included in section 4 of Appendix D1.

A flood modelling assessment for the southern WRD has also been undertaken and is detailed in section 3.2.6.

Table 2-6: Proposed drain details

Drain ID*	Drain cross section	Longitudinal slope	Base width (m)	Batter slope (V:H)	Finished drain depth (m)	Flow depth† (m)	Flow velocity† (m/s)	Recommended lining
CB1	Windrow	0.6%	-	1:2	0.8	0.5	1.2	Gravel (d50=25mm)
CB2	Windrow	0.4%	-	1:2	0.5	0.2	0.7	Gravel (d50=25mm)
CB3	Windrow	2.8%	-	1:2	0.8	0.5	1.5	Gravel (d50=25mm)
CB4	Windrow	2.6%	-	1:2	0.5	0.2	0.9	Gravel (d50=25mm)
CB5	Windrow	2.0%	-	1:2	0.5	0.2	0.9	Gravel (d50=25mm)
CB6	Windrow	1.0%	-	1:2	0.7	0.4	1.2	Gravel (d50=25mm)
CB7	Windrow	0.4%	-	1:2	0.5	0.2	0.6	Gravel (d50=25mm)
TD1	Windrow	2.4%	-	1:2	0.7	0.4	1.5	Gravel (d50=25mm)
TD2	Windrow	1.9%	-	1:2	0.4	0.1	0.7	Gravel (d50=25mm)
TD3	Windrow	2.1%	-	1:2	0.6	0.3	1.2	Gravel (d50=25mm)
DS1	Trapezoidal	25.0%	1	1:4	0.8	0.5	1.7	Rock (d50=385mm)
DS2	Trapezoidal	25.0%	1	1:4	0.6	0.3	1.4	Rock (d50=215mm)

* TD = toe drain/bund, CB = contour berm, DS = drop structure

† for the 10% AEP design event

Table 2-7: Proposed sediment dam specifications

Sediment Dam ID	Dam catchment area (ha)	Total dam capacity (ML)	Dam surface area (m2)	Length:width ratio
SED01	210	6.0	1,509	3
SED02	156	4.4	906	3

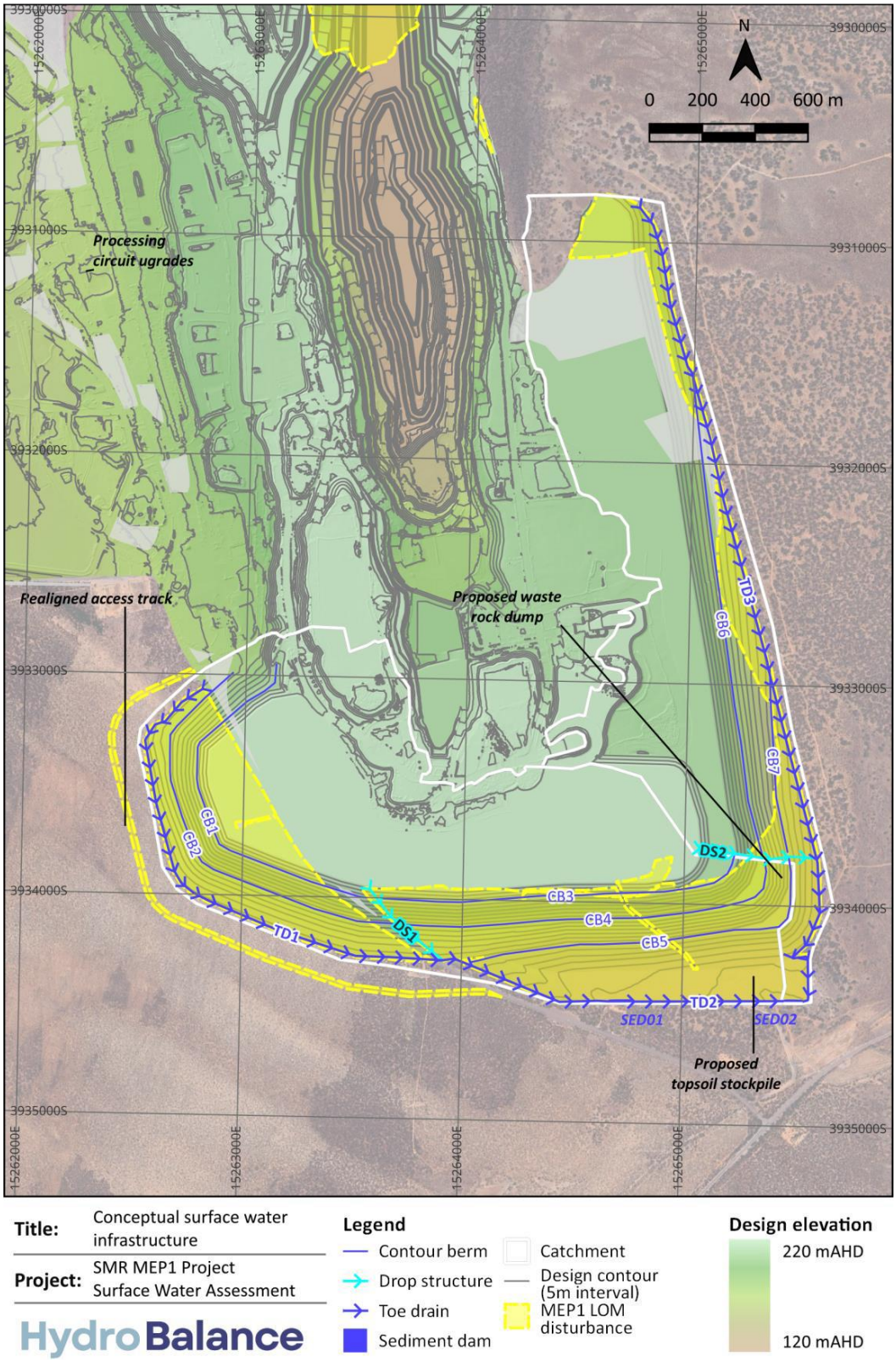


Figure 2-10: Conceptual site water management system configuration

Source: Hydrobalance, 2024

Topsoil stripping schedule from southern WRD

Topsoil stripping for the southern WRD occurs within the first 6 years of the proposed schedule. Figure 2-11 shows the areas which topsoil will be required to be stripped from and timing. Table 2-8 summarises the topsoil stripping schedule.

Table 2-8 Topsoil stripping schedule

Calendar year	Disturbance (ha)	Cumulative disturbance (ha)
2025	28.6	28.6
2026	48.7	77.2
2027	52.5	129.7
2028	8.4	138.2
2029	4.5	142.6
2030	5.9	148.6
Total	**148.6**	



Figure 2-11: Topsoil stripping schedule by calendar year

Rehabilitation

The southern WRD will be progressively developed, rehabilitated and re-profiled throughout mining operations, to blend with the surrounding landscape and arrive at an acceptable outcome in terms of visual amenity. This approach has been applied to the pre-MEP1 WRD with success. Earthworks will include slope remediation to final landform and sheeting of lower slopes with suitable soil followed by revegetation with local native species. The overall design of the WRDs will result in a profile that will blend in with the surrounding landscape. Earthworks will include slope remediation to final landform and sheeting of lower slopes with suitable soil followed by revegetation with local native species.

Stockpiled topsoil and subsoil will be placed and spread over the affected area to promote regrowth of original species.

Timing of WRD rehabilitation is triggered by completion of each lift.

Figure 3-65 and Figure 3-66 show the typical stylised construction of the initial and additional WRD terraces and the basic rehabilitation methodology. Rehabilitation batter angles and design parameters are included above in Table 2-4. Note that seed boxing may be used rather than contour ripping on the steeper final slopes.

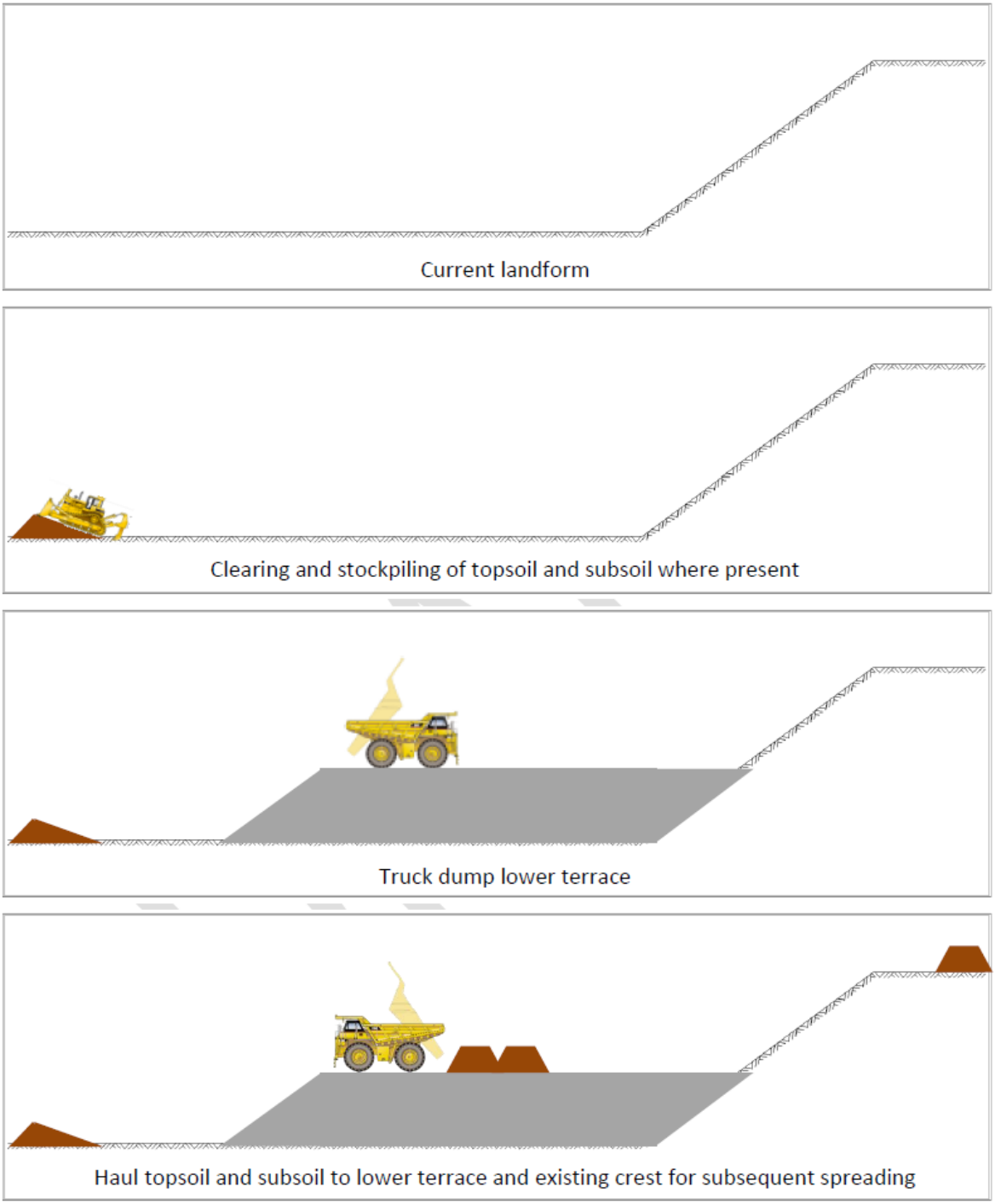


Figure 2-12: Initial WRD Construction and Rehabilitation Methodology

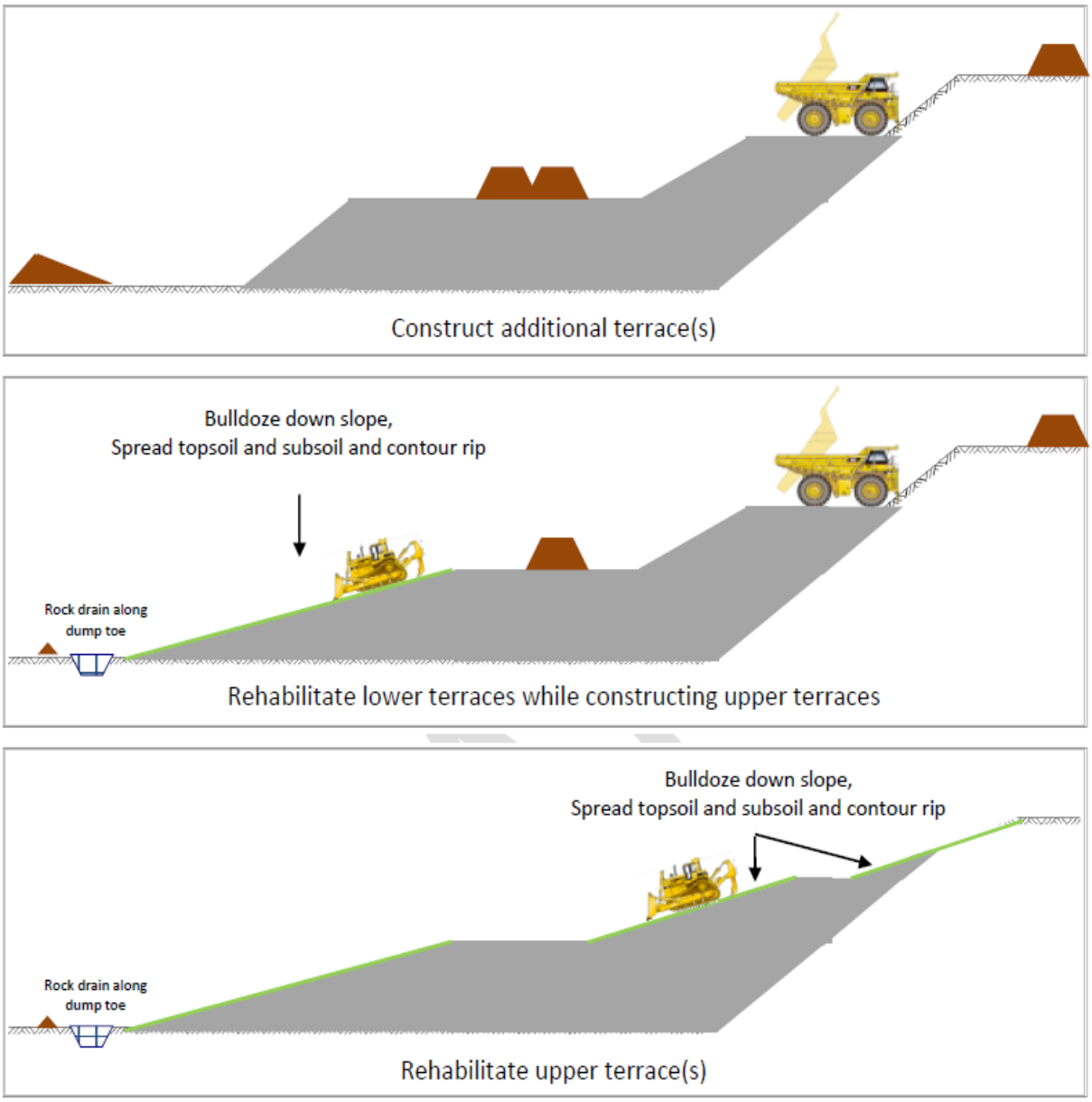


Figure 2-13: Final Stages of WRD Terrace Construction and Rehabilitation Preparation

Areas on these dumps will be rehabilitated as soon as safely and practically possible to ensure rehabilitation goals are achieved. Table 2-9 summarises the proposed rehabilitation schedule that will be conducted across the life of mine on the north and south waste rock dumps. This may be adjusted during mine life. A total of area of 361 ha will be required to be rehabilitated for MEP1 activities. Topsoil volumes are estimated based on a placement depth of ~0.2 m.

Table 2-9: Southern WRD yearly rehabilitation schedule

Calendar year	Rehab area (ha)	Cumulative rehab area (ha)	Topsoil required (m^3)	Cumulative topsoil required (m^3)
2025	0	0	0	-
2026	0	0	0	-
2027	0	0	0	-
2028	0	0	0	-
2029	0	0	0	-
2030	0	0	0	-
2031	68	68	136,275	136,275
2032	0	68	0	136,275
2033	0	68	0	136,275
2034	31	99	61,260	197,535
2035	23	122	45,471	243,006
2036	0	122	0	243,006
2037	0	122	0	243,006
2038	0	122	0	243,006
2040	0	122	0	243,006
2041	0	122	0	243,006
2042	0	122	0	243,006
2043	37	159	73,521	316,527
2044	37	196	74,477	391,004
2045	27	223	54,701	445,705
2046	55	278	110,846	556,551
Total	278		556,551	

2.2.4.2 Access Track

As detailed above, the expansion of the WRD will require the re-alignment of the existing MPL32 access road in approximately 2026-27. The access track will remain in place from the existing access point from the Lincoln Highway for approximately 1100 m, before re-routing to the west of the proposed southern WRD. It then continues along a new route before rejoining the existing access track which leads to the staff carpark and rest of the SMR site. The re-routed access track will be bitumised and constructed similarly to the current dimensions and grade of the existing road in the location shown in Figure 2-1.

Access to the mine will remain controlled by boom gate. The access road re-alignment will also include the installation of signage including road signs, speed limits and contacts.

2.2.4.3 Proposed Topsoil Stockpile

SIMEC propose to construct a 15-hectare topsoil stockpile that will store topsoil removed from MEP1 greenfield areas. The topsoil stockpile will be approximately 1 km by 150 m in size and have a capacity of approximately 450,000 m^3 as shown in Figure 2-1.

The topsoil stockpile will be managed in line with current stockpiling practices with regards to stockpiling height and erosion and sediment control management. Material stored within the stockpile will be used as part of rehabilitation works within the SMR in accordance with the Site's ongoing rehabilitation planning.

Soil quality within the Middleback Range environs is generally poor in structure and skeletal topsoils are generally deficient in organic material and nutrients due to high cycling rates.

Topsoil harvesting and stockpiling is carried out in accordance with the SIMEC Mining Soil Management Plan (QP50.66). Typically, only one layer of soil is collected, but in some areas with soils developed on deep sands or loams, both topsoil and subsoil will be separately collected. Topsoil will be stockpiled uncompacted, to a maximum height of 3 m. The locations of the topsoil stockpiles will be mapped and monitored. Water movement through topsoil/subsoil stockpiles is also expected to be limited.

Stockpiles will be drawn down for use in the progressive rehabilitation program, and the remaining areas will be prepared for closure in accordance with the closure plans.

2.2.4.4 Ancillary infrastructure

SIMEC would request that any licence change considers the potential to include any associated monitoring infrastructure (such as monitoring wells to be proposed as part of the revised SMR PEPR) to support the mining operation as required.

2.3 Alternatives considered

Alternative options, as well as alternative locations were considered for the placement of the WRD. All WRD alternate locations were ultimately a trade-off between:

- being constrained by existing operations;
- utilising existing mining tenure where possible;
- minimising additional native vegetation clearance; and
- distance to travel before depositing into storage.

SIMEC has selected disturbance areas which are within pre-existing mining tenements, and specifically avoids field survey verified Desert Greenhood (*Pterostylis xerophila*) habitat and known populations, and avoids identified and field survey verified core habitat of both Sandhill Dunnart (*Sminthopsis psammophila*) and Malleefowl (*Leipoa ocellata*).

The proposed location, being the expansion of the WRD into MPL32, was selected as it maximises use of existing mining tenure and waste rocks dumps, minimises land disturbance, and balances cost effectiveness.

With regard to the re-aligned access track, the alignment was selected due to it being the most direct and safest route, with the least impact on environmental aspects.

3. Self-Assessment of Change in Proposed Operations

In accordance with Section 56Q of the Mining Act and MG35, an assessment of the significance level of the proposed CiO has been undertaken and is summarised in Table 3-1. The detailed self-assessment is included as Appendix B.

Table 3-1: Summary of assessment of significance level of proposed change to operations

Existing authorised operations	Proposed Change to Operations	Justification for significance	Significance level of change
Access road from Lincoln Highway to the mine site.	Waste Rock Dump and topsoil stockpile.	To support the MEP1 operations.	Change in Operations Outside scope of original tenement application (MPL32), Preliminary EIA recommended.

3.1 Assessment of MPL conditions

In preparing this application, SIMEC Mining has cross-referenced the conditions of the MPL with the contents of the application to demonstrate compliance of the application with conditions (where relevant). The specific conditions for MPL32 are listed in Table 3-2 together with a summary of where the conditions of the MPL have been addressed in this document.

Table 3-2: Assessment against Relevant Licence Conditions

Licence Condition	Compliance (Y/N)	Reference / Section
MPL 32	**Expiry Date**	14/07/2030
Covering Letter Requirements		
(5) The Licensee shall do such things in pursuance of this licence in such a manner so as - a) to prevent pollution to or contamination of surface or underground waters, and (b) to minimise surface damage to the land	Y	Refer section 3.2.6 / 3.2.7 / 3.2.5
(6) The Licensee shall ensure that, in drilling or other underground investigations, no interconnection between ground water aquifers occurs.	Y	Refer section 3.2.7
SCHEDULE A (Clause 1)		
Constructing and using an access road from the Lincoln Highway to the mine site.	N - Requires amendment in line with this CiO	Refer proposed Change in Operations activities description in section 2.
SCHEDULE B		
Construction and use of the access road shall be in a manner which minimises damage to native vegetation.	N - Requires amendment in line with this CiO	Refer proposed Change in Operations activities description in section 2.

Licence Condition	Compliance (Y/N)	Reference / Section
SCHEDULE C		
1. Topsoil removed during construction shall be retained and used for rehabilitation of disturbed areas associated with the Iron Duke mining development.	Y	Refer section 2.2.3.1
2. The area of the licence shall be fenced and appropriate measures taken to restrict public access.	Y	Remains appropriate.

3.2 Assessment of changes to environmental impacts

3.2.1 Assessment methodology

The environmental impact assessment (EIA) steps as outlined in MG35 are:

- identify the project components that will change;
- identify the relevant impact events from the initial proposal (include source-pathway-receptor for each). Consider all phases of proposed change – construction, operation and post-completion;
- for each impact event, assess whether the change would result in any change to the impact on the relevant receptor, as described in the initial application (in this case, the MPL).
- assess whether the change could result in new impact events;
- reconsider impact events from the initial application that were not considered due to absence of a source/pathway/receptor link and if the conclusion remains valid; and
- based on the above assessment, confirm the new or changed potential impact events that require further assessment.

The original MPL application was lodged in 1987/1988 and is no longer available for viewing given the time that has elapsed. As such, an impact assessment has been undertaken to cover identified potential impacts/risks posed by all activities proposed on MPL32.

An Environmental Impacts and Risks Register (Appendix E2) has been developed in accordance with the TOR 005 and as per Appendix E1 to capture all credible environmental impacts, and associated risks, which relate to the CiO. The Appendix includes both environmental and social aspects, impacts and risks associated with the proposed WRD expansion, access track realignment and topsoil stockpile.

Any uncertainties or assumptions made for the new CiO items (e.g. WRD and topsoil stockpile) will be added to Table 5-13 of the PEPR, which outlines the SMR Forward Work Plan.

The following sections summarise the changes to the environmental outcomes.

3.2.2 Air quality / dust

An air quality impact assessment (Ramboll, 2024 – refer Appendix D2) was undertaken to identify the potential air quality impacts from the MEP1 development. The assessment considered air quality impacts from existing operations and proposed MEP1 operations and included a review of the potential air quality impacts at adjacent sensitive receptors. The report then predicted the likely worst-case air quality levels from the MEP1 operations to identify whether the CiO would result in any change to air quality impacts on relevant receptors. It should be noted that this assessment considered all aspects of MEP1, rather than the aspects specific to this CiO.

The report considered three scenarios, being the existing SMR operations, and the proposed MEP1 operations in both a mitigated and unmitigated scenario. The MEP1 operations scenarios considered the Financial Year (FY) that would have the greatest production of material to capture a worst-case/worst-year scenario.

The sensitive receptors considered as part of the assessment included:

- Moola Homestead;
- Broadview Homestead;
- Moonabie Homestead;
- Pine Hill Homestead;
- Plane Homestead; and
- Uplands Homestead.

These receptors are shown in Figure 3-1.

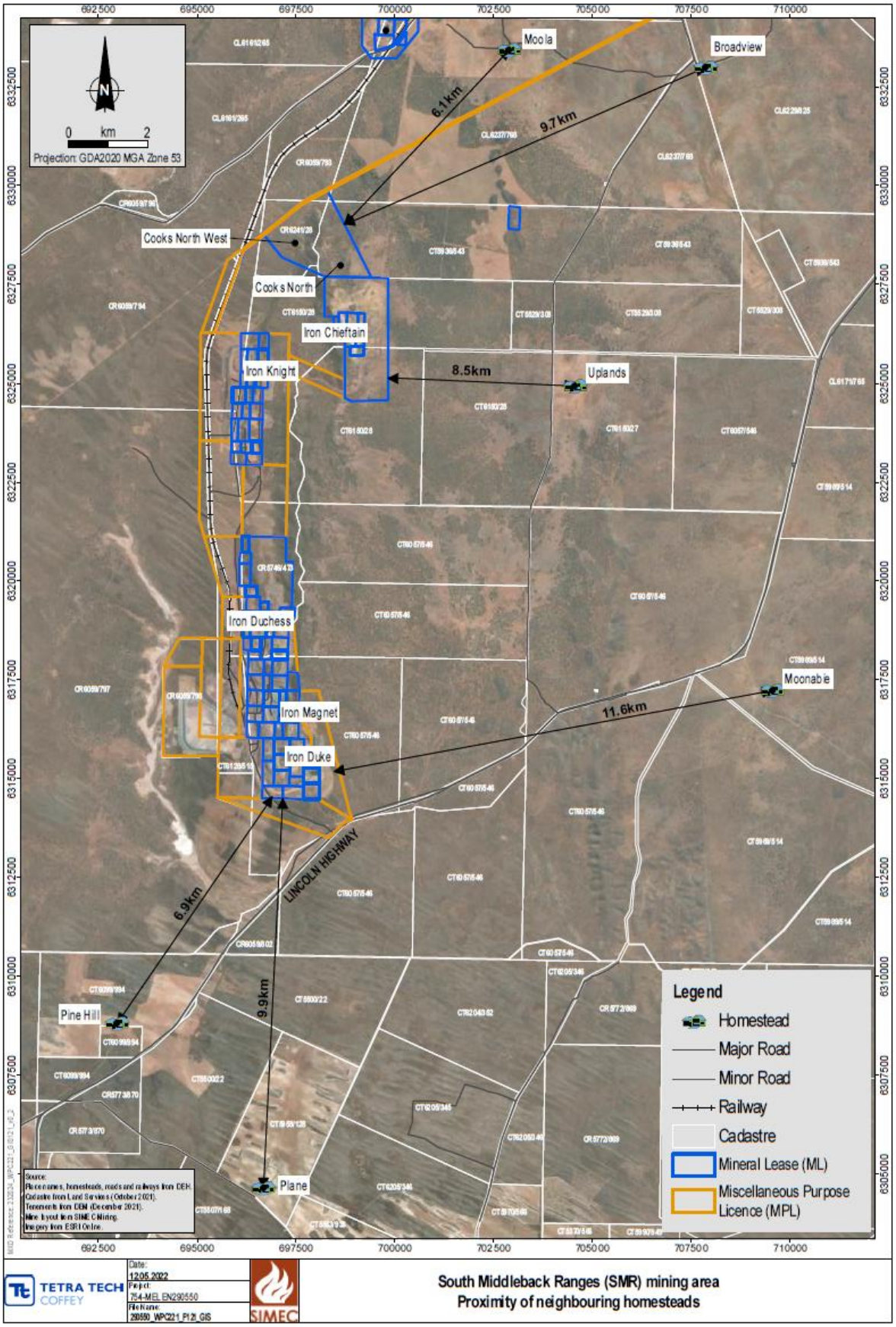


Figure 3-1: SMR Mining Area – Proximity of Neighbouring Homesteads

The assessment considered 24-hour average PM_{10}, annual average PM_{10}, 24-hour average $PM_{2.5}$ and annual average $PM_{2.5}$ and assessed the results for compliance against the *Environment Protection (Air Quality) Policy 2016*. The results identified that there is not expected to be any exceedances of any criteria for any of the scenarios (that is, both unmitigated and mitigated scenarios). These results are shown in Table 3-3.

Mitigation included in this scenario includes use of water sprayers for drilling works, along haul roads, on screening and crushing equipment and at truck dump locations. These are detailed further in Table 17 of Appendix E2.

The assessment also considered dust deposition for the three scenarios. The New South Wales Department of Environment and Climate Change criteria has been used in the absence of a criteria set by the South Australian (SA) Environmental Protection Agency (EPA). Deposition values show a general increase in rates relating to the addition of MEP1, particularly when no dust controls are in place. Although increases are observed with the addition of the MEP1, the overall deposition is lower than the criteria. These results are shown in Table 3-4.

Relevant environmental outcomes and measurement criteria are expected to be achieved for the construction, operation, and rehabilitation of the proposed MEP1 operations (see Appendix E2).

Table 3-3: Predicted, modelled air quality concentration levels at sensitive receptor locations

Particulate Concentrations	Scenario	Broadview	Uplands	Moonabie	Pine Hill	Plane	Moola
Maximum predicted ground level concentrations (GLCs) for 24-hour averaging period for PM_{10}							
PM_{10} Criteria (µg/m³)[1]	**50**						
Background PM_{10} Conc.	**5.30**						
Maximum 24-hour average PM_{10} (with no background)	**Existing SMR**	4.91	9.36	6.33	18.45	16.34	6.68
	MEP1 – Mitigated	6.03	15.47	9.24	26.42	22.39	9.40
	MEP1 – Unmitigated	11.13	23.53	16.87	43.44	29.75	15.95
Cumulative PM_{10}	**Existing SMR**	10.21	14.66	11.63	23.75	21.64	11.98
	MEP1 – Mitigated	11.33	20.77	14.54	31.72	27.69	14.70
	MEP1 – Unmitigated	16.43	28.83	22.17	48.74	35.05	21.25
Maximum predicted GLCs for annual averaging period for PM_{10}							
PM_{10} Criteria (µg/m³)[1]	**25**						
Background PM_{10} Conc.	**3.00**						

[1] South Australian Government (2016) *Environment Protection (Air Quality) Policy 2016.* https://www.legislation.sa.gov.au/__legislation/lz/c/pol/environment%20protection%20(air%20quality)%20policy%202016/current/2016.-.un.pdf

Particulate Concentrations	Scenario	Broadview	Uplands	Moonabie	Pine Hill	Plane	Moola
Annual average PM_{10} (with no background)	**Existing SMR**	0.32	0.88	0.63	0.72	0.61	0.49
	MEP1 – Mitigated	0.36	1.01	0.84	1.01	0.84	0.56
	MEP1 – Unmitigated	0.62	1.75	1.38	1.61	1.28	0.96
Cumulative PM_{10}	**Existing SMR**	3.32	3.88	3.63	3.72	3.61	3.49
	MEP1 – Mitigated	3.36	4.01	3.84	4.01	3.84	3.56
	MEP1 – Unmitigated	3.62	4.75	4.38	4.61	4.28	3.96
Maximum predicted GLCs for 24-hour averaging period for $PM_{2.5}$							
$PM_{2.5}$ Criteria ($\mu g/m^3$)[2]	**25**						
Background $PM_{2.5}$ Conc.	**3.80**						
Maximum 24-hour average $PM_{2.5}$ (with no background)	**Existing SMR**	3.03	4.59	3.23	8.67	8.27	3.44
	MEP1 – Mitigated	3.84	6.95	6.05	12.14	9.54	4.81
	MEP1 – Unmitigated	7.14	10.82	11.13	21.18	13.10	8.35
Cumulative $PM_{2.5}$	**Existing SMR**	6.83	8.39	7.03	12.47	12.07	7.24
	MEP1 – Mitigated	7.64	10.75	9.85	15.94	13.34	8.61
	MEP1 – Unmitigated	10.94	14.62	14.93	24.98	16.90	12.15
Maximum predicted GLCs for annual averaging period for $PM_{2.5}$							
$PM_{2.5}$ Criteria ($\mu g/m^3$)[2]	**8**						
Background $PM_{2.5}$ Conc.	**2.50**						
Annual average $PM_{2.5}$ (with no background)	**Existing SMR**	0.16	0.43	0.31	0.35	0.30	0.24
	MEP1 – Mitigated	0.17	0.48	0.39	0.46	0.38	0.26
	MEP1 – Unmitigated	0.30	0.83	0.65	0.75	0.58	0.46

[2] South Australian Government (2016) *Environment Protection (Air Quality) Policy 2016.* https://www.legislation.sa.gov.au/__legislation/lz/c/pol/environment%20protection%20(air%20quality)%20policy%202016/current/2016.-.un.pdf

Particulate Concentrations	Scenario	Broadview	Uplands	Moonabie	Pine Hill	Plane	Moola
Cumulative $PM_{2.5}$	Existing SMR	2.66	2.93	2.81	2.85	2.80	2.74
	MEP1 – Mitigated	2.67	2.98	2.89	2.96	2.88	2.76
	MEP1 – Unmitigated	2.80	3.33	3.15	3.25	3.08	2.96

Table 3-4: Predicted dust deposition rates at sensitive receptor locations

Particulate Concentrations	Scenario	Broadview	Uplands	Moonabie	Pine Hill	Plane	Moola
Dust Deposition Criteria[3]	4						
Background Deposition (measured as total insoluble solids)	1.62						
Predicted deposition (g/m^2/month) (annual average)	Existing SMR	0	0.02	0.02	0.01	0.03	0.01
	MEP1 – Mitigated	0.01	0.03	0.03	0.03	0.05	0.01
	MEP1 – Unmitigated	0.01	0.05	0.04	0.04	0.07	0.02
Cumulative Deposition	Existing SMR	1.62	1.64	1.64	1.63	1.65	1.63
	MEP1 – Mitigated	1.63	1.65	1.65	1.65	1.67	1.63
	MEP1 – Unmitigated	1.63	1.67	1.66	1.66	1.69	1.64

3.2.2.1 Outcomes and criteria applicable to air quality

Table 3-5: Air quality outcomes

Environmental outcome	Does the outcome remain appropriate and achievable?
No public health and/or public nuisance impacts from air emissions, dust or odour generated by mining operations.	Yes

[3] NSW EPA (2016). 'Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales'. State of New South Wales and the Environment Protection Authority, November 2016.

Table 3-6: Measurement criteria and leading indicator criteria (Air quality)

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
Air quality	No public health and/or public nuisance impacts from air emissions, dust or odour generated by mining operations.	Records will be reviewed to confirm that complaints of emissions, dust or odour are responded to within 24 hours, are logged and investigated and all corrective actions are closed out within 30 days of receiving a complaint, or as otherwise agreed with the affected party or regulator.	Manager stakeholder engagement	SMR mining area	Compliance with WI50_004 (Complaints Management Protocol) and WI50_008 (Stakeholder Engagement and Communications Management)	As required to respond to complaints	Complaints management database and Landholder issues register	Internal trigger: Not proposed Leading indicator criteria: Not proposed	Measurement criteria will be reported against in annual compliance reporting to DEM	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
		Total dust deposition (TDD) and directional dust deposition (DDD) is measured using instruments and equipment that meet the requirements of Australian Standard (AS)/ New Zealand Standard (NZS) 3580 Analysis of TDD and DDD is undertaken by methodology that is in accordance with the requirements of AS/NZS 3580 and AS 2724.	Environment assurance manager	Dust deposition gauge locations as shown on Figure 3-2.	All equipment used and analysis undertaken to measure dust deposition levels comply with the requirements of AS/ NZS 3580 and AS 2724	Monthly	EPA Monitoring station – Whyalla – PM_{10} EPA Monitoring station Netley – PM2.5	Internal trigger: Not proposed Leading indicator criteria: Not proposed		Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
		Mine records will be audited to confirm SIMEC Mining Dust management strategies are applied in accordance with the Dust TARP P50.84 and Mines FDR Standard QP50.68.	SMR operations manager	SMR mining area	Regulatory compliance and Environmental Management System (EMS) audits, as well as construction and operational process audits occurring through operations and closure, confirm no non-compliances against the Dust TARP (QP50.84) and Mines FDR Standard (QP50.68)	As per audit schedule	Dust TARP (QP50.84) and Mines FDR Standard (QP50.68)	Internal Trigger: Incidents of operations continuing in SMR mining areas without the implementation of appropriate controls as per QP50.84 are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department Leading indicator criteria: Not proposed		Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.

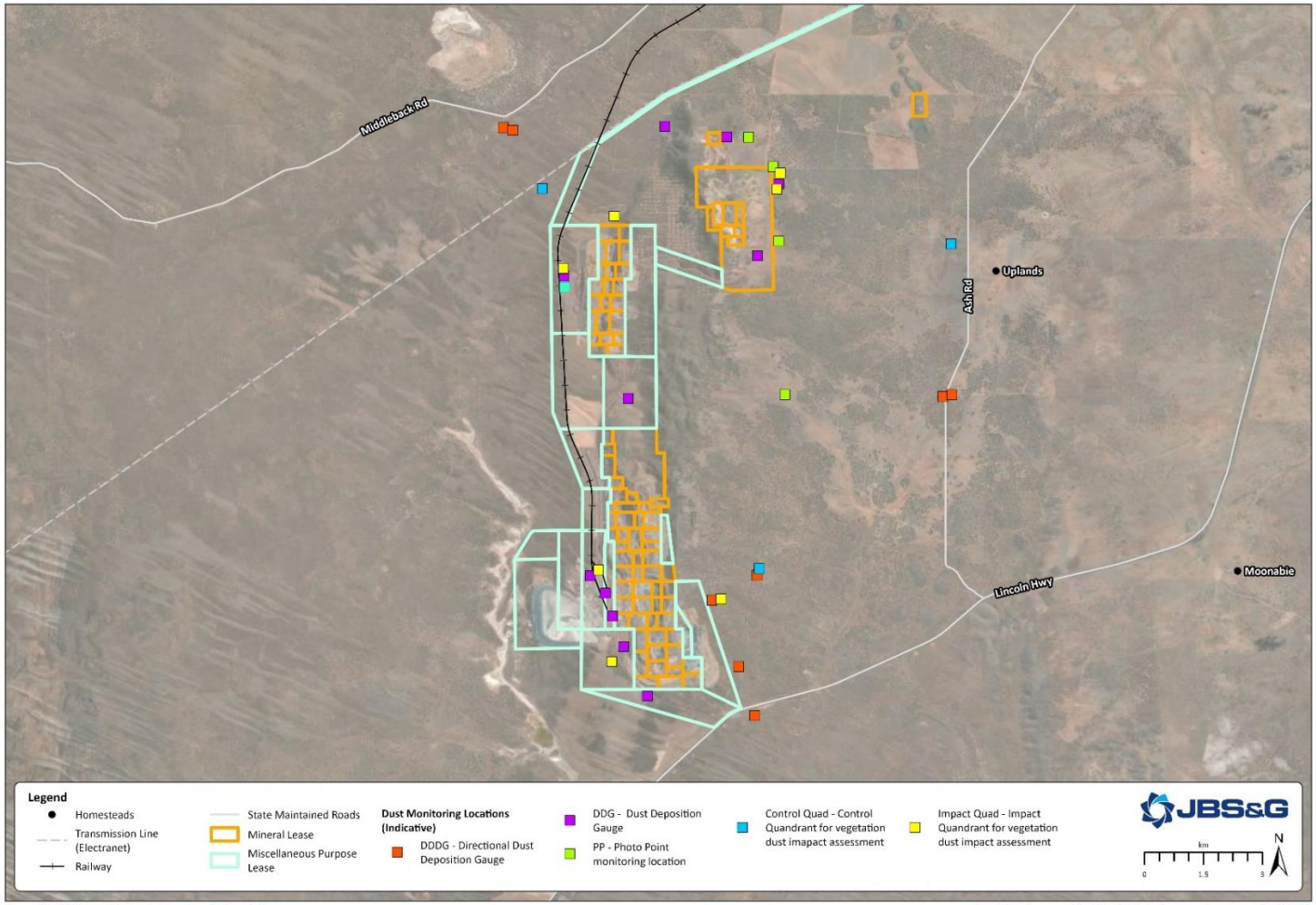


Figure 3-2: SMR Dust-Monitoring Locations (Indicative)

3.2.3 Visual amenity, nuisance noise and light

Visual amenity

A visual impact assessment (Landform Architects, 2024 – refer Appendix D3) was undertaken to determine the level of visual impact as a result of the proposed change in operations.

The visual impact assessment considered the potential impact from three viewpoint locations that demonstrate the range of views that are likely to be affected by the Project (Figure 3-3). The viewpoints included:

- viewpoint 1: Lincoln Highway #1 (roadside stop approximately 3.3 km southwest of the WRD);
- viewpoint 2: Lincoln Highway #2 (approximately 270 m east of the existing site entrance and 500 m south of the WRD); and
- viewpoint 3: Lincoln Highway #3 (intersection of Puddle Holes Dam Road and the Lincoln Highway, approximately 5.8 km east of the WRD).



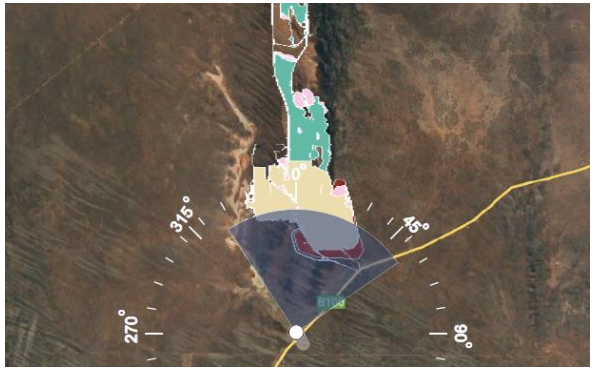
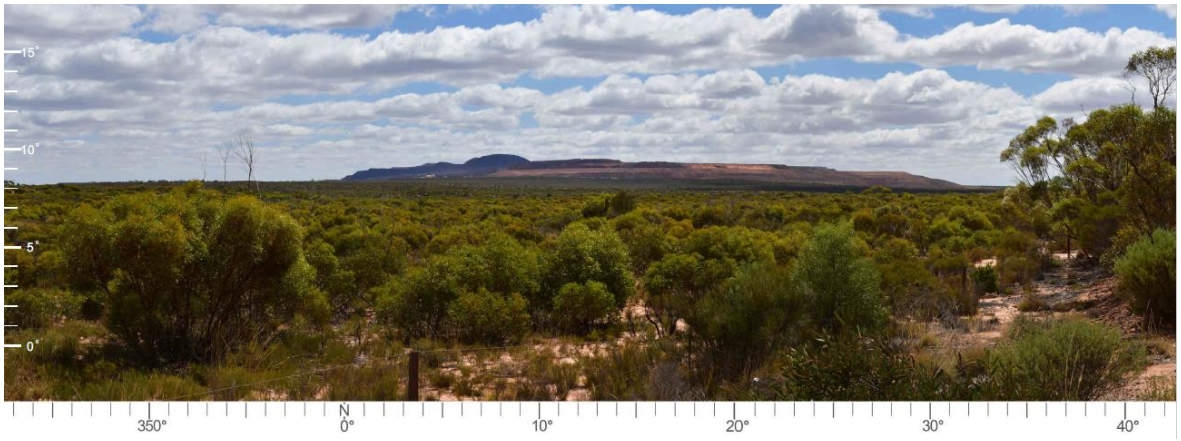
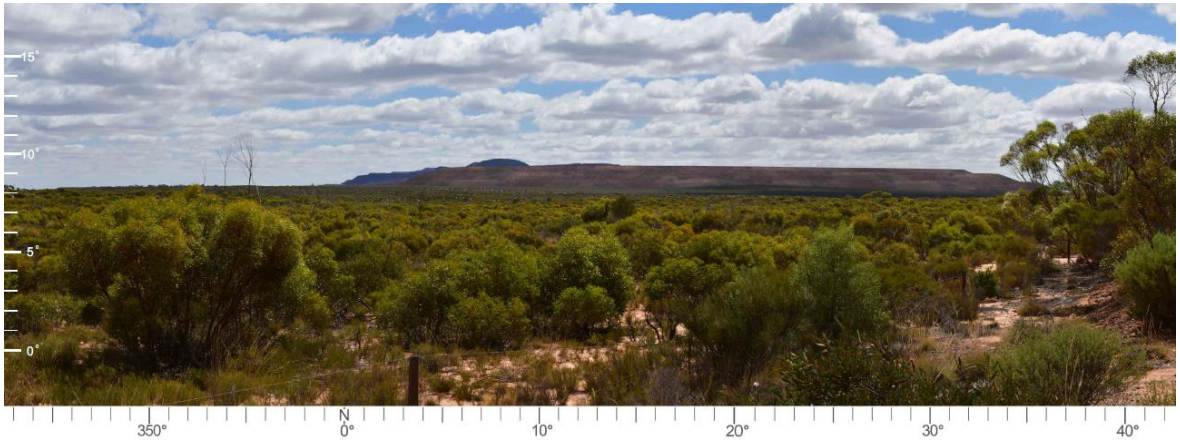
Figure 3-3 Viewpoint locations

The visual impact assessment identified that the changes proposed by MEP1 at each viewpoint would be negligible. Although the proposed modifications to the southern WRD would be noticeable when compared to the existing view, for most viewers, these changes would be added to a view that already includes similar landforms and features. Further, material would be deposited incrementally and over timeframes such that, for most regular viewers, the change would also not be discernible.

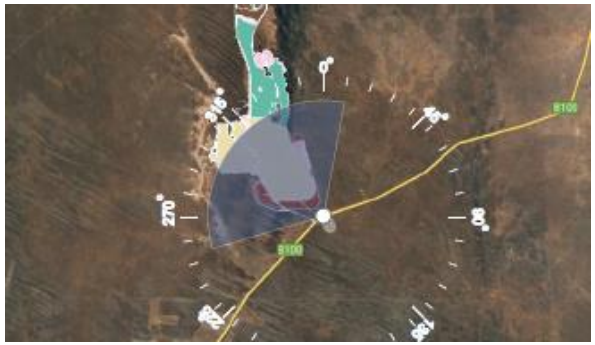
Refer to Table 3-7 for photomontages of the MEP1 operations at each viewpoint.

Resultantly, relevant environmental outcomes and measurement criteria are expected to be achieved for the construction, operation and rehabilitation of the proposed MEP1 operations (see Appendix F).

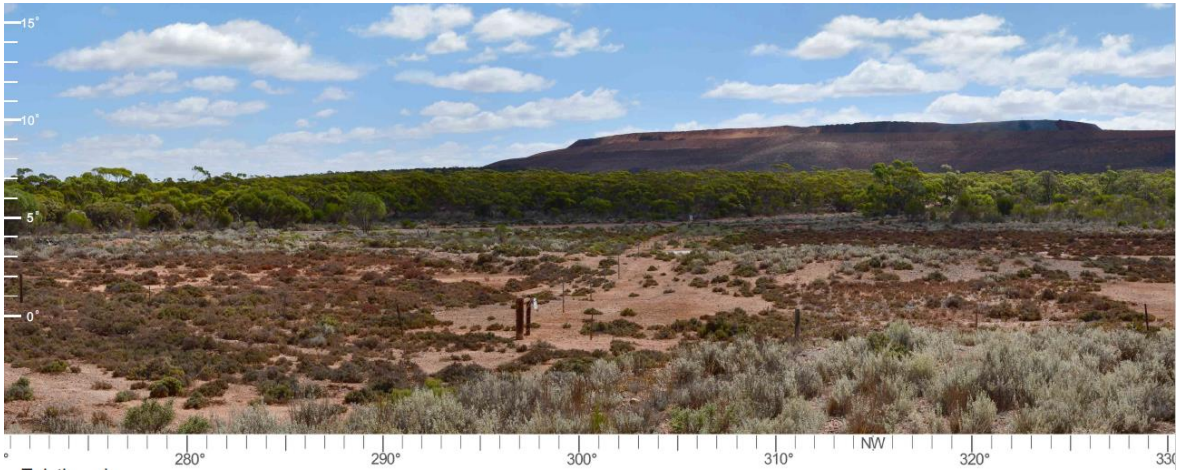
Table 3-7: Photomontages at the three viewpoint locations

Viewpoint 1	
	**Existing View**  **Expected View** 

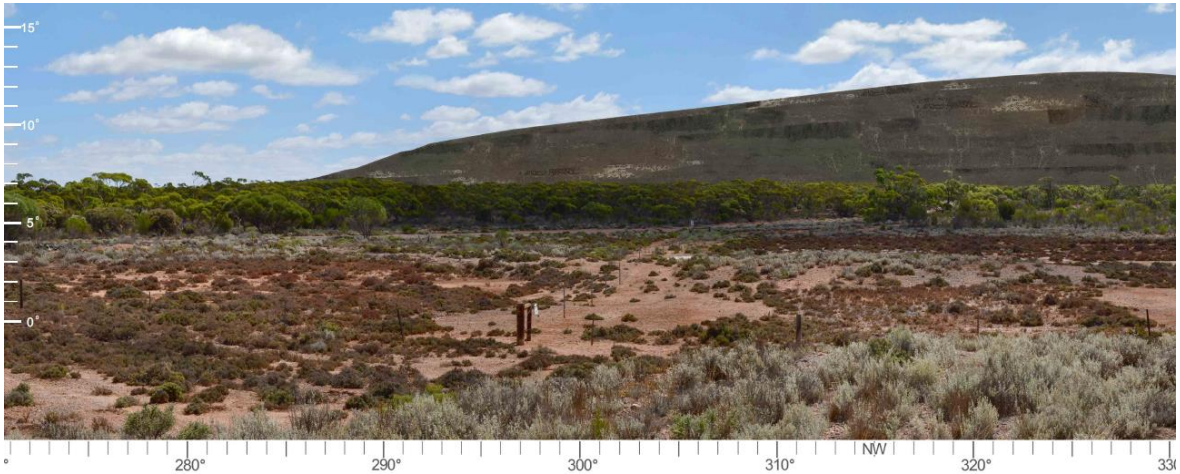
Viewpoint 2



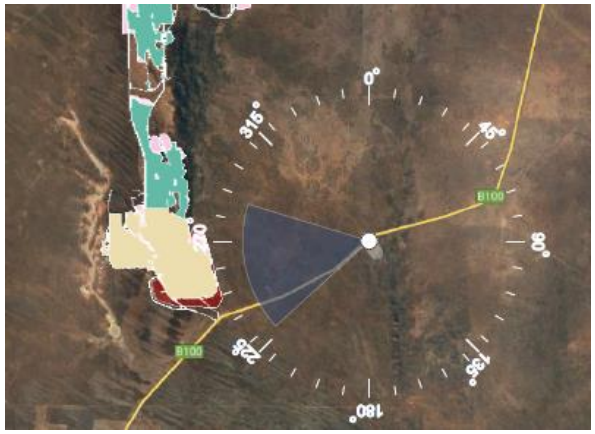
Existing View



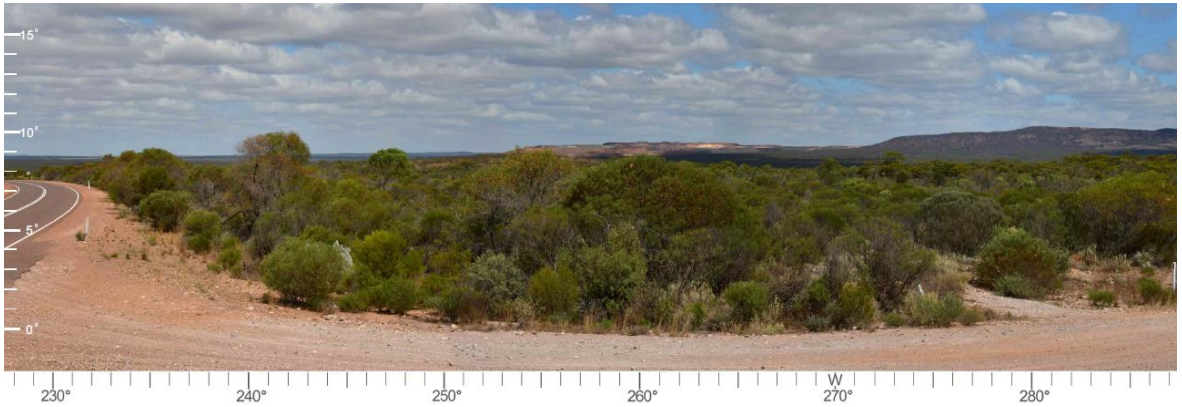
Expected View



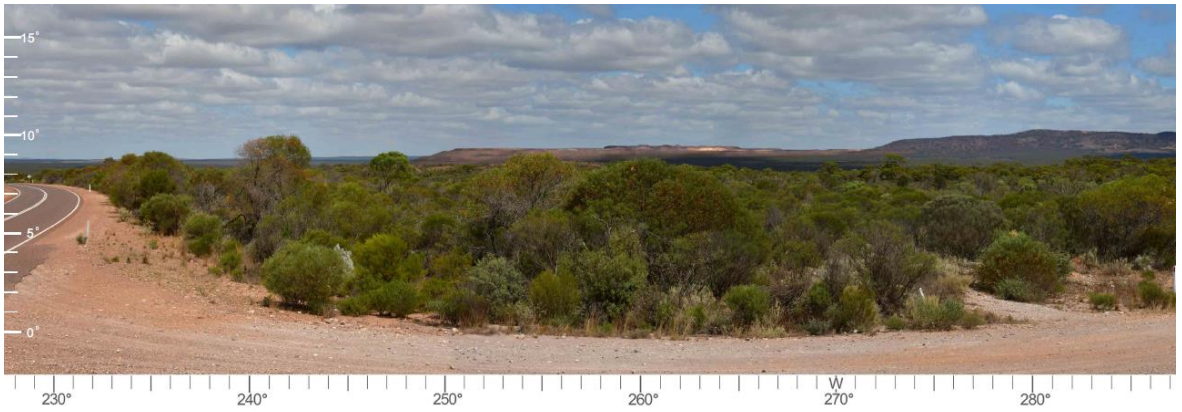
Viewpoint 3



Existing View



Expected View



Noise

A noise impact assessment (Resonate, 2024 – refer Appendix D4) was undertaken to identify the potential noise levels from the MEP1 development. The assessment considered noise impacts from existing operations and proposed MEP1 operations and included a review of the potential noise impacts at adjacent sensitive receptors. The report then predicted the likely worst-case noise levels from the MEP1 operations to identify whether the CiO would result in any change to noise impacts on relevant receptors. It should be noted that this assessment considered all aspects of MEP1, rather than the aspects specific to this CiO.

The sensitive receptors considered as part of the assessment are the same as those considered in the air quality assessment. The proposed CiO will result in the WRD being located approximately 400 m closer to both the Pine Hill Homestead and Plane Homestead.

The predicted noise levels were modelled to be less than the *Environmental Protection (Commercial and Industrial Noise) Policy 2023*[4] Criteria for rural industry at all noise sensitive receptor locations and are compliant with the requirements of the TOR006 – Metallic and industrial mineral PEPRs and the *Environmental Protection (Commercial and Industrial Noise) Policy 2023* at all sensitive receptors (Table 3-8).

Table 3-8: Predicted noise levels at sensitive receptor locations based on the MEP1 operations

Sensitive receptor	Environmental Noise Policy Criteria (dB(A))		Predicted Noise Level (L_{eq} dB(A))	
	Day time	Night time	Existing SMR operations	MEP1 operations
Moola	**57**	**50**	35	35
Broadview			31	31
Moonabie			26	33
Pine Hill			20	37
Plane			33	23
Uplands			38	39

Relevant environmental outcomes and measurement criteria are expected to be achieved for the construction, operation and rehabilitation of the proposed MEP1 operations (see Appendix F).

Light

No material changes to lighting are proposed as part of the CiO and as such, light nuisance is not anticipated.

[4] Note that the *Environment Protection (Noise) Policy 2007* has been replaced with the *Environmental Protection (Commercial and Industrial Noise) Policy 2023.*

3.2.3.1 Outcomes and criteria applicable to visual amenity, nuisance noise and light

Table 3-9: Visual amenity and nuisance noise outcomes

Environmental outcome	Does the outcome remain appropriate and achievable?
The contrasting and reflective aspects of WRDs and infrastructure are visually softened to blend in with the surrounding landscape	Yes
No public nuisance impacts from noise emissions generated from mining operations.	Yes
Comply with Environment Protection (Noise) Policy 2007	Yes * note: no specific OMC for this outcome

Table 3-10: Measurement criteria and leading indicator criteria (visual amenity, nuisance noise and light)

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
Visual Amenity	The contrasting and reflective aspects of WRDs and infrastructure are visually softened to blend in with the surrounding landscape	Annual audits will be conducted against the staged rehabilitation strategy, with the use of annual aerial and ground surveys of the landform development and biennial flora monitoring surveys demonstrate progressive rehabilitation undertaken in accordance with staged rehabilitation strategy for the SMR Mining area (see section 3.10 of the PEPR).	SMR operations manager	SMR Mining Area	Timing and rehabilitation outcomes are achieved in accordance with the Mine Plan closure and rehabilitation.	Annually	Mine plan closure and rehabilitation (see section 3.10 of the PEPR).	Internal Trigger: Audit findings show that rehabilitation outcomes and timings have not been achieved as per the mine plan closure and rehabilitation Leading indicator criteria: Not proposed	Measurement criteria will be reported against in annual compliance reporting to DEM.	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
Noise	No public nuisance impacts from noise emissions generated from mining operations.	Records demonstrate that complaints of noise or light pollution are responded to within 24 hours, are logged and investigated and all corrective actions are closed out within 30 days of receiving a complaint, or as otherwise agreed with the impacted party or the Regulator.	Manager stakeholder engagement	SMR Mining Area	Compliance with WI50_004 (Complaints Management Protocol) and WI50_008 (Stakeholder Engagement and Communications Management).	As required to respond to complaints	Complaints management database and Landholder issues register.	Internal trigger: Not proposed Leading indicator criteria: Not proposed	Measurement criteria will be reported against in annual compliance reporting to DEM.	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.

3.2.4 Flora and fauna

3.2.4.1 Native flora and fauna

MPL32 falls within the Gawler Interim Biogeographic Regionalisation for Australia (IBRA) bioregion, on the western edge of the Myall Plains subregion. A description of this is provided in Table 3-11.

Table 3-11: IBRA bioregions and subregions that span MEP1 Project Area of MPL32 (Source: Jacobs, 2021)

Region	Description
Gawler *(GAW)*	Semi-arid to arid, flat-topped to broadly rounded hills of the Gawler Range Volcanics and Proterozoic sediments, depositional plains and salt-encrusted lake beds, with Black Oak (Belah) and myall low open woodlands, open mallee scrub, bluebush/saltbush open chenopod shrublands and tall mulga shrublands on shallow loams, calcareous earths and hard red duplex soils.
	Subregion: Myall Plains (GAW01). Gently undulating calcrete plains and occasional hills. Includes a zone of salt lakes and gypsum dunes at Lake Gillies and steep strike ranges at the Middleback Ranges. Semi-arid climate dominated by Western Myall (*Acacia papyrocarpa*) +/- Mulga (*Acacia aneura*) woodlands over mixed chenopod and saltbush dominated shrublands, with pockets of Mallee woodland, heath and shrublands, over red calcareous earths and sandy soils with mottled yellow clayey subsoils.

Multiple surveys have occurred in the region which have mapped vegetation communities within MPL32. Jacobs (2021a, 2021b, 2022a, b, c and d) have mapped the area proposed to be cleared within MPL32 for the proposed changes detailed in Section 2.2. These vegetation communities within MPL32 are detailed in Table 3-12 and are shown on Figure 3-4.

It is anticipated that approximately 65.66 ha of the abovementioned vegetation communities will be cleared within MPL32 to allow for MEP1 and will include the clearing of the following areas of each vegetation community as detailed in Table 3-12 and shown in Figure 3-4.

Table 3-12: Vegetation communities within MPL32 intersected by MEP1 footprint

Vegetation Community	Area proposed to be cleared
E. oleosa (Red Mallee) over Chenopod +/- *C. conocephala* (Bluebush Daisy) low open shrubland	38 ha
E. socialis +/- *E. leptophylla* (Narrow-leaf Red Mallee) +/- *E. incrassate* (Ridge-fruit Mallee) over *T. scariosa* (Spinifex) hummock grassland	27.6 ha
E. phenax ssp phenax (White Mallee) / *E. gracilis* (Yorrell) over Chenopod low open shrubland and mixed tall shrubs	0 ha
S. artemisioides (Desert Cassia) / *C. conocephala* (Bluebush Daisy) open shrubland and emergent *M. platycarpum* (False Sandalwood)	0 ha
Total	**65.6 ha**

As a result of MEP1, a recalculation of the Significant Environmental Benefit (SEB) will be required. This will be included in a forthcoming PEPR review, and in an updated Native Vegetation Management Plan.

The proposed clearance area for the MEP1 has been subject to an *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cth) Self-Assessment. Previous ecology surveys and studies were reviewed, and habitat suitability mapping from Jacobs (2021a, 2021b, 2022a, b, c and d) and EBS (2023) was used to inform a likelihood assessment for all Matters of National Environmental Significance (MNES), with specific focus on Desert Greenhood, Malleefowl, Sandhill Dunnart, Southern Whiteface and Western Grasswren, which were all identified as possible or likely to occur within the likelihood assessment. The self-assessment

considered the nature and extent of all potential (direct, indirect and offsite) impacts and any mitigation measures in order to assess whether or not the proposed action is likely to have a significant impact on MNES.

The EPBC Self-Assessment has identified that the Project will result in the clearing of potentially suitable habitat for EPBC Act listed threatened species will occur as shown in Table 3-13. The outcome of the self-assessment is detailed below.

Table 3-13: EPBC Act species habitat within MPL32 intersected by the MEP1 footprint

Habitat	Area proposed to be cleared (Ha)
EPBC Act Listed Threatened Flora	
No potentially suitable habitat for listed threatened flora will be impacted by the MEP1 footprint	0
EPBC Act Listed Threatened Fauna	
Sandhill Dunnart potentially suitable habitat (not core habitat)	27.6
Western Grasswren potentially suitable habitat	38.0
Southern Whiteface potentially suitable habitat	27.6
Malleefowl potential habitat (not core habitat)	62.2

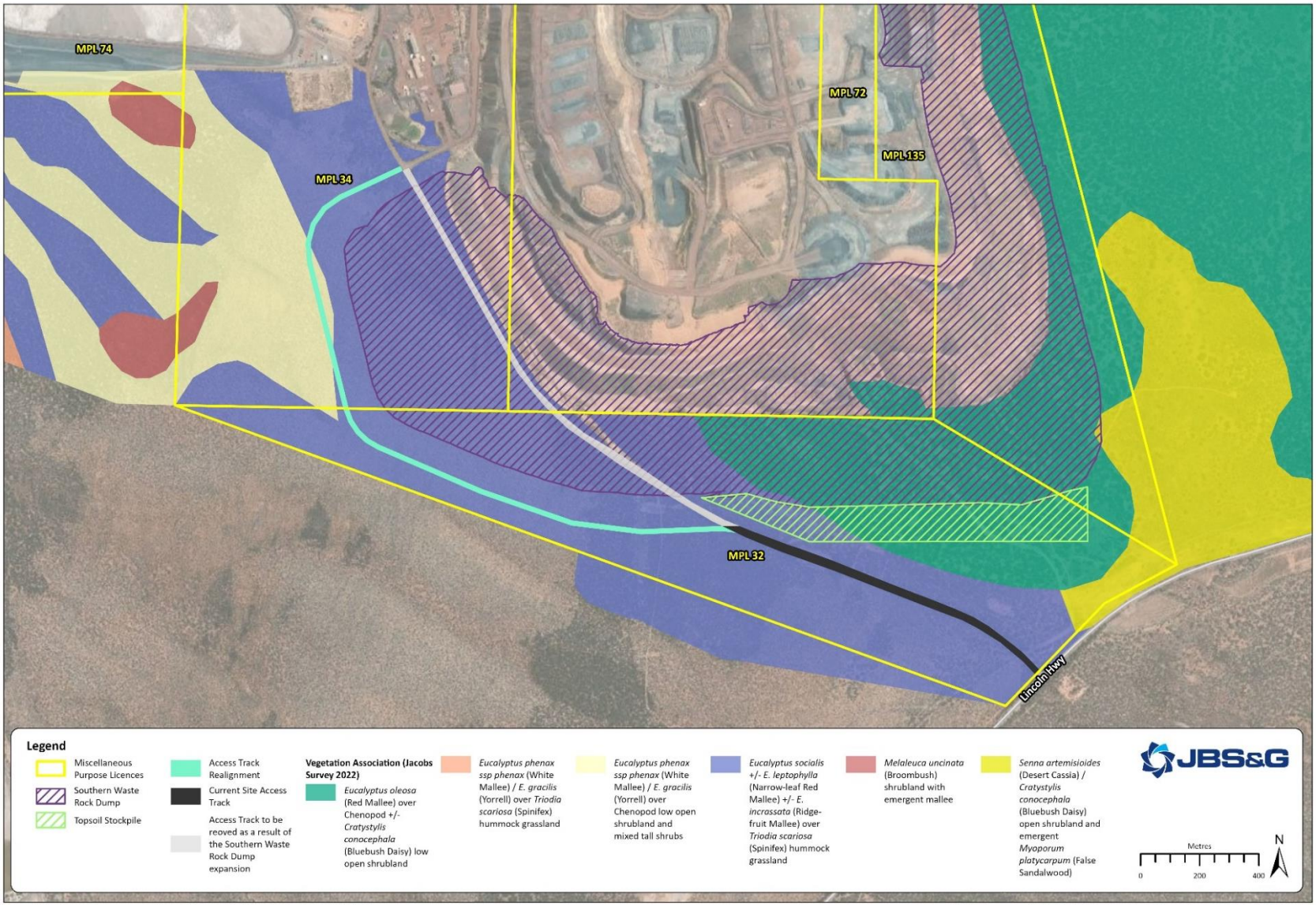


Figure 3-3: Vegetation communities within the MEP1 project extent of MPL32

Spatial Reference: GDA2020 MGA Zone 53; **Author:** rtandon; **Date:** 25/07/2024
Client: SIMEC; **Job Number:** 6622904

Figure 3-4 Vegetation communities within the MEP1 extent of MPL32

3.2.4.2 Avoidance and mitigation

SIMEC has selected disturbance areas which are within pre-existing mining tenements, and specifically avoids field survey verified habitat and known populations of the Desert Greenhood (*Pterostylis xerophila*) and avoids identified and field survey verified core habitat of both Sandhill Dunnart (*Sminthopsis psammophila*) and Malleefowl (*Leipoa ocellata*). The disturbance footprint actively avoids the area proximal to the one historic sighting of the Sandhill Dunnart which been made on the broader SMR site, however this is not inside the MEP1 area.

A long-term fauna monitoring site (known as M2A, Figure 3-5) located immediately adjacent to the western portion of the MEP1 area on MPL34, between the proposed road location and the remainder of the clearance area, has been continually monitored for 15 years and no Sandhill Dunnarts have been observed here.

The access road is not likely to intersect the monitoring site, but if required will be adjusted to account for the access road.

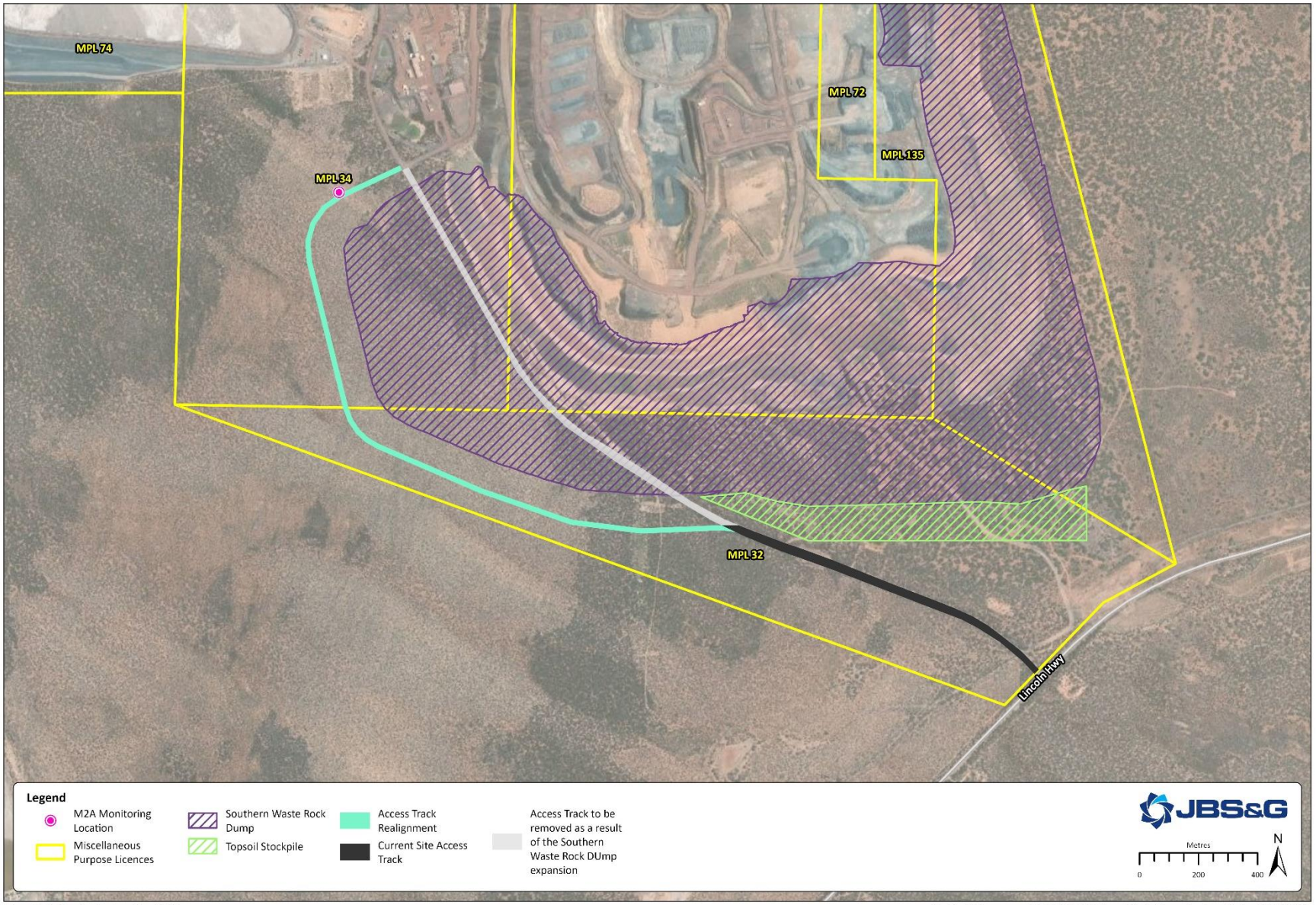


Figure 3-4: Monitoring Location M2A

Spatial Reference: GDA2020 MGA Zone 53; **Author:** rtandon; **Date:** 25/07/2024
Client: SIMEC; **Job Number:** 6622904

Figure 3-5: Long term monitoring site location (M2A)

3.2.4.3 EPBC Listed Threatened Flora

A total of three flora species were identified within the Protected Matters Search Tool (PMST) search area (PMST results in Appendix G). In general, the MEP1 area is a partially disturbed system, comprising pastoral grazing areas with some remnant vegetation and several areas already affected by mine operations.

The self-assessment included a likelihood of occurrence assessment to identify whether listed threatened flora species have likelihood of occurring within the MEP1 area, and if so, is there likely to be a significant impact on the species resulting from the Project. A summary of this assessment is provided in Table 3-14.

Table 3-14: Likelihood of species occurrence within MEP1 area and potential for significant impact

Scientific Name	Common Name	EPBC Status	Details	Likelihood of Occurrence in MEP1 area	Is the proposed action likely to have a significant impact?
Limosella granitica	Granite Mudwort	V	An aquatic perennial. Blades float on the surface of water bodies it resides in. Distributed through fine silt in granite rock holes and has been observed to be completely submerged. It is unknown whether flowering occurs above or below water. No records are present within 50 km of MEP1. Granite outcrops are present, but there are no known rock holes that retain water for a period of time within the MEP1 area, therefore this species is considered unlikely to occur. **Suitable habitat is unlikely to be present within the project area.**	Unlikely	No
Pterostylis xerophila	Desert Greenhood	V	Occurring in small populations in fertile soils on or around granite rock outcrops. Often occurring in areas of low rainfall. Multiple field surveys have been conducted in the MEP1 area and surrounding PMST search area in accordance with EPBC orchid survey guidelines. This method is intended as the minimum reasonable effort required to demonstrate absence of a species. The Desert Greenhood has only been observed in three of the mapped habitat patches (all outside the clearance area for the MEP1 area), see Figure 3-6. Multiple records within 5km of MEP1 area, species is known to occur in the PMST search area based on surveys conducted by JSB&G in 2021, 2022 and 2023. **No habitat patches present within the project area. Potentially present in habitat adjacent to (east of) the clearance footprint, however not detected in this patch despite intensive survey in accordance with EPBC orchid survey guidelines.**	Possible (adjacent to clearance footprint) – Figure 3-6.	No See Table 3-15.
Swainsona pyrophila	Yellow Swainson-pea	V	A short-lived, soft-wooded shrub growing up to 1 m in height (Jeanes, 1996; Tonkinson & Robinson, 2010). Grows in mallee scrub on sandy or loamy soils and is usually found to germinate only after fire followed by subsequent rain. Species have been found for the first time in areas of South Australia post fire event. Several records exist within the PMST search area, the most recent of these is from 2010. Not recorded in ecological surveys of the project area. **Suitable habitat is known to occur within the MEP1 area.**	Possible	No See Table 3-15.

MAP REDACTED

Figure 3-6: Mapped distribution of the Desert Greenhood
Source: JBS&G (2023)

A summary of the detailed assessment against the significant impact criteria for the Desert Greenhood and Yellow Swainson-Pea is provided in Table 3-15.

Table 3-15: Detailed assessment against significant impact criteria for Desert Greenhood and Yellow Swainson-Pea

Criteria	Details
***Pterostylis xerophila* – Desert Greenhood (Vulnerable)**	
Likelihood summary	**Possible** (adjacent to the MEP1 area). Observed during orchid surveys in the area surrounding the proposed MEP1 area by JBS&G in 2021, 2022 and 2023. Multiple records are present within the PMST search area. No habitat patches present within the MEP1 area. Potentially present in habitat adjacent to (east of) the clearance footprint, however not detected in this patch despite intensive survey in accordance with EPBC orchid survey guidelines.
Key potential impacts	Potentially impacted by clearance and dust. The clearance footprint for MEP1 has been designed to avoid potential Desert Greenhood habitat and known populations. The persistence of a population within a habitat patch directly adjacent to the existing TSF indicates that the species may be tolerant of the potential indirect impacts (such as dust).
Lead to a long-term decrease in the size of an important population of a species	Not likely. The proposed MEP1 area does not support an important population based on surveys by JBS&G (2021, 2022, 2023), Jacobs (2022b) and EBS (2023). Populations (and potential habitat) that were identified by JBS&G have been avoided by the design of the MEP1 footprint and will not be impacted.
Reduce the area of occupancy of an important population	Not likely. No known important population is present in the MEP1 area as the design does not include any of the known populations or mapped potential habitat for this species.
Fragment an existing important population into two or more populations	Not likely. No known important population is present in the MEP1 area as the design does not include any of the known populations or mapped potential habitat for this species.
Adversely affect habitat critical to the survival of a species	Not likely. Suitable habitat has been mapped in the surrounding area, however, as discussed above, design of the MEP1 area has meant that no habitat for known populations or broombush/granite outcrop potential habitat will be cleared. *Pterostylis xerophila* is known to have a highly specific habitat niche and requires this combination of factors to survive.
Disrupt the breeding cycle of an important population	Not likely. No suitable habitat or known population is present within the MEP1 project area. Not likely to impact the breeding cycle of any population of the species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely. None of the mapped suitable habitat will be cleared and it is unlikely any individuals would be present outside of this specific habitat association. Any clearance of areas not considered suitable habitat is unlikely to have any impact on species decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Not likely. Habitats in the MEP1 area are not considered suitable to support *Pterostylis xerophila*. Weed management and vehicle hygiene practices will be implemented when working in the clearance area. The region is not considered a high-risk Phytophthora area.
Introduce disease that may cause the species to decline	Not likely. Habitats in the MEP1 area are not considered suitable to support *Pterostylis xerophila*. Weed management and vehicle hygiene practices will be implemented when working in the MEP1 area. The region is not considered a high-risk Phytophthora area. Introduced species such as goats already exist in the PMST search area, as do several weed species. Proposed

Criteria	Details
	measures are not expected to increase grazing pressure nor spread any invasive weeds
Interfere substantially with the recovery of the species	Not likely. None of the proposed clearance/actions are in conflict with the approved recovery advice.
***Swainsona pyrophila* – Yellow Swainson-Pea (Vulnerable)**	
Likelihood summary	**Possible**. Several records have been identified within the PMST search area, the most recent of which is from 2010. Has not been recorded in ecological surveys of the MEP1 area. The species is short-lived and exists primarily as seed stored in soil and is known only known to exist as a plant for 1-5 years following fire or other disturbance. The life cycle of the plant can make it difficult to survey. Individuals have been known to occur in revegetated areas of the broader SMR site.
Key potential impacts	Habitat clearance is considered possible, however, as the plant exists predominantly as seed stored in topsoil it is considered more probable to be in this form. Topsoil removed from the clearance area will be retained and reused on site during rehabilitation, giving seeds the opportunity to germinated in revegetated land. Incidental habitat damage may occur through vehicle or machinery movements in the PMST search area. Because the species responds to disturbance, impacts from the project may be buffered or potentially benefit the species.
Lead to a long-term decrease in the size of an important population of a species	Not likely. In South Australia, four important populations have been identified in Hambidge, Munyaroo, Heggaton and Messent Conservation Parks (Tonkinson & Roberston, 2010). The closest of these is Munyaroo, approximately 10 km south of MEP1. Between the conservation park and the MEP1 area however there are areas of agricultural land. Plants north of this agricultural use are not expected to represent an important population, (Department of Environment, Water and Natural Resources 2014). Any potential impact would be to individual plants and not an important population.
Reduce the area of occupancy of an important population	Not likely. No known important population is present within the MEP1 area.
Fragment an existing important population into two or more populations	Not likely. No known important population is present within the MEP1 area.
Adversely affect habitat critical to the survival of a species	Not likely. The species typically exists as seed in topsoil. Topsoils removed during clearance will be retained and used during revegetation efforts. The species germinates following fire or disturbance and this disturbance may in fact allow individuals to germinate. Although suitable mallee habitat is present, given the absence of records and that it was not observed during ecological surveys, these habitats are not considered critical to the survival of the species.
Disrupt the breeding cycle of an important population	Not likely. No known important population is present within the MEP1 area. Not likely to impact the breeding cycle of any population of the species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely. Grows on sandy or loamy soils in mallee scrub and is not considered to have a highly specific habitat niche. Seeds stored in soils that are respread during recovery efforts are likely to be able to germinate following disturbance.

Criteria	Details
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Not likely. Introduced species such as goats already exist in the PMST search area, as do several weed species. Proposed measures are not expected to increase grazing pressure nor spread any invasive weeds. Weed management and vehicle hygiene practices will be implemented when working in the clearance area. The region is not considered a high-risk Phytophthora area.
Introduce disease that may cause the species to decline	Not likely. Weed management and vehicle hygiene practices will be implemented when working in the MEP1 area. The region is not considered a high-risk Phytophthora area.
Interfere substantially with the recovery of the species	Not likely. None of the proposed clearance/actions are in conflict with the approved recovery advice.

3.2.4.4 EPBC Listed Threatened Fauna

A total of twelve Nationally threatened fauna species[5] were identified within the PMST search area (PMST results in Appendix H). The majority of these were bird species.

The self-assessment included a likelihood of occurrence assessment to identify whether listed threatened fauna species have a likelihood of occurring within the MEP1 area, and if so, is there likely to be a significant impact on the species resulting from the Project. A summary of this assessment is provided in Table 3-16.

[5] Species that are listed as conservation dependent under the EPBC Act are not considered as MNES for the purposes of Part 3 of the EPBC Act and consequently have not been included in the assessment.

Table 3-16: Likelihood of occurrence in the project area and summary of impact significance for nationally listed threatened flora and fauna

Scientific Name	Common Name	EPBC Status	Details	Likelihood of Occurrence in MEP1 area	Is the proposed action likely to have a significant impact?
Mammals					
Sminthopsis psammophila	Sandhill Dunnart	E	A small carnivorous marsupial, usually only up to 16cm in length. Having large ears and thick tails for fat storage (Landscape South Australia, 2023). Occurs in isolated sandy arid and semi-arid areas across the Great Victoria Desert and the Eyre Peninsula. Occurs in Triodia (hummock) grassland. Species are especially likely to be found in the centre of hummocks that have died off in the centre where they often dig a circular depression. Several reported sightings have been made within the PMST search area. The most recent sightings include records from 2012. No records in or adjacent to the MEP1 area, despite long term monitoring (trapping) undertaken by Ecological Horizons, targeted trapping undertaken by Ecological Horizons (2010) and targeted searches undertaken by EBS (2023). No core habitat in **MEP1** area; small area of 'likely' suitable habitat present in south of clearance area (EBS 2023). **Suitable habitat mapped by EBS is shown in Figure 3-7**.	Possible	No See Table 3-15
Birds					
Amytornis textilis myall	Western Grasswren (Gawler Ranges)	V	Dull, stout-billed birds with pale grey-buff underparts, female birds have chestnut flanks (Pizzey & Knight, 1999). Occurs in open chenopod shrublands, often where dense stands of *Acacia tetragonophylla* or *Maireana pyramidata* surround drainage lines. Also occurring in Atriplex or Bluebush (*M. sedifolia*) shrublands. (Higgins et al. 2001; Matthew 2002, pers. Comm.; Matthew & Carpenter, 1993). No sightings within the PMST search area, records from within 20 years exist within 20km. Not recorded in surveys of the MEP1 area (Ecological Horizons 2010, EBS, 2023) which included targeted searches and call playback in (EBS, 2023). No core habitat identified in the MEP1 area and only 0.13 ha of habitat present classified as 'likely' suitable (EBS, 2023) (Figure 3-9). EBS (2023) concluded that the species is unlikely to be present in this habitat given their non-detection during surveys, but it is potentially suitable if they dispersed to this area in the future.	Possible	No See Table 3-15

Scientific Name	Common Name	EPBC Status	Details	Likelihood of Occurrence in MEP1 area	Is the proposed action likely to have a significant impact?
Aphelocephala leucopsis	Southern Whiteface	V	Small, sturdy, grey-brown bird with a stubby finch like bill. Inhabits dry, open forests and woodlands as well as inland scrubs of mallee, mulga and saltbush. Prefers areas with fallen timber, dead trees and leaf litter (Birdlife Australia, 2023a). Observed in 2022 in the PMST search area, several sightings within 20km of the MEP1 area. Potentially suitable habitat is present in the MEP1 area (Figure 3-10).	Likely	No See Table 3-15
Calidris ferruginea	Curlew Sandpiper	CE, Ma	Small, slim sandpiper 18-23 cm long. Bill long and decurved with a slender tip. Inhabit intertidal mudflats in sheltered coastal areas such as estuaries, bays, inlets and lagoons. Can be recorded inland, although this is much less common. No records within 20km of the clearance area, most records located along coastal areas. No suitable aquatic / intertidal habitat in the MEP1 area.	Unlikely	No
Falco hypoleucos	Grey Falcon	V	Endemic to mainland Australia, compact, grey, with heavy chest, long wings and dark wing tips. (Debus 2019; Schoenjahn, 2010). Occurs throughout arid and semi-arid Australia, especially where rainfall is low. A highly mobile species that frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses. Usually nests in the tallest trees along arid watercourses. No records within 20km of the clearance area, the closest observation being approximately 40km north of the MEP1 area, from 1998. No preferred tree-lined watercourses in the entire MEP1 area (larger than MPL32). **The area of occupancy of the Grey Falcon is estimated to be 1,690,000 km^2, the area of disturbance proposed represents approximately 0.00008% of the Area of Occupancy (AOO). If vagrant individuals did occur in the MEP1 area (given its widespread distribution), significant impact is not expected.**	Unlikely	No
Grantiella picta	Painted Honeyeater	V	Black headed and backed with bright yellow wings and pinkish bill. Juveniles are browner and have a greyish bill. Birds grow to approximately 15cm in length (Pizzey & Knight, 1997). Distributed predominantly across south-eastern Australia to Queensland and the Northern Territory. Lives in dry, open forests and woodlands,	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of Occurrence in MEP1 area	Is the proposed action likely to have a significant impact?
			particularly those dominated by Eucalypts, Melaleuca, Casusarina and Acacia. Usually occurs where Eucalypt sp are flowering and mistletoes are fruiting (Eddy, 1961; Stewart, 1988; Pizzey & Knight, 1997; Higgins et al. 2001; Oliver et al., 2003). No records exist on the Eyre Peninsula. The MEP1 area is outside species known range.		
Leipoa ocellata	Malleefowl	V	Occurs in scrubland and woodland dominated by mallee and wattle species. Builds large breeding mounds, used for incubating eggs within the sand or rotting leaves used to make its nest. Sandy soils and abundant leaf litter are required for breeding. Emerging chicks are self-sufficient. Several records exist within the PMST search area including records from 2018, multiple records are also present within 20km. No nest mounds or traces recorded in ecological surveys of the MEP1 project area. No core habitat identified in the MEP1 area – habitat present classified as 'likely' suitable. Minimal suitable nesting habitat is present (EBS, 2023). **Suitable habitat mapped by Jacobs (2022) and EBS (2023) is shown in Figure 3-8.**	Likely	No See Table 3-15
Neophema chrysostoma	Blue-winged Parrot	V, Ma	Grows up to 24 cm in length, slender olive-green parrot with blue patches on the wings and yellow underparts (Higgins, 1999). Known to inhabit the eastern states and eastern portion of South Australia as well as northern and central Tasmania. They favour grasslands and grassy woodlands and are often found near wetlands both near the coast and in the semi-arid zone. No records exist within 20 km of the MEP1 area, the closest being greater than 40 km north-west. Preferred habitat (grasslands, grassy woodlands or wetlands) do not occur in the MEP1 area.	Unlikely	No
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	CE, Mi, Ma	Australia's largest shorebird. Annually migrates north to Russia or China to breed. Birds appear bulky and dark-streaked with long necks and legs. Widespread across coastal regions of north-east and southern Australia, rarely ever seen inland (Birdlife Australia, 2023b).	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of Occurrence in MEP1 area	Is the proposed action likely to have a significant impact?
			No records within 20 km, the closest sighting is approximately 40 km away, no sightings have been recorded inland. No suitable aquatic / coastal habitat in the MEP1 area.		
Pedionomus torquatus	Plains Wanderer	CE	Ground-dwelling bird found in grasslands of the Queensland, New South Wales, Victoria and South Australia. Prefers sparce, native grasslands and are often absent from areas where grass is too dense or too sparce. They nest amongst grasses and herbs, sometimes amongst crops. No records in the PMST search area. Nearest record is well over 50 km away from the MEP1 project area. No suitable habitat in the MEP1 area. Outside of known range.	Unlikely	No
Rostratula australis	Australian Painted Snipe	E, Ma	A stocky, wading bird around 250 mm in length with a long, pinkish bill. The species is generally seen in pairs and less often in small flocks (Marchant and Higgins, 1993). It has been recorded in all Australian States, although most common in eastern Australia. Generally inhabiting shallow terrestrial freshwater (and occasionally brackish) wetlands, they also use inundated or waterlogged grasslands, saltmarshes and bore drains. They are also known to utilise scattered, washed up or fallen timbers. No records are present within 50 km of the MEP1 area. No suitable densely vegetated freshwater wetland habitat in the MEP1 area.	Unlikely	No
Stagonopleura guttata	Diamond Firetail	V	Ashy brown bodied with a grey crown, forehead and neck. Underparts are white with a crimson rump. They grow up to 12 cm and travel in low flying flocks (Birdlife Australia, 2023c). Endemic to south-eastern Australia, found in open grassy woodland, heath and farmland or grassland with scattered trees. No records within the PMST search area. One record from 1994 is noted within 20 km from the MEP1 area. Not recorded during ecological surveys. Preferred habitat not present in the MEP1 area.	Unlikely	No

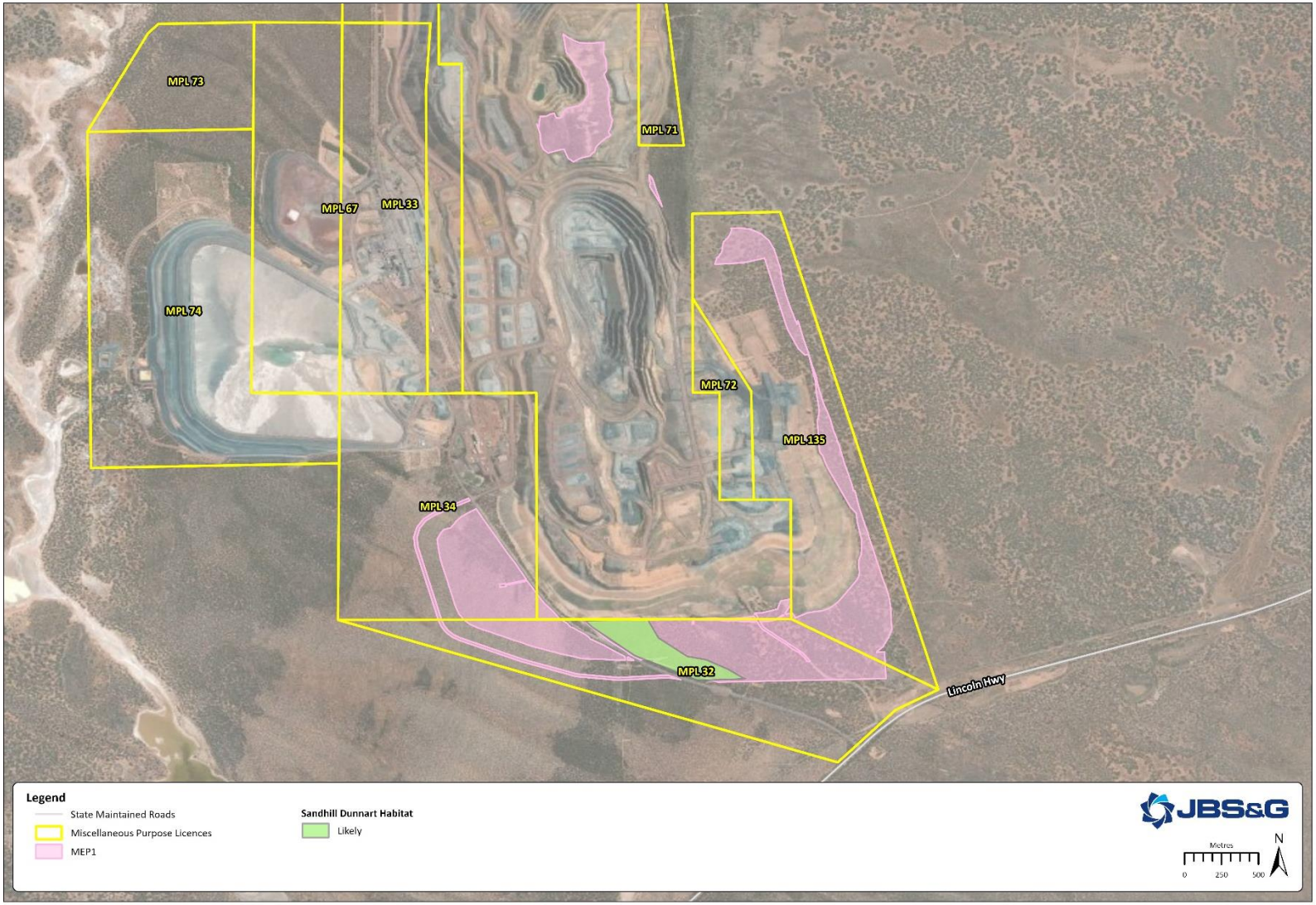


Figure 3-7: Mapped habitat distribution of Sandhill Dunnart

Spatial Reference: GCS GDA 1994; Author: jstrauss; Date: 15/08/2024
Client: SIMEC; Job Number: 6622904

Figure 3-7: Mapped habitat distribution of Sandhill Dunnart (note: no core habitat was identified)

Source: EBS (2023)

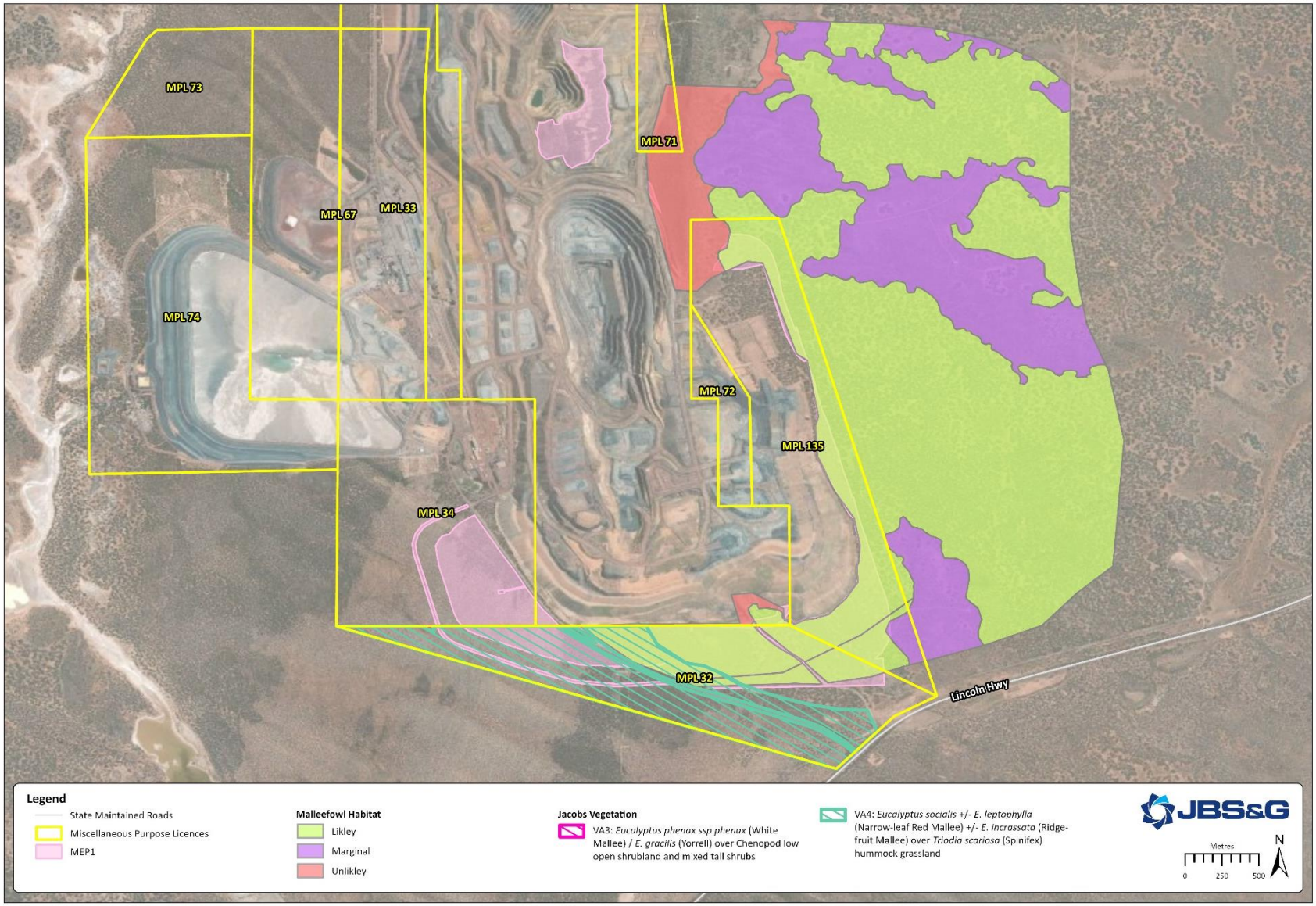


Figure 3-8: Mapped habitat distribution of Malleefowl

Spatial Reference: GCS GDA 1994; Author: jstrauss; Date: 15/08/2024
Client: SIMEC; Job Number: 6622904

Figure 3-8: Mapped habitat distribution of Malleefowl (note: no core habitat was identified)

Source: EBS (2023)

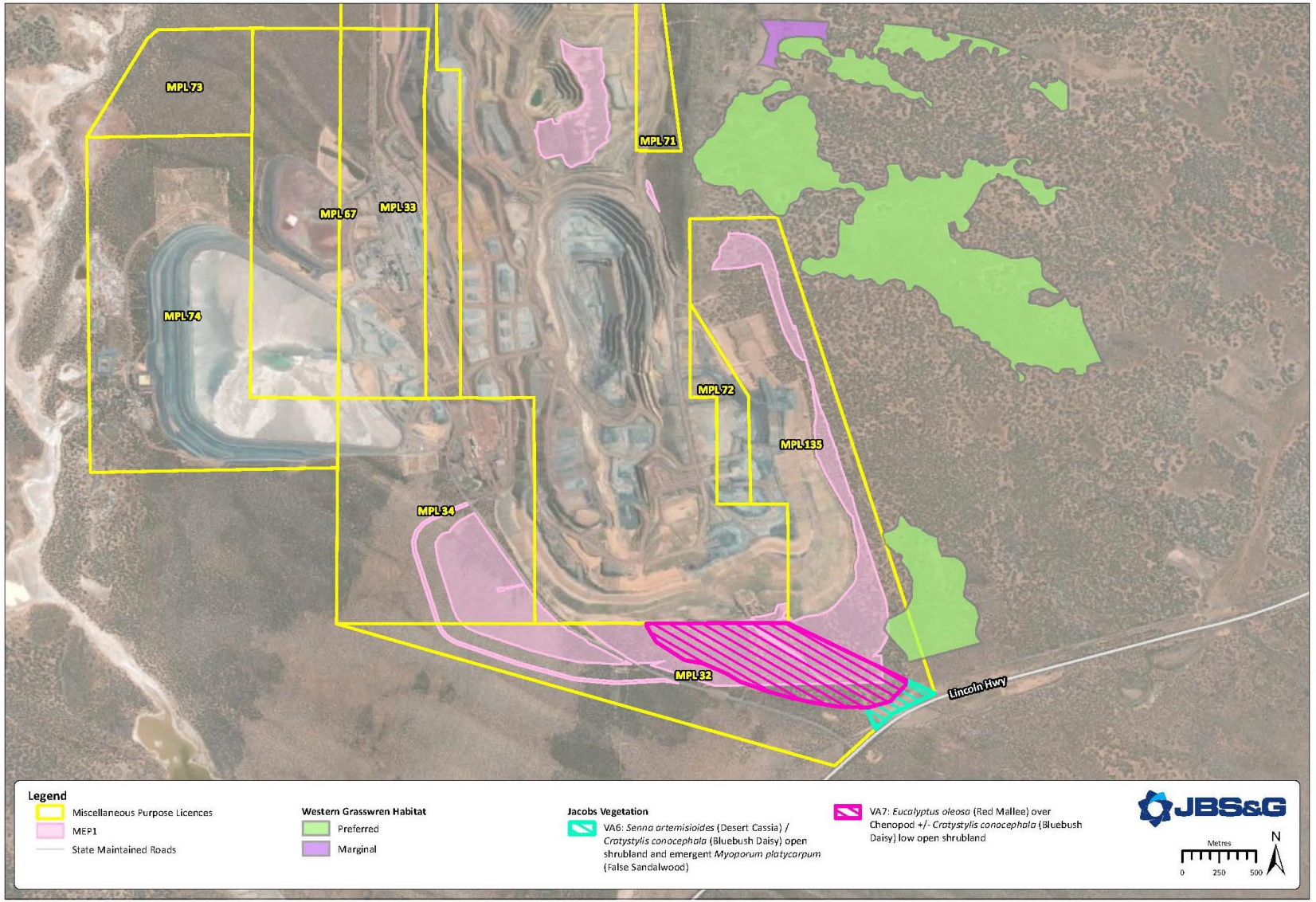


Figure 3-9: Mapped habitat distribution of Western Grasswren

Source: EBS (2023)

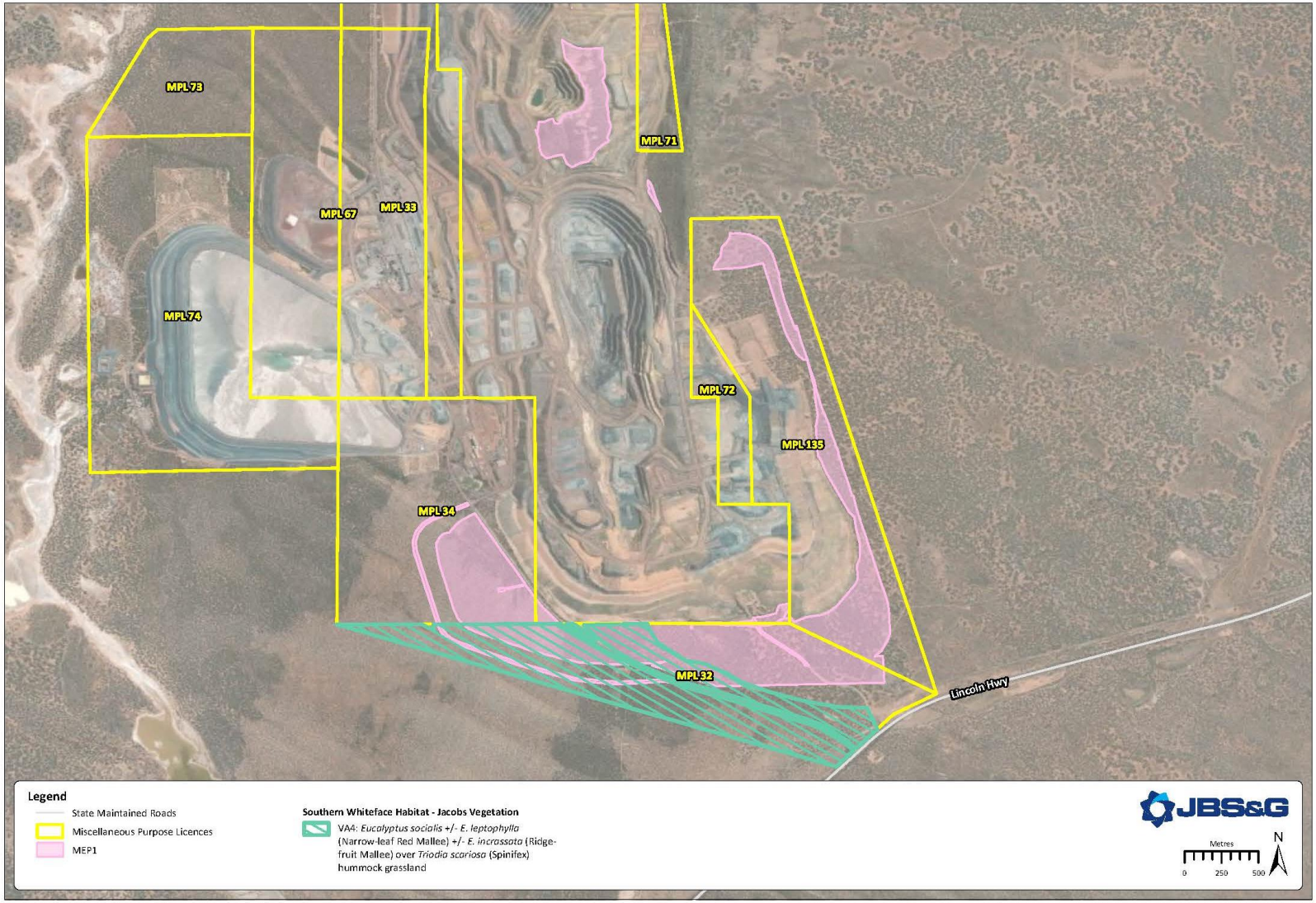


Figure 3-10: Mapped habitat distribution of Southern Whiteface

Spatial Reference: GCS GDA 1994; Author: jstrauss; Date: 15/08/2024
Client: SIMEC; Job Number: 6622904

Figure 3-10: Mapped habitat distribution of Southern Whiteface

Source: EBS (2023)

A summary of the detailed assessment against the EPBC Act significant impact criteria[6] for the Sandhill Dunnart, Western Grasswren, Southern Whiteface and Malleefowl is provided in Table 3-17.

Table 3-17: Detailed assessment against significant impact criteria for Sandhill Dunnart, Western Grasswren, Southern Whiteface and Malleefowl

Criteria	Details
***Sminthopsis psammophila* – Sandhill Dunnart (Endangered)**	
Likelihood summary (refer Table 3-16)	**Possible**. Several reported sightings within the 5 km PMST search area, the most recent of which is from 2012. There are approximately 280 records within 50 km of the MEP1 area, most of which are located within the Ironstone Hill Conservation Park (IHCP) adjacent to the western edge of the broader SMR site. One historic sighting has been made on the broader SMR site; however, this is not inside the MEP1 area. A long-term fauna monitoring site (known as M2A) (which is located immediately adjacent to the western portion of the MEP1 area, between the proposed road location and the remainder of the clearance area) has been continually monitored for 15 years and no Sandhill Dunnarts have been observed here. There are also two nearby control monitoring locations located south-west of the subject site and no dunnarts have been located at these locations during monitoring events (TBC – note: 2011 and 2015 monitoring reports not sighted. Requested from SIMEC). Targeted trapping undertaken in and adjacent to the project area by Ecological Horizons (2010) and targeted searches undertaken by EBS (2023) have also not detected Sandhill Dunnart presence. No 'core' habitat is present in the MEP1 area; a small area of habitat categorised as 'likely' to be suitable is present in the south of the clearance area (EBS, 2023). This area, however, is fragmented by the mine entry road from the known habitat to the west (EBS, 2023) and recent field inspections have indicated that it is not in good condition, with large amounts of dead Triodia and as such, is unlikely to provide suitable habitat.
Key potential impacts	Clearance of 27.6 ha of potentially suitable habitat within the MEP1 area within MPL32. Incidental damage to potentially suitable habitat may occur through vehicle or machinery movements in the area. Irritation from dust accumulation both in and outside the MEP1 area.
Lead to a long-term decrease in the size of a population	Not likely. Although the Sandhill Dunnart is known to occur across the region (and IHCP contains one of only three known populations in the area), there are no records in or adjacent to the MEP1 area, despite long-term monitoring and targeted surveys. No clearance is proposed in the IHCP or in other areas where Sandhill Dunnart is known to occur. The area of potential habitat that will be cleared is not core habitat and is fragmented by the mine entry road. If the species was present, the area of clearance represents a very small proportion of available habitat in the region. Consequently, the MEP1 area is not likely to support significant numbers of Sandhill Dunnart and the small area of clearance of potential habitat is not likely to lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species	Not likely. The AOO of the Sandhill Dunnart is estimated to be approximately 308 km^2. The area of habitat proposed to be cleared is not within the AOO of Sandhill Dunnart, as it has not been recorded in the area. If the species was present, the clearance of approximately 27.6 ha of habitat would represent a very small proportion (approximately 0.09%) of the total AOO of the species.

[6] Department of the Environment (2013) Matters of National Environmental Significance: Significant Impact Guidelines 1.1 *Environment Protection and Biodiversity Conservation Act 1999*. Australian Government. https://www.dcceew.gov.au/sites/default/files/documents/nes-guidelines_1.pdf.

Criteria	Details
Fragment an existing population into two or more populations	Not likely. No population is known to exist, and no records identified within the MEP1 area. A known important population exists within the IHCP which will not be impacted by works carried out as part of the MEP1 program. As the clearance area is located beyond the eastern extent of the IHCP (and on the eastern edge of the dunefield habitat in the broader area), it is considered unlikely clearance would fragment this population.
Adversely affect habitat critical to the survival of a species	Not likely. The conservation advice for this species does not define any habitat critical to the survival of the species. The habitat inside the MEP1 area is not likely to be critical to the species survival considering its location, existing fragmentation and condition discussed under the likelihood summary above, nor have any Sandhill Dunnarts been recorded in the area.
Disrupt the breeding cycle of a population	Not likely. The important population and important habitat in the nearby IHCP will not be impacted. If the species was present in the MEP1 area, it may impact some breeding individuals, however it is not considered to be of great enough magnitude to impact the population as a whole.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely. Although some habitat will be cleared that could potentially support some individuals if they were present, the neighbouring IHCP contains large amounts of important habitat that will not be impacted. The clearance of the small area of potential habitat inside the MEP1 area is not expected to have an adverse effect on the population or the species as a whole.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Not likely. Introduced species such as goats already exist in the PMST search area, as do several weed species. Proposed measures are not expected to increase grazing pressure nor spread any invasive weeds. Weed management and vehicle hygiene practices will be implemented when working in the clearance area. The region is not considered a high-risk Phytophthora area.
Introduce disease that may cause the species to decline	Not likely. The recovery plan for this species does not state any known diseases and hence introduced diseases are unlikely to cause a decline in species numbers.
Interfere with the recovery of the species	Not likely. There is no recovery plan for this species. Conservation actions for this species identified in the conservation advice include better understanding of locations and distributions of important populations and critical habitat. The proposed action will not interfere with the recovery of the species.
***Amytornis textilis myall* – Western Grasswren (Vulnerable)**	
Likelihood summary (refer Table 3-16)	**Possible**. No individuals have been located in the MEP1 area during surveys by EBS (2021, 2023), Ecological Horizons (2010) and Jacobs (2022b). No sightings have been recorded within the 5km PMST search area. There are several reported sightings located within 5-20 km within the past 20 years. EBS (2023) concluded that the species is unlikely to occur in the project area given the non-detection in surveys.
Key potential impacts	Clearance of 38.08 ha of potentially suitable habitat within the MEP1 area within MPL32. Incidental habitat damage may occur through vehicle or machinery movements in the PMST search area. Irritation from dust accumulation both in and outside the MEP1 footprint.
Lead to a long-term decrease in the size of an important population of a species	Not likely. Conservation advice for the species suggests that all populations of Western Grasswren should be considered important. Given that the species is unlikely to occur in the MEP1 area, the minimal nature of the vegetation clearance and the large area of suitable habitat in the PMST search area and broader region site the proposed clearance is not expected to significantly impact the population in the area.

Criteria	Details
Reduce the area of occupancy of an important population	Not likely. The AOO for the species does not overlap with the project area. The estimated AOO for *Amytornis textilis* myall is approximately 760 km^2 (Garnett & Baker, 2020), however it may range from 400 km^2 to 1,600 km^2. If the species was present, the clearance area of 38.08 ha represents less than 0.001% of the total AOO (using a conservative estimate of 400 km^2).
Fragment an existing important population into two or more populations	Not likely. There is no known population in the MEP1 area. The clearance proposed represents a small fraction of the total habitat available in the area for the Western Grasswren. This clearance is also situated on (or outside) the edge of the species range and so any fragmentation is considered highly unlikely.
Adversely affect habitat critical to the survival of a species	Not likely. The clearance of potential habitat has been reduced from initial designs to minimise any removal. It is not expected that the amount of vegetation clearance proposed represents enough to have an adverse effect on the species if it was present.
Disrupt the breeding cycle of an important population	Not likely. The species is unlikely to be present. If it was present, removal of the very small proportion of potential habitat in the area is not considered likely to disrupt breeding of any population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely. The clearance of potential habitat has been reduced from initial designs to minimise removal. It is not expected that the amount of vegetation clearance represents enough to have an adverse effect on the species.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Not likely. Introduced species such as goats already exist in the PMST search area, as do several weed species. Proposed measures are not expected to increase grazing pressure nor spread any invasive weeds. Weed management and vehicle hygiene practices will be implemented when working in the clearance area. The region is not considered a high-risk Phytophthora area.
Introduce disease that may cause the species to decline	Not likely. Weed management and vehicle hygiene practices will be implemented when working in the clearance area. The region is not considered a high-risk Phytophthora area.
Interfere substantially with the recovery of the species	Not likely. Conservation advice for this species is predominantly concerned with preserving extant populations. The small area of clearance at the edge of habitat range is not expected to result in any interference with the recovery of the species.
***Aphelocephala leucopsis* – Southern Whiteface (Vulnerable)**	
Likelihood summary (refer Table 3-16)	**Likely**. Observed during surveys by Jacobs (2022b) in the vicinity of the clearance area, also observed by EBS (2021) and Bebbington (2010). More than 50 records exist within 50 km of the clearance area however a number of these are within conservation parks. One additional sighting is recorded within the PMST search area. Considered likely to occur as species is identified as a habitat generalist and does not have a highly specific habitat niche.
Key potential impacts	Clearance of potentially suitable habitat within the MEP1 area. Incidental habitat damage may occur through vehicle or machinery movements in the PMST search area. Irritation from dust accumulation both in and outside the MEP1 area.
Lead to a long-term decrease in the size of an important population of a species	Not likely. No important populations are defined in the conservation advice. The population of Southern Whiteface is estimated at 470,000 mature individuals. The species is widespread and known to frequent a number of other ecological communities and is not expected to be dependent upon the habitat within the area of the proposed action. The proposed action is not likely to reduce the size of any population of the species.

Criteria	Details
Reduce the area of occupancy of an important population	Not likely. The AOO is estimated to be approximately 70,000 km^2, meaning the total clearance of the MEP1 area represents less than 0.0014% of the total AOO. This is not considered a significant reduction to the AOO.
Fragment an existing important population into two or more populations	Not likely. No important populations are defined in the conservation advice. The Southern Whiteface is also a known habitat generalist and is unlikely to be affected by the clearance proposed to support MEP1.
Adversely affect habitat critical to the survival of a species	Not likely. The species is a known habitat generalist and utilises a wide variety of habitats. Although the habitat present fits within the very broad definition of habitat critical to survival of the species, it represents a very small proportion of potential present in the region. Habitat proposed to be cleared during the MEP1 works is not expected to be critical to the survival of the species.
Disrupt the breeding cycle of an important population	Not likely. The species is a known habitat generalist and utilises a wide variety of habitats. Habitat proposed to be cleared during the MEP1 works is not expected to be critical to the survival or breeding of the species and clearance is not likely to disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely. Although the proposed works will remove some available habitat, it represents a very small proportion of available habitat and it is not likely to cause the species to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Not likely. Introduced species such as goats already exist in the PMST search area, as do several weed species. Proposed measures are not expected to increase grazing pressure nor spread any invasive weeds. Weed management and vehicle hygiene practices will be implemented when working in the clearance area. The region is not considered a high-risk Phytophthora area.
Introduce disease that may cause the species to decline	Not likely. Weed management and vehicle hygiene practices will be implemented when working in the clearance area. The region is not considered a high-risk Phytophthora area.
Interfere substantially with the recovery of the species	Not likely. None of the proposed clearance/actions are in conflict with the approved recovery advice.
***Leipoa ocellata* – Malleefowl (Vulnerable)**	
Likelihood summary (refer Table 3-16)	**Likely**. Extensive areas of potential habitat are present in the area surrounding the broader SMR facility, particularly to the west. Approximately 83.5 ha of suitable habitat has been mapped in the MEP1 area, however minimal nesting habitat was observed in the MEP1 project area (EBS, 2023). No nesting mounds have been detected in surveys in and adjacent to the MEP1 area (Ecological Horizons, 2010; Jacobs, 2022b; EBS, 2023; JBS&G, 2023) and it was considered that there was no core Malleefowl habitat within the MEP1 area (EBS, 2023). Several mounds both active and inactive have been sighted within 20 km of the site and one live bird was sighted (outside the project area footprint) during a 2021 survey by JBS&G. Another live bird was also observed via remote camera outside the MEP1 project area footprint by SIMEC Ecology staff (2023, pers comm, R Mason).
Key potential impacts	Clearance of 83.5 ha potential habitat (with minimal suitable nesting habitat present) within the MEP1 area. Incidental habitat damage may occur through vehicle or machinery movements in the PMST search area. Disturbance from dust accumulation inside the PMST search area.
Lead to a long-term decrease in the size of an important population of a species	Not likely. There are no defined important populations within the clearance area, however, (Benshemesh, 2007) identifies that all populations of the species should be treated as important. Most records of the species are concentrated in nearby conservation parks which will not be impacted by the proposed MEP1 works.

Criteria	Details
	There are no known records of birds or mounds from within the proposed clearance area. The proposed clearance represents a very small proportion of the habitat in the region, is not classified as core habitat and has minimal suitable nesting habitat, and consequently as not likely to lead to a decrease in the size of any population of the species.
Reduce the area of occupancy of an important population	Not likely. Malleefowl is widespread across southern Australia and in the region. Using estimates provided by the Action Plan for Australian Birds (Garnett et al, 2021), the clearance would represent approximately 0.000012% of the AOO of Malleefowl (using an estimate of A00 of 50,000km^2 ((Garnett et al, 2021)). These estimates suggest the impact to the AOO is not likely to be significant.
Fragment an existing important population into two or more populations	Not likely. Populations in the area are concentrated in nearby conservation parks rather than on the broader SMR site itself. It is not expected that any clearance is likely to fragment any population.
Adversely affect habitat critical to the survival of a species	Not likely. Malleefowl require a sandy substrate and abundance of leaf litter for the construction of their incubator-nest (Benshemesh, 2007). The National Recovery Plan for Malleefowl does not define any features as being critical for the survival of the species. Given that there are large areas of suitable / preferred habitat regionally outside of the project area (including in the IHCP) and the lack of definition of critical habitat for this species, clearance of a relatively small proportion of non-core habitat is not considered likely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Not likely. One (inactive) breeding mound has been located in the vicinity of the MEP1 area in surveys by JBS&G, EBS Ecology and Jacobs and minimal suitable nesting habitat is present. Breeding is unlikely to occur in the project area. It is possible that individual breeding pairs may in theory be disrupted, if present, however it is considered unlikely that the works could disrupt the breeding cycle of a population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Not likely. The area of potential Malleefowl habitat (with minimal suitable nesting habitat) that will be cleared for the purposes of the project represents such an insignificant proportion of available habitat that it is not considered likely to impact species numbers.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Not likely. Introduced species such as goats already exist in the PMST search area, as do several weed species. Proposed measures are not expected to increase grazing pressure nor spread any invasive weeds. Weed management and vehicle hygiene practices will be implemented when working in the clearance area. The region is not considered a high-risk Phytophthora area.
Introduce disease that may cause the species to decline	Not likely. The recovery plan for this species does not state any known diseases and hence introduced diseases are unlikely to cause a decline in species numbers.
Interfere substantially with the recovery of the species	Not likely. None of the proposed clearance/actions are in conflict with the approved recovery advice. Recovery actions for this species are predominantly focussed around better understanding of species distribution and critical habitat.

Relevant environmental outcomes and measurement criteria can be achieved for the construction, operation, and rehabilitation of the proposed MEP1 southern WRD (see Appendix F).

3.2.4.5 State Listed Threatened Flora

A total of nine State threatened flora species[7] were identified within the Biological Database of South Australia (BDBSA) Super Table (DEW 2024) search area (Table 3-18, Appendix H).

Table 3-18: Threatened Flora species recorded within 5km of the MEP1 Area (DEW 2024)

Scientific Name	Common Name	NPW ACT Status
Maireana suaedifolia	Lax Bluebush	R
Embadium johnstonii	Johnston's Slipper-plant	R
Acacia iteaphylla	Flinders Ranges Wattle	R
Acacia montana	Mallee Wattle	R
Acacia rhigiophylla	Dagger-leaf Wattle	R
Daviesia benthamii ssp. humilis (NC)	Mallee Bitter-pea	R
Pterostylis xerophila	Desert Greenhood	V
Geijera parviflora	Wilga	R
Santalum spicatum	Sandalwood	V

Ssp = rated sub-species; R= Rare; V = Vulnerable; CE = critically endangered, E = Endangered

3.2.4.6 State Listed Threatened Fauna

A total of 16 State threatened fauna species[8] were identified within the BDBSA Super Table (DEW 2024) search area (Table 3-19, Appendix H).

Table 3-19: Threatened Fauna species recorded within 5km of the MEP1 Area (DEW 2024)

Scientific Name	Common Name	NPW ACT Status
Birds		
Cinclosoma castanotum	Chestnut Quailthrush (Chestnut-backed Quailthrush)	R
Corcorax melanorhamphos	White-winged Chough	R
Dromaius novaehollandiae	Emu	ssp
Hylacola cauta cauta	Shy Heathwren (EP, YP, FR, MM, upper SE)	R
Leipoa ocellata	Malleefowl	V
Lichenostomus cratitius	Purple-gaped Honeyeater	ssp
Microeca fascinans	Jacky Winter	ssp
Myiagra inquieta	Restless Flycatcher	R
Strepera versicolor	Grey Currawong	ssp

[7] *National Parks and Wildlife Act 1972* (NPW ACT) rating

[8] *National Parks and Wildlife Act 1972* (NPW ACT) rating

Scientific Name	Common Name	NPW ACT Status
Mammal		
Sminthopsis psammophila	Sandhill Dunnart	V
Reptiles		
Echiopsis curta	Bardick	R
Neelaps bimaculatus	Western Black-naped Snake	R
Varanus rosenbergi	Heath Goanna	V

Ssp = rated sub-species; R= Rare; V = Vulnerable; CE = critically endangered, E = Endangered

3.2.4.7 Pests and weeds

Pests

A search of 5 km of the BDBSA Super tables (DEW, 2024) of the MEP1 area had recorded the following pest animals: Goat (Feral Goat) (*Capra hircus*), House Mouse (*Mus musculus*), Rabbit (European Rabbit) (*Oryctolagus cuniculus*) and Fox (Red Fox) (*Vulpes vulpes*) as having been sighted. Additionally, SIMEC have recorded feral cats on a number of occasions within and around the SMR.

The feral animal incursions into the region include:

- feral cat: a true survivor that has adapted extremely well to the region and is responsible for high level predation on native birds, reptiles and small mammals, including the Western Grasswren and Slender-billed Thornbills. Feral cats are a key contributor to the mainland extinction of many species, including the stick nest rat, which once lived in the Middleback Ranges.
- Fox: well adapted to the region and a significant predator of many native species including lizards, birds and snakes.
- Goat: introduced as domestic animals and quickly became one of the arid zones' most prolific and successful feral animals. Feral goats are browsers and are responsible for degrading native plant communities, including species of low palatability. Sightings of feral goats and fresh goat tracks were observed during the vegetation surveys (Bebbington, 2009b and 2014) and were also recorded during the fauna surveys (GHD, 2009; Ecological Horizons, 2014).
- Rabbit: responsible for widespread degradation of flora species particularly at the lower stratum and greatly reducing the recruitment success of larger species due to ring barking and consumption of seedlings.

All these species pose a direct threat to many native fauna and flora either through predation or habitat destruction on a regional scale. The southern WRD activities are not expected to change the existing impact/risk profile.

Weeds

The Middleback Ranges are in the north-eastern part of the Eyre Peninsula, just within the gazetted boundary for the South Australian Arid Lands (SAAL) region, which means it comes under the jurisdiction of the SAAL Landscape Board for pest plant and animal control as per the Landscape South Australia Act 2019.

A search of 5km of the BDBSA Super tables (DEW 2024) of the MEP1 area, and a review of previous surveys undertaken of the SMR area have identified a number of weed species within, and within 5 km of the MEP1 area, as detailed in Table 3-20.

The SMR is in a very low risk area for root-rot fungus *(Phytophthora cinnamomic)*, or Mundulla Yellows (a fatal plant disease), mainly due to the low rainfall (O'Gara et al. 2005). No evidence of either pathogen has been identified during field investigations to date.

SIMEC undertakes regular, scheduled weed inspections and maintains a weed record register in accordance with its internal Pest Plant and Animal Control Strategy, QP50.62

The southern WRD activities are not expected to change the existing impact/risk profile.

Table 3-20: Weeds recorded within 5km of the MEP1 Area (DEW 2024)

Scientific Name	Common Name	Record
Mesembryanthemum aitonis	Angled Iceplant	BDBSA Super Table
Mesembryanthemum crystallinum	Common Iceplant	BDBSA Super Table
Mesembryanthemum nodiflorum	Slender Iceplant	BDBSA Super Table
Asphodelus fistulosus	Onion Weed	BDBSA Super Table
Carthamus lanatus	Saffron Thistle	BDBSA Super Table, previous SMR surveys – creek lines and open areas
Centaurea melitensis	Malta Thistle	BDBSA Super Table
Dittrichia graveolens	Stinkweed	BDBSA Super Table
Hypochaeris glabra	Smooth Cat's Ear	BDBSA Super Table
Reichardia tingitana	False Sowthistle	BDBSA Super Table
Sonchus asper	Rough Sow-thistle	BDBSA Super Table
Sonchus oleraceus	Common Sow-thistle	BDBSA Super Table
Echium plantagineum	Salvation Jane	BDBSA Super Table, previous SMR Surveys – isolated, sparse populations
Brassica sp.		BDBSA Super Table
Carrichtera annua	Ward's Weed	BDBSA Super Table, previous SMR Surveys - the main weed species present in the understorey throughout the SMR (classified as a sparse to mid-dense infestation
Sisymbrium erysimoides	Smooth Mustard	BDBSA Super Table
Sisymbrium irio	London Mustard	BDBSA Super Table
Opuntia tomentosa	Velvet Pear*	BDBSA Super Table
Herniaria cinerea	Rupturewort	BDBSA Super Table
Sagina apetala	Annual Pearlwort	BDBSA Super Table
Medicago minima	Little Medic	BDBSA Super Table

Scientific Name	Common Name	Record
Medicago sp.	Medic	BDBSA Super Table
Erodium cicutarium	Cut-leaf Heron's-bill	BDBSA Super Table
Marrubium vulgare	Horehound	BDBSA Super Table, previous SMR surveys – isolated sparse populations (creek lines and open areas)
Salvia verbenaca var. verbenaca	Wild Sage	BDBSA Super Table
Aira sp.	Hair-grass	BDBSA Super Table
Avena barbata	Bearded Oat	BDBSA Super Table
Bromus diandrus (NC)	Great Brome	BDBSA Super Table
Bromus rubens	Red Brome	BDBSA Super Table
Cenchrus ciliaris	Buffel Grass	BDBSA Super Table
Hordeum glaucum	Blue Barley-grass	BDBSA Super Table
Pentameris airoides ssp. airoides	False Hair-grass	BDBSA Super Table
Piptatherum miliaceum	Rice Millet	BDBSA Super Table
Rostraria pumila	Tiny Bristle-grass	BDBSA Super Table
Schismus barbatus	Arabian Grass	BDBSA Super Table
Vulpia muralis	Wall Fescue	BDBSA Super Table
Vulpia myuros f. myuros	Rat's-tail Fescue	BDBSA Super Table
Galium murale	Small Bedstraw	BDBSA Super Table
Lycium ferocissimum	African Boxthorn	BDBSA Super Table
Galinsoga parviflora	Potato Weed	Previous SMR surveys – identified in open areas
Sisymbrium spp.	Wild Mustard	Previous SMR surveys – shrubland on undulating plains
Opuntoid cacti	-	Previous SMR surveys – isolated sparse populations

* Declared Landscape Act - Not For Sale

3.2.4.8 Outcomes and criteria applicable to flora and fauna

Table 3-21: Flora and fauna outcomes

Environmental outcome	Does the outcome remain appropriate and achievable?
No loss of abundance and/or diversity of native vegetation on or off the Land through clearance unless a significant environmental benefit has been approved in accordance with the relevant legislation.	Yes
No vegetation health impacts to neighbouring pastoral properties from dust generated by mining activities	Yes
No native fauna injuries or deaths due to mining operations that could have reasonably been prevented.	Yes
No introduction of new species of environmental weed, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species on the Land.	Yes

Table 3-22: Measurement criteria and leading indicator criteria (native vegetation and fauna)

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
Native Vegetation and fauna	No loss of abundance and/or diversity of native vegetation on or off the Land through clearance unless a significant environmental benefit has been approved in accordance with the relevant legislation.	Area of vegetation clearance will be measured through annual aerial and/or ground surveys	Environment assurance manager	SMR Mining area	Annual aerial and/or ground surveys of operational areas demonstrates that the total area cleared does not exceed the approved clearance areas in the NVMP.	Annually	Approved areas as per NVMP	<u>Internal Trigger:</u> Unauthorised clearances in the SMR area (i.e., clearance of areas not included under Section 3.8) are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department <u>Leading indicator criteria:</u> Not proposed	Measurement criteria will be reported against in annual compliance reporting to DEM	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
		The three designated monitoring sites will be inspected to assess vegetation condition and mine derived dust deposition impacts. Based on the assessment, sites will be designated a 'Dust Impact Score' (see QP50.85) which will factor in regional rangelands floristic health as measured at control sites.		Three vegetation monitoring quadrats on neighbouring pastoral properties	Assessments demonstrate that impact assessment scores at any of the three monitoring quadrats do not exceed a dust impact score of 2 from mine derived dust outside of approved clearance areas.	Quarterly (internal) Annually (external)	Regional rangelands floristic health as measured at the control sites	<u>Internal Trigger:</u> Dust impact scores of 2 from mine derived dust outside of approved clearance areas will require further investigation by the SIMEC Mining Environment Department Assurance to determine the likely contributing factors to the dust impact scores and review implementation of QP50.84. <u>Leading indicator criteria:</u> Not proposed		Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
		Five designated 100 m vegetation monitoring transects that cross from the area of previously known impact to outside of the area of impact. Three designated 100 m vegetation control transects that are outside the potential area of impact.		Five designated 100 m vegetation monitoring transects that cross from the area of previously known impact to outside of the area of impact Three designated 100 m vegetation control transects that are outside	Assessments demonstrate no increase in the extent of vegetation impact beyond the 2021 area of impact. Vegetation condition in the monitoring transects, is within two standard deviations of the vegetation condition in the control transects.	Annually in Spring 2022 and Spring 2023 to establish revised baseline for future comparison. Subsequent monitoring every 3 years in Spring, unless groundwater leading indicator trigger is exceeded. If groundwater leading indicator is	Revised baseline is the 2021 'extent of vegetation impact' geographic information system (GIS) polygon. The 2022 and 2023 vegetation transect data. TSF EMP (QP50.48 TSF) & Trigger Action	<u>Internal Trigger:</u> Incidents of operations continuing in SMR mining areas without the implementation of appropriate controls as per TSF EMP (QP50.48 TSF) & TSF TARP (TSFMn.001). As are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the		Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
				the potential area of impact.		exceeded, then vegetation assessment to occur between 6 and 12 months from the date of the groundwater trigger exceedance and in subsequent Spring time.	Response Plan (TARP) (TSFMan.001) Incorporating the TSF Impact Zone Vegetation monitoring procedure.	SIMEC Mining Environment Department <u>Leading Indicator Criteria:</u> Any incident of any critical operating parameter exceeding the 'orange' zone (as per the Magnetite TSF Operating Manual).		
		Results of regulatory compliance audits and EMS audits demonstrate that SIMEC Mining dust management strategies are in place and are implemented.		SMR Mining Area	Regulatory compliance and EMS audits, as well as construction and operational process audits occurring through operations and closure, confirm that SIMEC Mining dust management strategies are implemented as per the Dust TARP (QP50.84) and Mines FDR Standard (QP50.68)	As per audit schedule	Dust TARP (QP50.84) and Mines FDR Standard (QP50.68)	<u>Internal Trigger:</u> Incidents of operations continuing in SMR mining areas without the implementation of appropriate controls as per QP50.84 are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. <u>Leading indicator criteria:</u> Not proposed		Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
	No vegetation health impacts to neighbouring pastoral properties from dust generated by mining activities	Mine records will be audited to confirm SIMEC Mining Dust management strategies are applied in accordance with the Dust TARP P50.84 and Mines FDR Standard QP50.68.	Environment assurance manager	SMR Mining Area	Regulatory compliance and EMS audits, as well as construction and operational process audits occurring through operations and closure, confirm that SIMEC Mining dust management strategies are implemented as per the Dust TARP (QP50.84) and Mines FDR Standard (QP50.68).	As per audit schedule	Dust TARP (QP50.84) and Mines FDR Standard (QP50.68)	<u>Internal Trigger:</u> Incidents of operations continuing in SMR mining areas without the implementation of appropriate controls as per QP50.84 are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. <u>Leading indicator criteria:</u> Not proposed	Measurement criteria will be reported against in annual compliance reporting to DEM	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
	No native fauna injuries or deaths due to mining operations that could have	Mine records will be audited to confirm that incidents of drill collars not being capped immediately following exploration activities are	Environment assurance manager	SMR Mining Area	Regulatory compliance and EMS audits, as well as construction and operational process audits occurring through	As per audit schedule	-	<u>Internal Trigger:</u> Uncapped drill collars in the SMR area are observed during regular site inspections conducted by Environment Assurance	Measurement criteria will be reported against in annual compliance reporting to DEM.	Yes – this is expected to remain appropriate once PEPR

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
	reasonably been prevented.	logged and investigated and all corrective actions are closed out within 24 hours of receiving notification of the incident. Fauna deaths that are discovered on the mine site as part of regular inspections are recorded as an environmental incident.			operations and closure, confirm that any incidents are logged and investigated and all corrective actions are closed out within 24 hours of receiving notification of the incident.			personnel or are otherwise reported to the SIMEC Mining Environment Department. <u>Leading indicator criteria:</u> Not proposed		updated to reflect addition of southern WRD.
Weeds and pests	No introduction of new species of environmental weed, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species on the Land.	New weed and pest incursions, together with the abundance of existing weeds and pests are recorded during annual weed and pest surveys. Continuous weed mapping is undertaken as part of mining operations. Abundance data is assessed against baseline flora and fauna surveys.	Environment assurance manager	SMR mining area	Annual survey of the tenement undertaken by an independent and suitably qualified person demonstrates: no introduction of new species of weeds declared or listed under relevant legislation, plant pathogens or pests (including feral animals) as a result of mining-related activities when compared to previously recorded weed species and introduced fauna in Section 2.8.2. No increase in the abundance of existing weeds or pest species on the tenement compared to previous survey records as a result of mining-related activities.	Annually	Flora and fauna survey reports Weed maps (Weeds mapped as they are found/managed).	<u>Internal Trigger:</u> New weed species or a notable increase in the abundance of existing weed species are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. <u>Leading indicator criteria:</u> Not proposed	Measurement criteria will be reported against in Annual Compliance reporting to DEM.	Yes
		Continual pest animal observations and annual pest animal control reports demonstrate that feral animal abundance on the tenements is managed by control measures as per the Pest Plant and Animal Control Strategy QP50.62 on an ongoing basis such that pest animal abundance is low compared to the baseline fauna survey levels.	Environment assurance manager	SMR mining area	Continual pest animal observations and annual pest animal control reports demonstrate that feral animal abundance on the tenements is managed by control measures as per the Pest Plant and Animal Control Strategy QP50.62 on an ongoing basis such that pest animal abundance is low compared to the baseline fauna survey levels.	Annual	Pest Plant and Animal Control Strategy (QP50.62) Baseline fauna surveys.	<u>Internal Trigger:</u> New pest species or a notable increase in the abundance of existing pest species are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. <u>Leading indicator criteria:</u> Not proposed	<u>Internal trigger:</u> A new pest animal species is reported or a notable increase in the abundance of existing pest or feral animal species are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department.	Yes

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
									Leading indicator criteria: Not proposed	
		Implementation of the feral goat control measures as required.	Environment assurance manager	SMR mining area	Continual pest animal observations and annual pest animal control reports demonstrate that feral animal abundance on the tenements is managed by control measures as per the Pest Plant and Animal Control Strategy QP50.62 on an ongoing basis such that pest animal abundance is low compared to the baseline fauna survey levels.	Annual	Pest Plant and Animal Control Strategy (QP50.62).	Internal Trigger: Notable increase in the abundance of goats are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. Leading indicator criteria: Not proposed	Internal trigger: Not proposed Leading indicator criteria: Not proposed	Yes

3.2.5 Land and soil

The SMR lies at the southern end of the Middleback Ranges (MBR). The South Middleback Ranges are steep ranges surrounded by broad sloping plains to the east and west. There are two main ridgelines near MEP1: a primary ridgeline, and a secondary ridgeline. A gully lies between these two ridgelines. The maximum elevation of the primary ridgeline is approximately 410 mAHD and the maximum elevation of the secondary ridge line is approximately 370 mAHD.

Iron resources in the MBR occurs as stratabound Palaeoproterozoic deposits of the Lower Middleback Iron Formation (LMIF), which is part of the Hutchison Group. The Hutchison Group forms part of the Cleve Subdomain of the Gawler Craton and lies on its western edge. The Cleve Subdomain comprises tightly folded, high-grade metamorphic rocks that are mainly derived from marine shelf sediments and mafic and acidic volcanics (Parker, 2012). Figure 3-11 shows the regional geology of the MBR and Figure 3-12 shows the regional geology of the SMR.

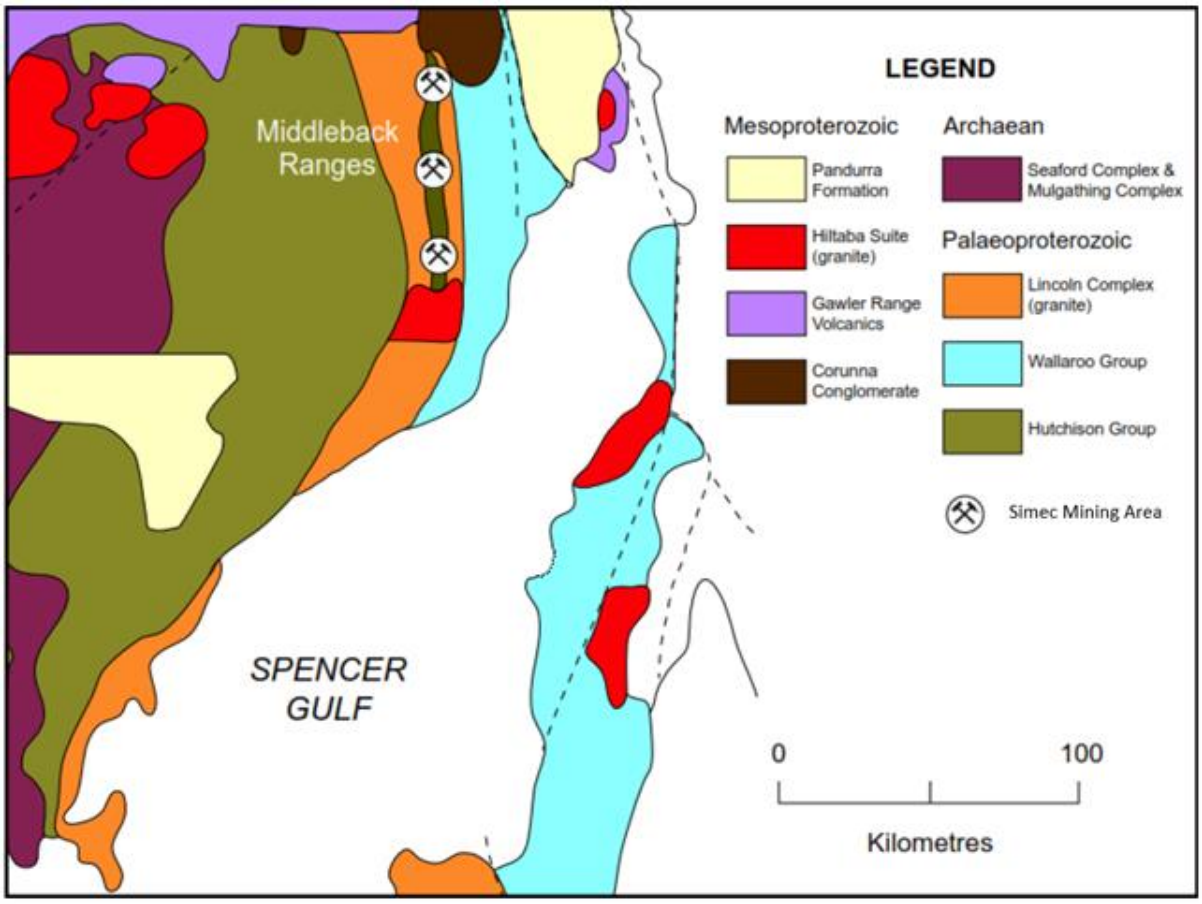


Figure 3-11: Regional geology of the MBR

Source: SIMEC (2023)

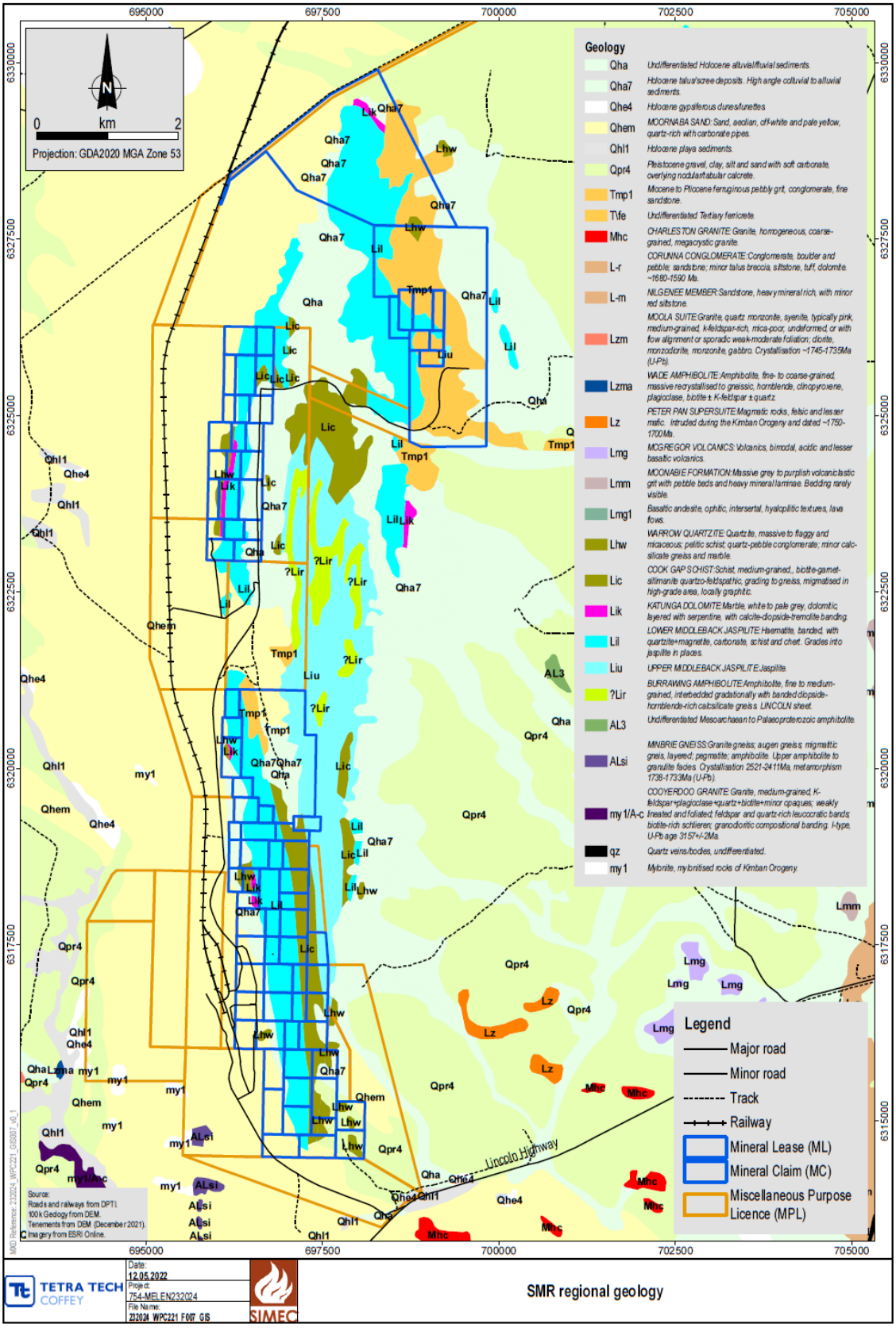


Figure 3-12: SMR Regional Geology

Source: SIMEC (2023)

Geochmeical assessment of 15 rock types identified within the MEP1 block model indicates that some rock types are PAF. PAF samples have been confirmed within ore and waste rock. It has also been noted that a high sulfur content was identified in samples localised on fault zones. PAF management is described in Section 2.2.4.1 above.

Soils of the SMR are generally skeletal but may contain shallow compact loamy soils. Steep gullies and some hill slopes contain loose scree material. West of the SMR, sand deposits are approximately 10 to 20 m thick up to the base of the ranges, with some soil development apparent in the top 1 or 2 m. To the east soils are generally brown calcareous earths, with some small dunes.

Soil quality within the MBR environs is generally poor in structure and skeletal topsoils are generally deficient in organic material and nutrients due to high cycling rates.

Topsoil will be stripped during clearing and site preparation wherever practicable and safe; and reused for on site revegetation and rehabilitation programs. Appropriate topsoil management is required to ensure the topsoil remains viable for reuse. Activities associated with mine development may contaminate soils if appropriate management measures and controls are not implemented.

Site contamination of land from spills will be prevented, and soil erosion managed with sediment, erosion and detention (SED) controls and existing detailed PEPR control strategies. Bunding will be designed to and comply with SA EPA Liquid Storage Guidelines for Bunding and Spill Management (May 2016) with spill-kits located onsite and procedures used for minor spill clean-up.

Topsoil will be managed consistently with the existing PEPR descriptions, that is, will be progressively stripped ahead of land disturbance and appropriately managed (i.e. stockpiled for re-use, vegetate to prevent erosion) for use in the rehabilitation of land disturbed by operations ancillary to mining. Refer Section 2.6.2 & 3.6.3 of the PEPR. No change to the overall risk profile is expected.

Relevant environmental outcomes and measurement criteria are expected to be achieved for the construction, operation and rehabilitation of the proposed MEP1 operations (see Appendix F).

3.2.5.1 Outcomes and criteria applicable to land and soil

Table 3-23: Land and soil outcomes

Environmental outcome	Does the outcome remain appropriate and achievable?
Ensure that the existing (pre-mining) soil quality and quantity is maintained.	Yes
No contamination of Land and soils either on or off the land as a result of mining operations.	Yes

Table 3-24: Measurement criteria and leading indicator criteria (land and soil)

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
Land and Soil	Ensure that the existing (pre-mining) soil quality and quantity is maintained as far as practicable.	Inspections audits are conducted to confirm that topsoil has been stripped, stockpiled and maintained in accordance with SIMEC Mining's Soil Management Plan (QP50.66) and that correct soil quality parameters (no disturbance and compaction, no erosion, weed controlled, stockpile heights) are maintained. Corrective actions from audits are monitored to confirm that all actions are logged and closed out within 60 days or as otherwise agreed with the Regulator.	Environmental assurance manager	Topsoil stockpile location	Topsoil is stripped, stockpiled and maintained in accordance with QP50.66, with stockpiles showing no evidence of disturbance, compaction, erosion or weed infestations and maximum stockpile heights adhered to. Zero outstanding action items after 60 days from audits.	Biannually	Stockpile records Annual aerial survey results	<u>Internal Trigger:</u> Evidence of disturbance or compaction, sheet or gully erosion, weed infestations or exceedance of maximum stockpile heights are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. <u>Leading indicator criteria:</u> Not proposed	Measurement criteria will be reported against in Annual Compliance reporting to DEM.	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
	No contamination of Land and soils either on or off the land as a result of mining operations.	Records will be audited to confirm that all spills are reported as per QP29.06 Incident Investigation and Reporting) Records will be audited to confirm that all contaminated soil is removed and treated in accordance with QP50.67 Spills Response That all potential contaminants are stored in accordance with EPA Guidelines and Australian Standards (details provided in QP29.22 Chemical Management Manual).		SMR Mining Area	All contaminated material was disposed of off-site in accordance with the requirements of QP60.57 Spills Response. Inspection records demonstrate that all storage of potential contaminants are stored in accordance with EPA Guidelines and Australian Standards.	As per audit schedule	QP50.67 Spills Response QP29.22 Chemical Management Manual QP75.WHS.INV.001 Incident investigation and Reporting.	<u>Internal trigger:</u> Not proposed <u>Leading indicator criteria:</u> Not proposed		Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.

3.2.6 Surface water

A surface water assessment (HydroBalance, 2024 – refer Appendix D1) was undertaken to determine the potential impact and/or risk associated with surface water flows as altered by the expended southern WRD.

3.2.6.1 Catchments

SMR is located within the Spencer Gulf basin. This is a semi-arid region with average rainfalls of less than 275 mm, most of which occurs during the winter months.

In general, there is little surface water in the northern part of Eyre Peninsula, and no permanent streams. Catchments in the Middleback Ranges do, however, feed a number of ephemeral watercourses and local depressions.

The location of the southern WRD within the Salt Creek Catchment is shown in Figure 3-13.

Salt Creek is a significant watercourse in the vicinity of the SMR. Salt Creek, like all the other minor watercourses and drainages on site, is ephemeral, only receiving surface runoff following significant rainfall. The upper reaches of Salt Creek are characterised by series of disconnected pools or salt pans, which cascade from north to south as each of the pools fill and overflow. Each of the pools may contain significant volumes of water, due to the large surface areas and depths of 0.5 m to 3 m, with and estimated combined capacity in the order of 5 GL across all pools. The large surface areas enhance evaporation and infiltration losses, suggesting that flows would rarely spill from the disconnected pools and flow into the downstream reaches of Salt Creek.

The downstream reach of Salt Creek is characterised by a flat (approximately 0.2% longitudinal grade), poorly defined channel which flows to the south of the site, adjacent to the MEP1 area. South of the MEP1 LOM area the elevation of Salt Creek is approximately 10 m to 20 m lower.

The local drainage characteristics of Salt Creek, adjacent and to the south of the MEP1 area are shown in Figure 3-13.

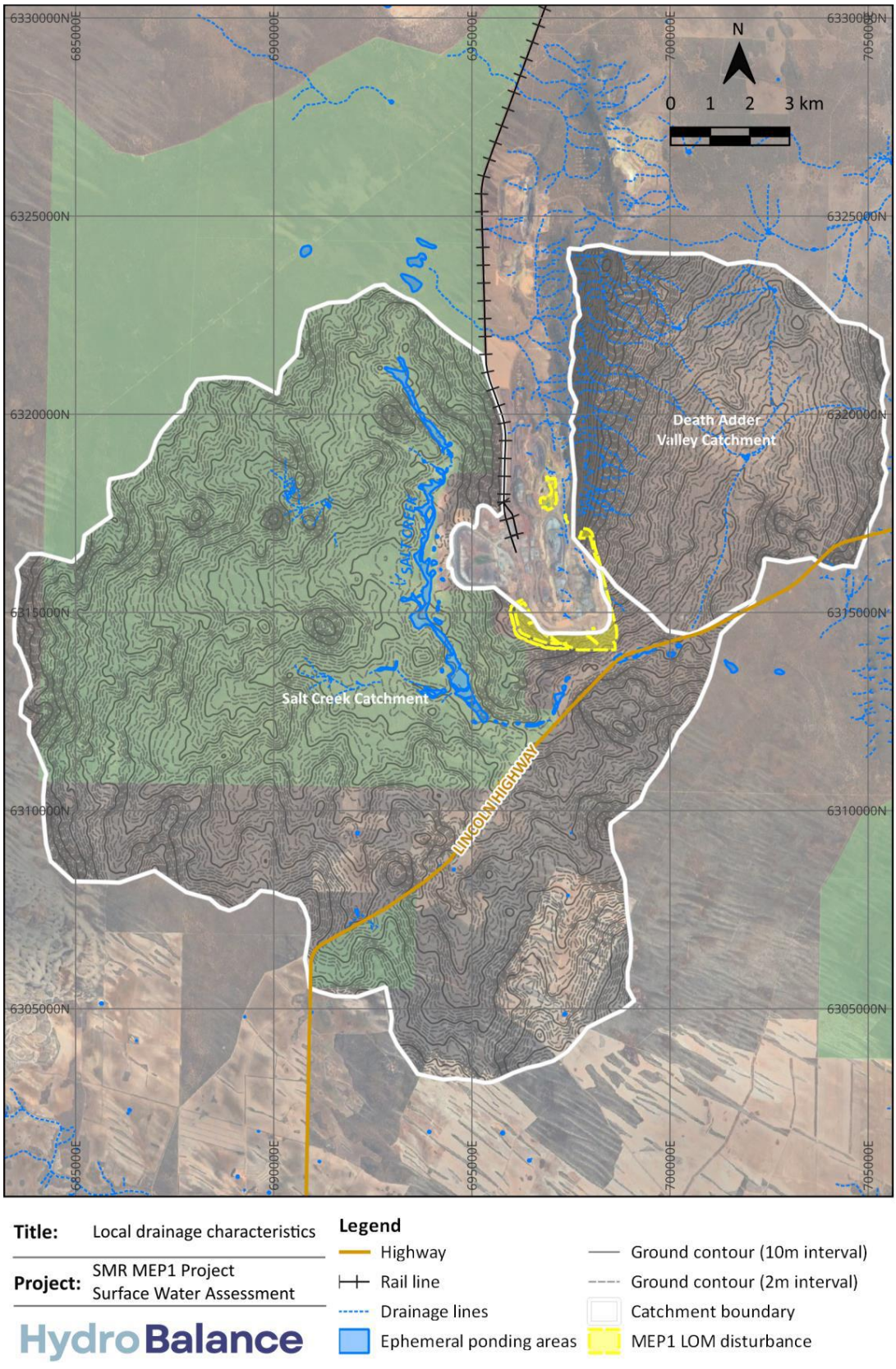


Figure 3-13: Local drainage characteristics of Salt Creek

Source: HydroBalance (2024)

3.2.6.2 Surface Water Management

Types of water generated on-site

The strategy for the management of surface water at the project is based on the separation of water from different sources based on anticipated water quality. Definitions of the types of water generated by the project are:

- sediment water: Surface water runoff from areas that are disturbed by mining operations (including out-of-pit waste rock emplacements). This runoff may contain high sediment loads but does not contain elevated level of other water quality parameters (e.g. electrical conductivity, pH, metals, metalloids, non-metals). This runoff must be managed to ensure adequate sediment removal prior to release to receiving waters.
- Clean/diverted water: Surface runoff from areas unaffected by operations. Clean catchment water includes runoff from undisturbed areas and fully rehabilitated areas.

Water Management infrastructure at SMR

The main components of water-related infrastructure at the existing SMR site include:

- active open-cut mining areas which are internally draining via roadways;
- active and inactive open-cut mining areas are surrounded by protection bunds to divert clean water away from the open-cut areas;
- active and inactive waste rock dumps are designed and constructed to minimise water retention on their surface and to divert clean water away;
- sediment dams to collect and all sediment settling within runoff from out-of-pit waste rock emplacement areas; and
- drains to divert sediment-laden runoff from out-of-pit spoil dumps to sediment retention ponds; and
- a mine-affected water system to store water pumped out of the open cut mining areas and to collect runoff from the ore stockpiles, Mine Infrastructure Area (MIA) and other hardstand areas that could potentially generate mine-affected water runoff.

No interaction is proposed between the proposed works and existing SMR water management system (WMS). The existing SMR WMS infrastructure will remain unchanged as part of the Project.

Sediment Water Management System

Sediment water containment (runoff from cleared and disturbed areas) will be managed in accordance with a Surface Water Management Plan (SWMP). The SWMP will adopt the three cornerstones of erosion and sediment control:

- drainage control – prevention or reduction of soil erosion caused by concentrated flows and appropriate management and separation of the movement of diverted and surface water through the area of concern.

- Erosion control – prevention or minimisation of soil erosion (from dispersive, nondispersive or competent material) caused by rain drop impact and exacerbated overland flow on disturbed surfaces.
- Sediment control – trapping or retention of sediment either moving along the land surface, contained within runoff (i.e. from up-slope erosion) or from windborne particles.

The Project will require control measures to manage sediment and erosion at the site Figure 3-14. The locations and number of sediment control infrastructure provided in this assessment is conceptual only. Details of sizing and placement of sediment control infrastructure would be finalised during detailed design of the project.

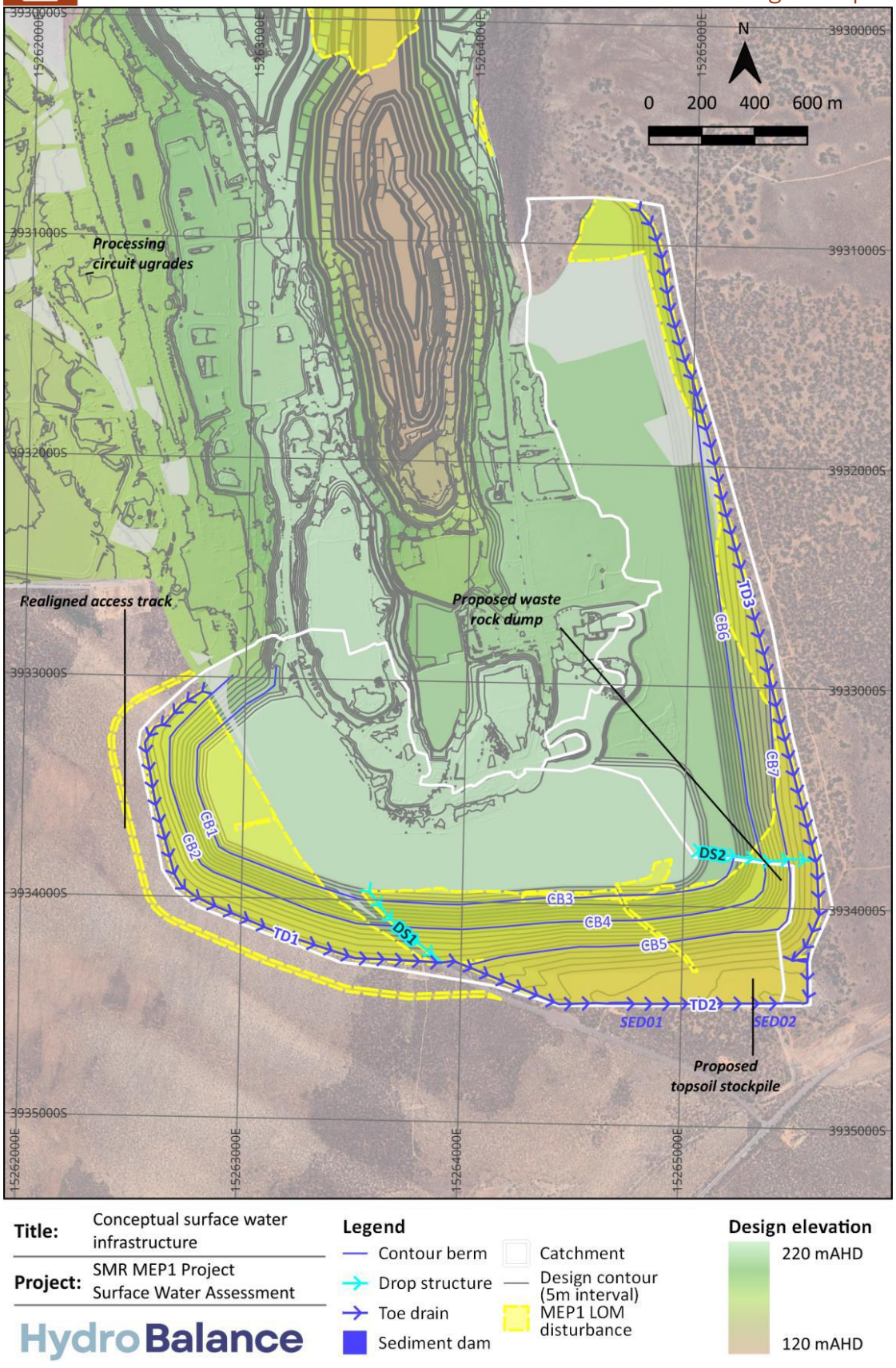


Figure 3-14: Conceptual site water management system configuration

Source: HydroBalance (2024)

3.2.6.3 MEP1 Surface Water Assessment

A surface water assessment and conceptual surface water management strategies design (HydroBalance, 2024 – Appendix D1) was undertaken to determine the potential impact and/or risk associated with surface water flows as altered by the expanded southern WRD.

The TUFLOW (An industry standard one- and two-dimensional modelling package) hydraulic model was used to assess any potential impacts of the Project on Salt Creek flooding for the 1% Annual Exceedance Probability (AEP) design flood event. The design flood event hydrographs were developed using the HEC-HMS hydrological model.

Modelled 1% AEP flood depths and extents for Salt Creek are shown in Figure 3-15. The flood depths in Salt Creek adjacent to the Project are generally in the range of 2 to 3 m, caused by the flat topography along the channel line which encourages the formation of pools. Due to the location of the channel between the two ridge lines, the flood flows are not expected to interact with the proposed works. There is a 1.9 m elevation difference between the 1% AEP flood surface and the toe of the proposed stockpile, suggesting that it is highly unlikely that Salt Creek would interact with the proposed works.

Modelled 1% AEP flood velocities for Salt Creek are generally low, remaining below 1.5 m/s along most of the creek section (Figure 3-16). There are some areas of localised high velocities (up to 3 m/s).

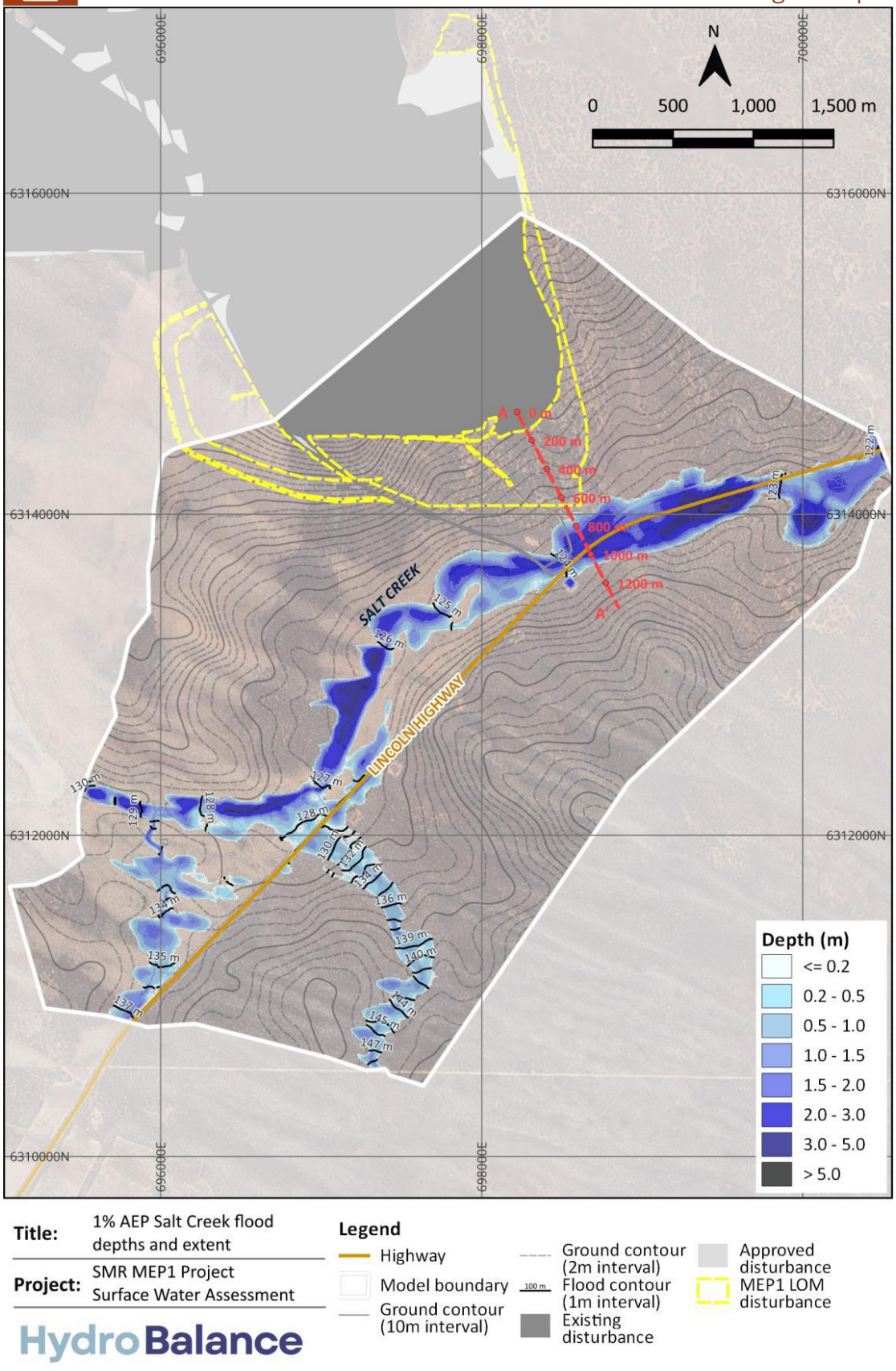


Figure 3-15: Salt Creek 1% AEP flood depths and heights

Source: HydroBalance (2024)

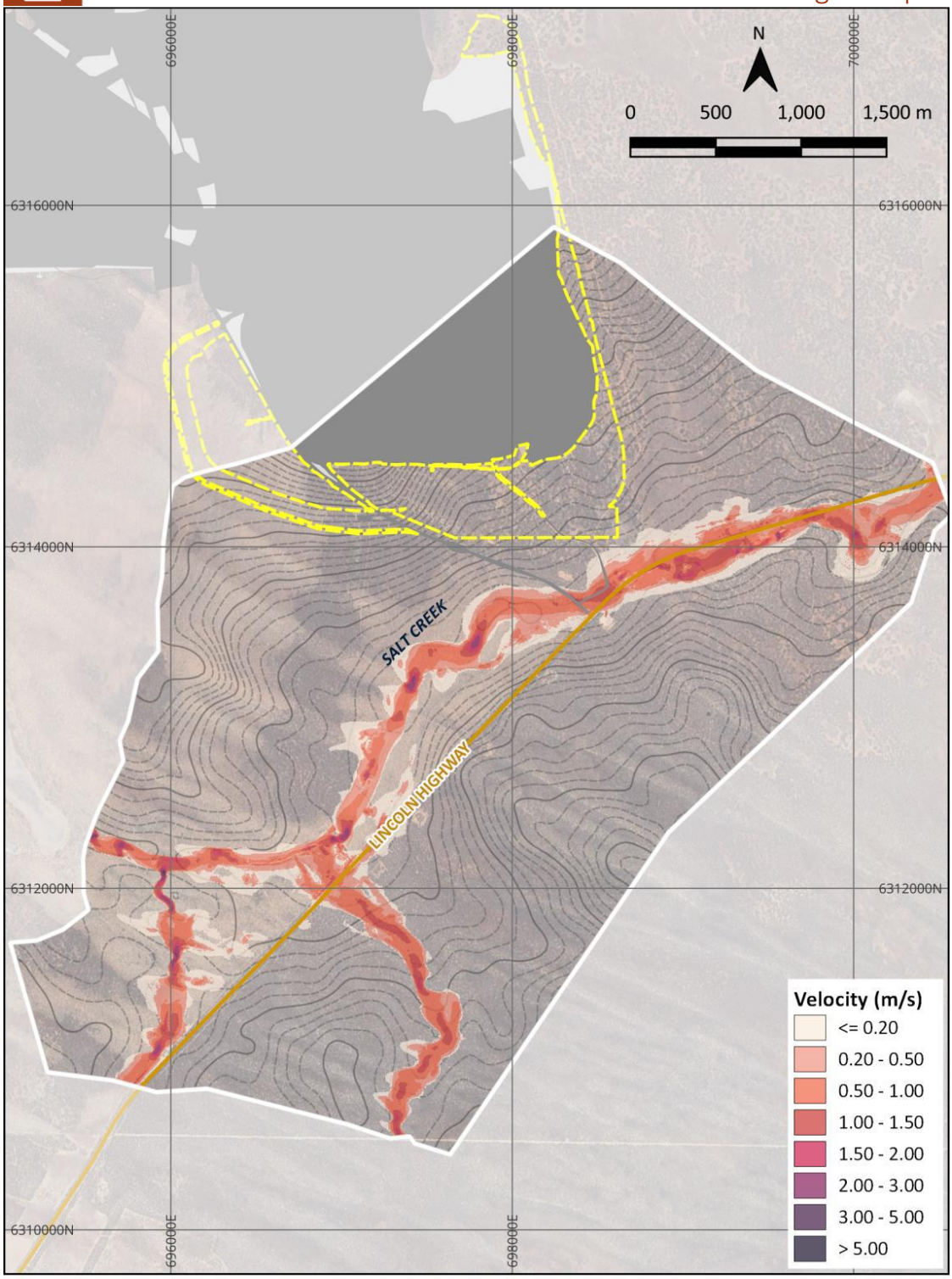


Figure 3-16: Salt Creek 1% AEP flood velocity

Source: HydroBalance (2024)

The potential impacts of the project on hydrology and flood behaviour (from the surface water assessment) include:

- impacts on flows and the flooding regime in the receiving waterways;
- impacts on streamflow volumes due to catchment excision; and
- cumulative impacts of all projects in the region on flows and the flooding regime in the receiving waterways.

An assessment of each of these potential impacts of the project is provided in the following sub-sections.

The assessment of flooding impacts has been undertaken based on commonly applied methodologies for the simulation of hydrologic and hydraulic processes using currently available data. The adopted approach is considered suitable for quantifying impacts to a level of accuracy consistent with current industry practice.

Flooding impacts

No proposed infrastructure associated with the project is located within the Salt Creek 1% AEP design flood extent. Hence, the expected impact of the project on the Salt Creek flood conditions is expected to be negligible.

Streamflow impacts

Surface runoff from the proposed disturbance (including the WRD extension and stockpile) will be treated and passively released via the proposed ESC infrastructure. The disturbed catchments will continue to report to Salt Creek via the ESC infrastructure and hence, the potential impacts to streamflow would be negligible.

Regional water quality and environmental values / sediment drain design

The MEP1 disturbed areas (WRD extension and topsoil stockpile) will be managed to mitigate potential impacts on regional water quality and environmental values through the Site SWMP. The Site SWMP will be updated to include the MEP1 disturbed areas once design is confirmed in subsequent project phases. The SWMP will comprise a practical guide manage risks to soil and water associated with specific management measures for all discrete disturbance areas.

Potential impacts on downstream water quality due to the disturbed areas will be mitigated through best-practice runoff management methods including diversion structures to keep clean water clean.

The site drainage has been designed to convey a 10% AEP design event plus an additional 0.3 m freeboard, which is sufficient to contain the 1% AEP design event.

Cumulative impacts – flooding

There are no other significant projects proximal to the SMR located upstream or downstream Salt Creek (or the local waterways) that could significantly affect flooding in Salt Creek. As such, there are no cumulative impacts in relation to flows and the flooding regime for the Project.

The potential impacts of the project on hydrology and flooding behaviour in the receiving waters have been mitigated through the careful design and location of proposed Project infrastructure.

3.2.6.4 Outcomes and criteria applicable to surface water

Table 3-25: Surface water outcomes

Environmental outcome	Does the outcome remain appropriate and achievable?
No surface water contaminated as a result of mining operations leaves the land.	Yes

Table 3-26: Measurement criteria and Leading Indicator Criteria (surface water)

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
Surface water	No surface water contaminated as a result of mining operations leaves the land.	Records will be audited to confirm that inspection audits of drainage silt traps are carried out as required to determine that culverts are not blocked and that >500mm of freeboard remains in silt traps and that spillways are not eroded or otherwise damaged, and that all corrective actions from inspections are logged and closed out within 30 days or as otherwise agreed with the Regulator. Review of all spill incident records and the implementation of QP50.67.	Principal mining contractor Occupational, Health, Safety and Environment (OHS&E) Manager.	Locations as approximately indicated in PEPR Figure 3 61 and PEPR Figure 3 62, contingent on operational designs.	All drainage channels and silt traps are installed as proposed and reactive maintenance and corrective actions closed out within 30 days of assignment to demonstrate that adequate head remains in the silt traps to retain surface water (contaminated by mining operations) on the Land A review of all spill incident records demonstrates that all spills were cleaned up prior to reaching the tenement boundary.	Within five days of rainfall events that result in flows of stormwater, or every three months, whichever is the lesser.	Approved design	Internal Trigger: Damaged or inadequately maintained stormwater infrastructure (including blocked culverts, insufficient remaining freeboard in silt traps, eroded or damaged spillways) are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. Leading indicator criteria: Not proposed	Measurement criteria will be reported against in annual compliance reporting to DEM.	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD locations (sediment dams and toe drains/bunds).

3.2.7 Groundwater

Groundwater is primarily within Paleoproterozoic metasediments, including banded iron formations (Lower and Upper Middleback Iron Formations), Katunga dolomite, Cook Gap Schist, and amphibolite dykes, as well as the regional granitic basement. Fractures within these formations serve as pathways for groundwater movement, collectively forming the regional unconfined Fractured Rock Aquifer.

The heavily folded and faulted metasediments in the SMR area exhibit slightly higher permeability than the regional granitic basement. Permeability is notably enhanced along north-south trending fold axes. This is evident by the seepage patterns in the existing pits, which generally align with shear/fracture zones oriented in a north-south fashion.

In addition to the fractured rock aquifer, there is a shallow, unconfined aquifer consisting of Tertiary and Quaternary sediments (including clays, silts, and sands) in the plains to the west and east of the SMR area. These sediments are saturated in the lower-lying regions centred along Salt Creek which is to the west of the existing mining pits. These sediments overlay the regional fractured rock aquifer with a maximum saturated thickness of approximately 10 m.

At the regional level, groundwater elevation typically influenced by and reflects the area's topography and also by discharge via evapotranspiration (ET) at Salt Creek. Groundwater movement from the SMR generally flows eastwards to Spencer Gulf and westwards towards Salt Creek and the surrounding plains. There also appears to be a groundwater / topographical gradient from the southern-most part of the SMR (i.e. MPL 32) towards the southern part of Salt Creek following the direction of higher permeability.

Within MPL 32 and specifically below the Southern WRD groundwater level is anticipated to be at approximately 50 m below ground level (bgl), based on data from nearby investigation wells and land elevation.

Impacts considered applicable to the construction of the southern WRD and the access road diversion are from seepage. There is no dewatering or water storage associated with these activities.

3.2.7.1 Impact on Groundwater Level from Seepage

CDM Smith completed a seepage assessment relating to the WRDs associated with MEP1 (report included as Appendix D5).

The seepage assessment included both a most likely scenario, and a conservative worst-case scenario.

- the most likely scenario was based on an existing calibrated groundwater model and the parameters are presented in Appendix D5; and
- the worst-case scenario assumed a 50% reduction in the hydraulic properties of the most likely scenario. The hydraulic parameters for the WRDs remain the same for both scenarios to maintain a consistent recharge rate.

The report indicates that within MPL 32 the expansion of the Southern WRD the most likely scenario will result in a rise in the groundwater head of 12 m, i.e. groundwater level increase from 60 m bgl to

~48 m bgl. For the worst-case scenario there may be a rise in the groundwater head of 18 m, i.e. groundwater level increase from 58 m bgl to ~40 m bgl.

Based on a 200-year simulation period, the potential groundwater level increase is predicted to extend up to 4 km radially surrounding the Southern WRD. However, between 500 m and 1000 m from the edge of the expanded WRD the increase in groundwater level is only by 1 m relative to the existing baseline water table. The report also states that *"…groundwater flow from beneath the WRDs is predicted to occur towards the Iron Magnet pit".*

Significantly, this modelling does not include the impacts of mine pit dewatering, and thus are considered conservative in nature. The updated PEPR will include updated groundwater modelling for the entirety of MEP1 activities.

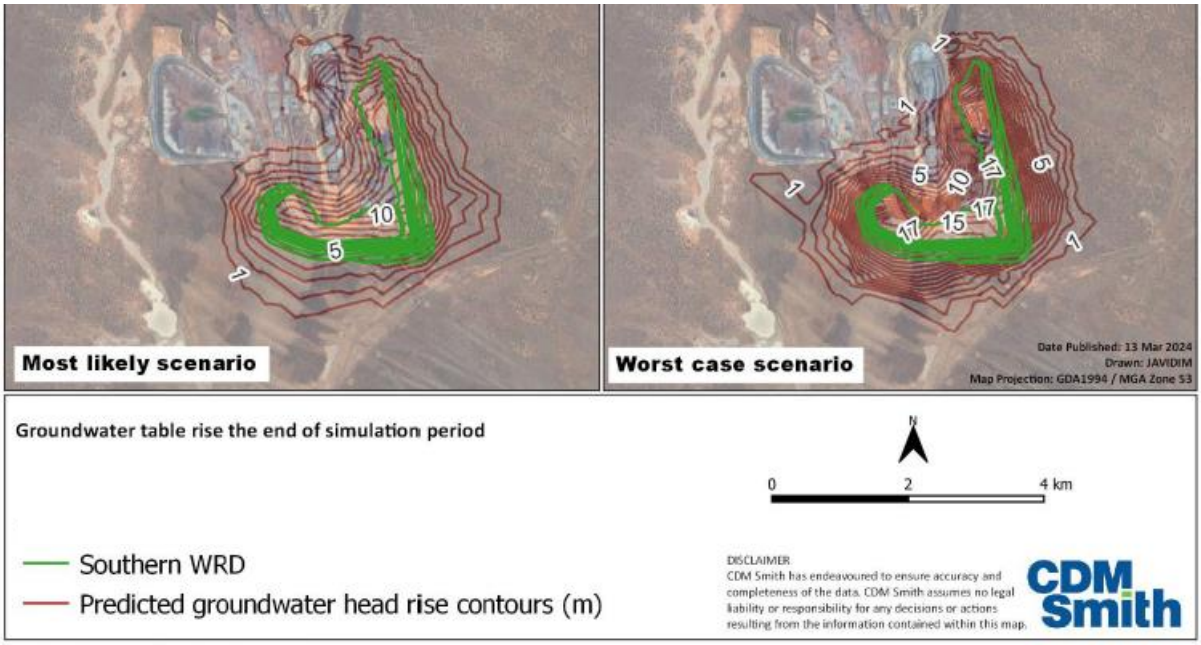


Figure 3-17: Predicted groundwater head increase following 200-year simulation period

Source: CDM Smith (2024)

3.2.7.2 Impact on GDEs

Publicly available mapping of Potential Groundwater Dependent Ecosystems (GDEs) indicates that in the location of the WRD extension in MPL32:

- there are no aquatic GDEs mapped within MPL32, the closest aquatic GDE is Salt Creek which is more than 1 km west of MPL32; and
- there is moderate to high potential for terrestrial GDEs where the vegetation is described as Eucalyptus mallee forest and mallee woodland.

Aquatic GDEs located in Salt Creek are more than 1 km from the Southern WRD and groundwater mounding is anticipated to be less than 1 m as a result of the WRD expansion. Therefore, the impact of mounding is anticipated to be unlikely.

A review of the technical and site information available and the specialist hydrogeological assessment indicates that terrestrial GDEs are unlikely to be present within MPL 32 area owing to the depth to groundwater (approximately 56 m bgl) which is anticipated to be deeper than the root zone of the existing vegetation (Jacobs, 2024). If the Southern WRD expansion increases the groundwater depth to 48 m bgl it remains very unlikely that terrestrial GDEs will be impacted as groundwater will likely remain deeper than the root zone of the existing vegetation. Experience in the area of the Magnetite TSF, west to north-west of MPL32, has shown no adverse impact to mallee vegetation unless the water table rises to within about 2 m or less of the ground surface, and conversely no detriment from deepening of the water table has been observed close to mining pits that extend below the water table and have locally lowered groundwater levels.

3.2.7.1 Impact to Groundwater Quality

The CDM Smith report states that *"Groundwater flow is not predicted to interact with regional aquifers outside the mining areas, with groundwater flow beneath the WRDs predicted to report to Iron Magnet pit…".* Therefore a change in quality of regional aquifers is not anticipated as a result of the expansion of the Southern WRD.

The WRD will include PAF material, however it will be isolated by appropriately designed and constructed containment. As such the PAF is unlikely to interact with groundwater and no change to groundwater quality is anticipated.

3.2.7.2 Outcomes and Criteria Applicable to Groundwater

Table 3-27: Groundwater outcomes

Environmental outcome	Does the outcome remain appropriate and achievable?
No adverse impact to the quantity of groundwater available to existing users and groundwater dependent ecosystems due to Magnetite TSF operations.	This outcome is not applicable to the activities covered by this change in operations application
No adverse impact to the environmental value of groundwater or groundwater dependent ecosystems as a result of leached elements from a TSF or the movement of the solid contents of a TSF beyond the boundaries of the TSFs	This outcome is not applicable to the activities covered by this change in operations application
No changes to groundwater levels that adversely impact vegetation due to Iron Duchess water storage operations	This outcome is not applicable to the activities covered by this change in operations application
No adverse impact to the environmental value of groundwater or groundwater dependent ecosystems as a result of AMD (from Iron Duchess WRDs or Magnetite TSF buttress)	Yes

Table 3-28: Measurement Criteria and Leading Indicator Criteria (Groundwater)

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
Groundwater	No adverse impact to the quantity of groundwater available to existing users and groundwater dependent ecosystems due to Magnetite TSF operations.	Records and reports will be reviewed to assess compliance with the Iron Duke TSF EMP (QP50.48)	Manager magnetite processing	SMR Mining area	All operations and activities are compliant with the Iron Duke TSF EMP.	Monthly	Iron Duke TSF EMP Tracking Sheet	Internal trigger: Not proposed Leading indicator criteria: Not proposed	Measurement criteria will be reported against monthly to management (internal). Quarterly report on TSF seepage and listed groundwater monitoring borehole levels externally to DEM in the months of January, April, July October annually. Measurement criteria will be reported against in annual compliance reporting to DEM.	Not relevant to southern WRD
		Records and reports of groundwater extraction well function will be reviewed to confirm that groundwater extraction wells are in place and working effectively.			Enough groundwater extraction wells are in place and are working effectively to maintain low groundwater levels.	Monthly	Approved design	Internal Trigger: Any incident of groundwater extraction wells failing to report expected water flows Leading indicator criteria: Not proposed		Not relevant to southern WRD
		Groundwater levels	Environment assurance manager	Monitoring wells: • BHMB1VWP • BHMB2VWP • BHMB3VWP • BHMB4VWP • BHMB5VWP • WEST1A • WEST2 • WEST3 • WEST4 • And any other replacement boreholes subsequent to these locations, as necessitated by operational requirements.	For all nominated monitoring wells except BHMB1VWP, WEST3 and WEST4: Groundwater levels maintained below the vegetation root zone (nominally deeper than 1.0 m BGL).	Monthly	Known vegetation root zone Records of historic groundwater levels in the existing monitoring network (groundwater monitoring spreadsheet).	Internal Trigger: Groundwater levels: A change in levels by more than 0.5m sustained relative to the observed variations documented to date, which are unrelated to a significant rainfall event. Any exceedance of the internal trigger level will require an investigation into the cause and effect of the exceedance and corrective actions will be assigned. Leading indicator criteria : Not proposed		Yes – however PEPR may add additional monitoring locations.

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
	No adverse impact to the environmental value of groundwater or groundwater dependent ecosystems as a result of leached elements from a TSF or the movement of the solid contents of a TSF beyond the boundaries of the TSFs.	Groundwater quality will be monitored via analysis of groundwater taken from monitoring wells.	Environment assurance manager	Monitoring wells: • WEST1A • WEST2 • WEST3 • WEST4 And any other replacement boreholes subsequent to these locations, as necessitated by operational requirements.	Groundwater sampling conducted and reviewed as per the WI50.302 Groundwater Monitoring - Mines Groundwater criteria do not elevate beyond the following investigation trigger levels: a change in pH by more than 2 pH units. Findings and corrective actions from trigger exceedance investigations are tracked internally annually and detailed review of groundwater chemistry results every three years.	Annually 3-yearly detailed review of results	Records of historic groundwater quality in the existing and background monitoring network (groundwater monitoring spreadsheet) for the last 10 years of operation. Within the observed variations documented to date of the background and historic on site data.	<u>Internal Trigger</u>: Groundwater quality: a change in pH by more than 1 pH unit relative to the observed variations documented to date. Any exceedance of the internal trigger level will require an investigation into the cause and effect of the exceedance and corrective actions will be assigned. <u>Leading indicator criteria</u> : Not proposed	Measurement criteria will be reported against internally according to the Environmental Management Plan (QP50.48) Achievement of measurement criteria will be reported against in annual compliance reporting to DEM.	Not relevant to southern WRD.
		Critical operating parameters (COPs) for the Magnetite TSF will be monitored as per the Magnetite Tailings Storage Facility Operating Manual – Raise 7[9].	Manager magnetite processing.	As per the Magnetite Tailings Storage Facility Operating Manual and the Environmental Management Plan (QP50.48).	No movement of the solid contents of a TSF beyond the boundaries of the TSFs as measured by the COPs.	Daily/Weekly: as per Magnetite Tailings Storage Facility Operating Manual Environmental Management Plan (QP50.48).	As per the Magnetite TSF Operating Manual.	<u>Internal Trigger</u>: Any incident of any critical operating parameter entering the 'orange' zone (as per the Magnetite TSF Operating Manual). <u>Leading Indicator Criteria</u>: Any incident of any critical operating parameter exceeding the 'orange' zone (as per the Magnetite TSF Operating Manual).		Not relevant to southern WRD.

[9] This manual is updated with each raise of the TSF, or on an interim basis if recommended by the Engineer of Record

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
	No changes to groundwater levels that adversely impact vegetation due to Iron Duchess water storage operations.	Groundwater levels will be monitored on a quarterly to monthly basis.	Environment assurance manager	DMW04 and DSMW03	Groundwater levels at monitoring well DMW04 do not exceed 173 m AHD and at DSMW03 does not exceed 175 mAHD.	Quarterly (monthly if triggered).	Records of historic groundwater levels in the existing monitoring network (groundwater monitoring spreadsheet).	Internal trigger: Not proposed Leading Indicator Criteria: Any incident of groundwater level exceeding 163m AHD at DMW04 or 165 m AHD at DSMW03 will trigger an investigation and monthly monitoring of groundwater level.	Measurement criteria (groundwater levels) will be reported against monthly or quarterly as appropriate.	Not relevant to southern WRD.
		Annual aerial and/or ground surveys demonstrate that the total area of vegetation cleared does not exceed the approved area as per the NVMP.		SMR Mining area, specifically vegetated areas downslope of the Iron Duchess Pit.	No adverse impact to vegetation resulting from Iron Duchess water storage operations.	Annually/continuous	Native Vegetation Management Plan.	Internal Trigger: Otherwise unexplained decline in health of vegetation in areas downslope of the Iron Duchess Pit is observed during regular site inspections conducted by Environment Assurance personnel.	Measurement criteria (vegetation impacts) will be reported against in annual compliance reporting to DEM.	Not relevant to southern WRD.
	No adverse impact to the environmental value of groundwater or groundwater dependent ecosystems as a result of AMD from Iron Duchess WRDs or Magnetite TSF buttress). *Note, Geochemistry of TSF buttress material indicates AMD seepage from buttress is of negligible risk, however an outcome was	Groundwater quality will be monitored via analysis of groundwater taken from monitoring wells. The following parameters will be included in the analysis: EC/TDS pH		Monitoring wells: • WEST1A • WEST2 • WEST3 • WEST4 And any other replacement boreholes subsequent to these locations, as necessitated by operational requirements (to be provided in PEPR revision).	Groundwater criteria do not elevate beyond the following investigation trigger levels: a change in pH by more than 2 pH units.	Annually	Iron Duchess groundwater quality baseline levels Baseline groundwater quality in BHMB series boreholes and in CPMW01.	Internal Trigger: Any elevation of indicator values greater than the natural range of variability plus 2 standard deviations Leading indicator criteria: Not proposed	Measurement criteria will be reported against in annual compliance reporting to DEM.	Yes – however PEPR may add additional monitoring locations and updated analysis parameters e.g. SWTSF08. **to be provided in

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
	proposed due to stakeholder (DEM) interest.									PEPR revision.

3.2.8 Heritage

SIMEC Mining meets regularly with the Traditional Owners regarding developments in the ILUA area, represented by the Barngarla Determination Aboriginal Corporation (BDAC), a Registered Native Title Body Corporate (RNTBC) under the *Native Title Act 1993* (Cth).

The Indigenous Land Use Agreement (ILUA) between SIMEC Mining and BDAC sets out clear heritage clearance protocols to be followed by both parties, including protocols for notifications concerning proposed changes and developments within the ILUA area.

All information relating to Aboriginal heritage matters including the Heritage Management Plan are subject to strict confidentiality obligations in accordance with the *Aboriginal Heritage Act 1988* (SA) and the ILUA.

SIMEC has worked collaboratively with traditional owners throughout the planning phase to manage and protect significant sites and will continue to consult and engage during the operational phase through to rehabilitation and mine closure.

3.2.8.1 Outcomes and Criteria Applicable to Heritage

Table 3-29: Heritage outcomes

Environmental outcome	Does the outcome remain appropriate and achievable?
No damage, disturbance or interference to Aboriginal and non-Aboriginal heritage sites, objects or remains as a result of mining operations unless authorised under the relevant legislation.	Yes

Table 3-30: Measurement Criteria and Leading Indicator Criteria (Heritage)

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
Heritage	No damage, disturbance or interference to Aboriginal and non-Aboriginal heritage sites, objects or remains as a result of mining operations unless it is authorised under the relevant legislation.	Records will be reviewed to confirm that discoveries of suspected heritage sites, objects or remains are left without further disturbance, reported to the Traditional Owners in accordance with our ILUA and investigated, with work only recommencing after authorisation has been granted by the appropriate authority.	SMR operations manager	SMR Mining area	All suspected discoveries of Aboriginal or non-Aboriginal sites, objects or remains are left without further disturbance, reported to the Traditional Owners and investigated with work recommenced only after authorisation from the appropriate authority.	On discoveries of suspected Aboriginal or non-Aboriginal artefacts or remains or sites of significance.	Incident records relating to discovery of potential sites, objects or remains.	Internal trigger: Not proposed Leading indicator criteria: Not proposed	To be reported to the Traditional Owners Measurement criteria will be reported against in Annual Compliance reporting to DEM.	Yes

3.2.9 Other matters

The following outcomes, measurement criteria and associated impacts and risks have been reviewed and are considered to be either not relevant to the proposed MPL32 activities, or do not change the overall existing risk profile.

3.2.9.1 Outcomes and criteria applicable to Other Matters

Table 3-31: Other Matters outcomes

Environmental outcome	Does the outcome remain appropriate and achievable?
No adverse impacts from airblast, flyrock, vibration, fumes, or dust caused by blasting to: - public safety, human comfort, third party property (including stock), adjacent land use, adjacent infrastructure and operations, adjacent public roads, aircraft, other receptors.	This outcome is not applicable to the activities covered by this change in operations application
No adverse impact to the surrounding environment due to the TSF.	This outcome is not applicable to the activities covered by this change in operations application
Ensure that unauthorised entry to the land does not result in public injuries and or deaths that could have been reasonably prevented.	Yes
No unauthorised damage (including that caused by fire) to adjacent public or private property and infrastructure.	Yes
No incidents or accidents resulting from road accidents associated with the SMR operational or access traffic that could have been reasonably prevented.	Yes

Table 3-32: Measurement and leading indicator criteria for other matters

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
Public Safety	Ensure that unauthorised entry to the land does not result in public injuries and or deaths that could have been reasonably prevented.	Independent investigation records will be reviewed to confirm that any recorded injuries from unauthorised access to the site could not have been prevented through implementation and use of reasonable preventative measures and that all incidences of unauthorised access are investigated and corrective actions closed out within 30 days or as otherwise agreed with the Regulator.	SMR operations manager General manager mining (accountable)	SMR mining area	No public injuries or deaths as a result of unauthorised entry to the site that could have reasonable been prevented by SIMEC Mining.	When or if an incident occurs.	Independent investigations of accidents Incident reports	Internal Trigger: Any incident of unauthorised access by a member of the public Leading indicator criteria: Not proposed	Reported to management via monthly safety incident reports, KPIs, daily shift reports, mine inspection records. Measurement criteria will be reported against in annual compliance reporting to DEM.	Yes
Third party property	No unauthorised damage (including that caused by fire) to adjacent public or private property and infrastructure.	Records will be reviewed to confirm that any complaints of unauthorised damage are responded to within 24 hours, are logged and investigated and all corrective actions are closed out within 30 days of receiving a complaint, or as otherwise agreed with the affected party or regulator.	Manage stakeholder engagement	SMR mining area	No confirmed damage to adjacent property or infrastructure.	When or if a complaint is received.	Complaints register / incident reporting register.	Internal Trigger: Not proposed Leading indicator criteria: Not proposed	Measurement criteria will be reported against in annual compliance reporting to DEM.	Yes
Traffic	No incidents or accidents resulting from road accidents associated with the SMR operational or access traffic that could have been reasonably prevented.	Independent investigation records will be reviewed to confirm that any recorded incidents and accidents involving SMR operations traffic, or SMR access road/public road interface traffic could not have been prevented through implementation and use of reasonable preventative measures and that all incidents or complaints related to SMR related traffic are investigated and closed out within 30 days or as otherwise agreed with the Regulator.	SMR operations manager	SMR mining area Site access roads	No incidents or accidents resulting from SMR operational traffic or SMR road/rail traffic that could have been reasonably prevented by SIMEC Mining.	When or if an incident occurs.	Incident reports Independent investigations or incidents.	Internal Trigger: Any incident or near miss associated with the SMR operational or access traffic Leading indicator criteria: Not proposed	Reported to management via monthly safety incident reports, KPIs, daily shift reports, mine inspection records. To be reported to relevant authorities as required by legislation and regulations. Measurement criteria will be reported against in annual compliance reporting to DEM	Yes

3.2.10 Mine completion/closure

The objective at mine completion is to achieve the post-closure land use outcome that is agreed with identified stakeholders – currently that is to rehabilitate WRDs to enable them to become native ecosystems. Closure OMC in the current PEPR remain appropriate. The overall impact to receptors as a result of decommissioning and rehabilitation is not expected to change.

As part of MEP1, SIMEC have updated the SMR Mine Closure Plan to include the expanded southern WRD. Broadly, this includes rehabilitation techniques consistent with existing WRDs at the SMR, with the additional closure considerations in relation to the PAF storage areas (refer section 2.2.4.1).

PAF materials will be encapsulated within landforms and not placed on outer surfaces, and this will be managed through design, planning and scheduling. NAF mine waste materials will be placed on the outer surfaces prior to slope remediation. As part of mine completion/closure a geological inspection to verify no PAF materials are present on outer surfaces of landforms will be undertaken.

Refer PEPR Section 3.10.4 for general guidance as to how the southern WRD would be rehabilitated.

Broadly, this includes that the southern WRD will be progressively developed, rehabilitated and re-profiled throughout mining operations, to blend with the surrounding landscape and arrive at an acceptable outcome in terms of visual amenity.

Earthworks will include slope remediation to final landform and sheeting of lower slopes with stockpiled topsoil and subsoil. Revegetation with local native species will be undertaken as applicable.

3.2.10.1 Outcomes and Criteria Applicable to Closure

Table 3-33: Closure outcomes

Environmental outcome	Does the outcome remain appropriate and achievable?
Ensure all rehabilitated landforms integrate and harmonise with the surrounding landscape.	Yes
Ensure the land is progressively and finally rehabilitated to support the future land use.	Yes
Risk to health and safety of the public, native fauna and livestock are as low as reasonably practical	Yes
Ensure the site is physically stable post closure.	Yes
The site will be rehabilitated to a stable condition that supports a resilient, self-sustaining natural ecosystem suitable for the post mining land use that will be determined in consultation with relevant stakeholders	Yes
Ensure that all mining related infrastructure is decommissioned and removed from the site prior to mine completion unless the Director of Mines (or other authorised officer) has approved, in writing, for the infrastructure to remain.	Yes
Local groundwater levels remain within long term (or otherwise agreed) safe and acceptable ranges and do not have an unacceptable impact on the	Yes

Environmental outcome	Does the outcome remain appropriate and achievable?
health of the vegetation adjacent to the TSF, or adverse effects on Salt Creek.	
All mine waste materials left on site are chemically and physically stable.	Yes

Table 3-34: Measurement Criteria and Leading Indicator Criteria (Closure)

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
Visual amenity	Integrate and harmonise final landforms and vegetation with surrounding landscape	An annual progressive rehabilitation compliance audit and final landform profile and revegetation audit will be conducted to confirm that WRDs have been constructed and remediated to integrate and harmonise the final landform and vegetation with the surrounding landscape as each lift is completed in accordance with the design, closure and rehabilitation strategy describe in Section 3.10 of the PEPR.	SMR operations manager	WRDs	Design, closure and rehabilitation strategy as described in Section 3.10 of the PEPR.	Annually (annual progressive rehabilitation compliance audit). At completion of rehabilitation (final landform profile and revegetation audit).	Design, closure and rehabilitation strategy as described in Section 3.10 of the PEPR.	Internal trigger: Not proposed Leading indicator criteria: Not proposed	Annually (annual progressive rehabilitation compliance audit) At completion of rehabilitation (final landform profile and revegetation audit).	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
		The final landform profile and revegetation audit will include a ground and flora survey to confirm that all constructed haul roads and open areas are remediated in accordance with the design, closure and rehabilitation strategy described in Section 3.10 of the PEPR.		Haul roads and open areas	Final landform profile and revegetation of all constructed haul roads and open areas are remediated in accordance with design, closure and rehabilitation strategy described in Section 3.10 of the PEPR.	At completion of rehabilitation	Design, closure and rehabilitation strategy as described in Section 3.10 of the PEPR.	Internal trigger: Not proposed Leading indicator criteria: Not proposed	At completion of rehabilitation (final landform profile and revegetation audit).	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
Landscape function	Re-establishment of mine site ecosystem and landscape function	Annual assessments (by internal specialists or external consultants) and a final report from a suitably qualified person will be conducted to confirm that Landscape Function Analysis (LFA) indicates that the LFA curve has moved above or is likely to move above the critical threshold of sustainability.	Environment assurance manager	WRDs Pits Infrastructure areas	LFA curve has moved above, or is likely to move above, the critical threshold of sustainability as determined by qualified external consultant	Annual	Critical threshold of sustainability, which varies on specific site variables are within the following ranges (stability index; 45-55%, infiltration index; 30-33%, nutrient cycling index, 23-28%), on remediated WRDs, haul roads and operational and fixed plants areas. These criteria to remain open until the target is met.	Internal trigger: Not proposed Leading indicator criteria: Not proposed	Annually (annual progressive rehabilitation compliance audit). At completion of rehabilitation (final landform profile and revegetation audit).	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
Public safety	Risk to health and safety of the public and fauna are as low as reasonably practical	A completion safety audit will be conducted to confirm that WRDs, quarry pit and operational areas have been constructed and remediated and that safety bunds are 10 m outside of the potentially unstable pit edge zone	SMR operations manager	WRDs Pits Infrastructure areas	Final landform profile and revegetation via the final landform profile and revegetation audit.	Annual post-closure	Design, closure and rehabilitation strategies as described in Section 3.10 of the PEPR.	Internal trigger: Not proposed Leading indicator criteria: Not proposed	Annually	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
		Signage and fence integrity will be inspected on an ongoing basis after mine closure		Fencing and signage within the SMR area	Fencing and signage is maintained after mine closure.	Ongoing regular inspection of fence and signage	-			Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
Landform stability	The site is physically stable	Annual and final landform profile compliance audits, which will include a ground audit, will be conducted to confirm that WRDs, pits, TSFs and infrastructure areas are constructed and remediated in accordance with the	SMR operations manager	WRDs Pits Infrastructure areas TSFs	Design, closure and rehabilitation strategy as described in Section 3.10 of the PEPR.	Annually (annual progressive rehabilitation compliance audit) At completion of rehabilitation	Design, closure and rehabilitation strategies as described in Section 3.10 of the PEPR.	Internal trigger: Not proposed Leading indicator criteria: Not proposed	Annually (annual progressive rehabilitation compliance audit) At completion of rehabilitation (final	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.

Environmental Aspect	Environmental Outcome	Outcome Measurement Criteria						Internal Trigger and/or Leading Indicator Criteria (if applicable)	Reporting frequency	Is the criteria expected to remain appropriate?
		What will be measured and form (method) of measurement	Responsibility	Locations	Outcome achievement	Frequency	Control or baseline data			
		design, closure and rehabilitation strategies set out in Section 3.10.				(final landform profile and revegetation audit).			landform profile and revegetation audit).	
Land use	The site will be rehabilitated to a stable condition that supports a resilient, self-sustaining natural ecosystem suitable for the post-mining land use that will be determined in consultation with relevant stakeholders.	A site audit will be conducted at mine closure by an independent professional to confirm that the site has been rehabilitated as per the closure domain objectives described in Section 3.10 of the PEPR.	Environment assurance manager	SMR mining area	Design, closure and rehabilitation strategy as described in Section 3.10 of the PEPR. Relevant stakeholders accept final land use	At completion of rehabilitation.	Design, closure and rehabilitation strategies as described in Section 3.10 of the PEPR.	Internal trigger: Not proposed Leading indicator criteria: Not proposed	At completion of rehabilitation.	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
Equipment removal	All equipment is removed from the site prior to mine closure.	Final closure and divestment audit will be conducted to confirm that all mobile machinery and equipment is removed from site within 12 months (or as otherwise agreed with DEM) of completion of rehabilitation of all WRDs, haul roads and impacted areas.	SMR operations manager	SMR Mining area	All mobile machinery and equipment are removed from site within 12 months of completion of all WRDs, haul roads and impacted areas	Within 12 months of completion of all WRDs, haul roads and impacted areas	-	Internal trigger: Not proposed Leading indicator criteria: Not proposed	Within 12 months of completion of all WRDs, haul roads and impacted areas– will be included as part of final closure and divestment audit report.	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD.
Groundwater	All mine waste materials left on site are chemically and physically stable.	Local groundwater levels The health of the vegetation adjacent to the TSF.	SMR operations manager	TSF	Local groundwater levels remain within long term (or otherwise agreed) safe and acceptable ranges and do not have an unacceptable impact on the health of the vegetation adjacent to the TSF, or adverse effects on Salt Creek.	TBD following DEM consultation.		Triggers and Indicators are being developed in consultation with DEM and will be incorporated in to future PEPR reviews. Internal trigger: Not proposed Leading indicator criteria: Not proposed	TBD following DEM consultation..	Yes – this is expected to remain appropriate once PEPR updated to reflect addition of southern WRD. **NOTE: Additional Criteria to be developed to cover AMD geochemical characteristics.**

3.3 Reasonable prospect of access to Land

The WRD expansion, new topsoil stockpile and re-routing of the MPL32 access road is located on private freehold land (CT 6057/546). SIMEC have an existing access agreement for this area.

To date, SIMEC have always been able to negotiate land access for SMR development with all stakeholders. Based on historic dealings, it can be assumed that SIMEC are still able to reasonably access land for the construction, operation, and rehabilitation of the proposed MEP1 works within MPL32.

3.4 Results of Consultation

In accordance with Regulation 56 of the Mining Regulations, the results of consultation undertaken by SIMEC Mining about the proposed CiO must be summarised.

Key SMR stakeholders are outlined in Table 3-35 and are reflective of those identified within the current PEPR.

Outcomes of stakeholder consultation relevant to the overarching MEP1 works have been detailed in Table 3-36.

Table 3-35: Key SMR stakeholders

Stakeholder Group	Specific Stakeholders
Project proponent	OneSteel Manufacturing Pty Ltd
Project team	SIMEC Mining Project Team
Directly affected landholders (Tier 1)	Moonabie Station
Indigenous groups (Tier 1)	Barngarla Determination Aboriginal Corporation (BDAC) RNTBC
Surrounding landowners, residents and community groups (Tier 2)	• Broadview station • Moola station • Crown Lands SA • Plane homestead • Pine Hill Station • Myola Station • Uplands Station • Secret Rocks / Ecological Horizons Pty Ltd • Whyalla Community / Residents • Middleback Alliance of Land Managers • Whyalla Environmental Consultation Group • Nonowie Station • Cooyerdoo Station • Midgee Station
Local government and councils	• Outback Communities Authority (OCA) • The City of Whyalla • Franklin Harbour Council

Stakeholder Group	Specific Stakeholders
State Government	• South Australian Arid Lands (SAAL) Landscape Board • Eyre Peninsula Landscape Board • South Australian Pastoral Board (SAPB) • State Commission Assessment Panel (State Planning Commission) • Department of Premier and Cabinet (Aboriginal Affairs and Reconciliation)
Regulatory body	• Department for Energy and Mining • Department for Environment and Water • Native Vegetation Council • Department for Infrastructure and Transport • Environment Protection Authority • SA Water • South Australian Native Title Services
Federal Government	• Department of Climate Changes, Energy, the Environment and Water • Department of Defence (Cultana)
Non-government organisations	• Regional Development Australia Eyre Peninsula • SA Power Networks • ElectraNet Pty Ltd
Natural history, environment and heritage conservation groups	• Friends of the Whyalla Conservation Park • Ironstone Hill Conservation Park • Gawler Ranges Landscape Group
Emergency services	• SA Police (Whyalla and Port Augusta police stations) • South Australian State Emergency Service (SES) • Country Health SA (Whyalla Hospital)

Table 3-36: Stakeholder consultation

Stakeholder	Date	Matters discussed	Issues raised	SIMEC response
BDAC	April 2024	Cultural heritage survey undertaken for multiple areas proposed for MEP1 infrastructure.	CONFIDENTIAL	SIMEC have revised project designs to consider indigenous heritage features identified through site surveys. Prior to any works commencing, a final development survey based on final project footprint will be undertaken by BDAC to confirm locations for indigenous heritage sites that may require protection.
DEW and DEM	7 March 2024	Technical presentation held to discuss the South Middleback targeted groundwater model.	Both DEM and DEW provided commentary around requirements for the groundwater modelling.	SIMEC have incorporated DEM and DEW's comments into their updated modelling.
DEW and DEM	15 March 2024	Slides from the meeting on the 7 March 2024 were issued.	DEM response 18 March- • Queries regarding uncertainty testing/actions taken to address uncertainty in the modelling process. • It would be beneficial to see hydrogeological cross sections to provide justification for the employed groundwater modelling method. • Model should use a boundary condition that	SIMEC have incorporated DEM and DEW's comments into their updated modelling.

Stakeholder	Date	Matters discussed	Issues raised	SIMEC response
			models pit water storage as surface water. DEW response 5 April 2024 • Queries basis for boundary conditions. • Justification required for boundary locations and conditions, modelling methodology, assumptions used in model.	SIMEC have incorporated DEM and DEW's comments into their updated modelling.
All stakeholders	December 2023	A newsletter was released to the following stakeholders to provide an update on the overarching Magnetite Iron Ore Operations, including the activities proposed as part of MEP1 and SIMEC Mining's Magnetite Expansion Project #2: • BDAC • Directly affected and various surrounding landholders • DEW – Crown • DEW – National Parks • Whyalla Council • ElectraNet • DIT • DEM	No issues raised.	N/A

Stakeholder	Date	Matters discussed	Issues raised	SIMEC response
		• South Australian Arid Lands (SAAL) Landscape Board • Eyre Peninsula Landscape Board • Gawler Ranges Landscape Group • Middleback Alliance of Land Managers • Franklin Harbour Council.		
All stakeholders	July 2024	An information brief was released to the following stakeholders to provide an update on MEP1: • BDAC • Directly affected and various surrounding landholders • DEW – Crown • DEW – National Parks • Whyalla Council • ElectraNet • DIT • DEM • South Australian Arid Lands (SAAL) Landscape Board • Eyre Peninsula Landscape Board • Gawler Ranges Landscape Group • Middleback Alliance of Land Managers • Franklin Harbour Council.	No issues raised to date.	N/A

4. Conclusion

To summarise, this change in operations application requests changes to the existing Licence for MPL32, to enable the construction, operation and rehabilitation of an expanded WRD and topsoil stockpile, in addition to the alignment of the existing licenced access road.

Environmental impacts and risks have been assessed and are considered As Low As Reasonably Practical (ALARP), with control measures proposed to mitigate or prevent impacts to the environment.

A range of stakeholders have been consulted, with no issues raised to date on the overarching MEP1 project.

The existing Outcomes and Measurement Criteria have been reviewed in light of the proposed changes to MPL 32 and are expected to remain appropriate and achievable for the overall SMR.

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6. Abbreviations and Definitions

Abbreviation	Definition
AEP	Annual Exceedance Probability
AMD	Acid and metalliferous drainage
AOO	Area of Occupancy
AS	Australian Standard
BDAC	Barngarla Determination Aboriginal Corporation
BDBSA	Biological Database of South Australia
BF	Blast furnace
CiO	Change in Operations
COPs	Critical operating parameters
DDD	Directional Dust Deposition
DEM	Department for Energy and Mining
DLIMS	Dry Low Intensity Magnetic Separator
EIA	Environmental impact assessment
EPBC	Environment Protection and Biodiversity Conservation
ESCPs	Erosion and Sediment Control Plans
ET	Evapotranspiration
FY	Financial Year
FDR	Fugitive Dust Ranking
FOS	Factor of Safety
GDEs	Groundwater Dependent Ecosystems
GIS	Geographic information system
GLCs	Ground level concentrations
IBRA	Interim Biogeographic Regionalisation of Australia
IHCP	Ironstone Hill Conservation Park
ILUA	Indigenous Land Use Agreement
LFA	Landscape Function Analysis
LMIF	Lower Middleback iron formation
LOM	Life of mine
MBR	Middleback Ranges
MEP1, the Project, MEP1 LOM	Magnetite Expansion Project Stage 1
MG2b	Ministerial Guideline, Preparation of a PEPR for metallic and industrial minerals

Abbreviation	Definition
MG35	Ministerial Guideline 35, Applying for a Change in Operations
MIA	Mine infrastructure area
Mining Act	*Mining Act 1971*
Mining Regulations	*Mining Regulations 2020*
Mwmt	Million wet metric tonnes
ML	Mineral Lease
MPL	Miscellaneous Purpose Licence
MTC	Magnetite carbonate ore
Mtpa	Million tonnes per annum
MTS	Magnetite silica ore
NAF	Non-acid forming
NPW Act	*National Parks and Wildlife Act 1972*
NVC	Native Vegetation Council
NVMP	Native Vegetation Management Plan
NZS	New Zealand Standard
OCA	Outback Communities Authority
OHS&E	Occupational, Health, Safety and Environment
OMC	Outcome and measurement criteria
OneSteel	OneSteel Manufacturing Pty Limited
PAF	Potentially acid forming
PEPR	Program for Environment Protection and Rehabilitation
PMST	Protected Matters Search Tool
QP	Quality Procedure
RNTBC	Registered Native Title Body Corporate
RUSLE	Revised Universal Soil Loss Equation
SA	South Australia or South Australian
SAAL	South Australian Arid Lands
SANTS	South Australian Native Title Services
SAPB	South Australian Pastoral Board
SEB	Significant environmental benefit
SES	South Australian State Emergency Service
SIMEC/ SIMEC Mining	OneSteel, trading as SIMEC Mining
SMR	South Middleback Range
TARP	Trigger Action Response Plan

Abbreviation	Definition
TDD	Total Dust Deposition
TOR	Terms of Reference
TSF	Tailings Storage Facility
TUFLOW	An industry standard one- and two-dimensional modelling package
VWP	Vibrating wire piezometer
WMS	Water Management System
WRD	Waste rock dump

6.1 Measurements and Symbols

Unit	Definition
BCM	Bank cubic metres
bgl	Below ground level
g/m^2/month	Grams per square metre per month
GL	Gigalitre
ha	Hectares
km	Kilometre
m	Metre
Mm^3	Million cubic metres
m^3	Cubic metres
m^3/ha/year	Cubic metres per hectare per year
mAHD	Metres Australian Height Datum
ML	Megalitre
mm	Millimetres
m RL	Metres relative to/above sea level
Mtpa	Million tonnes per annum
$PM_{2.5}$	Particulate matter (particles with a diameter of 2.5 micrometres or less)
PM_{10}	Particulate matter (particles with a diameter of 10 micrometres or less)
RL	Reduced level
t	Tonnes
TDS	Total dissolved solids
t/ha/year	Tonnes per hectare per year
µg/m^3	Micrograms per cubic metre
>	Greater than
≥	Greater than or equal to
≤	Less than or equal to
~	Approximately
°	Degrees

Appendices

Appendix A CIO Content Checklist

Framework	Requirement	Included/ section in CIO?
TOR025	**Form of the change in operation application**	
	Applicant name(s) (company and/or individual)	Cover Page, Section 2.1
	Applicant contact details including: • postal address • email • phone number(s)	Cover page
	Primary tenement the change applies to	Section 2.1
	Statement of whether the application relates to a change in the following: • Authorised operations; and/or • Mineral intended to be recovered; and/or • Ability of the tenement holder to achieve a particular outcome of change in criteria to be adopted; and/or Terms and/or conditions of the tenement. • An application for a change in operations must, in accordance with section56(R)(b)(i) of the Mining Act 1971, be in the following form, unless otherwise specified by the Director of Mines or other authorised officer:	Section 3.1
	An electronic version must be submitted in accordance with regulation 88 of the Mining Regulations 2020.	Acknowledged
	Each page, plan or other separate sheet must include the tenement number(s), date of the application submission and sequential page numbering.	Acknowledged
	The electronic version must be submitted in one single Acrobat PDF file or, if requested by the Director of Mines or an authorised officer, as Microsoft Word-compatible files.	Acknowledged
TOR0025 – 1	**Purpose and reason for the change**	

Framework	Requirement	Included/ section in CIO?
	Provide a statement specifying whether the proposed change is: 1.1 a change to the authorised operations to be carried out under the tenement, and/or; 1.2 a change in the mineral that is intended to be recovered; and/or 1.3 a change that may reduce the ability of the tenement holder to achieve a particular outcome, including an environmental outcome, and/or; 1.4 a change to the criteria to be adopted to measure a particular outcome; and/or 1.5 a change to the terms or conditions of the tenement. Describe the reasons why the proposed changes in operations are required. If the purpose relates to clause 1.2, 1.3, 1.4 or 1.5 above, provide a detailed description of the proposed change.	Section 3.1
TOR025 - 2.1.	**Description of Change to Authorised Operations**	
	In setting out any change in relation to the environmental impacts of the proposed authorised operations in accordance with regulation 55(1)(b)(i) of the Mining Regulations 2020, the Minister determines in accordance with regulation 55(4)(e) of the Mining Regulations 2020 that a proposal must include the following:	Acknowledged
TOR025 – 2.1.1	**Describe all elements of the proposed change in operations.**	
	A proposal must include a description of the proposed change in operations and address each of the elements listed in the following Terms of Reference to the extent that they apply to the proposed change in authorised operations: • For metallic and industrials minerals: Terms of Reference TOR 005 Clause 2 Description of Operations. • For extractive minerals: Terms of Reference TOR 002 Clause 2 Description of Operations. • For uranium in situ recovery operations: Terms of Reference TOR 010 Clause 2 Description of Operations.	Acknowledged

Framework	Requirement	Included/ section in CIO?
	For retention leases: • Describe the change to authorised operations. • Provide a statement demonstrating that the operations and/or steps proposed are sufficient investigations to ensure the tenement holder can be in a position to make an application for a mining lease. • Provide a schedule for undertaking the above described operations and/or steps up to a maximum term of five years.	Not applicable as not a retention lease
	If tailings generation and management is proposed, the standards set out in Minerals Policy MPOL007 must be complied with.	Not applicable as tailings not proposed on MPL32
TOR005 – 2	**Description of the Mining Operation**	
	Terms of Reference 005 - section 2.6 - section 2.7.1 - section 2.4.5 (topsoil)	Section 2.2.4.1 Section 2.2.4.2 Section 2.2.4.3
TOR025 – 2.1.2	**Maps, plans and cross-sections**	
	Provide maps, plans and cross-sections relevant to the change in operations. The maps, plans and cross-sections must include the elements described in the following Terms of Reference, which are applicable to the proposed change in authorised operations: • For metallic and industrials minerals: Terms of Reference TOR 005 Clause 5 Maps, Plans and Cross-sections. • For extractive minerals: Terms of Reference TOR 002 Clause 5 Maps and Cross-sections. • For uranium in situ recovery operations: Terms of Reference TOR 010 Clause 5 Maps and Cross-sections.	Various throughout
	For retention leases, provide appropriate maps, plans and cross-sections relevant to supporting the change to authorised operations.	Not Applicable

Framework	Requirement	Included/ section in CIO?
	If tailings generation and management is proposed, the standards set out in Minerals Policy MPOL007 must be complied with	Not Applicable
TOR025 – 2.1.3	**Scope of proposed change to authorised operations**	
	Scope of proposed change to authorised operations Provide an analysis of the key differences between the existing authorised operations and the proposed changed authorised operations, and provide an assessment of the significance of the differences and/or changes.	Section 2.2.4
TOR025 – 2.1.4	**Assessment of alternatives**	
	Describe the alternative approaches and options that were considered when determining the proposed change to authorised operations.	Section 2.3
	Describe the consequence of not undertaking the proposed change to authorised operations.	Section 2.3
TOR025- 2.2	**Assessment of Changes to Environmental Impacts**	
	In setting out any change in relation to the environmental impacts, measures, environmental outcomes and criteria of the proposed authorised operations in accordance with regulation 55(1)(b) of the Mining Regulations 2020, the Minister determines in accordance with regulation 55(4)(e) of the Mining Regulations 2020 that a proposal must include the following:	Appendix E
TOR025 – 2.2.1	**Changes to environmental impacts of the authorised operations**	
	Describe potential impact events the proposed change in operations might have on the environment. The impact assessment must consider each phase of the proposed operations (construction, operation, rehabilitation/closure and post completion).	Section 3, Appendix C, Appendix E
	Describe whether the potential environmental impacts identified are additional to or different from those impacts identified in the initial application for a lease or license.	Section 3, Appendix C, Appendix E
TOR025 – 2.2.2	**Control strategies**	

Framework	Requirement	Included/ section in CIO?
	Describe the measures proposed to manage, limit or remedy each additional or different impact. Demonstrate that the measures proposed are commensurate with the potential impacts, achieve compliance with other applicable statutory requirements and promote progressive rehabilitation.	Section 3, Appendix C, Appendix E
TOR025 – 2.2.3	**Description of uncertainty**	
	Describe any significant degree of uncertainty pertaining to the impact assessment and effectiveness of control strategies, including (but not limited to) lack of site-specific information, limitations on modelling and quality of data. Describe any assumptions connected with the identified uncertainty.	Section 3, Appendix C, Appendix E
	So far as is relevant, identify the sensitivity to change of any assumption that has been made and assess: • whether a change in assumption may result in a new environmental impact	Section 3, Appendix C, Appendix E
	• the likelihood of an outcome not being achieved if an assumption is later found to be incorrect.	Section 3, Appendix C, Appendix E
TOR025 – 2.2.4	**Assessment of environmental outcomes**	
	Provide an assessment of whether the existing environmental outcomes, as included in the lease/licence and/or the currently approved PEPR, are appropriate or if new or modified environmental outcomes are required.	Section 3, Appendix C, Appendix E, Appendix F
	Where modified outcomes are required, provide a statement of the proposed modified environmental outcome(s), which describes the likely consequence of the expected impact on the environment by the proposed operations, subsequent to the implementation of the control strategies described in clause 2.2.2.	Section 3, Appendix C, Appendix E, Appendix F
TOR025 – 2.2.5	**Changes to criteria**	
	Provide a description of any changes to the criteria to be adopted to measure the existing or modified environmental outcomes. For any proposed changes to criteria, include details about any change to the five elements of criteria set out in Regulation 55(2).	Section 3, Appendix C, Appendix E

Framework	Requirement	Included/ section in CIO?
	Where appropriate, use recognised industry standards, codes of practice or legislative provisions from other Acts as part of the criteria.	Section 3, Appendix C, Appendix E
TOR025- 3	**Effective and efficient mining (Mining Leases only)**	
	In preparing a statement in accordance with regulation 55(1)(c)(i) of the Mining Regulations 2020 that demonstrates that the change will not adversely affect the ability of the tenement holder to ensure that land comprised in the tenement can be effectively and efficiently mined, the Minister determines in accordance with regulation 55(4)(e) of the Mining Regulations 2020 that the statement must be supported by the following evidence: 3.1 Reserves or resources (or both) If the change involves the extraction of minerals that are not currently authorised, for those minerals provide: • a JORC-compliant reserve or resource estimate (or both) • the accompanying JORC Public Report and competent person statement. If a JORC-compliant reserve or resource (or both) has not been reported provide: • a detailed estimate of the resource to be mined, the basis of this estimate, and evidence that demonstrates that the resource can be economically mined at current market prices. 3.2 Reasonable prospect of access to land So far as is relevant to the proposed changes to authorised operations, provide the following evidence: • A statement that demonstrates that any waivers of exemption under Section 9AA of the Mining Act 1971 required for the proposed changes have been obtained, or there is a reasonable prospect that they can be; and	Not Applicable

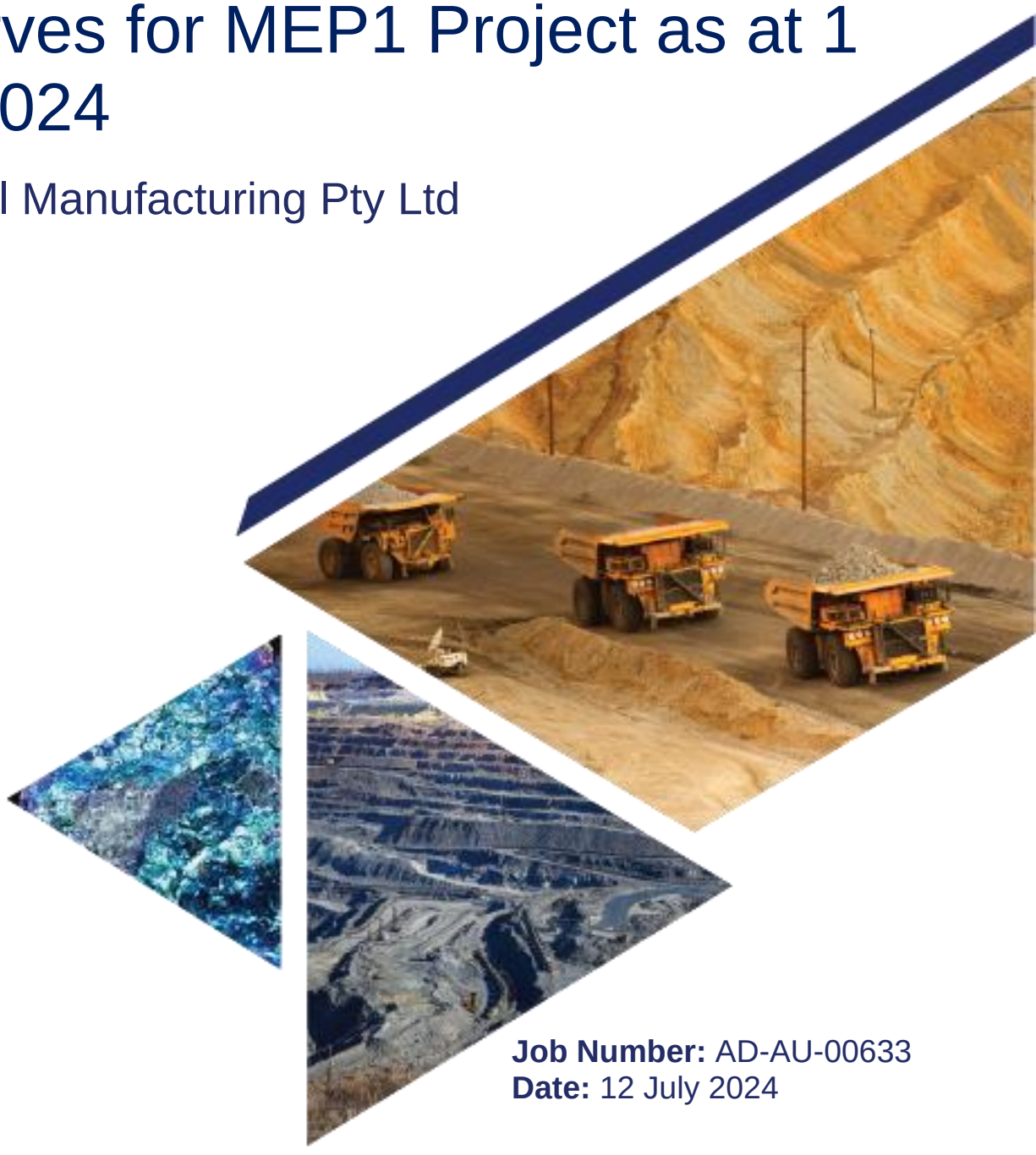
Framework	Requirement	Included/ section in CIO?
	• A statement that demonstrates how the proposed changes relate to any native title mining agreements obtained under the Mining Act 1971 or Indigenous Land Use Agreements (ILUA) under the Native Title Act 1993 (Cth).	
TOR025- 4	**Assessment of lease and/or licence terms/ conditions and the ACT**	
	In preparing a statement in accordance with regulation 55(1)(c)(iii) of the Mining Regulations 2020 that demonstrates that the change will not adversely affect the ability of the tenement holder to comply with the other requirements of the Act, the Minister determines in accordance with regulation 55(4)(e) of the Mining Regulations 2020 that the statement must be supported by the following evidence: • With the exception of any proposed changes to lease and/or licence terms and conditions (as per clause 1.3), provide an assessment that demonstrates the proposed change in operations would be compliant with the terms and conditions of the lease/licence	Appendix C, Appendix E, Appendix F

Appendix B SIMEC MEP1 Ore Reserve and Duchess South Magnetite Resource

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Statement of Open Cut Ore Reserves for MEP1 Project as at 1 July 2024

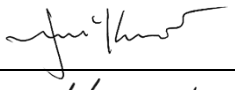
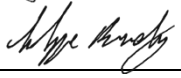
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Job Number: AD-AU-00633
Date: 12 July 2024

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Executive Summary

RPM Advisory Services Pty Ltd (RPM) has been engaged by OneSteel Manufacturing Pty Ltd (SIMEC or the Client) to complete a Statement of Open Cut Ore Reserves for MEP1 Project as at 1 July 2024 (hereafter referred to as the Report).

The Statement estimates the Ore Reserves as at 1 July 2024 and has been undertaken in compliance with the requirements of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves reporting guidelines of the 2012 Joint Ore Reserves Committee (JORC Code).

The Duchess South magnetite deposit is situated in the Southern Middleback Ranges (SMR) in north-eastern Eyre Peninsula, South Australia, 53 km southwest of Whyalla. The MEP1 area is the northern extension of the existing Iron Magnet resource and the southern extension of the Iron Duchess North hematite resource.

A Feasibility Study which targets an accuracy equivalent of Class 3 as defined by the Association for the Advancement of Cost Engineering (AACE) has been completed on the Project and is the basis to support the declaration of an Ore Reserves estimate. The mine plan demonstrates that the Ore Reserves are technically achievable and economically viable with the assumed project parameters.

The information presented in the Executive Summary relates to the Statement of Open Cut Ore Reserves for the Duchess South magnetite deposit and is based on information compiled and reviewed by Mr Igor Bojanic who is a Chartered Professional and Fellow of the Australasian Institute of Mining and Metallurgy and is an employee of RPM. Mr Igor Bojanic has sufficient experience, which is relevant to the style of mineralisation and type of deposit under consideration and to the activity, which he has undertaken to qualify as a Competent Person, as defined in the JORC Code.

The MEP 1 Project mine plan includes negligible quantities of hematite ore. The Ore Reserve estimate is only for the magnetite.

A total of 145.5 Mt of magnetite Ore Reserves were estimated as of 1 July 2024, and are as set out in **Table A**.

Table A MEP1 Magnetite Ore Reserve as of 1 July 2024

Ore Reserve Classification	Tonnage (Mt)	Mass Rec (%)	Fe (%)	SiO_2 (%)	Fe_P (%)	SiO_2_P (%)
Proved	116.1	37.5	31.4	48.7	65.2	8.9
Probable	29.3	28.3	28.2	50.2	64.9	8.9
Total	**145.5**	**35.6**	**30.8**	**49.0**	**65.2**	**8.9**

Notes:

1) *Based on information provided up to 1 July 2024.*
2) *For the purposes of Ore Reserve estimation, MEP1 is defined as portion of the deposit to be extracted for the purposes of the MEP1 development. MEP1 excludes the existing Iron Magnet Pit with the exclusion surface being the MAG-E Cutback Design.*
3) *Reserves are based on Mineral Resource estimates as of 1 July 2023.*
4) *The cut-off grade for magnetite is variable as it is a function of blending different ore types to meet the plant specifications. The actual application of cut-off grade and the resulting processable quantities can only be known following detailed scheduling.*
5) *Economic mining area and ultimate pit design have been validated against the FS costs, modifying factors, and Consensus long-term pricing.*
6) *Inferred Mineral Resource is considered as waste for pit limit optimisation purposes and excluded from the Ore Reserve estimate.*
7) *Ore Reserve estimates are not precise calculations, being dependent on the interpretation of limited information on the location, shape and continuity of the occurrence and the available sampling results. The quantities contained in the above table have been rounded to reflect the relative uncertainty of the estimate. Rounding may cause values in the table to appear to have computational errors.*
8) *All Ore Reserve tonnage and quality estimates are on a dry moisture basis.*
9) *The Fe_P and SiO_2_P qualities are reported on post-concentrator / pre flotation basis.*

SIMEC is targeting the commencement of the MEP 1 Project in February 2025.

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The reporting of post-concentrator grades is based on the Grind Liberation - Davis Tube recovery testwork and is coded to the block model to support feasibility study planning. The product targets grades following flotation are an Fe grade of 70.45% and a silica grade of 1.8%.

The estimate of Ore Reserves for the Duchess South Project is not, to RPM's knowledge, materially affected by any other known environmental, permitting, legal, title, taxation, socio-economic, marketing, political or other relevant factors other than that described in the preceding text. It is believed that the classification of Ore Reserves as set out in this report is reasonable.

SIMEC has prepared a detailed financial model for the purposes of assessing the economic potential and key drivers of MEP1. The economic assessment with the capital and operating costs as set out in **Section 4.15** and the application of the SIMEC revenue drivers presented in **Section 4.16** indicates that the MEP1 project has a net present value (NPV) at a discount rate of 7.3% of over AUD 900 million. The Project is most sensitive to changes in revenue drivers such as iron ore price or foreign exchange rates. However, the sensitivity analysis indicates that at a range of +/-20%, the NPV@7.3% remains positive for all key drivers. Furthermore, the average product selling price has to decline by 25% (to USD 116 /dmt average for the LOM) before the NPV is reduced to zero. This indicates that the Project is reasonably robust to changes in economic factors.

Outside of the economic risk, the FS report notes that the higher risk items for the Project are:

- Delays in the construction of Tailings Storage Facilities (TSF) will impact the ability for the concentrator to operate at its maximum capacity.
  - Current control includes a TSF raise schedule.
  - Proposed mitigation includes raising a separate Tailings Master Plan which will identify critical timings for TSF construction/upgrades.
- Delays in the delivery of regulatory approvals will affect the ability for MEP1 to operate as planned.
  - Current control includes Indigenous Land Use Agreement (ILUA), heritage surveys and EPBC submissions.
  - Proposed mitigation includes a detailed permitting strategy and early funding for approvals
- Delays in the delivery of critical process plant equipment to support the expansion.
  - Procurement contract strategy to reduce risk.
- Failure to deliver planned process debottlenecking upgrades will impact SIMEC's ability to deliver the volumes of magnetite concentrate predicted in the mine plan.
  - Current control includes a resourcing study
  - Proposed mitigation includes test work to understand the improvement gained from any process upgrades.
- Non-acceptance of geochemistry work by regulators will cause delays in approval to expand mine pit outside of existing approvals and to construct waste rock dumps with PAF cells.
  - Current controls include a geochemical assessment with a focus on Acid Metalliferous Drainage (AMD).
  - Proposed mitigation includes a review of the actions identified in the geochemical assessment with a focus on ensuring that actions align with the proposed waste rock dump design.

This Statement may only be presented in its entirety alongside JORC Table 1. Parties wishing to publish or edit selected parts of the text, or use the Statement for public reporting, must obtain prior written approval from RPM and the signatories of this Statement.

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1. Introduction

1.1 Study Introduction

RPM Advisory Services Pty Ltd (RPM) was commissioned by OneSteel Manufacturing Pty Limited (SIMEC or the Client) to complete an independent estimate of the Open Cut Ore Reserves (the Statement) for the Reporting of Ore Reserves for the SIMEC Magnetite Expansion Stage 1 (MEP1) Bankable Feasibility Study. The Statement estimates the Ore Reserves as of 1 July 2024. It has been undertaken in compliance with the requirements of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves reporting guidelines of the 2012 Joint Ore Reserves Committee (JORC Code).

The Project owner is SIMEC, which operates across three areas in the Middleback Range on the north-eastern side of the Eyre Peninsula in South Australia. The Project is located adjacent to the existing Iron Magnet (MAG) pit in the southern-most mining region, referred to as the South Middleback Range (SMR). The Stage 1 Feasibility Study ("FS") examined the extension of the Iron Magnet pit into the new MEP1 (DCS or Duchess South) area. The Feasibility Study has been targets an accuracy equivalent of Class 3 as defined by the Association for the Advancement of Cost Engineering (AACE) to support project funding and provide a basis for implementation studies.

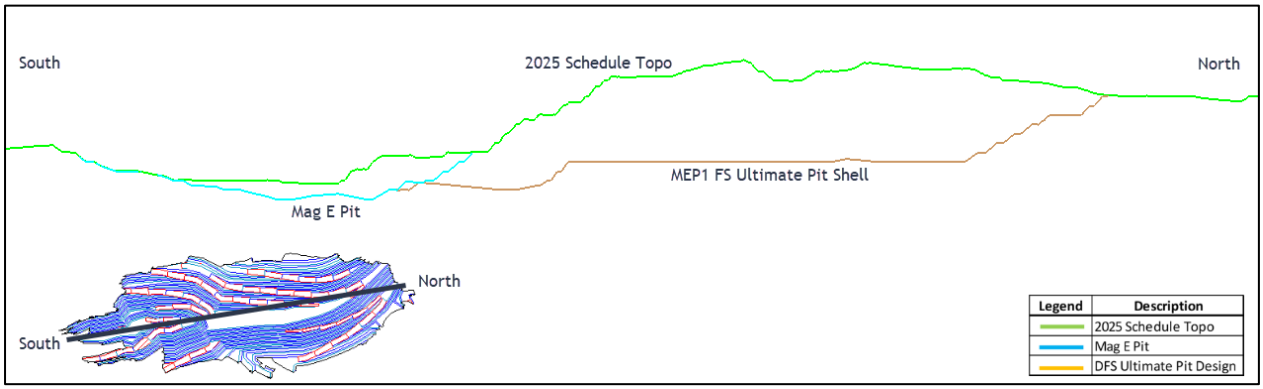
This Statement is based on the Mineral Resource estimate for the Project reported as of 1 July, 2023.

1.2 Definition of Relevant Asset

The relevant asset for the estimation of Ore Reserves is the Magnetite Expansion Project – Phase 1 (MEP1) area. The MEP1 development proposes to extract magnetite and hematite resources associated with the Iron Duchess South Mineral Resource. The MEP1 mining area extends northwards from the existing Iron Magnet pit to the southerly extent of the mined-out Iron Duchess North pit.

The Iron Magnet final pit limit is the "MAG-E" pit cutback. That is, the MEP1 pit extends northwards from the MAG-E pit limit. **Figure 1-1** is a long-section showing the proposed MEP1 pit from the MAG-E cutback to the Iron Duchess North pit, looking West.

Figure 1-1 Long Section Showing MEP1 and MAG-E Pit



1.3 Terminology

RPM has adopted the following JORC terms for the reporting of Mineral Resources and Ore Reserves:

- ***Mineral Resources,*** as used in this Statement, are the same as "Mineral Resources" as defined in the JORC Code. "Geological Resources" and "In Situ Resources" are also common terms used in the industry.
- ***Measured, Indicated and Inferred Resources*** are categories of Mineral Resources and are defined in the JORC Code to reflect the level of confidence in the quantities and grade estimated in the Resource Statement.

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- ***Ore Reserves,*** as used in this Statement, are the same as "Ore Reserves" as defined in the JORC Code.
- ***Ore Reserves*** in the JORC Code are subdivided into ***Proved and Probable*** to reflect the confidence in the underlying resource estimate and the associated Modifying Factors; and
- Mineral Resources are reported inclusive of Ore Reserves (that is, Ore Reserves are not additional to Resources).

Additional terminology applied within this Statement includes the following:

- ***Geological model*** (or in situ resource model) is the computerised three-dimensional estimate of the mineralisation and deposit based on topographic survey data, samples derived from outcrop, drill hole or other methods. No loss or dilution parameters have been applied to this model.
- ***Mineable in situ ore*** (non-JORC terminology) is used in this Statement to refer to in situ ore within the mineable pit shell that has not had loss and dilution applied.

1.4 Relevant Data and Studies

The contents of this Statement have been created using data and information provided by or on behalf of the Client. In RPM's opinion, the information provided was reasonable, and nothing discovered during the preparation of this Statement suggested that there was any material error or misrepresentation in respect to that information. Information generated by third parties, consultants or contractors to the Client through the generation of new work or new data has not been independently validated by RPM.

The following reports, documents and studies were used as reference material in the preparation of the Statement:

- Duchess South Mineral Resource November 2023, Colin Badenhorst, 24/11/23.
- Duchess South Mining Model: DM_2310B1, Rob DeCeukelaire, 22/11/23.
- Magnetite Expansion Project Stage 1 Bankable Feasibility Study, SIMEC Mining, 19 June 2024.
- MEP1 Project Valuation model, file name: MEP 1 BCFM (25.2.9) v21.xlsx.
- FastMarkets report (SIMEC MEP1 Final Report April 18th 2024_IW update_20240508.pptx)
- SIMEC Mining MEP 1 BFS only Macro Assumptions FINAL 17 April 2024, (SIMEC Mining MEP 1 BFS only Macro Assumptions V1.3 20240611.*pptx)*

1.5 Limitations and Exclusions

This report was prepared by RPM at the request of SIMEC, and in accordance with the terms and conditions of its engagement and the limitations and exclusions in **Appendix A** of this report. For the purposes of this report, items 1-8 of the limitations and exclusions in **Appendix A** are incorporated as if they were included verbatim in this report.

1.6 Inherent Mining Risks

Mining is carried out in an environment where not all events are predictable. Whilst an effective management team can identify the known risks and take measures to manage and mitigate those risks, there is still the possibility for unexpected and unpredictable events to occur. Therefore, it is impossible to remove all risks or state with certainty that an event that may have a material impact on the operation of a mine will not occur.

It is, therefore, not possible to state with certainty forward-looking production and economic targets, as they are dependent on numerous factors that are beyond the control of RPM and cannot be fully anticipated by RPM. These factors include, but are not limited to, site-specific mining and geological conditions, the capabilities of management and employees, availability of funding to properly operate and capitalise the operation, variations in cost elements and market conditions, developing and operating the mine in an

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efficient manner. Unforeseen changes in legislation and new industry developments could also substantially alter the performance of any mining operation.

1.7 Currency and Units

Any reference to currency within this Report, unless specifically identified as other, refers to Australian dollars. Some iron ore product pricing information is in United States dollars and designated by the term “USD”.

The units are all in the metric system unless otherwise specified.

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2. Project Description

2.1 Project Location and Access

The MEP1 Project is located in the Southern Middleback Ranges in the northeastern Eyre Peninsula of South Australia, 53 km southwest of Whyalla (refer to **Figure 2-1**).

The MEP1 mining area extends north from the existing Iron Magnet (MAG) Resource to the southern limit of the Iron Duchess North (DCN) pit. It is mining out the Iron Duchess South (DCS) Mineral Resource. A description of the MEP1 mining area, and long-section through the MEP1 Pit mining area, is presented in **Figure 1-1** in **Section 1.1**.

The current Southern Middleback Ranges site layout is shown in **Figure 2-2**.

2.2 Current Operation

The Iron Magnet Pit currently utilises Hitachi EX2600 excavators loading Cat 785 and Komatsu HD1500 rear-dump trucks with mining on a 12 m bench utilising 3 x 4 m flitches. Mining occurs on a 4-panel roster; 2 x 12 hour shifts per day, 7 day week. Mining is undertaken by a contractor.

The remaining mineable quantity of magnetite ore for the Iron Magnet Pit, as of January 2024, was estimated to be 15.6 million dry metric tonnes (Mdmt). It mines approximately 5.6 Mdmt of ore to produce 2.2 Mdmt of concentrate per year. The current mine plan has Iron Magnet ending operations in 2026.

The magnetite concentrate provides feed for SIMEC's blast furnace and steelmaking operations in Whyalla, with Hematite DSO mostly shipped out of Whyalla (a small amount of lump is also fed to the blast furnace).

The Duchess South deposit with higher silica is not suitable for processing in the existing process plant. The MEP 1 Project proposes to modify the process plant to enable treatment of higher silica magnetite ores and thereby extend the operational life of the region.

2.3 Proposed Development

The proposed site layout and mining area for MEP 1 is shown in **Figure 2-2**.

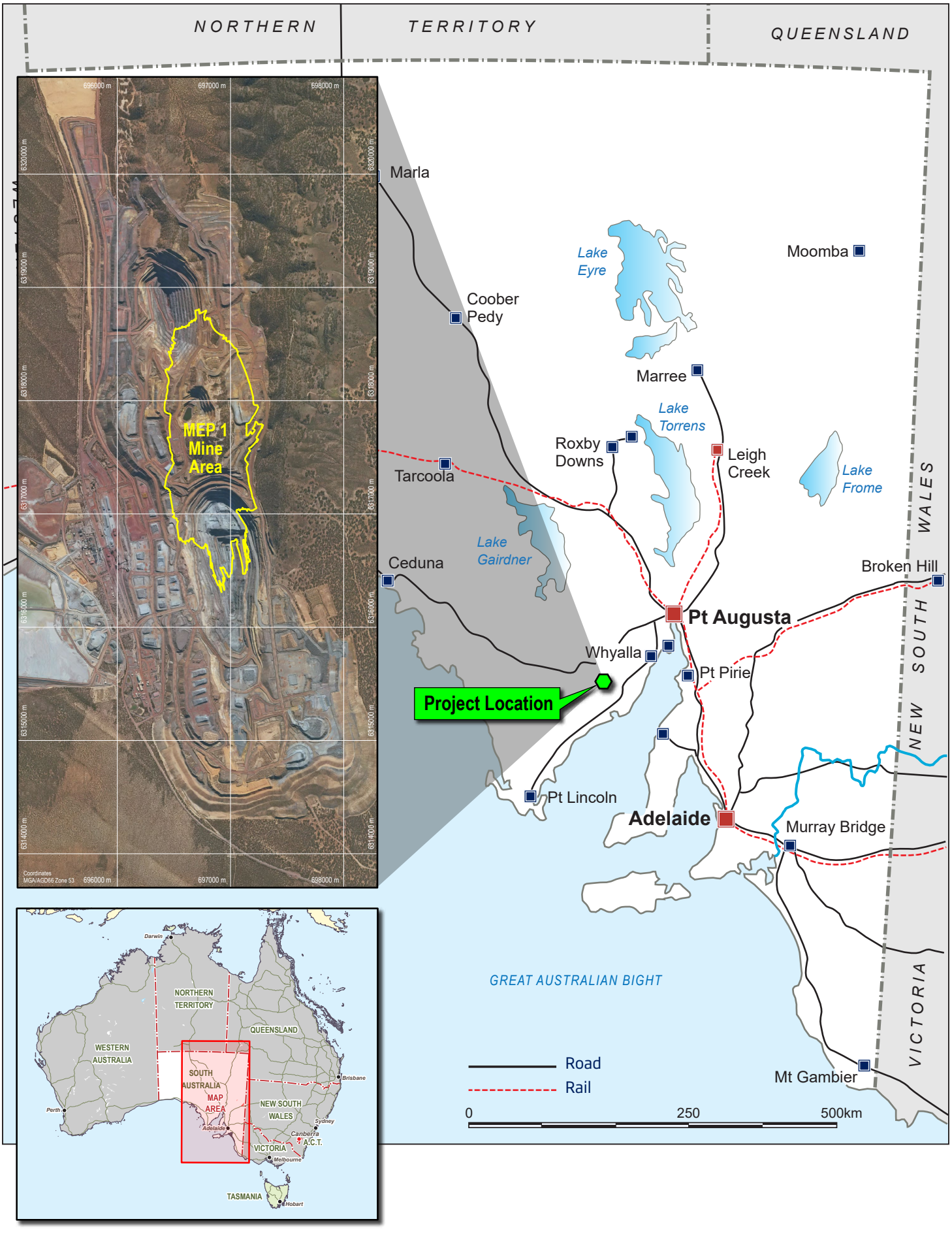
The primary purpose of MEP 1 is the improvement of the current ore processing plant to treat higher silica magnetite ore contained within the DCS deposit. The new process uses reverse flotation to remove excess silica from concentrate. This process will enable the production of a high-quality Direct Reduction concentrate, targeting 70.5% Fe and 1.8% silica.

MEP 1 proposes mine and feed the plant magnetite ore at a rate of approximately 8.5 Mtpa to continue to produce 2.5 Mdmt of concentrate per year. Over 160 Mt of ore will be processed over a +20 year life. Total material movement ranges from 11 to 20 Mtpa.

Technical understanding of the DCS deposit is well advanced, with 96% of the minable quantity for MEP1 being comprised of Measured or Indicated resources.

SIMEC is targeting the commencement of the MEP 1 Project in February 2025.

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LEGEND

N

CLIENT

SIMEC

PROJECT

NAME

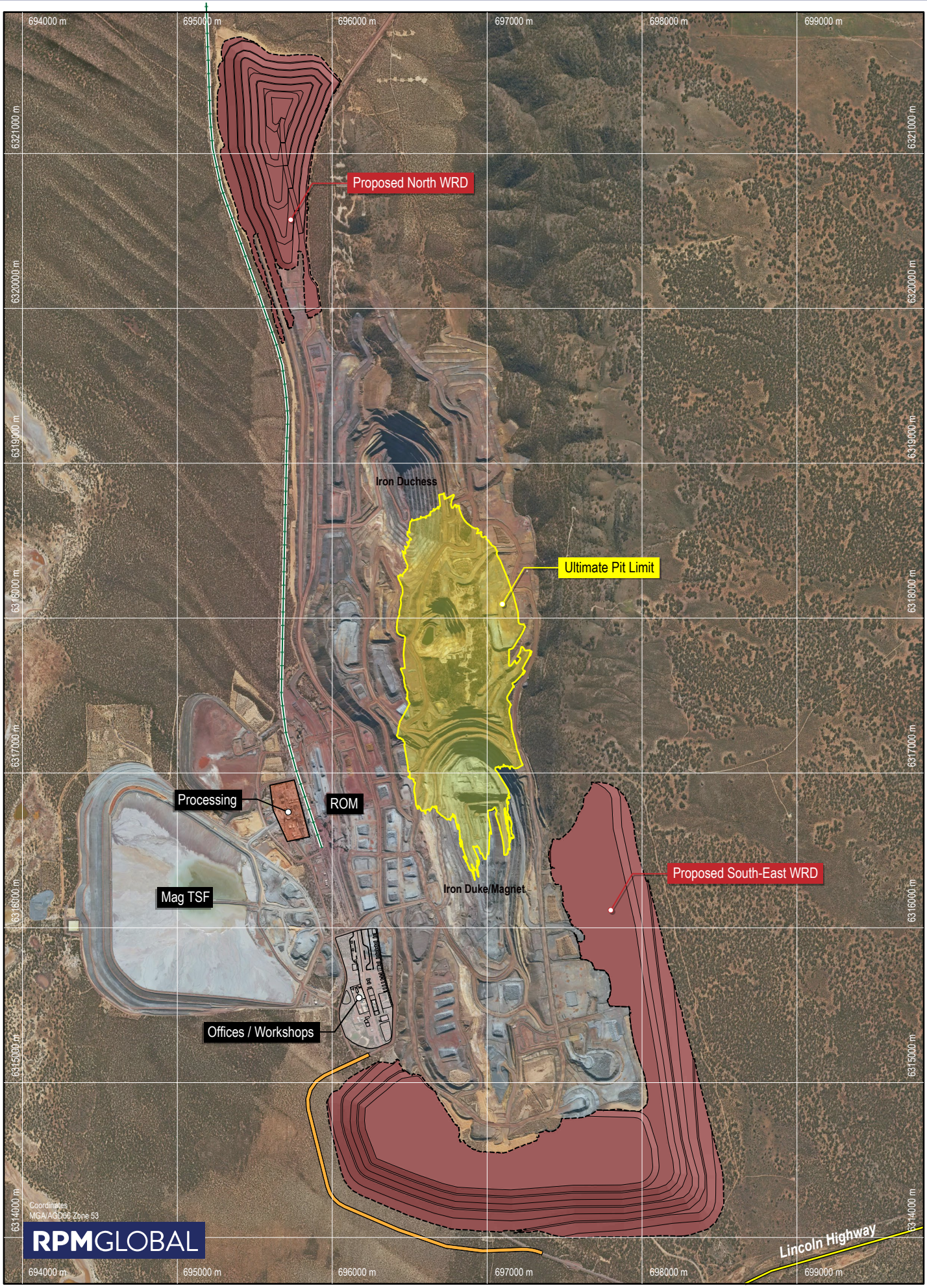
MEP 1 ORE RESERVE STATEMENT

DRAWING

REGIONAL LOCATION PLAN

FIGURE No.	PROJECT No.	Date
2-1	ADV-AU-00633	June 2024

DO NOT SCALE THIS DRAWING - USE FIGURED DIMENSIONS ONLY. VERIFY ALL DIMENSIONS ON SITE



LEGEND

- Highway
- Site Access Road
- Rail

N

0 400 800 1200 1600 2000m

DO NOT SCALE THIS DRAWING - USE FIGURED DIMENSIONS ONLY VERIFY ALL DIMENSIONS ON SITE

CLIENT

SIMEC

PROJECT

NAME: MEP 1 ORE RESERVE STATEMENT

DRAWING: SITE LAYOUT

FIGURE No.	PROJECT No.	Date
2-2	ADV-AU-00633	June 2024

2.4 Project Environment and Land Ownership

2.4.1 Tenure

MEP1 is located wholly within existing exploration and mining tenure held by SIMEC Mining's legal entity, OneSteel Manufacturing Pty Ltd. Underpinned by the Iron Duchess South magnetite resources, new and expanded mining and processing facilities will be required to support MEP1 operations.

New tenure, or changes to existing tenure, will be required for the waste rock dumps (WRDs) and tailings storage facility (TSF) and an additional mineral lease (ML) is required for the expansion of the mine pit. The grant of new tenure will result in the surrender of three existing miscellaneous purposes leases (MPL). The duplication of the existing slurry and water pipelines under MPLs 69 and 70 will remain under existing tenure and is subject to ongoing discussions with the Barngarla Determination Aboriginal Corporation (BDAC) and underlying landholders. Various proposed MEP1 works on existing tenure may also be subject to Change in Operations (CiO) applications, which avoids the requirement for new MLs or MPLs.

All mining tenure will be secured under the Mining Act 1971 (SA) (Mining Act) and Mining Regulations 2020. Secondary approvals will include a new Program for Environment Protection and Rehabilitation (PEPR) and any others indicated by conditions attached to the mining approval documentation.

The current tenure and land ownership holdings are illustrated in **Figure 2-3**.

2.4.2 Land Ownership

Landholders have been divided into two categories for the purpose of the Project administration. The categories assist in identifying those landholders immediately affected and others located within the nearby surrounding area.

The land immediately affected by the proposed MEP1 is:

- Moonabie Station;
- Broadview and Moola Stations (jointly owned by a single landholder); and
- Nonowie Station.

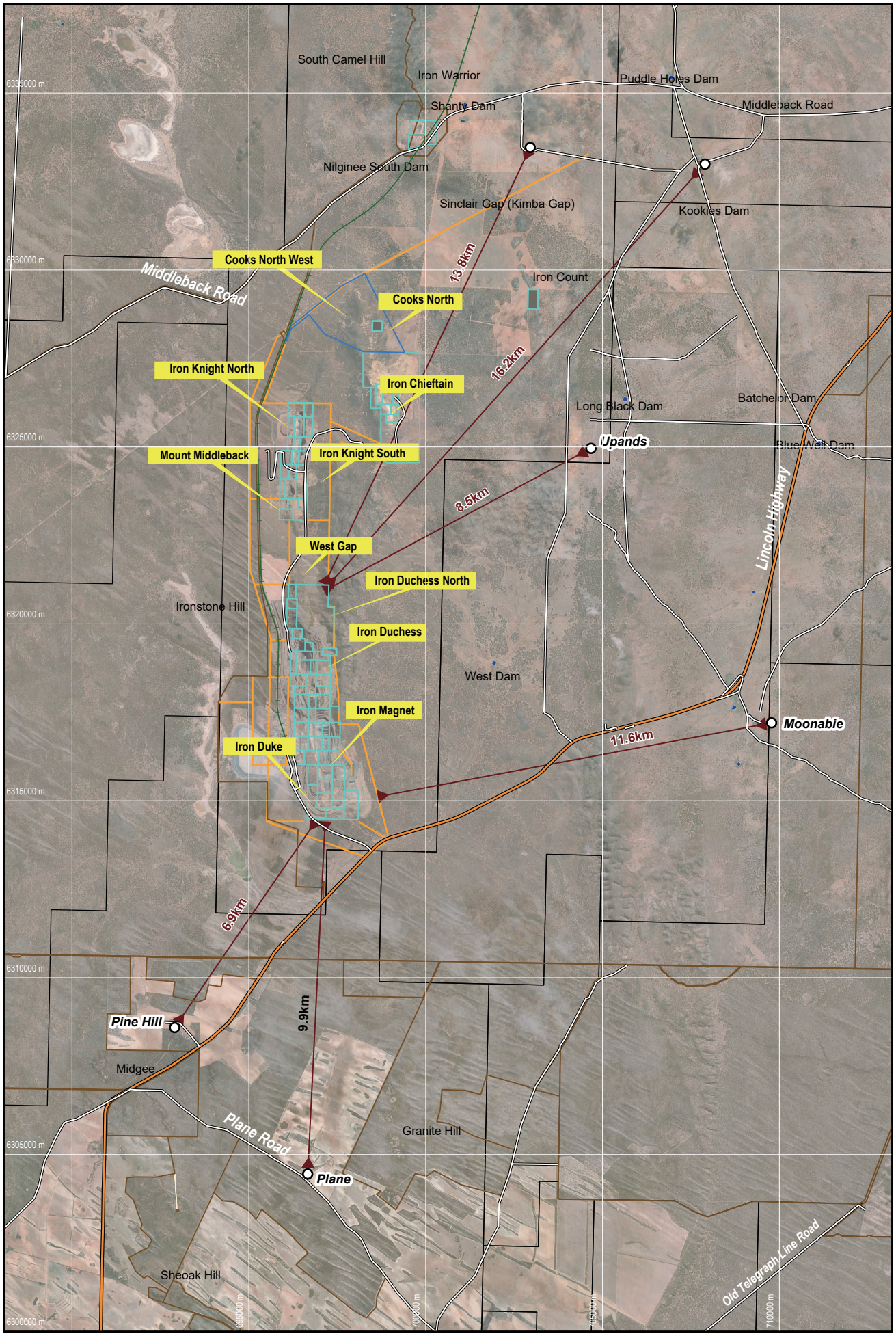
Ongoing engagement with these landholders (Tier 1 stakeholders) is a priority, particularly concerning the proposed new TSF and WRD required to support MEP1 operations.

The next group of landholders who are identified as Tier 2 stakeholders and have an interest in the proposed MEP1 operations are:

- Uplands Station Homestead;
- Myola Station;
- Secret Rocks Property;
- Pine Hill Station; and
- Plane Farm Homestead.

Access to land to conduct environmental studies and project activities is managed through a negotiated agreement with the relevant landholders. Refer to **Figure 2-3** for homestead locations associated with the South Middleback Range (SMR) operational region.

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LEGEND

- Mionor Road
- Major Road
- Rail
- Cadastre
- Mineral Lease (ML)
- Miscellaneous Purpose Licence (MPL)
- Mineral Claim (MC)
- Exploration Licences

N

0 200 400 600 800 1000m

DO NOT SCALE THIS DRAWING - USE FIGURED DIMENSIONS ONLY. VERIFY ALL DIMENSIONS ON SITE

CLIENT

SIMEC

PROJECT

NAME

MEP 1 ORE RESERVE STATEMENT

DRAWING

TENURE AND LAND OWNERSHIP

FIGURE No.	PROJECT No.	Date
2-3	ADV-AU-00633	June 2024

3. Geology and Mineral Resources

3.1 Regional and Local Geology

Underlying central South Australia, the Gawler Craton is an extensive region of Archaean to Mesoproterozoic age crystalline basement bounded by faults to the west, northwest and northeast and by thick sedimentary basins of Neoproterozoic and Phanerozoic age to the east. The Torrens Hinge Zone defines the east and southeast boundary of the craton, while the southern boundary extends to the edge of the continental shelf. The area has been affected by three orogenic events, the Sleafordian Orogeny (Late Archaean to earliest Proterozoic, 2,440 Ma), the Kimban Orogeny (Palaeoproterozoic, 1,850–1,700 Ma) and the Kararan Orogeny (Mesoproterozoic, 1,670–1,540 Ma). During the Archaean, banded iron formation, chert, carbonate, calcsilicate, quartzite and aluminous metasediments of the Sleaford Complex and the Mulgathing Complex were laid down while igneous units (basalts, gabbros, granite and granodiorite) were emplaced. Metamorphism has resulted in orthogneisses, paragneisses and various meta-igneous units.

The Iron Magnet lithological sequence is bounded by the Katunga Dolomite, which marks the base of magnetite mineralisation, and the Cook Gap Schist. The sequence grades up successively through the basal sequence (a coherent mix of relatively thinly bedded lithologies), hematite-carbonate (hematite carbonate rock), mixed hematite-magnetite-carbonate rock with naming dependent on dominant iron species), magnetite-carbonate (magnetite carbonate rock, historically the most important source of ore), magnetite-talc (magnetite talc rock, including amphibole silicates transitional to talc), talc- and talc silica-dominated rock types and schists, magnetite-silica (magnetite silica rock of variable ore quality with variable minor amphibole), and finally jaspilite with variable minor to distinctive amphibole and relatively minor iron oxides. Magnetite-sulphide is locally present as pinching lenses and is thought to represent a transitional unit between the basal sequence rocks and magnetite mineralisation.

Several types of variably mineralised breccia occur within the other rock types. The intrusive rocks, which are altered to amphibolite and generally weather to clay, cut through the deposit and have a north–south strike and a steep westerly dip. Individual dyke thicknesses range from less than one metre up to 15 m. Occasionally the dykes can be continuous, with some having recorded lengths of more than 2 km. More commonly, however, the dykes pinch and swell rapidly, bifurcate and, on rare occasions, are observed to be folded. The amphibolites are generally devoid of mineralisation, but are sometimes slightly hematised, containing low-grade iron. They are the typical source of Al_2O_3 and TiO_2 contamination within the Southern Middleback Range deposits.

3.2 Mineralisation

Magnetite mineralisation is primarily metamorphic and hydrothermal in origin, and includes the following styles:

- Primary banded iron formation hosted magnetite (magnetite silica mineralisation);
- Pervasive magnetite replacement of layers at all scales from laminae to beds;
- Selective magnetite replacement of layers at all scales from laminae to beds;
- Magnetite as matrix to breccias and clasts within breccias;
- Magnetite as discontinuous veins, open space filling in fractured carbonate, bedding-parting and any other fractures and openings;
- Disseminated and spotty magnetite mineralisation, and
- Poorly developed magnetite stockwork veining.

The first two styles (i.e. banded iron formation and bedding replacement) are the primary sources of economic mineralisation, with pervasive replacement often leading to intervals of massive magnetite. Magnetite breccias contribute much less volume than replacement-style ore, but are generally of higher grade, often with a massive magnetite matrix. Open space infill, including veining, generally contributes where magnetite replacement mineralisation is already strong. The last two styles do not contribute to economic mineralisation.

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Magnetite mining and processing in the Middleback Ranges has been focused on high-grade magnetite-carbonate mineralisation at the Iron Magnet Pit since 2005. This ore is favourable for processing due to its grindability and low SiO2 content. Recent advancements in metallurgical processing have shown that oxide-facies (magnetite, hematite, quartz) BIF may also be economically extracted from BIF in the Middleback Ranges.

High-grade hematite mineralisation is thought to occur due to supergene alteration of primary magnetite. This supergene enrichment at depth is especially apparent at the base of the sequence in a strata-bound sense and along both faults/fractures and dyke contacts in a cross-cutting sense. The interpreted control is higher permeability, allowing the ingress of water. Increased hematite development is observed in direct association with some cross faults. The hematite ore-bodies are interpreted to represent up-dip supergene enrichment of magnetite carbonate proto-ore. The drill core shows a clear transition from magnetite carbonate through mixed magnetite-hematite carbonate rock to hematite carbonate. The enrichment process of hematite carbonate to hematite ore involves the removal of carbonate leading to increased porosity (and hence permeability, which would further enhance iron enrichment).

Hematite is the dominant ore mineral with significant goethite and minor limonite present. Hematite mineralisation forms as a discontinuous zone along the western flanks of the ridges, with a variable easterly dip ranging from 30° to almost vertical. Ore widths are highly variable, ranging from greater than 50 m in the central areas of the Iron Duchess area to less than 5 m in some of the eastern areas.

3.3 Mineral Resource Estimate

The Statement is based on the Mineral Resource estimate compiled by Colin Badenhorst, a full-time employee of SIMEC and the competent person for the Mineral Resource Statement. The Duchess South Mineral Resource (November 2023) report is provided in **Appendix B,** which includes JORC Table Sections 1 to 3. The reader can refer to this document for a more comprehensive discussion of the Mineral Resource approach and outcomes.

The cut-off grades used to determine the Duchess South Magnetite Mineral Resource are:

- Hematite - Head grade >47% Fe and a SiO_2 head grade < 50%.
- Magnetite - Mass Recovery > 15% and Fe head grade >15% and SiO_2 head grade <70% and SiO_2 concentrate grade <30%.

The reporting of Mineral Resources only applies the cut-off to in situ (un-mined) magnetite host rocks contained within the 162% Revenue Factor Whittle shell representing Reasonable Prospects for Eventual Economic Extraction (RPEEE). The Mineral Resource estimate for hematite and magnetite is set out in **Table 3-1** and **Table 3-2**, respectively.

The Mineral Resource estimate is based on a mine topography as of 1 July 2023 and is inclusive of remaining Iron Magnet resources, which will be excluded from the Ore Reserve estimate. Furthermore, hematite carbonate is reported with the Magnetite Resource in **Table 3-2**. The mining team assumes this to be processed as a hematite product and is therefore reported as part of the Hematite Ore Reserves.

Table 3-1 Duchess South Hematite Mineral Resource as of 1 July 2023

Resource Classification	Tonnage (Mt)	Fe (%)	SiO_2 (%)	Al_2O_3 (%)	LOI (%)	P (%)	Density (t/m^3)
Measured	2.4	56.80	6.31	1.19	4.97	0.08	3.59
Indicated	6.9	56.12	7.72	1.47	4.21	0.09	3.55
Inferred	8.9	56.17	8.48	1.33	3.14	0.09	3.63
Total	**18.2**	**56.23**	**7.9**	**1.36**	**3.79**	**0.09**	**3.59**

Source: Duchess South Mineral Resource, November 2023
Cut-off: Fe_H > 47% and SiO_2_H < 50%, inside optimised Whittle Shell 57 2023, below 1 July 2023 mining surface, south of Y19,800N. Tonnages rounded to nearest hundred thousand.

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Table 3-2 Duchess South Magnetite Mineral Resource as of 1 July 2023

Resource Classification	Tonnage (Mt)	Mass Rec (%)	Fe_C (%)	Fe_H (%)	SiO_2_C (%)	SiO_2_H (%)	Density (t/m^3)
Measured	253	36.86	64.33	32.92	8.84	41.33	3.49
Indicated	245	31.97	64.03	30.42	9.00	45.00	3.43
Inferred	175	25.89	64.84	28.49	7.99	48.23	3.40
Total	**673**	**32.23**	**64.35**	**30.86**	**8.68**	**44.46**	**3.44**

Source: Duchess South Mineral Resource, November 2023
Cut-off: Mass recovery > 15% and Fe_H > 15% and SiO_2_H < 70% and SiO_2_C < 30%, inside optimised Whittle Shell 57 2023, below 1 July 2023 mining surface. Tonnages rounded to nearest million.

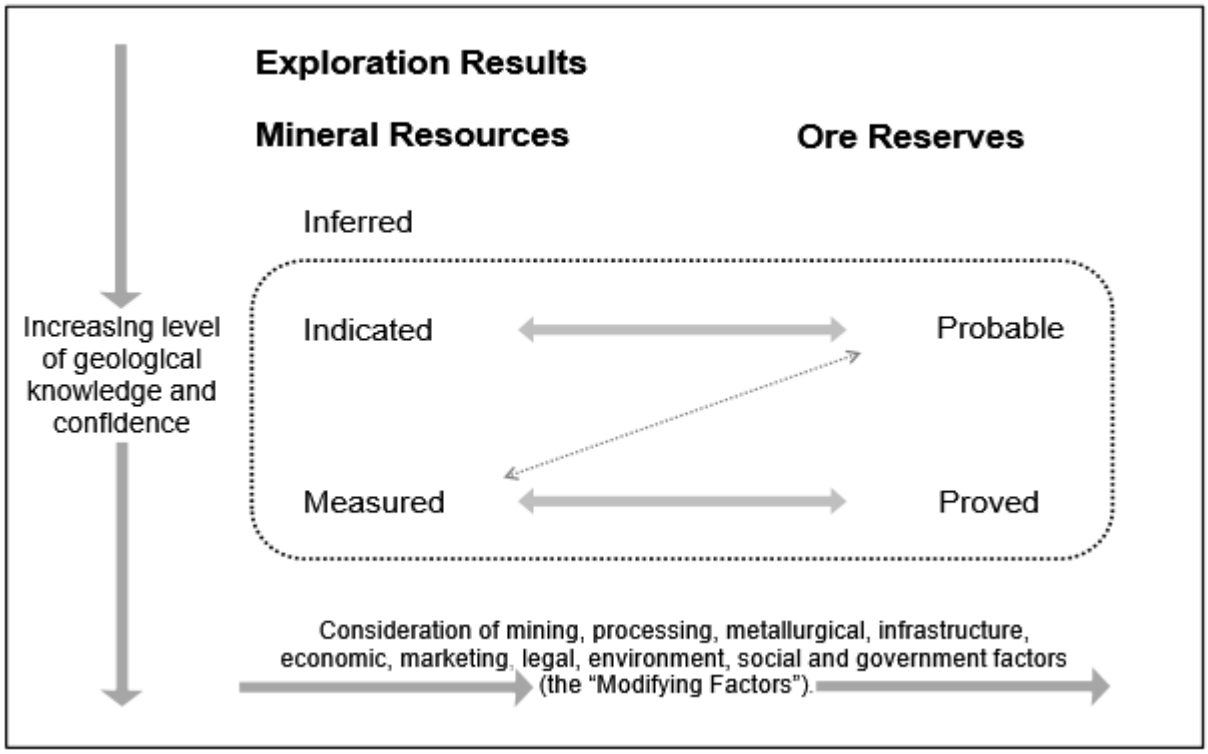
In the table above, the element label “Fe_H” refers to the iron head grade, and the “Fe_C” label refers to the pre-flotation concentrate grade.

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4. Ore Reserve Estimate

The following sections describe the process used in converting the Mineral Resources into Ore Reserves. The order generally follows that of Section 4 of Table 1 of the JORC Code. This process includes defining viable pit limits and applying various mining, cost, revenue and other modifying factors to the Mineral Resources to estimate Ore Reserves. The Mineral Resources can be classified into the two Reserve categories as shown in **Figure 4-1**.

Figure 4-1 JORC 2012 Resource to Reserve Relationship



4.1 Approach

The following sections describe the approach and modifying factors applied to the Mineral Resources to estimate Ore Reserves. The order generally follows "Table 1 - Check List of Assessment and Reporting Criteria" in the JORC Code, which is included as **Appendix C** to this Statement.

The approach adopted for completing the Statement is described below.

- SIMEC and RPM have completed mining studies for MEP1. The mining study will be incorporated into a comprehensive MEP 1 Feasibility Study, managed and compiled by SIMEC. The detailed Feasibility Study is the basis for the estimate of Ore Reserves.
- The in-situ Resource Model was prepared by SIMEC and provided for conversion to a mining model.
- The conversion to a mining model was undertaken by dC Mining Engineering and Technology (dC-MET). The Selected Mining Unit (SMU) dimensions were determined for the deposit based on the mining equipment sizes and anticipated degree of selective mining for the particular material types. The block model was then re-blocked to the defined SMU parameters. This process considers mining practicalities to incorporate the ore loss and dilution modifying factors.
- SIMEC used dC-MET pit limit optimisation software project to define the open cut economic mining area. The mining model was imported into software with the estimates of operating costs and metallurgical parameters. The iron ore price and product pricing is based on a marketing study completed by SIMEC with assistance from consultants. RPM reviewed the process for reasonableness.

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- Two sets of pit shells were generated in the pit limit optimisation software. One set was generated on a Measured, Indicated and Inferred (MII) Resource basis and the other on a Measured and Indicated (MI) only basis.
- The pit shell results were examined, and there is a reasonable correlation between the MI and MII pit shells across all revenue factors.
- SIMEC prepared an ultimate pit design for MEP 1 that forms the basis for the Ore Reserve estimate. RPM reviewed the pit design.
- The FS life-of-mine (LOM) mining schedule was updated for the new mining model to confirm practical extraction, the quantities to be directed to the process plant, and the quantities of product. Only the rock quantities allocated to the process plant can be converted to Ore Reserves. The LOM schedule also confirmed the practicality of the proposed mining development.
- The economic viability of the operation was examined by a total project financial model developed by SIMEC.
- Upon confirmation that the scheduled ROM quantities were practical and economical to mine, the ROM process plant feed quantities were designated as Ore Reserves.
- The Ore Reserves were categorised as either Proved or Probable based on the underlying Mineral Resource categories and the confidence in the modifying factors applied to the Mineral Resource.
- Spot checks were completed to validate the accuracy of the estimate. The results and supporting data were documented in this Statement.

4.2 Mineral Resource Estimate

The Mineral Resource estimate that supports the Ore Reserve estimate is summarised in **Section 3.3** of this Statement and provided in **Appendix B**. The Competent Person who prepared the Mineral Resource estimate is Mr Colin Badenhorst. Mr Colin Badenhorst is a current Member of the Australian Institute of Mining and Metallurgy (MAusIMM No. 225506) and a full-time employee of SIMEC.

Mineral Resources quoted in Chapter 3 of this Statement are inclusive of Ore Reserves.

4.3 Planning Status

A Feasibility Study which targets an accuracy equivalent of Class 3 as defined by the Association for the Advancement of Cost Engineering (AACE) has been completed on the Project. The Feasibility Study has been used to support the declaration of an Ore Reserves estimate. The study indicates that the Ore Reserves are technically achievable and economically viable, though the outcomes are highly sensitive to economic factors.

No previous Ore Reserve Statement has been reported for the MEP1 Project. An Ore Reserve Statement has been reported for the Iron Magnet Mine in 2021 and is provided for reference in **Appendix D**.

4.4 Site Visit

A site visit was undertaken by the Competent Person for MEP1 Ore Reserves, Mr Igor Bojanic, on 13 February 2024. The purpose of the visit was to assess the current state of the site and the implications for the MEP 1 Project.

4.5 Mining Modifying Factors

The mining modifying factors are those parameters applied to the mineable in situ ore to enable conversion to ROM ore. The key mining modifying factors are the ore loss and waste rock dilution. The ore loss and waste rock dilution are largely a function of the geometry and grade distribution characteristics of the ore body and the mining method.

Mining loss and dilution are estimated by modifying the geological block model to the selective mining unit (SMU) size. The SMU defines the volume of material that can be selectively excavated based on the mining

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parameters. The SMU is applied by spatially modelling the mineable material types across the deposit, where each contiguous region of material honours the minimum level of mining selectivity. In this way, the ore loss and dilution are applied directly to the geological model and will vary by location depending on changes in the mineralised structures.

dC-MET undertook the process of converting the resource model to a mining model. The following was applied to the magnetite ore:

- Ore selection objective:
  - Minimum SMU size: 10 m x 10 m in the X and Y direction. The block height was set to 12 m to align with the digging height of the mining method;
  - Maximise NV/P2 (Net Value per P2 Bottleneck Unit value) ≥ product cut-off (all except MHW, which is low grade, high sulfur and hence considered to be mineralised waste); and
  - Maximise MR (Mass Recovery) ≥ 10% (MHW only).
- Additional block edge dilution:
  - X-dimension: 0.6m edge transfer, and
  - Y-dimension: 0.6m edge transfer.

The individual product-specific selection criteria are listed in **Table 4-1**. The primary ore selection objective is to maximise material value above the Net Value per P2 Bottleneck Unit Value (NV/P2) cut-off. Secondary selection criteria are applied to head silica and product sulphur grades as listed.

Table 4-1 Magnetite Mining Model Product Selection Criteria

MAG Product	≤ % SiO_2	≤ % Product S	≥ NV/P2	Description
M32	70	0.08	32	MAG ≥ $32/NV.P2
M27	70	0.08	27	MAG ≥ $27/NV.P2
MLM	70	0.03	14	MAG Low Sulfur Medium Value
M22	70	0.08	22	MAG ≥ $22/NV.P2
M17	70	0.08	17	MAG ≥ $17/NV.P2
M11	70	0.08	11	MAG ≥ $11/NV.P2
MHH	70	0.25	27	MAG High Sulfur High (“MHH”) Value
MHL	70	0.25	18	MAG High Sulfur Low (“MHL”) Value
MHW				MR >10% Subgrade background magnetite, MAG High Sulfur Waste (“MHW”)

Table 4-2 summarises the change from the Resource model to mining model. The conversion process increases the quantity of magnetite product by 3% with only minor changes to overall head grades and mass recovery.

Table 4-2 Mining Model MAG Material Conversion and Modifying Factors (excluding MHW)

MAG	Tonnes (Mt)	Fe (%)	SiO_2 (%)	Al_2O_3 (%)	P (%)	S (%)	LOI (%)	Mass Rec (%)
Resource	652.3	30.6	44.6	0.7	0.05	0.18	2.3	33.4
- Loss	23.8	29.5	46.3	0.7	0.05	0.34	2.3	28.0
+ Dilution	43.0	25.7	44.2	3.9	0.07	0.30	3.9	20.0
Mining Model	671.5	30.3	44.5	0.9	0.06	0.18	2.4	32.7
Change (abs)	19.2	-0.3	-0.1	0.2	0.00	0.00	0.1	-0.7
Change (%)	**3**	**-1**	**0**	**29**	**2**	**1**	**5**	**-2**

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4.6 Geotechnical Parameters and Other Pit Design Criteria

The geotechnical design parameters applied to the mine design applied are shown in **Table 4-3**. The inputs are largely based on work completed by the geotechnical consultants, Peter O'Bryan and Associates (PBA).

Table 4-3 Geotechnical Pit Design Parameters

Domain	IRSA (degrees)	Bench Height (m)	Berm Width (m)	Batter Angle (degrees)
North Wall	41.8	24	10	55
West Wall				
Above and within expected Western Shear Zone influence	38.5	24	10	50
Below Western Shear Zone	41.8	24	10	55
East Wall				
Above Eastern Shear Zone	41.8	24	10	55
Within Eastern Shear Zone and near splay/link structures	36.8	24	12	50
Below Eastern Shear Zone	41.8	24	10	55

The south wall is the existing Iron Magnet Pit and is not planned to be modified.

The pit design parameters are set out in **Table 4-4**.

Table 4-4 Pit Design Parameters

Description	Units	Item
Final Bench Height – between Berms	m	24
Flitch Height – for Excavation	m	12
Minimum Mining Width - Stages	m	75
Minimum Mining Width - Goodbye Cut	m	25
Ramp Width	m	35
Ramp Gradient	%	10

4.7 Pit Limits

SIMEC determined the economic open cut limits for mining using proprietary dC-OreFlow software developed by dC Mining Engineering and Technology (dC-MET). The pit limit optimisation software uses the Pseudoflow algorithm to define a three-dimensional shape for the open cut pit, which is considered the "optimal" economic shell for mining. Generally, a number of pit shells are defined based on a range of product selling prices. Each shell is then evaluated at the base input costs and product selling price to select the preferred shell to guide the ultimate pit.

Key inputs to the software were:

- Mining model developed from the SIMEC 2023 mineral resource model;
- Geotechnical parameters based on a study by geotechnical specialist Peter O'Bryan and Associates;
- Metallurgical parameters to estimate product quantities from grind liberation test work with product physicals estimated in the resource modelling;
- Mining costs from a cost study completed by RPM for the MEP 1 FS, and
- Product pricing from a marketing study completed by SIMEC as part of the MEP2 FS.

As the intention of the FS is to identify the preferred strategic approach to develop MEP1, the pit limit optimisation was inclusive of Measured, Indicated and Inferred (MII) Mineral Resources. This approach enabled the full potential size of the open pit and waste dumps to be assessed, as it has critical importance

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for the location of infrastructure and site management. To support the estimation of compliant Ore Reserves, a second scenario was considered on a Measured and Indicated (MI) only basis.

The mine operating costs used for the pit limit optimisation are listed in **Table 4-5**.

Table 4-5 Summary of Key Pit Optimisation Inputs

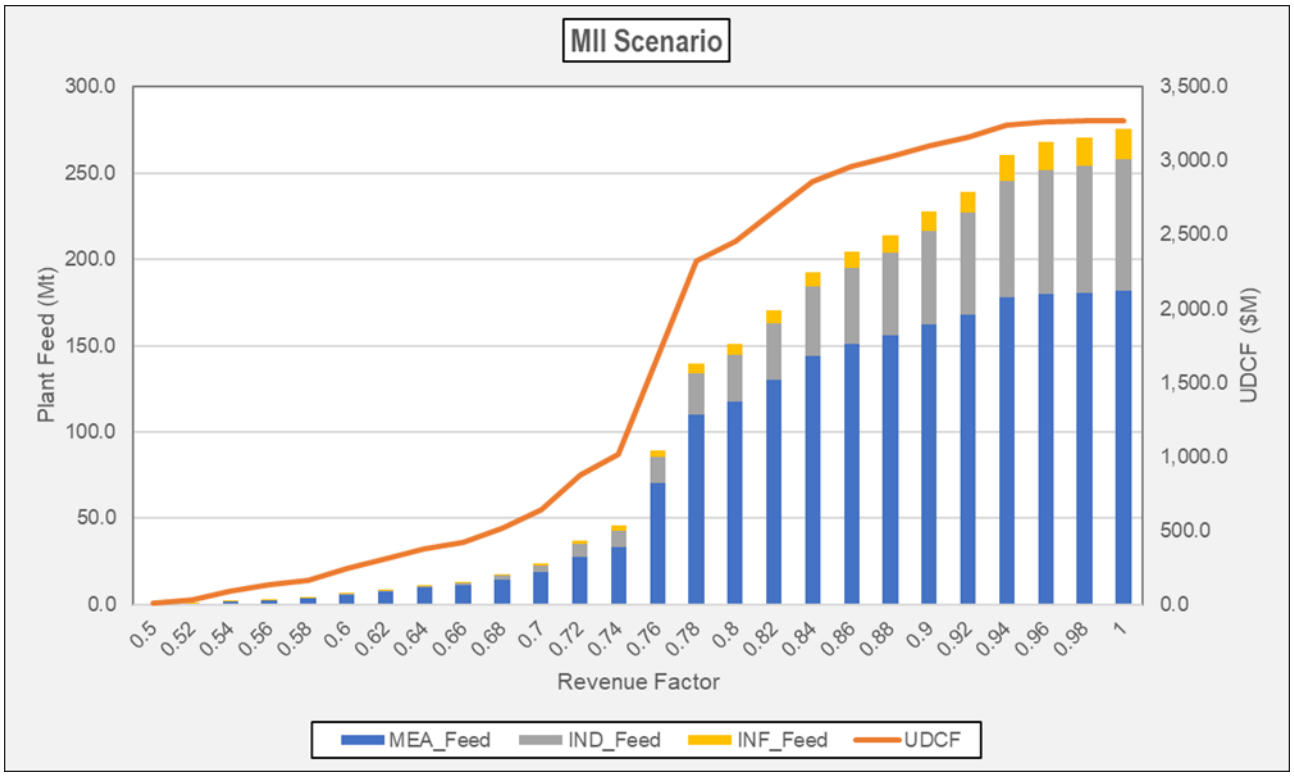
Mining Costs	**Unit**	**Ore**	**Waste**
-Fixed	AUD/t	5.73	3.90
-Variable Uphill	AUD/t.mv	0.007	0.007
-Variable Downhill	AUD/t.mv	0.004	0.004
Average	AUD/wmt	6.12	4.55
Total Mining	**AUD/t**	**5.74**	
Process Costs	**Unit**	**Magnetite**	
Crushing	AUD/Feed t	3.32	
DLIMS	AUD/Feed t	1.11	
DLIMS Rejects Removal	AUD/DLIMS Reject t	3.67	
Concentrator	AUD/Feed t	11.32	
Flotation	AUD/Feed t	6.40	
Filter Plant	AUD/Mag Conc t	5.38	
Overhead and Sales Costs	**Unit**	**Magnetite Concentrate**	
Site G&A	AUD/Mag Conc t	0.07	
Head Office G&A	AUD/Mag Conc t	1.97	
Sustaining Capex	AUD/Mag Conc t	10.81	
Transhipping	AUD/Mag Conc t	11.55	
Sea Freight	AUD/Mag Conc t	20.94	

The sale price for magnetite has been derived from SIMEC marketing studies conducted by DAZMIN. An average magnetite concentrate product price of $AUD 207/product t was assumed.

The discounted cash flow analysis per pit shell for the MII is presented in **Figure 4-2**. A key outcome is that the likely mineable feed to the plant will be in the range of 200 Mt and 260 Mt, as there is only minor additional value beyond the 0.84 revenue factor pit shell. Furthermore, the bulk of the feed is classified as Measured and Indicated.

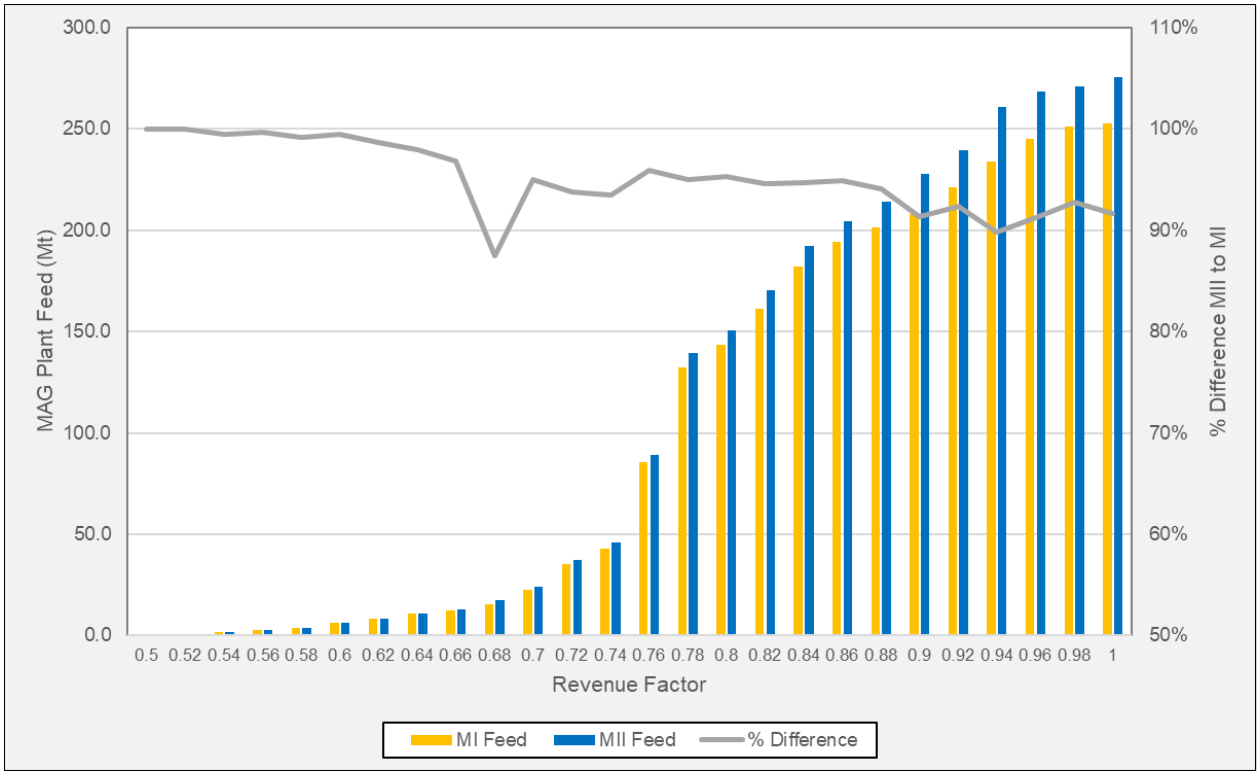
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Figure 4-2 Pit Optimisation Price Sensitivity – MII Scenario



The proportion of Inferred in the pit shell assessment is illustrated in **Figure 4-3**.

Figure 4-3 Comparison of the Proportion of Inferred in the Optimisation Pit Shells



The results show that, within the likely range of preferred pit shells, Inferred Resources are less than 10% of the total. That is, the inclusion of Inferred Resources in the mine planning would be immaterial to the study outcomes.

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Pit Shell Selection

The data resulting from the pit limit optimisation is presented in **Table 4-6**. SIMEC selected the 0.84 revenue factor pit shell as the basis for the ultimate pit design. The shell was selected as a low-risk option, as it can withstand a reasonable degree of variability in market conditions and product pricing. At SIMEC's proposed rates of ore processing, this shell has a mine life of 20 years.

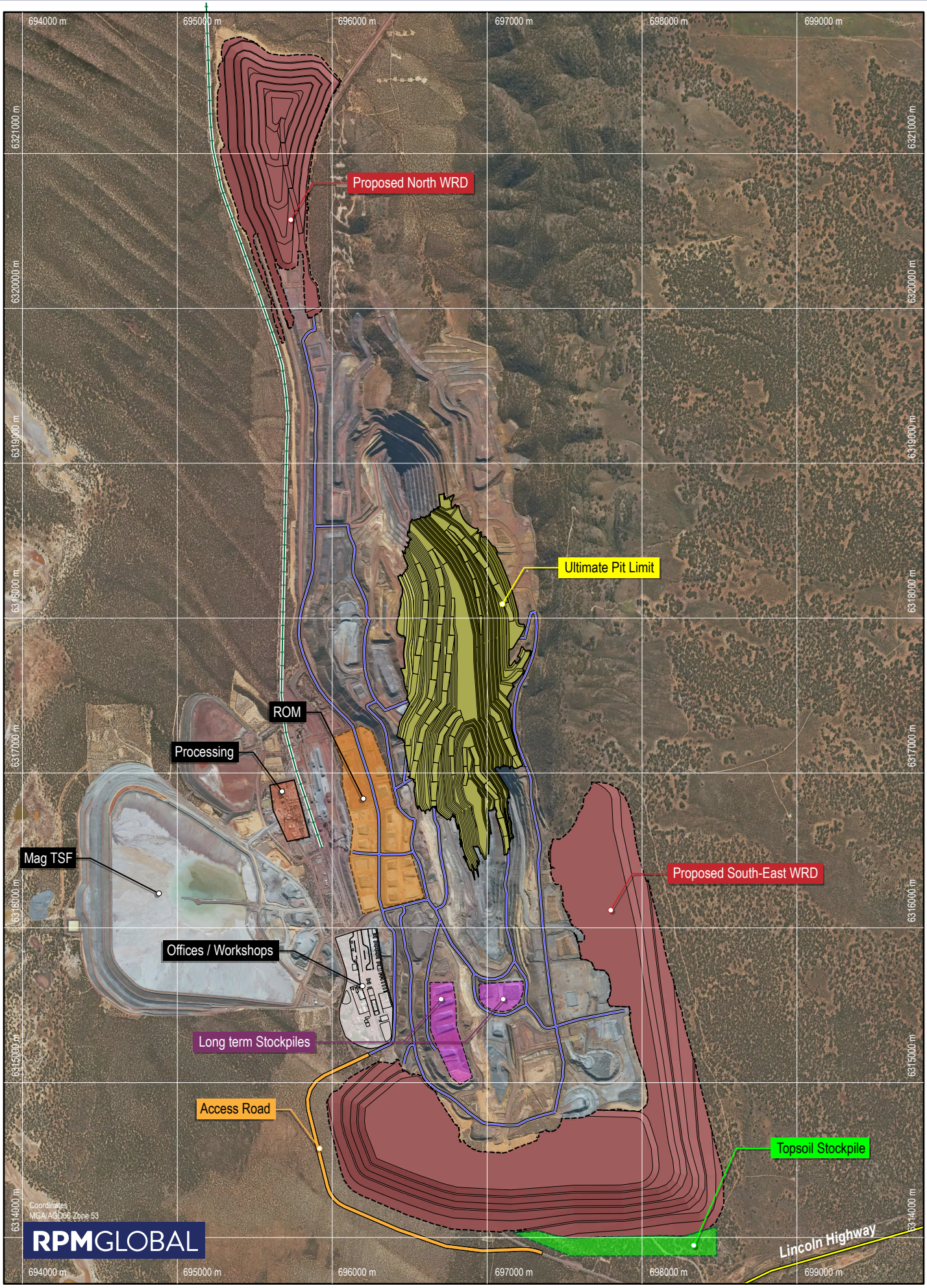
Table 4-6 Price Sensitivity Analysis – MII Scenario

RF	Total Mass (Mt)	Ore Mass (Mt)	Strip Ratio	Undiscounted Pit Value ($M AUD)	Magnetite Ore Mass (Mt)	Magnetite Conc Mass (pre-flot, Mt)
0.5	0.1	0.1	0.00	8.1	0.1	0.1
0.6	6.7	6.1	0.10	245.3	6.1	2.9
0.7	34.4	24.0	0.44	644.6	24.0	9.6
0.8	286.3	150.8	0.90	2,457.1	150.8	53.8
0.84	386.1	192.5	1.01	2,862.3	192.5	67.9
0.9	482.2	227.7	1.12	3,105.0	227.7	79.6
1	643.6	275.7	1.33	3,270.8	275.7	95.4

4.8 Mine Design and Site Layout

The ultimate pit design from the Feasibility Study, and the corresponding site layout, is illustrated in **Figure 4-4**. The road network and pit access are aligned with the existing roads to minimise future construction requirements. The stockpile placement area uses the current stockpile areas, as they are adjacent to the primary crusher area.

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LEGEND

Highway
Haul Road
Site Access Road
Rail

N

0 400 800 1200 1600 2000m

DO NOT SCALE THIS DRAWING - USE FIGURED DIMENSIONS ONLY VERIFY ALL DIMENSIONS ON SITE

CLIENT

SIMEC

PROJECT

NAME

MEP 1 ORE RESERVE STATEMENT

DRAWING

SITE, ULTIMATE PIT AND SURFACE WRD LAYOUT

FIGURE No.	PROJECT No.	Date
4-4	ADV-AU-00633	June 2024

4.9 Cut-Off Grade

As magnetite processing relies on blending to meet processing constraints and product requirements, the actual application of cut-off grade and the resulting processable quantities can only be known following detailed scheduling.

The materials used for scheduling and processing constraints are summarised in **Table 4-7**. The material types on the limit of the ore-waste boundary are highlighted in bold (MLM, M11 and MHL). The other material types provide additional bins for scheduling.

Table 4-7 Cut-Off Grade Approach

Material Categories	DESTN (Material Type)	Description	Fe Head Grade (%)	Margin - MNPR (NVP2-CON) ($/t)	Grind Lib Sulfur (%)	SiO_2 Head Grade (%)
			Minimum	Minimum	Maximum	Maximum
Hematite	OHG	High-Grade Hematite*	55	-	-	-
Hematite	OLG	Low-Grade Hematite	**47**	-	-	-
Magnetite	M32	High Value	-	32	0.08	70
Magnetite	M27	Medium-High Value	-	27	0.08	70
Magnetite	**MLM**	**Low Sulfur Medium Value**	**-**	**14**	**0.03**	**70**
Magnetite	M22	Medium Value	-	22	0.08	70
Magnetite	M17	Low-Medium Value	-	17	0.08	70
Magnetite	**M11**	**Low Value**	**-**	**11**	**0.08**	**70**
Magnetite	MHH	High Sulfur High Value	-	27	0.25	70
Magnetite	**MHL**	**High Sulfur Low Value**	**-**	**18**	**0.25**	**70**

**Hematite is excluded from the MEP 1. Minor quantities are present in the life of mine schedule.*

4.10 Metallurgical Modifying Factors

The successful development of MEP 1 is dependent on the successful beneficiation of high SiO_2 ore present in the Iron Duchess South deposit. The process includes a Dry Low-Intensity Magnetic Separation (DLIMS) stage followed by post-magnetic separation and reverse flotation to separate the silica and create a sellable grade. Test work has demonstrated that SiO_2 in concentrate by DTR as high as 30% has been successfully treated to magnetite concentrate of less than 2% SiO_2.

The processing flowsheet to achieve this outcome covers the following stages:

- Primary crushing of ore material which is then stacked on a post-crush stockpile
- Front-end loader feed of material from the post-crush stockpile to the DLIMS unit.
  - Non-magnetic material is directed to a rejects stockpile for transportation to the waste dump using a front-end loader and trucks.
  - Magnetic material is directed to the plant feed bin.
- Plant feed bin to high-pressure grinding rolls (HPGR)
  - Material is put through a rougher magnetic separation (RMS) unit, with non-magnetics directed to the wet tailings disposal area. The over-sized magnetic material is sent back to HPGR, and the under-sized magnetic material is sent for processing at the primary or auxiliary concentration unit.
- Primary concentration stage includes:
  - Ball mill hydro-cyclone;
  - Deslime intermediate magnetics separation (DIMS);
  - Fine grinding pre-screen;
  - Fine grinding IsaMill;

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  - Fine screening; and
  - Cleaner magnetic separation (CMS).
- Auxiliary concentration stage includes:
  - Regrind hydro-cyclone;
  - Low-intensity magnetic separation (LIMS);
  - Magnetic gravity separation (LJC);
  - Screening; and
  - CMS.
- Material from the CMS goes to the reverse silica flotation which includes:
  - Rougher scavenger flotation;
  - Flotation silica regrind; and
  - Cleaner flotation
- Finally, the post-flotation material is sent to a concentrate thickener, with the thickened concentrate sent to Whyalla via a pipeline.

The metallurgical factors are based on the estimated magnetite grind liberation / DTR product physicals defined in the resource model and flotation recoveries defined in the SIMEC Business Model. The average metallurgical recovery for each ore type from the selected pit shell is provided below in **Table 4-8**. It is important to note that the rock types of MHW and low-grade hematite material (OLG) these were considered waste and excluded from the Ore Reserve estimate.

Table 4-8 Average Grind Lib. Metallurgical Recoveries for Magnetite

Ore Type	Avg. Mass Recovery
M11	17%
M17	26%
M22	31%
M27	34%
M32	40%
MHH	30%
MHL	25%
MLM	25%

The higher-grade hematite ore is a direct shipped product, and no processing modifying factors are applied.

4.11 Production Schedule

An updated life of mine production schedule using RPM's Open Pit Metals Solution (OPMS) was prepared to support the reporting of Ore Reserves. The schedule has a starting date of 1 February 2025, approximating the commencement of mining the DCS deposit. Though the production schedule focuses primarily on mining DCS, it does include some remanent mining and stockpiles from the Iron Magnet Pit.

Key characteristics of the production schedule are:

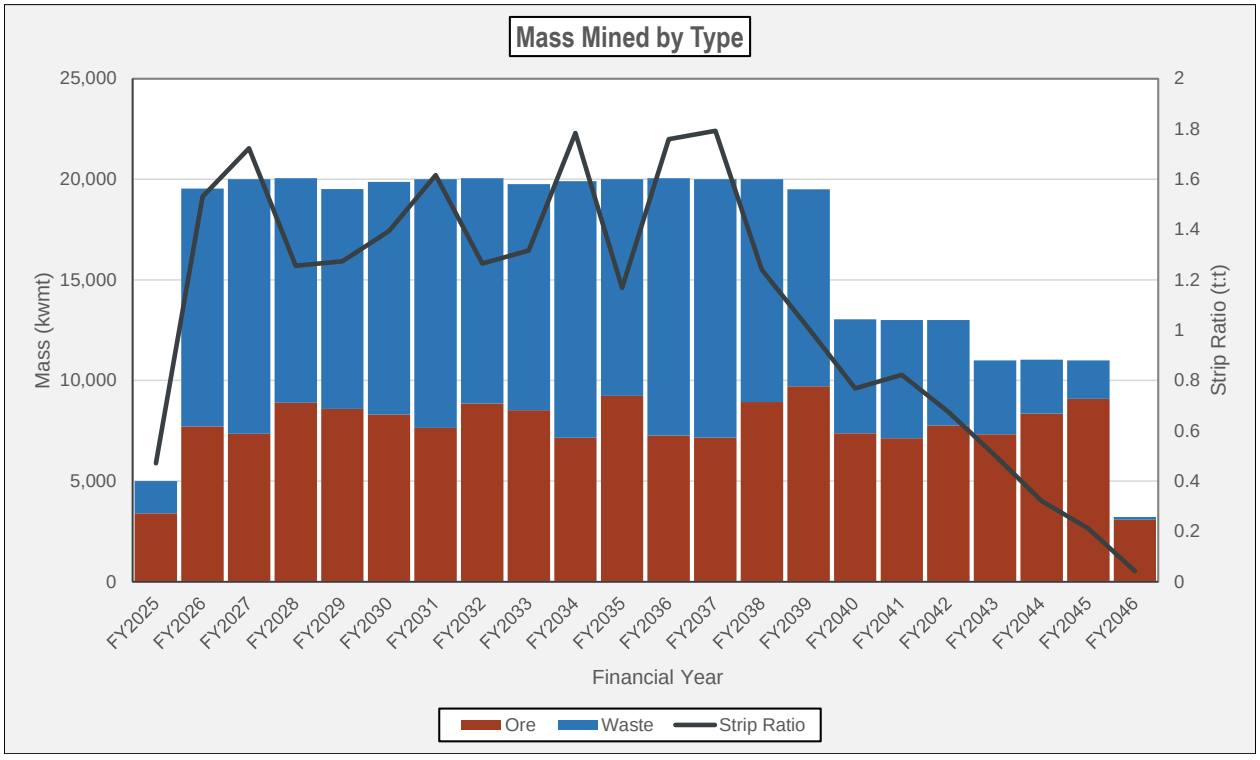
- 22 years of operational life;
- 20 Mtpa from the start of schedule to the end of FY39;
- 13 Mtpa from FY39 to end of FY42;
- 11 Mtpa from FY42 to the end of schedule (FY46);
- Strip Ratio is relatively steady at an average of 1.4:1 over the mine plan (t waste: t ore), with a steady drop in strip ratio from FY38;

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- Meets Concentrator capacity;
- 164 Mt of ore processed (100% of total mineable quantity);
- Crusher feed averages 96% Measured and Indicated Resources over the mine life;
- Total 50.5 Mt of concentrate product; and
- Stockpiling strategy results in a maximum stockpile balance of 10 Mt, with an average balance between 8-10 Mt throughout LOM.

The annual material movement is shown graphically in **Figure 4-5**. Material movement is steady at 20 Mtpa for most of the schedule, with a ramp-down towards the end in response to a decreasing strip ratio.

Figure 4-5 Total Material Mined and Strip Ratio



The ore mined is split into two major categories, hematite and magnetite, as shown in **Figure 4-6**. The focus of MEP1 is on Magnetite ore, as Hematite quantities are insignificant throughout the LOM.

Grind-liberation (post-concentrator, pre-flotation) iron grade is shown in **Figure 4-7**. The grind liberation silica grade is shown in **Figure 4-8**. Average grind-liberation iron sits at 66.6% for the first half of the schedule but drops to 64.3% when lower quality material from DCS-C is scheduled. From the conclusion of MAG-E (first two years of schedule), pre-flotation silica sits at 9.1%, highlighting the importance of the addition of flotation in reducing silica to 1.8% in the final product grade.

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Figure 4-6 Ore Mined by Type – Hematite and Magnetite

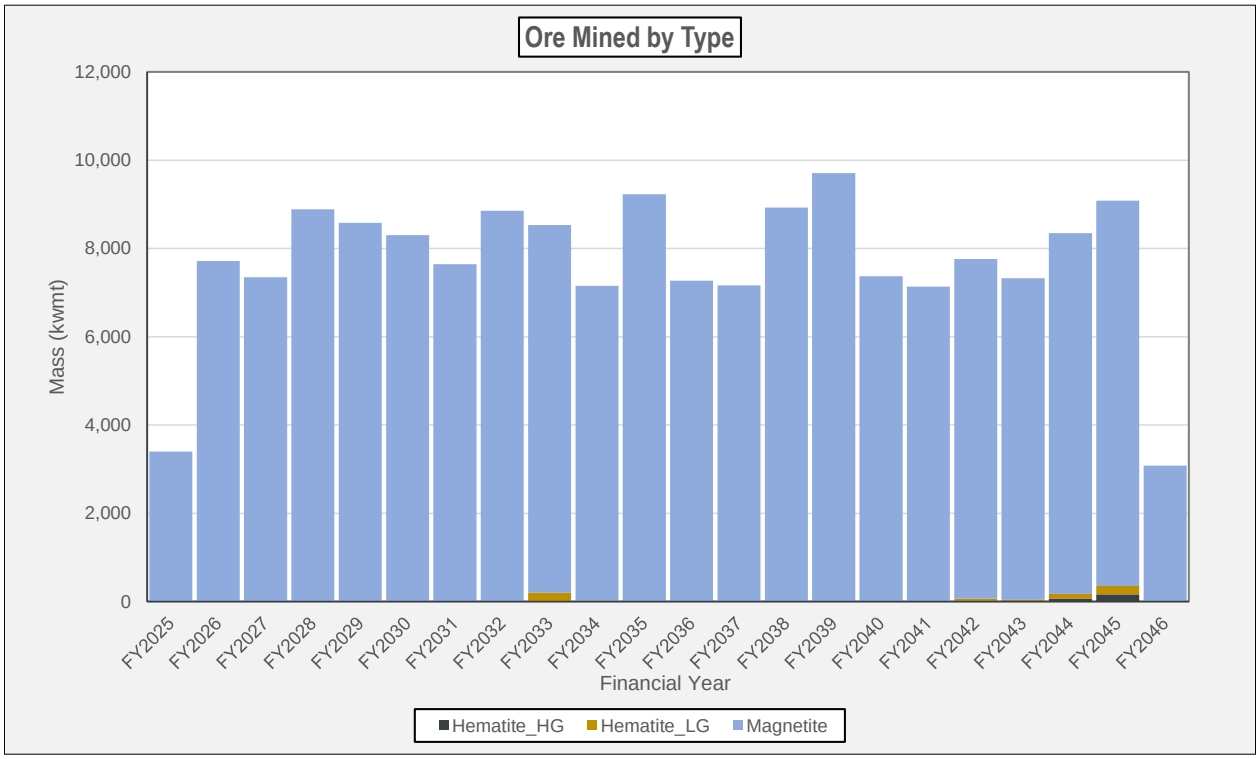
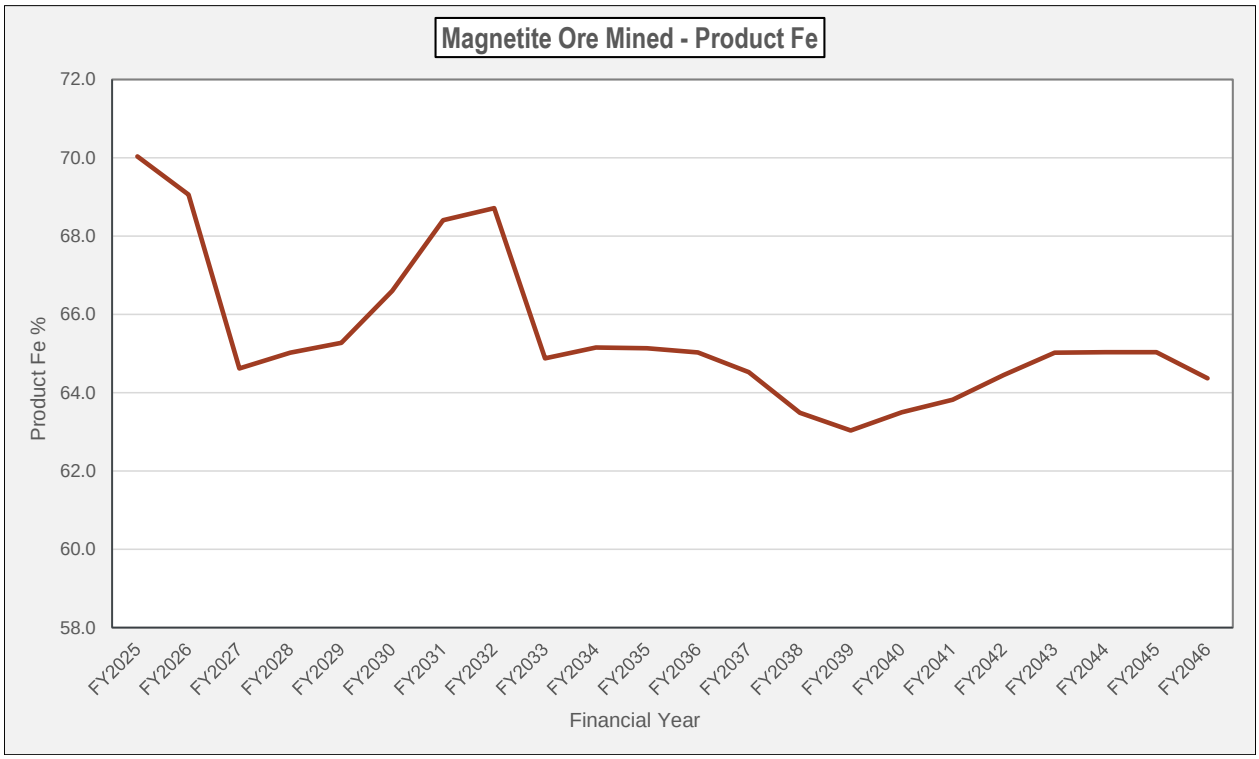


Figure 4-7 Magnetite Ore Mined – Product Iron Grade (Grind Liberation DTR)



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Figure 4-8 Magnetite Ore Mined – Product Silica Grade

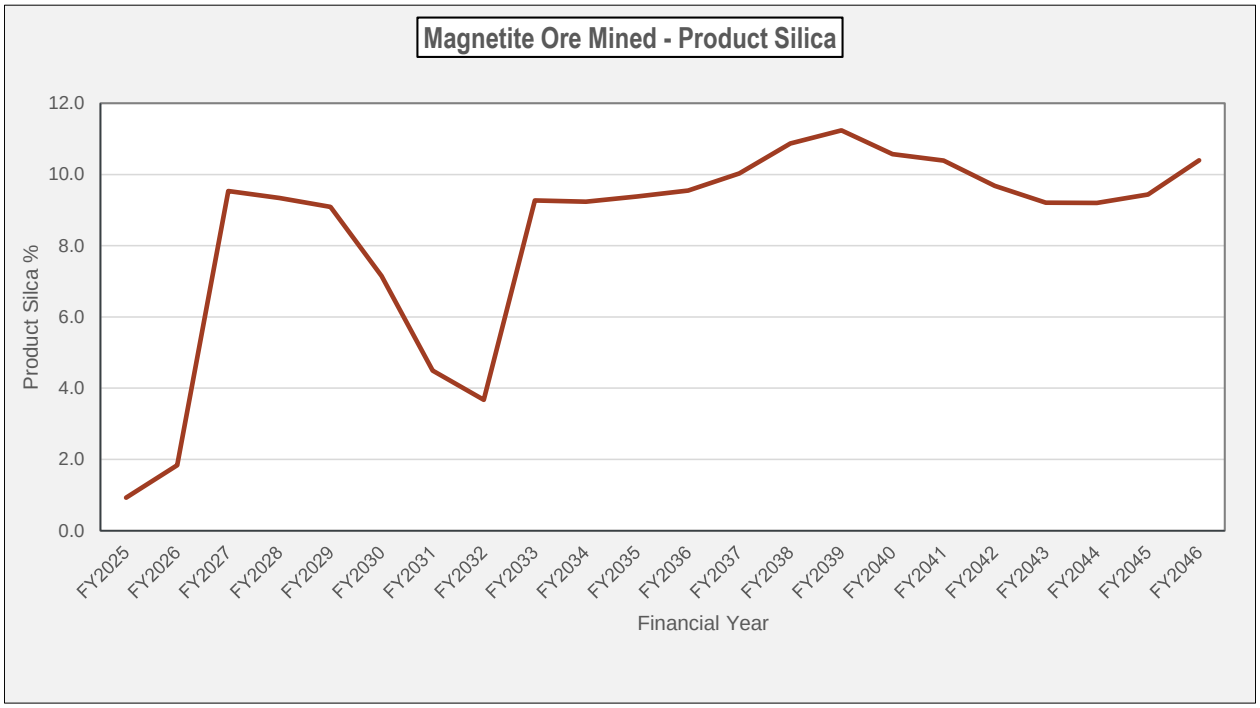
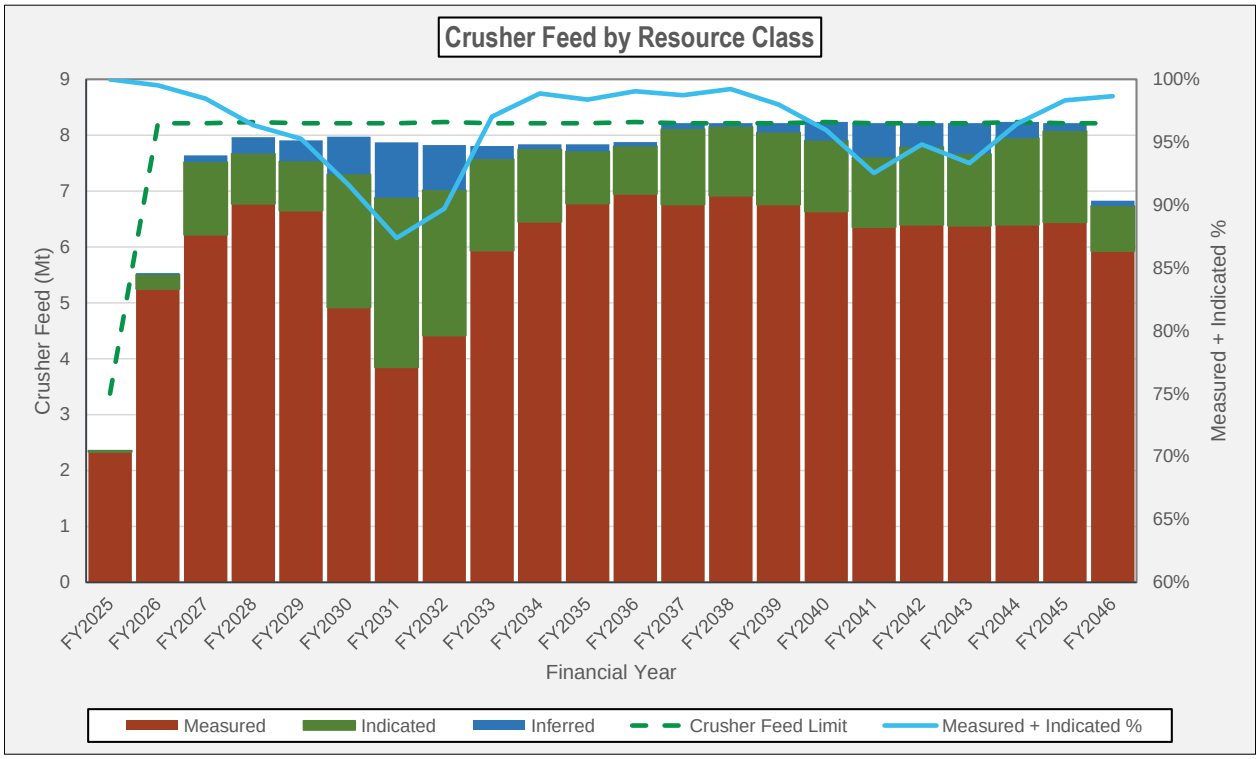


Figure 4-9 indicates the mining schedule with Measured, Indicated and Inferred Resources is at a high confidence as the crusher feed averages 96% Measured and Indicated Resources over the mine life, with annual fluctuations between 90% and 100%.

Figure 4-9 Total Plant Feed for MII Schedule



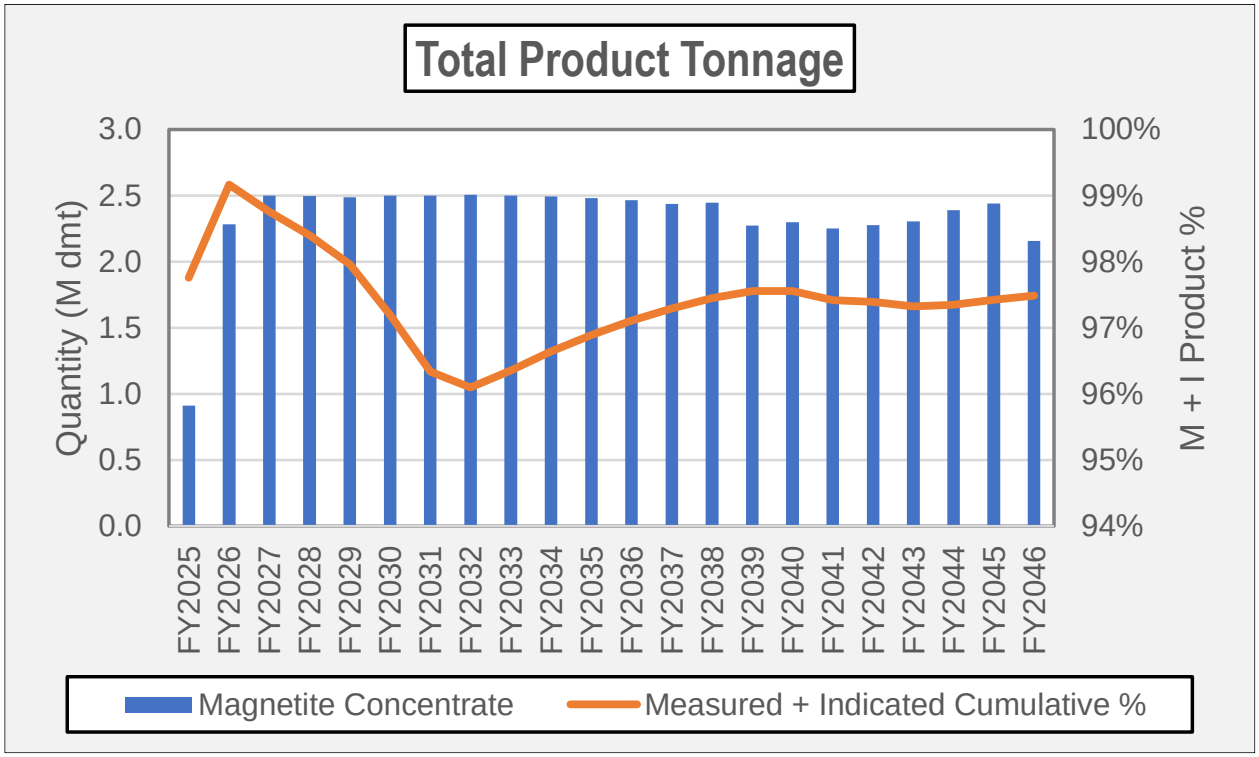
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4.12 Marketing and Product Schedule

To estimate Ore Reserves, MEP1 is considered to have magnetite concentrate as its product. This concentrate will be produced as a traditional blast furnace grade concentrate, or a higher quality direct reduction concentrate once the flotation plant is operational.

MEP1 will increase magnetite concentrate production from 2.2 Mtpa to 2.5 Mtpa, at a higher quality than currently produced. The annual product made is presented in **Figure 4-10**. It also indicates well over 90% of the product is classified as either Measured or Indicated.

Figure 4-10 Annual Product for MII Schedule



MEP1 has identified the primary target market based on the grades of concentrate it plans to produce as direct reduction iron (DRI) pellet makers: DRI pellets are a critical input for Direct Reduction Plants (DRP) which supply Hot Direct Reduction Iron (HDRI) to electric arc furnaces and are a key emerging market for those looking to reduce their carbon footprint.

The MEP1 project, with its focus on upgrading and expanding the South Middleback Range (SMR) concentrator's capabilities, both rate and grade is linked to the broader strategy of transition to green iron and green steel. Where the proven hybrid circuit of using direct reduction pellets (DRP) in an electric arc furnace (EAF) is replacing the traditional blast furnace – coke ovens route. The objective of decarbonisation of steelmaking is creating a market where producers are increasingly seeking high grade ferrous feed to support their decarbonisation strategies. MEP1 has the capability to be agile in the marketplace to deliver a high-grade direct reduced (DR) concentrate which enables a decarbonisation route.

The demand for DR grade concentrate is driven by the global direct reduced iron (DRI) /hot briquetted iron (HB)I demand and is expected to continue by demand in the Middle East and India. Other key regions include the European Union where EAF-H2DRI is being pursued as a solution for decarbonisation of the steel industry.

SIMEC engaged Fastmarkets Pty Limited (Fastmarkets) to complete a study on the proposed product to increase confidence in both the market acceptance and pricing of the concentrate. The Fastmarkets report is provided in **Appendix F**. The typical concentrate specifications are set out in **Table 4-9**.

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Table 4-9 Typical Concentrate Specifications

DR Mag. Conc.	Weighted Average
Concentrate mass (000' dmt per quarter)	625
Fe %	70.45
SiO_2 %	1.80
Al_2O_3 %	0.09
P %	0.01

In summary, Fastmarkets considers the proposed product to be of very high iron content, with low impurities of alumina, silica, and phosphorus. It also benefits from being close to green steel markets with increasing demand for high-grade and potential premium products. It can benefit from possible supply shortages of pellet feeds and associated product premiums. Fastmarkets suggested that the production of pellets may reduce some of these risk factors associated with concentrate.

4.13 Environmental and Social

SIMEC Mining has effective and mature management plans and procedures to meet its environmental obligations under relevant legislation and the terms and conditions of its existing tenements and development approvals. Systems, processes and management plans are reviewed and updated to support the project and in accordance with an ISO14001-certified environmental management system (EMS).

The project will be subject to a range of regulatory approvals under various South Australian and Commonwealth legislation, including the *Mining Act 1971* (SA), *National Parks and Wildlife Act 1972* (SA), *Environment Protection Act 1993* (SA) and the, the *Whyalla Steelworks Act 1958* (SA).

Environmental studies to support the regulatory approvals applications are advanced as part of the PFS. Ecological work, including desktop flora/fauna assessments and targeted field assessments, has been undertaken and provided useful data on vegetation types, conditions, and the potential presence of other threatened species, and in some contexts, provided project constraints. A groundwater impact assessment has commenced and will be updated once results from the upcoming groundwater investigation drilling programme and associated numerical modelling are available.

Baseline studies in noise, air quality, hydrogeology, geochemistry and visual amenity have commenced and are ongoing. Other studies that have commenced include traffic and transport and social. All studies will cover the expanded project footprint.

Cultural heritage surveys with the Traditional Owners of the land, the Barngarla People, have been undertaken over the project footprint. Further survey works and ongoing engagement will likely be required prior to development.

The SIMEC team, guided by specialist engagement professionals, has engaged with stakeholders over the past 24 months, including directly affected landholders, surrounding landholders, Traditional Owners and government agencies. The Stakeholder Engagement Plan for the project consists of a list of all stakeholders, the engagement approach for each stakeholder group, an engagement and communication action plan, and a method of receiving and utilising feedback in project design.

SIMEC has considered closure requirements for MEP1, and these include:

- Post-mining land use and closure objectives.
  - The proposed post-mining land use objective is to return the mined areas to a self-sustaining native ecosystem, compatible with low intensity grazing in the east. Closure objectives have been previously identified for post-closure safety, physical and chemical stability, ecological function and amenity. Detailed relinquishment criteria remain to be developed.
- Closure implementation strategies.
  - Post-closure landform designs were developed with consideration to all of the above. Given the scale of the proposed waste rock landforms and the proximity to the Lincoln Highway, an

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aesthetically pleasing closure landform was of high importance. A concave profile has been adopted for the lower levels of the landform. This will enable the landform to blend with the surrounding environment more effectively and contribute to a greater resistance to erosion.

- Progressive Rehabilitation.
  - A progressive rehabilitation strategy was developed based on the mine schedule. This is a continuation of current practice at the site
- Monitoring requirements.
  - Rehabilitation and closure monitoring programmes are proposed to facilitate the success of rehabilitation works, demonstrating achievement of completion criteria and identifying the need for potential maintenance works. Monitoring aspects include compliance with engineering designs, physical and chemical stability, ecological function, impacts on final land use objectives and the potential requirement for maintenance or remedial work.
- Financial provisioning for closure.

4.14 Infrastructure

SIMEC Mining engaged Wood Australia Pty Ltd (Wood) to complete the aspects of this feasibility study, including the engineering design and costing of infrastructure, including the process plant and associated facilities and the provision of services.

The proposed development will require plant upgrades/additions at the SMR fixed plant location. The proposed new infrastructure includes a DLIMS plant to remove non-magnetic feed material before the concentrator, de-bottlenecking to allow higher material flows through the MEP1 concentrator, and a flotation plant to remove silica from the final product for improved DR grade concentrate final product.

SIMEC's concentrator production will incorporate an existing 2.2 Mtpa magnetite concentrator (MEP1) at the site. The upgrades to MEP1 will expand plant capacity to 2.5 Mtpa.

Existing maintenance workshop facilities will be utilised, and process water storage will be moved from Duchess South to Duchess North. The stored water will augment the water supply during the summer months. No changes are needed or planned for the water supply system.

An upgrade to the power services is proposed, including a second 132 kV/11 kV 25 MVA transformer, an additional switch room, and additional cables buried in conduits. The original 132 kV overhead transmission line will feed both the existing and new transformers.

4.15 Capital and Operating Costs

The capital and operating costs estimated in the FS targets an accuracy equivalent of Class 3 as defined by the Association for the Advancement of Cost Engineering (AACE). This included quotations for major infrastructure and mining costs from mining contractors. **Table 4-10** sets out the MEP1 capital cost estimate over the life of the project.

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Table 4-10 Capital Cost Estimate

Capital cost element	Estimated cost (M AUD)	Percentage summary (%)
Growth		
Mining owner operator	24.11	3.5
PPE DLIMS	51.28	7.4
PPE Concentrator - Auxiliary plant	59.92	8.6
PPE Flotation	73.35	10.5
PPE Flux Plant	-	0.0
PPE Filter Plant	9.40	1.4
PPE Pellet Plant	-	0.0
Process Plant Power & IT	26.01	3.7
Other (Owner's Team Costs)	32.22	4.6
Total Growth	**276.29**	39.7
Sustaining Capital		
Mining owner operator	11.57	1.7
Other (Owner's Team Costs)	0.29	0.0
PPE DLIMS	17.87	2.6
PPE Concentrator	132.42	19.0
PPE Flotation	26.07	3.7
TSF 9	36.29	5.2
Iron Knight Tails	57.73	8.3
Iron Duke Dry Stack Tailings	38.48	5.5
OSM reimbursement	16.30	2.3
Total Sustaining Capital	**337.03**	**48.4**
Closure		
Closure Costs	82.89	11.9
Total Closure	**82.89**	**11.9**
Total Capital Costs	**696.20**	**100**

The operating costs estimated for the MEP 1 Project are set out in **Table 4-11**. These have been completed to a Feasibility Study level of accuracy.

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Table 4-11 Cost of Production per Unit of Saleable Product

Item	AUD/dmt product	USD/dmt product
Mining	28.64	20.05
Crushing & Screening	2.99	2.09
Ore Beneficiation	8.34	5.84
DLIMS	6.12	4.28
Concentrator	35.96	25.17
Flotation	5.78	4.05
Filter Plant	5.60	3.92
Direct Cash Costs	93.42	65.39
Transhipping	9.41	6.59
Site G&A	8.03	5.62
FOB Cash Costs	110.86	77.60
Sea Freight	19.67	13.77
C1 Direct Cash Costs	130.53	91.37
Head Office G&A	2.00	1.40
Royalties	10.06	7.04
Total Cash Costs	**142.59**	**99.81**

4.16 Revenue

The Project produces a magnetite concentrate product. The long-term product pricing assumptions in that SIMEC financial model are provided in **Table 4-12** for the magnetite concentrate.

Table 4-12 SIMEC Magnetite Pricing Assumptions

Year	Iron ore sinter fines, Fe-62% USD/dry metric tonne (dmt)	Iron ore fines Fe-65% USD/dry metric tonne (dmt)	Iron ore fines Fe-67.5% USD/dry metric tonne (dmt)	67.5% premium over 62%
2025	106	114	134	126%
2026	105	113	132	126%
2027	104	112	131	126%
2028	92	109	122	132%
2029	95	112	126	132%
2030	97	116	130	134%
2031	99	119	134	135%
2032	101	122	137	135%
2033	104	125	142	136%
2034	106	128	145	137%
2035	110	133	151	137%
2040	96	122	139	145%
2045	84	112	134	159%
2050	65	102	130	200%

Fastmarkets was engaged by SIMEC for an independent estimate of pricing for the concentrate product, with the results summarised in **Table 4-13**.

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Table 4-13 Fastmarkets Consulting Marketing Magnetite Premium Conclusion

Year	Iron ore sinter fines, Fe-62% USD/dmt CFR China	Iron ore fines Fe-67.5% USD/dmt CFR China	SIMEC DR Conc 70.45% USD/dmt CFR China	SIMEC DR Conc over 62%	SIMEC DR Conc over 67.5%
2025	106	134	149	141%	111%
2026	105	132	148	141%	112%
2027	104	131	147	141%	112%
2028	92	122	138	150%	113%
2029	95	126	142	149%	113%
2030	97	130	146	151%	112%
2031	99	134	151	153%	113%
2032	101	137	155	154%	113%
2033	104	142	162	156%	114%
2034	106	145	166	157%	114%
2035	110	151	173	157%	115%
2040	96	139	160	167%	115%
2045	84	134	156	185%	116%
2050	65	130	154	237%	118%

RPM considered both the SIMEC pricing position and the Fastmarket outcomes and has run an alternative scenario with regard to Foreign Exchange (FX) rate (AUD/USD) and ore pricing in the SIMEC valuation model. RPM has also undertaken sensitivities to understand the impacts this alternative scenario has.

The FX rate (USD/AUD) and ore pricing for the preferred scenario and as applied in the financial model is provided in **Table 4-14**. The major input assumptions into this scenario are:

- FX Rate AUD/USD: **0.70**.
- Ore pricing based on Fastmarket iron ore pricing.
- The premium applied to the 70.45% Fe magnetite concentrate is 41% - 57% which is based on the conclusion of the market analysis by Fastmarket.

The basis for this premium is the FastMarkets report provided in **Appendix F**.

The average product selling price is USD154/dmt over the Project life. The price forecast is initially USD146 /dmt, increasing to a high of USD173 /dmt by 2035 before falling back to ~USD160/dmt by 2039.

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Table 4-14 FX and Ore Pricing Assumptions in Financial Model

Foreign Exchange Rate (FX)	USD/AUD	2026 0.7	2027 0.7	2028 0.7	2029 0.7	2030 0.7	2031 0.7	2032 0.7	2033 0.7	2034 0.7
Magnetite Conc Pricing										
Iron Ore Fines Base 67.5% Fines	US$/t dmt	132	131	122	126	130	134	137	142	145
Premium (Based on Fastmarket Report)	%	11%	11%	13%	13%	13%	13%	13%	14%	15%
Realised Price	**US$/t dmt**	**146**	**146**	**138**	**142**	**146**	**151**	**155**	**162**	**166**
Realised Price	**A$/t dmt**	209	209	197	203	209	216	222	232	238

Foreign Exchange Rate (FX)	USD/AUD	2035 0.7	2036 0.7	2037 0.7	2038 0.7	2039 0.7	2040 0.7	2041 0.7	2042 0.7	2043 0.7
Magnetite Conc Pricing										
Iron Ore Fines Base 67.5% Fines	US$/t dmt	151	154	147	146	143	139	133	127	138
Premium (Based on Fastmarket Report)	%	14%	12%	13%	13%	14%	15%	16%	17%	16%
Realised Price	**US$/t dmt**	**173**	**173**	**167**	**166**	**163**	**160**	**154**	**148**	**159**
Realised Price	A$/t dmt	247	247	238	237	233	228	220	211	228

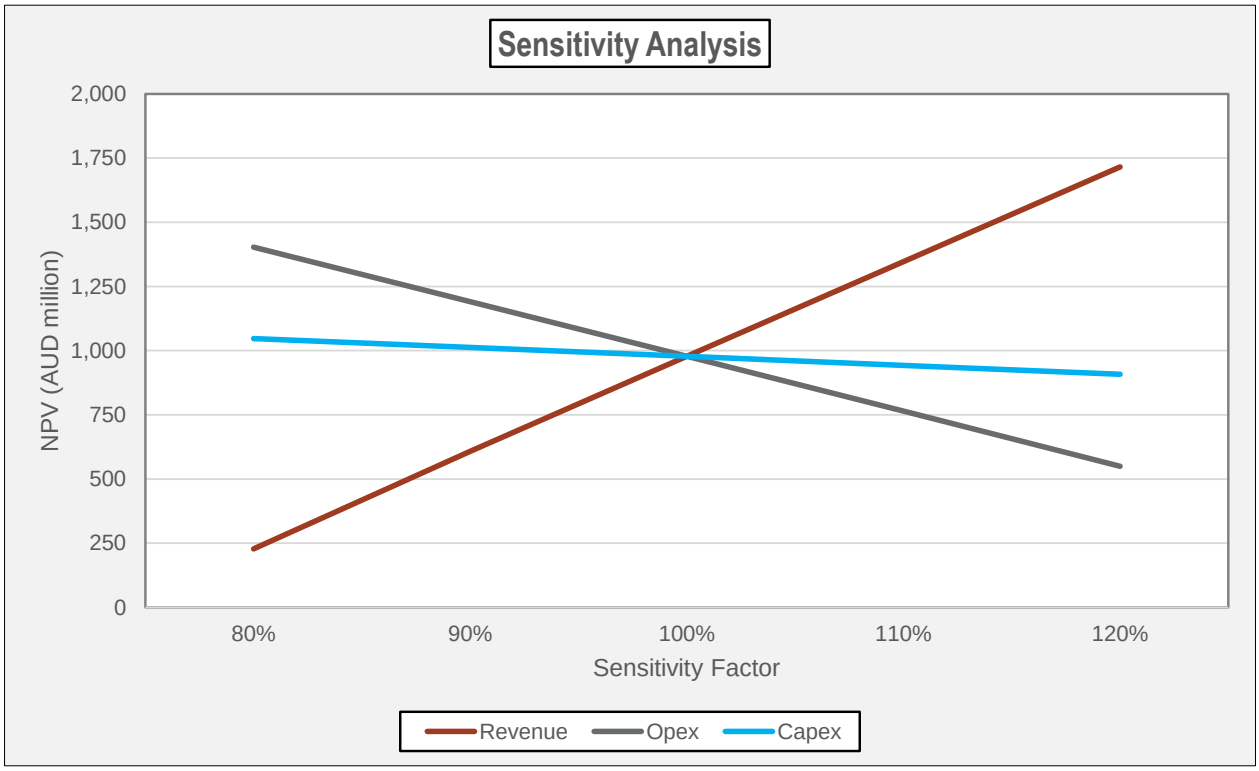
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4.17 Economic Assessment

SIMEC has prepared a detailed financial model for the purposes of assessing the economic potential and key drivers of MEP1. The economic assessment with the capital and operating costs as set out in **Section 4.15** and the application of the SIMEC revenue drivers presented in **Section 4.16** indicates that the MEP1 project has a net present value (NPV) at a discount rate of 7.3% of over AUD 900 million.

The Project is most sensitive to changes in revenue drivers such as iron ore price or foreign exchange rates as illustrated in **Figure 4-11**. As MEP 1 is a "lower" cost capital expenditure option as it primarily involves a modification to the existing plant rather than a new build, it is more sensitive to changes in operating cost than capital. Of importance, the analysis indicates that at a range of +/-20%, the NPV@7.3% remains positive for all key drivers.

Figure 4-11 MEP1 Sensitivity Analysis



The average product selling price has to decline by 25% (to USD 116 /dmt average for the LOM) before the NPV is reduced to zero at a real discount rate of 7.3%. This indicates that the Project is reasonably robust to changes in economic factors.

4.18 Other Relevant Factors

The estimate of Ore Reserves for the MEP1 Project is not, to RPM's knowledge, materially affected by any other known environmental, permitting, legal, title, taxation, socio-economic, marketing, political or other relevant factors other than that described in the preceding text. It is believed that the classification of Ore Reserves, as set out in this report, is reasonable.

A consideration in the assessment of the Ore Reserves is that the Project is sensitive to economic and cost factors as discussed in **Section 4.17**. The economic sensitivity analysis concluded that though there is some risk, the Project is reasonably robust with a 25% fall in iron ore pricing for a breakeven NPV@7.3%.

Outside of the economic risk, the FS report notes that the higher risk items for the Project are:

- Delays in the construction of Tailings Storage Facilities (TSF) will impact the ability for the concentrator to operate at its maximum capacity.

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  - Current control includes a TSF raise schedule.
  - Proposed mitigation includes raising a separate Tailings Master Plan which will identify critical timings for TSF construction/upgrades.
- Delays in the delivery of regulatory approvals will affect the ability for MEP1 to operate as planned.
  - Current control includes Indigenous Land Use Agreement (ILUA), heritage surveys and EPBC submissions.
  - Proposed mitigation includes a detailed permitting strategy and early funding for approvals
- Delays in the delivery of critical process plant equipment to support the expansion.
  - Procurement contract strategy to reduce risk.
- Failure to deliver planned process debottlenecking upgrades will impact SIMEC's ability to deliver the volumes of magnetite concentrate predicted in the mine plan.
  - Current control includes a resourcing study
  - Proposed mitigation includes test work to understand the improvement gained from any process upgrades.
- Non-acceptance of geochemistry work by regulators will cause delays in approval to expand mine pit outside of existing approvals and to construct waste rock dumps with PAF cells.
  - Current controls include a geochemical assessment with a focus on Acid Metalliferous Drainage (AMD).
  - Proposed mitigation includes a review of the actions identified in the geochemical assessment with a focus on ensuring that actions align with the proposed waste rock dump design.

SIMEC consider all of the above project risks to be manageable and are considering strategies to mitigate risk.

4.19 Classification

Ore Reserves are classified based on the underlying Mineral Resources classifications and the level of detail in the mine planning. Mineral Resources are classified as Measured, Indicated and Inferred. Ore Reserves are based only on the Measured and Indicated Resources and are classified as Proven and Probable Ore Reserves, respectively.

The Duchess South iron ore deposit contains Measured, Indicated and Inferred Resources. The Ore Reserve is classified as Proved and Probable in accordance with the JORC Code, corresponding to the Measured and Indicated Mineral Resource classification and considering other factors where relevant. The deposit's geological model is well constrained. The Ore Reserve classification is considered appropriate given the nature of the deposit, the moderate grade variability, drilling density, structural complexity and mining history. Therefore, it was deemed appropriate to use Measured and Indicated Mineral Resources as a basis for Proved and Probable Reserves.

Inferred Mineral Resources were not included in the Ore Reserve estimate.

4.20 Audits and Reviews

The JORC Code provides guidelines that set out minimum standards, recommendations, and guidelines for the Public Reporting of exploration results, Mineral Resources, and Ore Reserves. Within the code is a "Checklist of Assessment and Reporting Criteria" (Table 1 - JORC Code). This checklist has been used as a systematic method to undertake a review of the underlying Study used to report in accordance with the JORC Code.

Section 1 – 3 of Table 1 was completed as part of the JORC Mineral Resource Statement. This has been attached to this report (**Appendix B**) for reference and was completed by Mr Colin Badenhorst, who is a full-time employee of SIMEC. Section 4 of Table 1 pertains to the Reserves estimate and can be seen in **Appendix C**.

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The process and inputs for the Reserves estimate have been subject to internal peer review by RPM staff. The current estimate has also been reconciled against the previous estimate to ensure internal consistency and to confirm the impacts of subsequent mining or changes to the mine plan.

4.21 Ore Reserve Estimate

A total of 145.5 Mt of magnetite Ore Reserves were estimated as of 1 July 2024 and are as set out in **Table 4-15**.

Table 4-15 Iron Duchess South Magnetite Ore Reserve as of 1 July 2024

Ore Reserve Classification	Tonnage (Mt)	Mass Rec (%)	Fe (%)	SiO_2 (%)	Fe_P (%)	SiO_2_P (%)
Proved	116.1	37.5	31.4	48.7	65.2	8.9
Probable	29.3	28.3	28.2	50.2	64.9	8.9
Total	**145.5**	**35.6**	**30.8**	**49.0**	**65.2**	**8.9**

Notes:

1) *Based on information provided up to 1 July 2024.*
2) *For the purposes of Ore Reserve estimation, MEP1 is defined as portion of the deposit to be extracted for the purposes of the MEP1 development. MEP1 excludes the existing Iron Magnet Pit with the exclusion surface being the MAG-E Cutback Design.*
3) *Reserves are based on Mineral Resource estimates as of 1 July 2023.*
4) *The cut-off grade for magnetite is variable as it is a function of blending different ore types to meet the plant specifications. The actual application of cut-off grade and the resulting processable quantities can only be known following detailed scheduling.*
5) *Economic mining area and ultimate pit design have been validated against the FS costs, modifying factors, and Consensus long term pricing.*
6) *Inferred Mineral Resource is considered as waste for pit limit optimisation purposes and excluded from the Ore Reserve estimate.*
7) *Ore Reserve estimates are not precise calculations, being dependent on the interpretation of limited information on the location, shape and continuity of the occurrence and the available sampling results. The quantities contained in the above table have been rounded to reflect the relative uncertainty of the estimate. Rounding may cause values in the table to appear to have computational errors.*
8) *All Ore Reserve tonnage and quality estimates are on a dry moisture basis.*
9) *The Fe_P and SiO_2_P qualities are reported on post-concentrator / pre flotation basis..*

The reporting of post-concentrator grades is based on the Grind Liberation - Davis Tube recovery testwork and is coded to the block model to support feasibility study planning. The product targets grades following flotation are an Fe grade of 70.45% and a silica grade of 1.8%.

4.21.1Key Changes from Previous Ore Reserves Statement

No previous Ore Reserves have been reported for the Iron Duchess South Project in relation to the MEP 1 development. As the MEP 1 development overlaps with the Iron Magnet Pit, **Appendix D** provides the Ore Reserve Statement for the Iron Magnet Pit to support the discussion.

4.21.2 Reconciliation Between Resource and Reserve

The MEP 1 Project mines negligible quantities of hematite ore. The Ore Reserve estimate is only for the magnetite ore. The following discussion reconciles the magnetite Mineral Resource estimate and the Ore Reserve. In comparing quantities, the conversion from an in situ resource model to a mining model results in a very minor increase to the magnetite increases of 2%. This difference is assumed to be immaterial within the accuracy of this reconciliation.

The magnetite Mineral Resource estimate is defined within a resource shell as of 1 July 2023. The mine planning quantities are defined within a detailed ultimate pit design, assuming a start date of 1 February 2025. The change in the Mineral Resource from the current estimate to within the ultimate pit design as of 1 February 2025 is set out in **Table 4-16**. Estimating the Mineral Resources within the ultimate pit design reduces the total estimate to 170 Mt. Depleting to 1 February 2025 reduces this further to 167 Mt, including 6 Mt designated as stockpile.

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Table 4-16 Change in Mineral Resource to In-Pit Quantities as at 1 January 2025

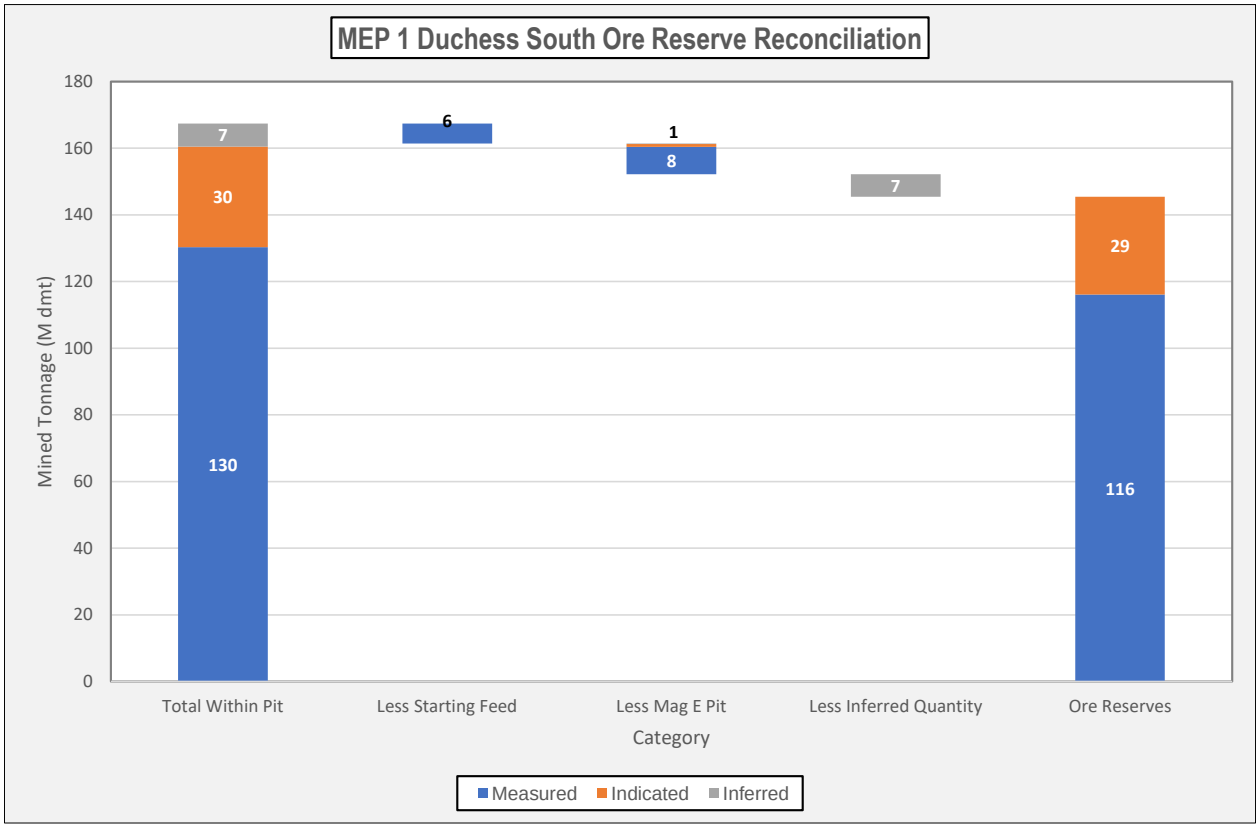
Resource Classification	Resource Shell 1 July 2023	Ultimate Pit Design 1 July 2023	Potential Plant Feed 1 February 2025
Measured	253.0	130.5	130.4
Indicated	245.0	32.2	30.2
Inferred	175.0	7.6	6.9
Total	**673.0**	**170.3**	**167.4**

The 167 Mt of potential plant feed is further modified to meet the requirements for Ore Reserves. To meet the requirements for MEP 1, the following conditions must be met:

- Ore restricted to Measured and Indicated Resource categories only;
- Only includes quantities in the MEP 1 Duchess South mining area, excluding all material associated with Iron Magnet MAG-E; and
- Only includes material of suitable specification to be processed through the process plant.

A detailed reconciliation has been completed between the total potential feed quantities scheduled (167.4 Mt) and the estimated Ore Reserves (145.5 Mt), as illustrated in the waterfall chart in **Figure 4-12**.

Figure 4-12 Reconciliation Between Scheduled Tonnage v Ore Reserve



Additional notes to the above figure are:

- The total “Mineable quantity” of potential plant feed is 167 Mt, comprising 130.Mt of Measured, 30 Mt of Indicated, and 7 Mt of Inferred resources.
- As of 1 February 2025, the remaining quantities associated with the Iron Magnet pit are estimated to be 6 Mt of stockpile and 9 Mt from its final mining stage, MAG-E.
- The potential feed quantity associated with DCS is 152 Mt, (167 Mt less 15 Mt associated with the Stockpiles and MAG-E).

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- Subtracting Inferred Resources of 7 Mt, results in the final Ore Reserve estimate of 145 Mt, comprising 116 Mt of Proved (formerly Measured Resources) and 29 Mt of Probable (formerly Indicated Resources) Reserve.
- No potential plant feed was rejected based on its specification. The scheduling strategy enabled all potential feed to be directed to the plant.

4.21.3 Relative Accuracy and Confidence

A number of checks have been completed to validate the Ore Reserve estimate. The reported Ore Reserves have been estimated by the results of the Life-Of-Mine schedule completed in RPM's Open Pit Metals Solution (OPMS) software. The broad quantities and resource classifications were also checked using Geovia Surpac mine planning software. The checks indicated a good correlation between the quantity of ore mined from the OPMS schedule and the ore reported within the same pit shells from Geovia Surpac.

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5. Competent Person's Statement

The information in the report, to which this Statement is attached, that relates to the Statement of JORC Ore Reserves for MEP 1 Project, based on information compiled and reviewed by **Igor Bojanic**, who is a Fellow of the Australasian Institute of Mining and Metallurgy and is a full-time employee of RPM Advisory Services Pty Ltd (RPM).

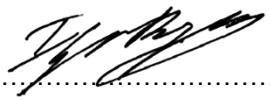
I, **Igor Bojanic**, confirm that I am the Competent Person for the Ore Reserve stated in this Report and:

- I have read and understood the requirements of the 2012 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code, 2012 Edition);
- The estimates of Ore Reserves presented in this Report have been carried out in accordance with the "Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves" (2012);
- I am a Competent Person as defined by the JORC Code 2012 Edition, having over 10 years' experience that is relevant to the style of mineralisation and type of deposit described in the Report, and to the activities which have been undertaken in the preparation of this report;
- I am a Fellow of The Australasian Institute of Mining and Metallurgy; and
- I have reviewed the Report to which this Consent statement applies.

I confirm I am a full-time employee of RPM Advisory Services Pty Ltd, which has been engaged by OneSteel Manufacturing Pty Ltd to prepare an independent estimate (hereafter referred to as the "Statement") of the Ore Reserves of the Duchess South Magnetite Deposit.

I am not aware of any potential for a conflict of interest in relation to this work for the Client. I have no interest whatsoever in the mining assets reviewed and will gain no reward for the provision of this Ore Reserve Statement. RPM will receive a professional fee for the preparation of this Statement. Accordingly, I have disclosed to the reporting company the full nature of the relationship between myself and the Client, including any issue that could be perceived by investors as a conflict of interest.

I verify that the Report is based on and fairly and accurately reflects in the form and context in which it appears, the information in my supporting documentation relating to the Ore Reserves.

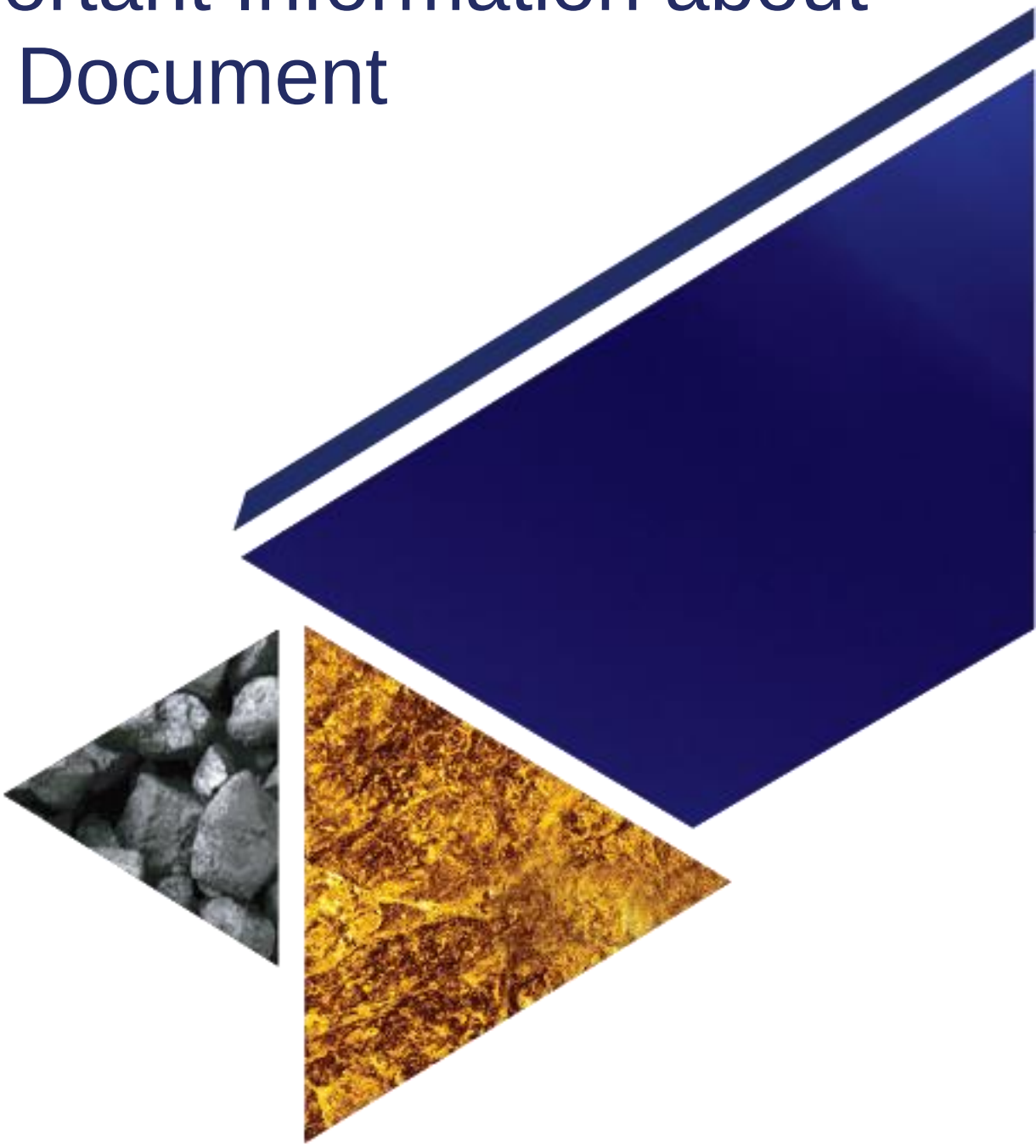


……

Igor Bojanic, CP Credentials BE (Min)(Hons) FAusIMM.

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Appendix A.
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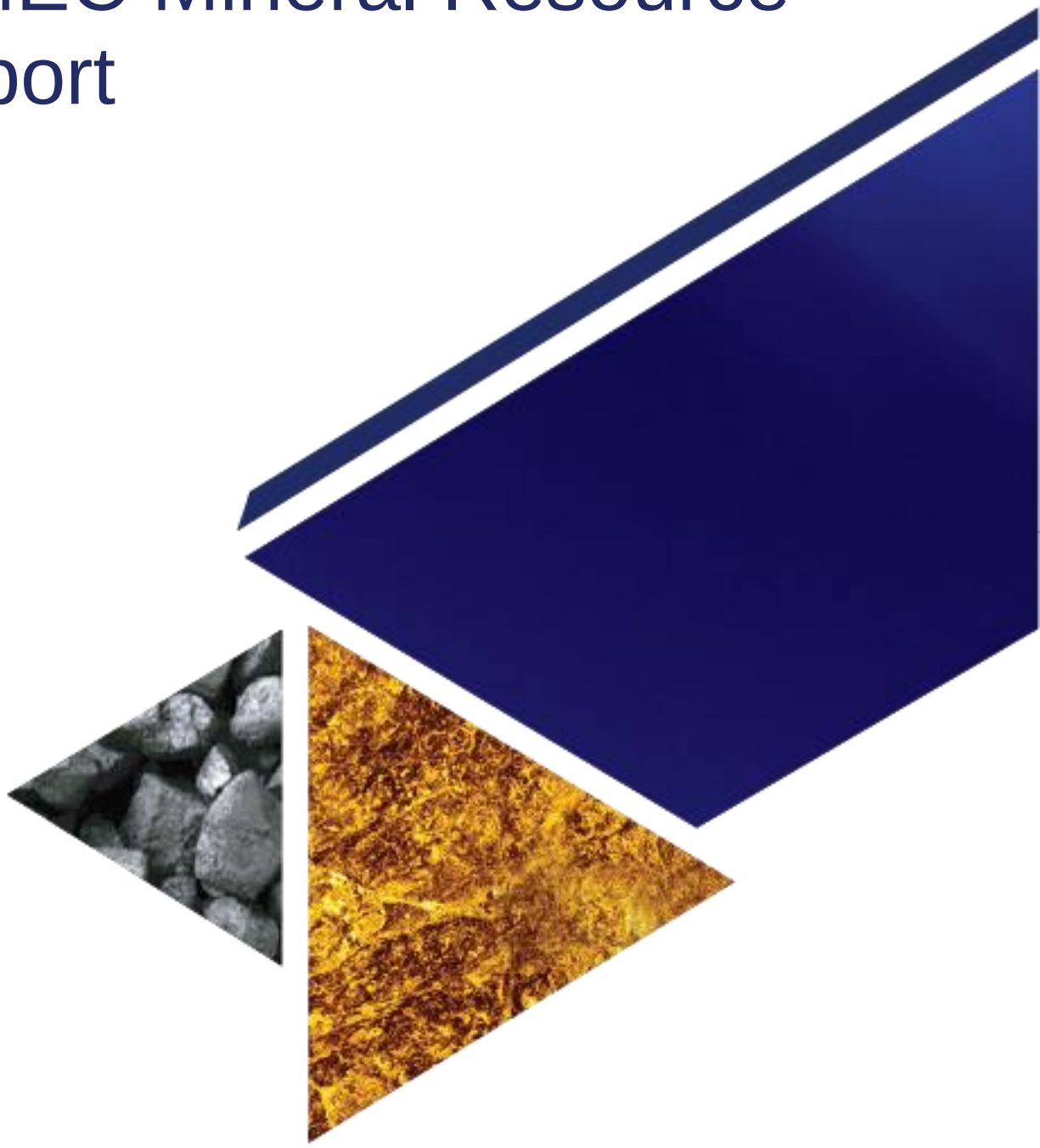
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Appendix B.
SIMEC Mineral Resource Report



SIMEC

MEMBER OF GFG ALLIANCE



DUCHESS SOUTH MINERAL RESOURCE NOVEMBER 2023

Document Control

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Summary

An updated mineral resource and accompanying uncertainty model has been completed for the Southern Middleback Range haematite and magnetite mineralisation in an area encompassing the Duchess Haematite, Iron Duke, Iron Magnet, and Duchess South Magnetite deposits.

The resource model incorporates 2,185 drill holes totalling 307.5km, and the uncertainty model incorporates 2,130 drill holes totalling 292.7km. The most recent drilling was undertaken between October 2018 and December 2022 totalling 81.3km for 387 drill holes.

Multi-element XRF assay results for Fe, SiO_2, Al_2O_3, P, CaO, Cu, Pb, Ba, V, MgO, Mn, S, TiO_2, Na_2O, Zn, LOI and K_2O, and their concentrate equivalent after Davis Tub Recovery magnetic separation, and density, have been estimated using Ordinary Kriging into a model of interpreted litho-geochemical domains. Conditional simulation using the same data and domains was used to construct an uncertainty model for the resource estimate. The sample assays used in both models are fully verified and validated using industry standard QAQC processes.

The resource model estimate has been classified into Measured, Indicated, and Inferred categories, the assessment of which is informed by geological continuity, drill hole spacing, estimation quality, bulk density determination, and expected variation outcomes from the uncertainty model.

The mineral resource statement for the haematite and magnetite resources are summarised in Table 1 and Table 2. The relative confidence in the magnetite resource estimate is summarised in Table 3.

Table 1 – Duchess South Haematite Mineral Resource as of 1 July 2023.

Resource Classification	Tonnes mt	Fe %	SiO_2 %	Al_2O_3 %	LOI %	P %	Density t/m³
Measured	2.4	56.80	6.31	1.19	4.97	0.08	3.59
Indicated	6.9	56.12	7.72	1.47	4.21	0.09	3.55
Inferred	8.9	56.17	8.48	1.33	3.14	0.09	3.63
Total	**18.2**	**56.23**	**7.90**	**1.36**	**3.79**	**0.09**	**3.59**

Cut-off: Fe_H > 47% and SiO_2_H < 50%, inside optimised Whittle Shell 57 2023, below 1 July 2023 mining surface, south of Y19,800N. Tonnages rounded to nearest hundred thousand.

Table 2 – Duchess South Magnetite Mineral Resource as of 1 July 2023.

Resource Classification	Tonnes mt	Mass Rec %	Fe_C %	Fe_H %	SiO_2_C %	SiO_2_H %	Density t/m³
Measured	253	36.86	64.33	32.92	8.84	41.33	3.49
Indicated	245	31.97	64.03	30.42	9.00	45.00	3.43
Inferred	175	25.89	64.84	28.49	7.99	48.23	3.40
Total	**673**	**32.23**	**64.35**	**30.86**	**8.68**	**44.46**	**3.44**

Cut-off: Mass recovery > 15% and Fe_H > 15% and SiO2_H < 70% and SiO2_C < 30%, inside optimised Whittle Shell 57 2023, below 1 July 2023 mining surface. Tonnages rounded to nearest million.

Table 3 – Expected Annual Variation for Duchess South Magnetite Mineral Resource at a 90% confidence interval.

Classification	Tonnes mt	Mass Rec %	Fe_C %	Fe_H %	SiO_2_C %	SiO_2_H %
Measured *	± 1.2 - 2.1%	± 2.0%	± 0.1%	± 0.5%	± 2.5%	± 1.3%
Indicated	± 2.1 - 5.1%	± 0.8%	± 0.2%	± 0.6%	± 1.6%	± 1.0%
Inferred	± 8 - 10%	± 2.6%	± 0.6%	± 1.3%	± 3.9%	± 1.4%

Note: Uncertainty modelled based on data for the May 2023 estimate.

1 Introduction

Following the 2022 Duchess South mineral resource estimate, an updated mineral resource model was undertaken to account for a re-interpretation of the geology due to an improved understanding gained from additional infill drilling carried out between 21 January 2022 and 22 August 2023. This report details the outcomes and work completed, with the following broad outline:

- Review and validation of the geological interpretation and litho-geochemical domaining.
- Verification and validation of drill hole information, including assay QAQC outcomes.
- Review and revision of pre-existing estimation procedures.
- Construction of a fit-for-purpose block model.
- Exploratory data analysis and statistical review of composited assays on a domain basis.
- Revision of the variography for all estimates and all domains.
- Estimation and validation of grade and bulk density.
- Conditional simulation of geology and key grade variables for uncertainty.
- Classification of mineral resource in accordance with guidelines set out in the JORC Code 2012 Edition.
- Selection of an optimal Whittle shell for consideration of reasonable prospects of eventual economic extraction.
- Tabulation of mineral resources.

All activities related to the data gathering, geological modelling, mineral resource estimate, conditional simulation, and related activities, were performed by SIMEC technical personnel and/or contractors.

Colin Badenhorst is the Competent Person for the mineral resource and is a current Member of the Australian Institute of Mining and Metallurgy (MAusIMM No. 225506) and a full-time employee of SIMEC. The Competent Person visited site from Monday 6 February to Tuesday 7 February 2023, and Monday 1 May to Tuesday 2 May 2023, to review the project, with particular focus on assay laboratory and QAQC practices, geology, infill drilling practices, and site operations. The Competent person has regularly visited the site each year since 2020.

2 Exploration and Mining History

2.1 Location

The Iron Magnet and Duchess South magnetite deposits are situated in the Southern Middleback Ranges in the north-eastern Eyre Peninsula, South Australia, approximately 53 km south-west of Whyalla (Figure 2.1).

The Duchess South magnetite deposit is the northern extension of the mineral resource currently exploited from the Iron Magnet Pit. These, and other iron ore deposits in the Middleback Ranges are fully owned and operated by SIMEC, with magnetite ore from the Iron Magnet Pit providing feed for SIMEC's blast furnace and steelmaking operations in Whyalla, whilst haematite is exported as direct shipping ore (DSO).

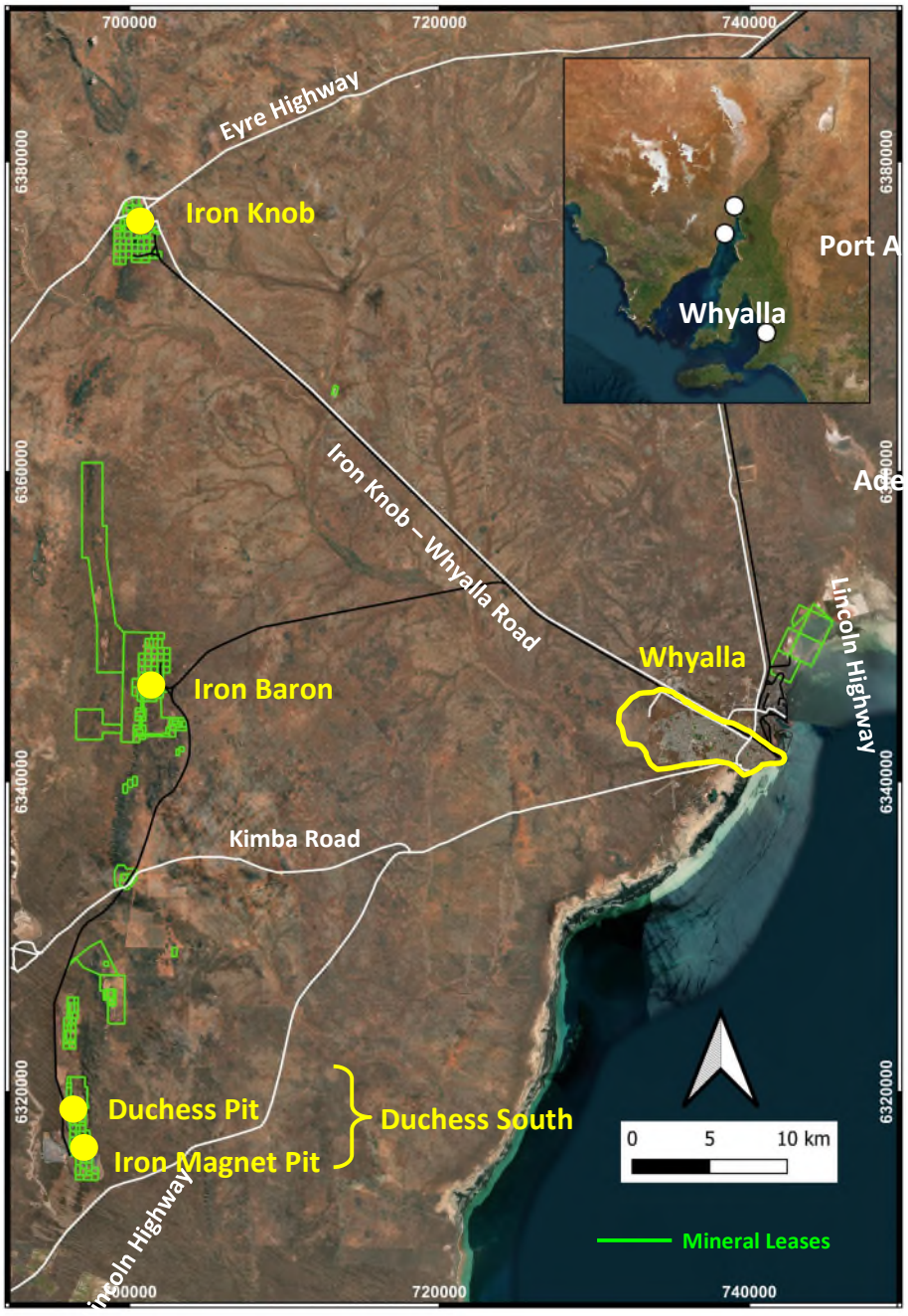


Figure 2.1 – Location of the Duchess South area, in relation to Whyalla, South Australia

2.2 Exploration and Drilling History

Exploration and resource drilling activities across the Iron Duchess Haematite, Iron Magnet and Duchess South magnetite areas have been undertaken in various targeted campaigns between 1958 to 2023 (Table 2.1). Drilling campaigns since 2005 have exclusively comprised of reverse circulation (RC) methods, with occasional diamond drilling for geotechnical and/or metallurgical investigation, and sonic drilling for surface waste rock dump investigations.

Table 2.1 – Summary of drilling campaigns over the Duchess South area

Years Drilled	Open Hole Percussion		Reverse Circulation		Diamond Core Drilling		Other Methods		Total	
	Holes	Metres	Holes	Metres	Holes	Metres	Holes	Metres	Holes	Metres
1958 1960	16	1,762	-	-	11	2,681	1	140	28	4,583
1961 1965	37	4,839	-	-	10	3,028	-	-	47	7,868
1966 1970	-	-	-	-	1	236	-	-	1	236
1971 1975	110	9,374	-	-	4	1,267	-	-	114	10,641
1976 1980	26	2,087	-	-	-	-	-	-	26	2,087
1981 1985	56	4,761	-	-	6	627	7	533	69	5,920
1986 1990	125	9,755	-	-	26	4,263	46	4,335	197	18,353
1991 1995	5	264	126	13,596	34	8,869	-	-	165	22,729
1996 2000	67	2,288	134	10,216	-	-	20	4,081	221	16,585
2001 2005	13	104	324	49,154	63	17,896	31	496	431	67,651
2006 2010	-	-	157	18,252	1	154	-	-	158	18,406
2011 2015	-	-	205	24,833	9	974	34	1,224	248	27,031
2016 2020	-	-	312	57,380	8	1,811	-	-	320	59,191
2021 2023	-	-	135	39,747	25	6,453	-	-	160	46,200
TOTAL	**455**	**35,233**	**1,393**	**213,178**	**198**	**48,259**	**139**	**10,809**	**2,185**	**307,480**
%	**21**	**11**	**64**	**69**	**9**	**16**	**6**	**4**		

Note: Lengths rounded to nearest metre. Other Methods = early RC drilling variants, air core drilling, sonic drilling, and records where drilling type was not recorded.

2.3 Development History of the Haematite Mineral Resource

The Iron Duchess haematite resource includes three key mining areas referred to as Duchess, Duchess South, and Iron Duke, covering a strike length of approximately 4 km. Together with the Iron Magnet Pit, the area is collectively referred to as the Southern Middleback Ranges operations, but more recently is commonly referred to as just Duchess South. Haematite mining activities are currently focused on the Duchess Pit, with the Duchess South Pit and Iron Duke Pit now inactive after being mined out. Recent resource drilling was focused in and around the Duchess Pit, targeting the easterly-dipping extension of the haematite resource. The Duchess haematite mineral resource estimate has been regularly updated for new drilling information with updates in August 2018, July 2019, May 2020, April 2022, May 2023 and this most recent update (October 2023).

2.4 Development History of the Magnetite Mineral Resource

Previously, resource estimates have been completed separately for the haematite and magnetite mineralisation, with the focus on haematite mineralisation for DSO. An understanding of magnetite mineralisation had developed successively with the expansion of mining and development of the Iron Duke haematite resource, culminating in the first haematite/magnetite geological model in 2004, based on logging and litho-geochemical criteria, referred to as the Iron Duke / Iron Magnet mineral resource. This model incorporated five broad litho-chemical domains: haematite-magnetite, haematite-magnetite-carbonate, magnetite-silicate-silica-schist, magnetite-carbonate, and the basal sequence. The magnetite-type domains were further sub-domained for an initial mineral resource estimate in 2005. Subsequent updates to the mineral resource were performed in 2006, 2013, and 2019 building on the existing understanding and interpretation of the magnetite mineralisation. In late 2018 a significant and ongoing campaign of infill drilling was undertaken with specific focus on magnetite mineralisation, culminating in updates to the mineral resource in May 2020, April 2022, May 2023, and this most recent update (October 2023).

2.5 Mining Activity

2.5.1 Historical Mining

Historically haematite ore has been mined from Duchess South Pit and the southern and upper parts of the Iron Duke Pit, with mining of these completed between 2015 and 2017. The Iron Duke Pit was combined with the Magnet Pit in 2013. Additional smaller open pits and historical stockpiles and waste dumps are distributed to the north across the Middleback Ranges and have been predominantly mined for haematite. Significant historical pits include Iron Knight, Iron Chieftain, numerous pits in the Iron Baron area, and Iron Monarch and Iron Princess in the Iron Knob area.

2.5.2 Current Mining, Grade Control and Reconciliation

Current mining activities within the Duchess South area are focused on extraction of DSO haematite from the Duchess Pit haematite pit, and extraction of magnetite ore from the Iron Magnet Pit. Mineral resources are subject to SIMEC optimisation, scheduling, planning and grade control processes and activities. Grade control models incorporate closely spaced blasthole data. Ore is excavated using a contract miner operating conventional load and haul methods, with material mined to stockpiles prior to processing. Reconciliation between the reserve and mining is subject to periodic site review by the mine planning and operations teams and is considered appropriate for SIMEC purposes.

2.6 Current Mineral Resource Update

The current mineral resource update incorporates recent drilling results from an ongoing dedicated resource definition drilling program since the previous modelling data cut-off of 14 November 2022. This mineral resource update builds on increased geological knowledge and metallurgical understanding developed from the drilling, mining, and development of the Iron Magnet resource. Some of the salient features incorporated into this update include:

- An objective litho-geochemical geological model based on observations and experiences from the most recent drilling and mining activities.
- Linear estimation of variables on an independent basis, without the need for a service variable for the estimation of concentrate grades.
- Linear estimation of in-situ density.

- Linear estimation of acid production potential for acid forming waste rock in mine planning activities.
- Inclusion of an uncertainty model using conditional simulation techniques to provide objective criteria to inform the resource classification scheme.
- Use of a re-optimised Whittle shell for consideration of RPEEE using updated financial cost models and price protocols.

3 Geology

3.1 Regional Geology

Underlying central South Australia, the Gawler Craton is an extensive region of Archaean to Mesoproterozoic age crystalline basement bounded by faults to the west, northwest and northeast and by thick sedimentary basins of Neoproterozoic and Phanerozoic age to the east (Figure 3.1). The Torrens Hinge Zone defines the east and southeast boundary of the craton while the southern boundary extends to the edge of the continental shelf. The area has been affected by three orogenic events, the Sleafordian Orogeny (Late Archaean to earliest Proterozoic, 2,440 Ma), the Kimban Orogeny (Palaeoproterozoic, 1,850–1,700 Ma) and the Kararan Orogeny (Mesoproterozoic, 1,670–1,540 Ma).

During the Archaean, banded iron formation, chert, carbonate, calcsilicate, quartzite and aluminous metasediments of the Sleaford Complex and the Mulgathing Complex were laid down while igneous units (basalts, gabbros, granite and granodiorite) were emplaced. Metamorphism has resulted in orthogneisses, paragneisses and various meta-igneous units.

The Palaeoproterozoic Hutchison Group metasediments (1,950–1,850 Ma) unconformably overlie the Archaean sequence and are made up of chemical and clastic sediments and basic and acid volcanics. The key horizons are the Katunga Dolomite, the Lower Middleback Jaspilite, the Burrawing Amphibolite, the Cook Gap Schist, the Upper Middleback Jaspilite and the Yadnarie Schist. Metamorphism has affected the entire sequence. The overlying Wallaroo Group is also a sequence of marine shelf sediments. Other rocks include the granitoids of the Donington and Moody Suites, mafic dykes, and younger metamorphosed sediments and felsic volcanics.

The thick felsic sequence of Gawler Range Volcanics was the result of a large felsic volcanic province being emplaced in the Mesoproterozoic period. The lower horizon of dacite-rhyodacite-rhyolite, ignimbrites and other flows is interbedded with basaltic lavas while the upper horizon is made up of thick, sub-horizontal, porphyritic dacite sheets of ignimbritic origin. The extensive Hiltaba Suite dominated by felsic granite plutons is comagmatic with the Gawler Range Volcanics. The Corunna Conglomerate (which grades into finer sandstones and mudstones) unconformably overlies the Moonabie Formation and McGregor Volcanics and is intruded by dykes of the Gawler Range Volcanics. Spilsby Suite granites are the last known magmatic intrusion.

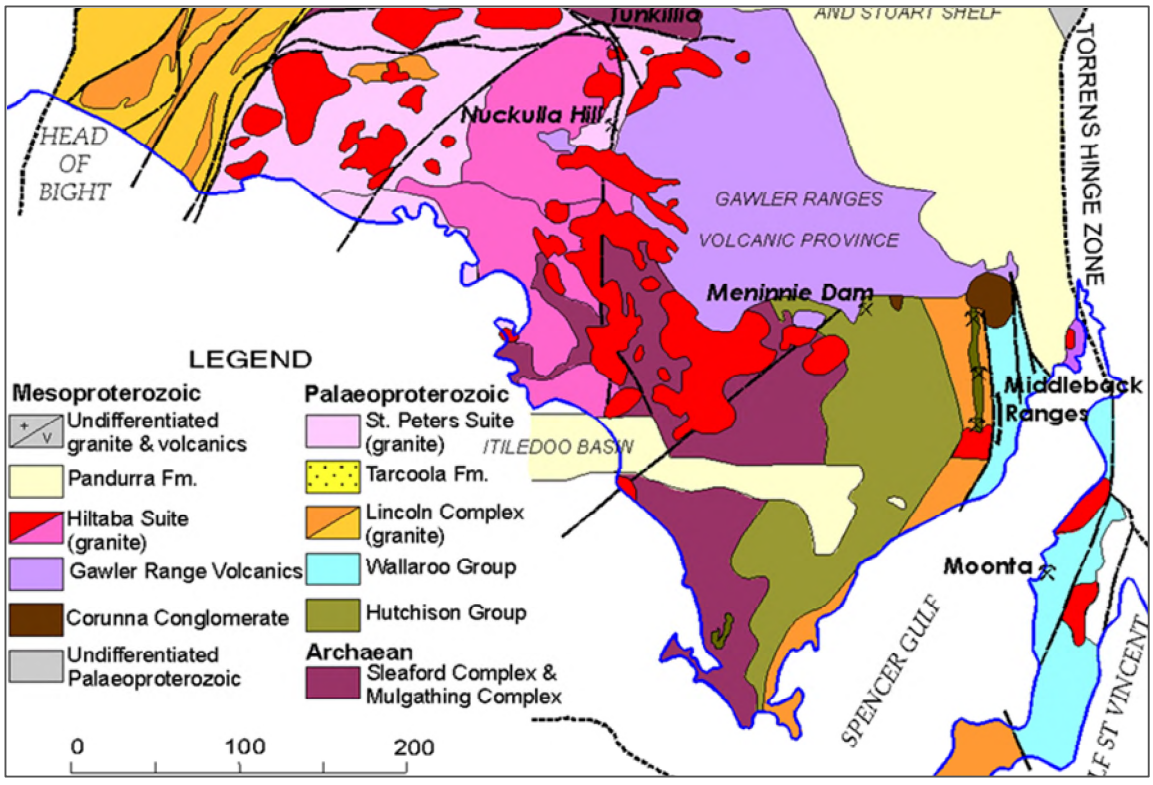


Figure 3.1 – Regional Geological Setting of the Middleback Ranges.

Lemon (1979) originally mapped and described the structure and stratigraphy of the eastern Eyre Peninsula, focusing particularly on the Middleback Ranges. Thirteen 1:10,000 mapping sheets compiled between 1975 and 1979 supported his report.

The litho-tectonic understanding of the district has remained essentially unchanged since then, although Bubner et al., (1998) stated that recent integrated interpretations (involving magnetics, drilling, mapping, and petrological data) have "revealed inconsistencies with the accepted interpretations". Recent work by RSG Global/Coffey Mining focussed on providing an updated structural and stratigraphic interpretation using recent geophysical data. This study highlighted a more detailed stratigraphy that, whilst historically recognised by BHP/SIMEC Mining in the southern areas, seemed to propagate throughout the Middleback Ranges, from Iron Duke in the south to Iron Knob in the north.

3.1.1 Stratigraphy

The Hutchison Group is the key stratigraphic unit and host of the Middleback Ranges iron mineralisation. Basement to the Hutchison Group is the Sleaford Gneiss Complex, although outcrop of this sequence in the Middleback Ranges is poor. Areas between Hutchison Group exposures are most probably Lincoln Complex granites, though exposure in these areas is poor (Painter 2007).

Parker and Lemon (1982) defined the stratigraphy of the Hutchison Group for the entire Eyre Peninsula. They invoked facies variations to account for the significant iron formations of the Middleback Ranges. The Hutchison Group stratigraphy in the Middleback Ranges comprised, from its stratigraphic base, the Warrow Quartzite, Katunga Dolomite, Lower Middleback Jaspilite, Cook Gap Schist, and the Upper Middleback Jaspilite. They further subdivided the Lower Middleback Jaspilite into four members: the Duke, Duchess, Knight and Long Gully members. These were limited to the South Middleback Ranges only, but RSG Global/Coffey Mining geophysical interpretations suggest that the lower 3 members can be identified throughout the entire range.

Other workers prefer to view the Upper Middleback Jaspilite as a structural repeat of the Lower Middleback Jaspilite, highlighting the similarities between the units. Yeates (1990) preferred this interpretation, citing unpublished data and implicitly preferring a faulted repeat. More convincingly, Vassallo and Wilson (2001) suggested that the Upper Middleback Jaspilite was a folded repeat of the Lower Middleback Jaspilite. Instead of a simple syncline (e.g. Parker and Lemon, 1982), they suggested that the South Middleback Ranges are a result of the interaction of an early large-scale sheath fold overprinted by an upright synform. Under these regimes, the Cook Gap Schist represents the uppermost unit of the Hutchison Group.

Later work by Szpunar et al (2011) suggested the Hutchison Group comprised three temporally and isotopically distinct groups divided by the Kalinjala Mylonite Zone (KMZ). According to Szpunar et al, the Middleback Group which lies to the east of the KMZ consists of Archean source rocks likely to have been deposited around c. 2500Ma. The Group is suggested to be of temporal equivalence to the Late Archean succession of the Gawler Craton and the Hamersley Group in the Pilbara Craton. The Darke Peak Group and the Cleve Group lie to the west of the zone. The Darke Peak Group is the older succession of the two, consisting of felsic volcanic rocks, quartzite, pelite and carbonate rocks possibly deposited around c. 1865Ma. Highly evolved intra-crustally reworked felsic rocks (c2500 Ma and c.2000Ma), associated with local basement complexes of the Late Archean to Early Proterozoic Gawler Craton, dominated the sources to the metasedimentary component of the Group. The volcanic unit in this Group was observed to bear the geochemical signature that marks the initiation of Paleoproterozic rifting. Disconformably overlying the Darke Peak Group is the Cleve Group with age of deposition between 1780Ma and 1730 Ma. The geochemical composition of the Group is consistent with felsic, upper crustal sources supporting Proterozoic assembly models.

Ongoing geochronology and geochemistry work by the Geological Survey of South Australia and others has further improved the understanding of separate intrusive and metamorphic events on the Gawler Craton, leading to formal abandonment of the term Lincoln Complex (Cowley et al 2017) and the definition of a new stratigraphy.

To the east of the Middleback Ranges, a younger series of felsic to intermediate volcanics and volcaniclastics including the Myola Volcanics (1792 Ma) and the Broadview Schist (1795 Ma) occur, separated from the Hutchinson Group and the surrounding basement gneisses by a series of major regional structures that may be related to the KMZ. The Myola Volcanics include felsic to intermediate volcanics and fine-grained quartz–feldspar–hornblende gneisses, while the Broadview Schist is a sequence of schist, amphibolite, and thin-bedded quartzite units. The overlying McGregor Volcanics (1754 Ma) consist of porphyritic to non-porphyritic rhyodacite and rhyolite with minor basalt and dacite with some inter-bedded volcaniclastic grit, which may be associated with the overlying volcaniclastic grits of the

Moonabie Formation (1750Ma). To the south, the volcano-sedimentary sequence is intruded by the Hiltaba Suite Charleston Granite (1585Ma), a massive phenocrystic granite with large pink potassium feldspar phenocrysts and green plagioclase. The area is also intruded by a series of other undifferentiated synorogenic Proterozoic granites.

The KMZ is a major crustal-scale feature and a prominent domain boundary in the Southern Gawler Craton, separating the Cleve Domain to the west from the Spencer Domain to the east. It occurs to the west of the Middleback Ranges but the prominent structural corridors to the east of the Middleback Ranges are believed to be related splays.

3.1.2 Deformation and Metamorphism

Historical work indicated the Middleback Ranges had undergone several deformation episodes and one major metamorphic event (e.g., Parker and Lemon, 1982; Yeates, 1990). The first three events were attributed to the Kimban Orogeny and are overprinted by the weak Watarkan Orogeny (D4), and include:

- D1 – layer parallel schistosity.
- D2 – E-W compression, tight to isoclinal folding coinciding with amphibolite facies metamorphism.
- D3 - E-W compression, open regional folding coinciding with upper greenschist facies retrograde metamorphism, and local mylonite development.
- D4 – N-S cross warping and NE and NW cross faulting (Watarkan Orogeny).

Vassallo and Wilson (2001) described two deformation events, their D1 of the same generation as Parker and Lemon's D1, and their D2 equivalent to a combination of Parker and Lemon's D2 and D3. A major difference was that the D1 event of Vassallo and Wilson (2001) involved extensive development of non-cylindrical folds throughout the region. As such, they considered it a major influence on outcrop patterns, whereas Parker and Lemon dismissed the deformation event as irrelevant. Vassallo and Wilson (2001) did not discuss the Watarkan event in detail.

Mylonite observed along some truncated Hutchison Group contacts, developed during D3. Post-D3 faulting recognised throughout the region has all been lumped into D4, though it is likely that there are several generations of faulting. For example, the available literature does not discuss the north-south-trending normal faults that are prominent features in the geophysics. Prior to 2011, there had been no dedicated structural geological study along the length of the Middleback Ranges. This is despite general acceptance that many of the larger iron deposits show a spatial, and potentially genetic, relationship with regional and mine-scale brittle and ductile structures.

In 2011, Arrium Mining engaged consulting structural geologist Brett Davis of Olinda Gold Pty Ltd to undertake a structural geological assessment of the Middleback Ranges (Davis 2011). Davis resolved a multistage structural history incorporating stages of brittle and ductile deformation. These structures include folds, cleavages, vein populations, fracture sets, ductile shear zones and faults. He interpreted relative ages based on structural style, orientation, associated metamorphic and hydrothermal minerals, and overprinting relationships.

The relative timing relationships between structures are consistent with a sequence comprising seven deformation events. The major events interpreted as important for the localisation and/or dislocation of iron orebodies are:

- D1: produced a planar fabric that is locally mylonitic and which involved north-to-south tectonic transport.
- D2: described as a separate event. It may represent a later higher-level, relatively more brittle manifestation of D1. Importantly, D2 involved accommodation of strain on lithological horizons and contacts.
- D3: a contractional event and the main fold-forming event. F3 folds are upright with steeply dipping, N-S striking, axial planes and axes that plunge at a low angle to the north and south. F3 folding has produced fold axes that are locally collinear with the mylonitic lineation, commonly making it difficult to resolve structures associated with each event.
- D4: represents an extensional event and produced recumbent folds at scales from centimetres to a few metres across. Pre-existing contractional structures were reactivated and accommodated extension.
- D6: characterised by the development of dominantly brittle structures, in particular the pervasive NW-SE faults. D6 far-field stress axes appear to have been similar in magnitude, resulting in the formation of structures at a variety of orientations that accommodated both contractional and extensional movements.

Davis considered the D5 and D7 events weak and unimportant in terms of ore deposit development. He had difficulty correlating the specific structural history from his study with those of previous workers, as his work suggested

historical misinterpretation of timing relationships. Both Davis and previous workers recognised two corresponding sets of structures that would appear to be best structural 'tie-lines' for correlation:

the event that produced N-S trending folds (Davis' D3); and

the event that produced the pervasive NW-SE faults (Davis' D6)

Davis interpreted regional-scale influences on the structural architecture of the Middleback Ranges to include:

- Early N-S trending faults.
- A population of NE-SW striking faults (largely unrecognised by previous workers).
- The presence of ovoid intrusions (largely undocumented by previous workers).
- E-W shortening that produced N-S trending folds.
- Pervasive NW-SE striking faults.
- The imposition of a far-field stress that varied in magnitude and orientation over time.

3.1.3 Igneous Activity

Intrusive rocks in the region have traditionally been grouped as post-Hutchison Group in origin and part of the ~1650-1680 Ma "Lincoln Complex", with the exception being the younger Charleston Granite to the south of the Middleback Ranges at 1585 Ma (Creaser & Fanning 1993). The recent comprehensive geochronological study of the region by Geoscience Australia and PIRSA (now DEM) shed new light on the geological history of the region and identified the Cooyerdoo Granite as Meso-Archaean in age at ~3150 Ma (Fraser & Neumann 2010). In addition to the felsic intrusive rocks, four distinct generations of dolerite dyke intrusion have been identified. Two of these are pre- to syn- Hutchison Group in age and are now amphibolitic. The stages are:

- Stage 1 Dykes are amphibolitised, parallel to bedding and folded by D2. Though some conformable amphibolites may have originally been shales, dolerites were preferentially intruded into the Duchess Member. This may have been a function of the development of a structural parting that allowed intrusion of the dykes subparallel to layering.
- Stage 2 Dykes are typically parallel to F2-F3 fold axes.
- Stage 3 Post-mineralisation dykes have not been amphibolitised.
- Stage 4 Late NW-SE Gairdner dyke swarm is prominent throughout the region.

3.1.4 Mineralisation

Major high-grade iron ore mineralisation appears to be primarily structurally controlled by crosscutting faults that may or may not contain intrusive dolerite, and occurs in synclinal structures. Internal dykes often control enrichment locally within major structures and influence formation of some minor deposits. SIMEC Mining has long recognised the preference of high-grade mineralisation for the lower-most Duke Member of the Lower Middleback Jaspilite. The work done by RSG Global/Coffey Mining in extending this stratigraphy throughout the Middleback Ranges has implications for the identification of further iron mineralisation in the region. Theses by Fietz (1989) and McKeown (1993) complement work by Ohmoto (2003) on redox reactions between magnetite and haematite.

The current preferred mineralisation model suggests that primary hydrothermal magnetite is altered to goethite, and subsequently to haematite in a second phase of burial, which includes metasomatic replacement and volume reduction (after Leevers et al, 2005). There is a strong association with the carbonate facies of the Lower Middleback Jaspilite, although the carbonate may be of metamorphic metasomatic origin rather than a sedimentary carbonate facies. The strongest consistent magnetite mineralisation coincides with the iron carbonate unit, and the haematite orebodies at the Iron Duke pit are interpreted to represent up-dip supergene enrichment of the same unit. Dalstra & Guedes (2004) regarded the iron mineralisation as hydrothermal, metasomatic sedimentary carbonate replacement deposits, like those of the Proterozoic in the Pilbara, Brazil and South Africa.

Magnetite mining and processing in the Middleback Ranges has been focused on high-grade magnetite-carbonate mineralisation at the Iron Magnet Pit since 2005. This ore is extremely favourable for processing due to its grindability

and low SiO_2 content. Recent advancements in metallurgical processing have shown that oxide-facies (magnetite, haematite, quartz) BIF may also be economically extracted from BIF in the Middleback Ranges.

3.2 Local Geology

3.2.1 Stratigraphy

The Iron Magnet lithological sequence (Figure 3.2) is bounded by the Katunga Dolomite which marks the base of magnetite mineralisation, and the Cook Gap Schist. The sequence grades up successively through the basal sequence (a coherent mix of relatively thinly bedded lithologies), haematite-carbonate (haematite carbonate rock), mixed haematite-magnetite-carbonate rock with naming dependent on dominant iron species), magnetite-carbonate (magnetite carbonate rock, historically the most important source of ore), magnetite-talc (magnetite talc rock, including amphibole silicates transitional to talc), talc- and talc silica-dominated rock types and schists, magnetite-silica (magnetite silica rock of variable ore quality with variable minor amphibole), and finally jaspilite with variable minor to distinctive amphibole and relatively minor iron oxides. Magnetite-sulphide is locally present as pinching lenses and is thought to represent a transitional unit between the basal sequence rocks and magnetite mineralisation.

Several types of variably mineralised breccia occur within the other rock types. The intrusives, which are altered to amphibolite and generally weather to clay, cut through the deposit and have a north–south strike and a steep westerly dip. Individual dyke thicknesses vary from less than a metre up to 15m. Occasionally the dykes can be continuous, with some having lengths of more than 2km being recorded. More commonly, however, the dykes pinch and swell rapidly, bifurcate, and on rare occasion are observed to be folded. The amphibolites are generally devoid of mineralisation but are sometimes slightly haematised containing low-grade iron. They are the typical source of Al_2O_3 and TiO_2 contamination within the Southern Middleback Range deposits.

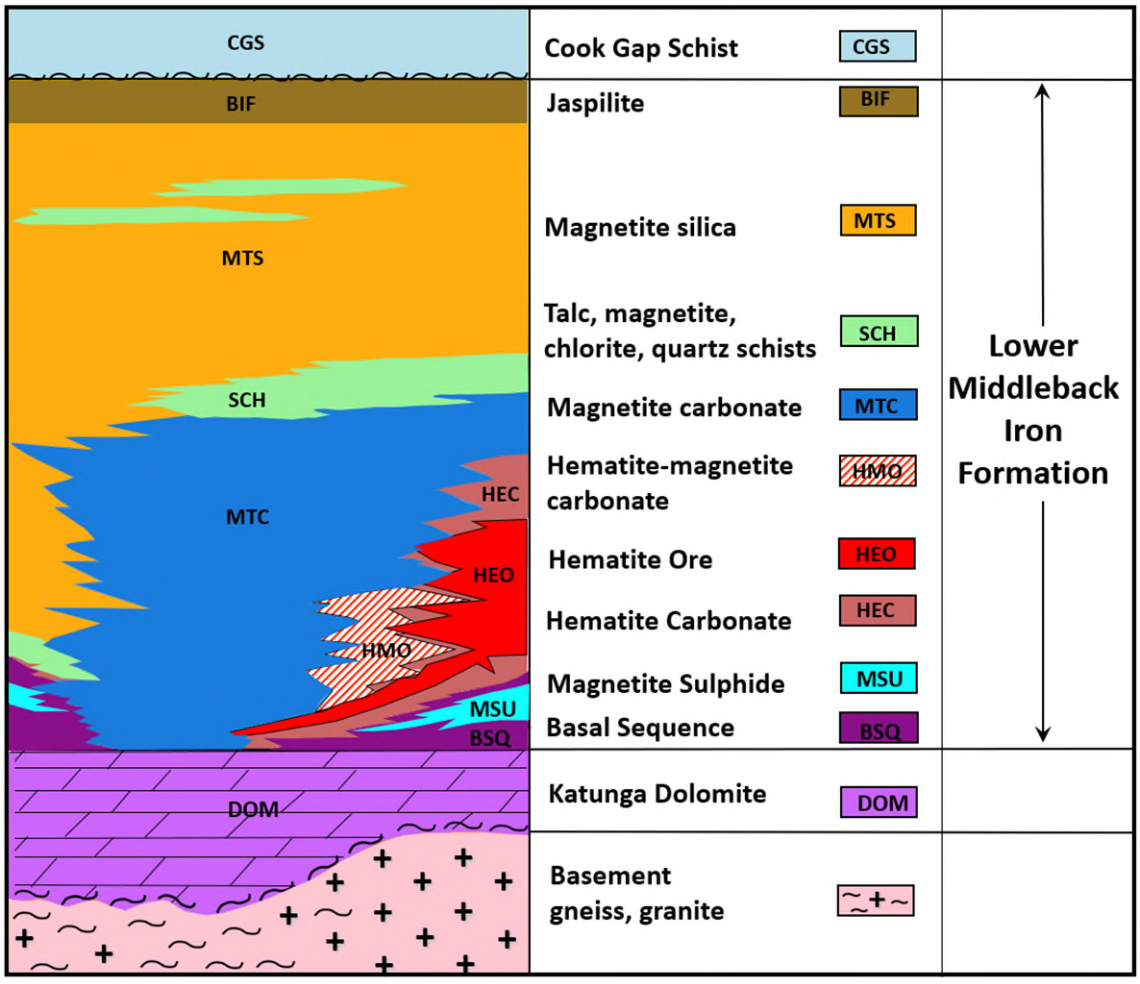


Figure 3.2 – Local stratigraphic sequence for the Duchess South area.

3.2.2 Structure

The magnetite host lithologies in the Duchess South area are bounded in the east by the Eastern Shear Zone (ESZ), and in the west by the Western Shear Zone. The bedding, foliation, and fold axial surfaces all strike roughly NS, with steep to subvertical dips to the east. The dominant structural features controlling the distribution and geometry of the lithological units are EW parasitic folds on the east dipping limb of a large syncline. Cross-cutting faults on a WNW, NW, NE and NNE orientation have been mapped historically, with mine-scale displacements of 50m on WNW faults occurring locally. The offset in the haematite mineralisation in the Iron Duke pit have been correlated with mapped NE cross-cutting faults. Steeply dipping amphibolised dykes occur and strike NW sub-parallel to the regional fold axis and the eastern and western bounding shear zones.

3.2.3 Haematite Mineralisation

Haematite in the various haematite-bearing rocks is thought to be due primarily to supergene alteration of primary magnetite, although the presence of primary haematite cannot always be discounted. This supergene process at depth is especially apparent at the base of the sequence where it manifests in a strata-bound sense, and along both faults/fractures and dyke contacts in a cross-cutting sense. Permeability allowing the ingress of water is the obvious control for the supergene alteration and increased haematite development is observed in direct association with some cross-cutting faults. The haematite orebodies are interpreted to represent up-dip supergene enrichment of the magnetite carbonate. Examination of drill core shows a clear transition from magnetite carbonate through mixed magnetite-haematite carbonate rock to haematite carbonate. The enrichment process of haematite carbonate to haematite mineralisation involves the removal of carbonate and an increase in porosity which further enhances iron enrichment. Haematite mineralisation (HEO) is observed to form a discontinuous zone along the western flanks of the topographic ridges, with a variable easterly dip from 30° to almost vertical (Figure 3.3).

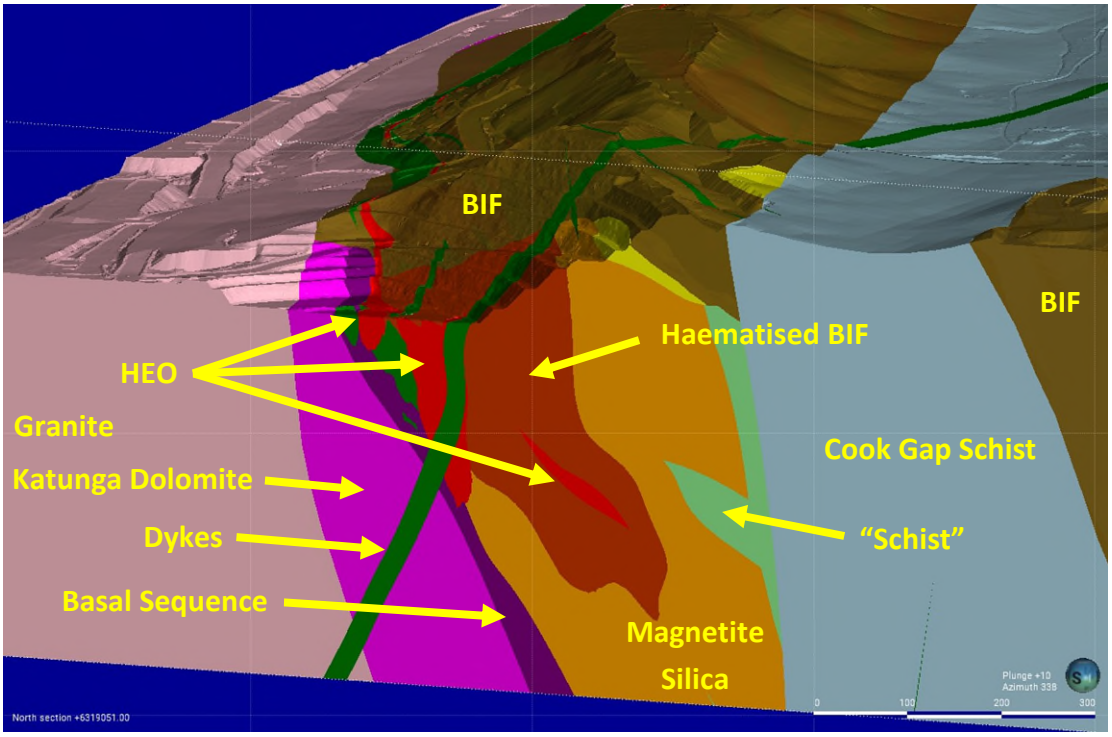


Figure 3.3 – Oblique EW section through the Duchess Pit, showing the geological interpretation of the major lithologies, and discontinuous nature and variable dip of the haematite mineralisation (HEO).

Haematite is the dominant iron ore mineral with significant goethite and minor limonite also present. Mineralisation widths are highly variable, ranging from 50m in the central parts of the Iron Duke and Duchess deposits, to less than 5m in some of the eastern edges of the deposits.

3.2.4 Magnetite Mineralisation

Magnetite mineralisation is hydrothermal in origin, and includes the following styles listed in decreasing order of economic significance:

- pervasive replacement of layers at all scales from laminae to beds.
- selective replacement of layers at all scales from laminae to beds
- matrix to breccias, and clasts within breccias.
- discontinuous veins, open space filling in fractured carbonate, bedding-parting planes and other fractures, and openings.

Bedding replacement magnetite is the primary source of economic mineralisation with pervasive replacement often leading to intervals of massive magnetite. Magnetite breccias contribute much less volume than replacement-style ore but are generally of higher grade, often having a matrix of massive magnetite. Open space infill, including veining, generally occurs where magnetite replacement mineralisation is already present. Lesser occurrences of disseminated and spotty magnetite mineralisation is often too low grade to have any economic implications.

Gangue mineralogy associated with the magnetite host rocks show a broad vertical zonation from carbonate to talc to silica, reflected in the ore type naming conventions. The gangue minerals are largely layer-selective with lesser occurrences of fracture fill and veining and considered to reflect mineralogical differences in the precursor lithology or compositional gradient in the hydrothermal fluids on a mineralogically uniform precursor lithology. Talc and silica alteration is typically pervasive and fabric destructive, with pervasive talc alteration often accompanying magnetite stockwork veining. Dolomite and ankerite make up the bulk of carbonate alteration, with lesser occurrences of siderite. Amphibole and chlorite gangue are widespread but volumetrically much less significant. Chlorite occurs most noticeably as intense wall rock and clast alteration associated with magnetite-matrix breccia. Iron and iron-magnesium amphibole (grunerite and cummingtonite), commonly gradational to talc, occur mainly in association with talc and silica dominated rocks. Silica alteration is almost exclusively fine-grained quartz, with lesser amounts of iron silicates.

Magnetite mineralisation is largely strata bound, manifesting as two distinct types, with gradational boundaries both vertically in the sequence as well as laterally along strike (Figure 3.4).

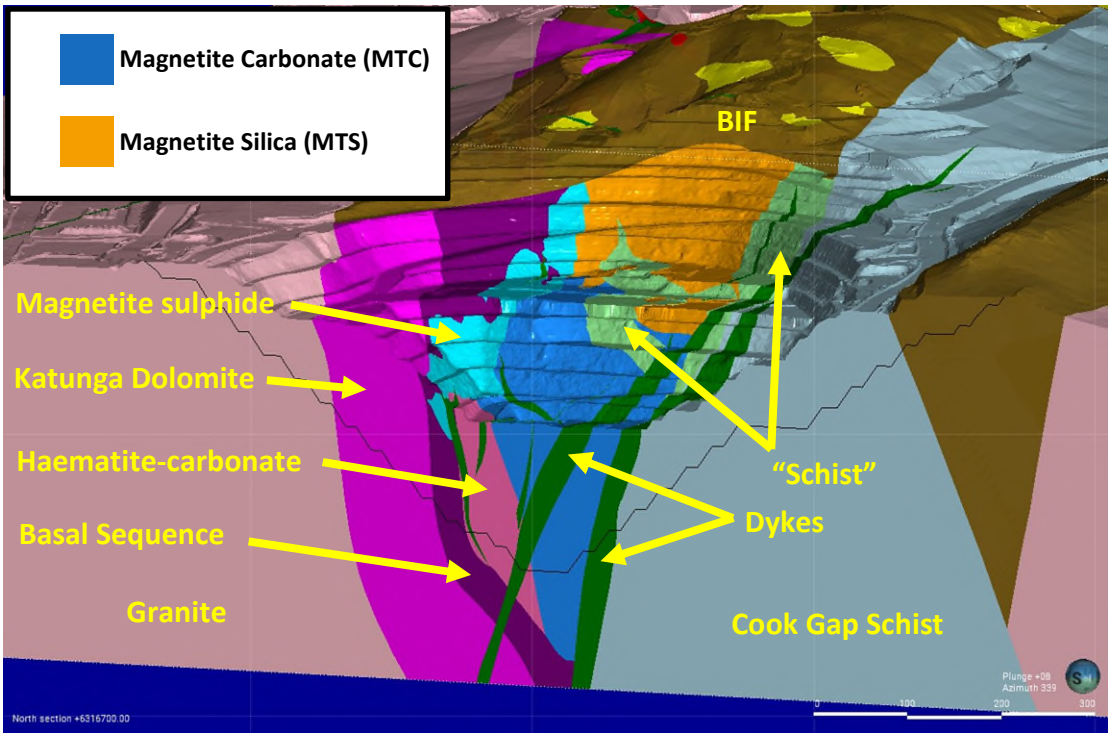


Figure 3.4 – Oblique EW section through the Iron Magnet Pit, showing the geological interpretation of major lithologies and the vertical and lateral transition from carbonate dominated magnetite mineralisation (MTC), to silica dominated magnetite mineralisation (MTS).

Magnetite-carbonate (MTC), historically the main magnetite ore type exploited but now almost mined out, occurs locally in the Iron Magnet Pit in the south of the Duchess South area, and can be described as a structurally controlled massive magnetite unit, with localised hydrothermal carbonate alteration as fracture filling (Figure 3.5).

Magnetite-silica (MTS) occurs as a largely homogenous semi-tabular banded unit. It typically occurs as alternating magnetite-rich silica-poor, and magnetite-poor silica-rich banding at the centimetre scale (Figure 3.6). Typically, MTS comprises of 45% magnetite and 55% fine grained quartz, with lesser occurrences of other minor iron silicates and carbonates. MTS is by far the most dominant ore type in the Duchess South area.



Figure 3.5 – Photograph showing a large grab sample of typical MTC with pervasive carbonate alteration in open fracture filling.

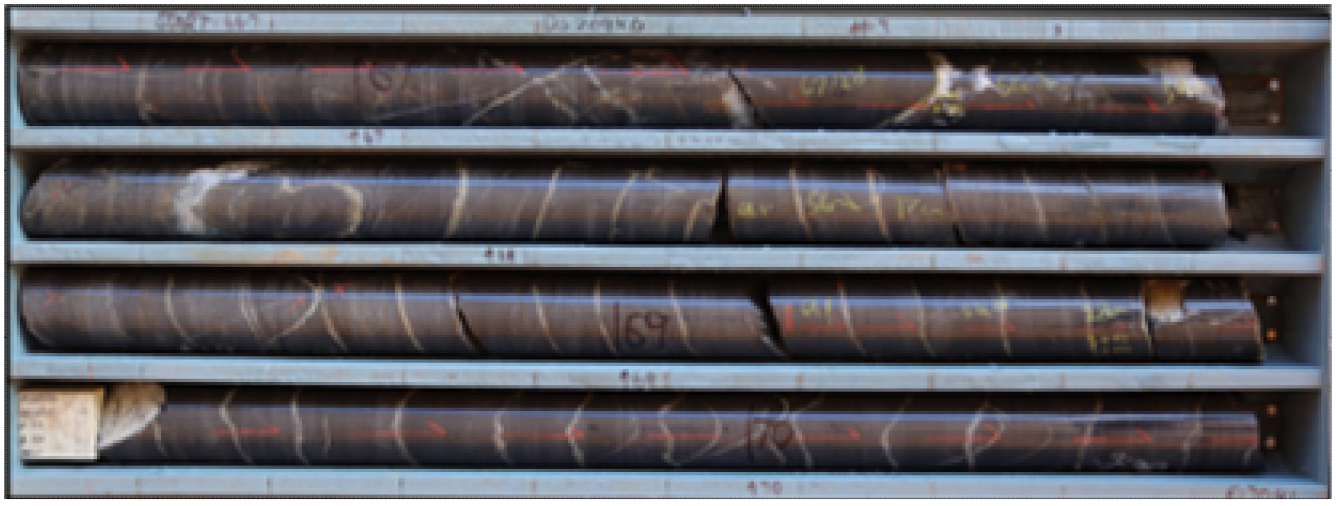


Figure 3.6 – Photograph of drill core from hole DS209 in the Duchess South area showing typical banded MTS. Note alternating banding and thin fine-grained quartz laminae.

4 Drilling, Sampling and QAQC Procedures

4.1 Drilling

There have been several drilling campaigns, either for mineral resource definition, or infilling of existing mineral resources, over the Duchess South area (Figure 4.1). Open hole percussion and reverse circulation hollow hammer was the dominant drilling method employed prior to 2005, after which all drilling was exclusively modern reverse circulation, with NQ or HQ diamond core drilling where required. A total of 2,185 drill holes for 307.5km have been completed across the Duchess South area since 1958 (Table 4.1).

Table 4.1 – Drilling types, number of holes, meterage, and date ranges across the Duchess South area

Drilling Method	No. Holes	Meters Drilled	% Holes	% Meters	Earliest Date	Latest Date
RC - reverse circulation	788	136,911	36	45	Apr 1996	Mar 2023
RCHH - RC hollow hammer	608	76,621	28	25	Nov 1992	Jun 2006
OHP - open hole percussion	447	32,866	20	11	Jan 1958	Jun 2004
OHPDD - OHP + diamond drilling tail	60	14,742	3	5	Jan 1958	Mar 1992
DDH - diamond drilling core	105	26,208	5	9	Jan 1958	Jan 2023
AC - air core	39	3,627	2	1	Oct 1985	Jan 1988
Missing - type not recorded	51	4,577	2	1	Jan 1996	Dec 2002
RD - RC + diamond drilling core tail	31	7,096	1	2	Jul 2012	Apr 2023
OHPAC - OHP collar + AC tail	8	2,368	<1	1	Jan 1961	Jan 1965
SD - sonic drilling	34	1,224	2	<1	Nov 2011	Feb 2015
RCXS - RC cross-over sub	14	1,240	1	<1	Oct 1988	Oct 2008
Total	**2,185**	**307,480**				

Note: Lengths rounded to nearest metre

For the current mineral resource update, and additional 55 RC drillholes have been included up to 22 August 2023 since the previous mineral resource update completed in May 2023. The current drilling campaign was designed to test the extent of specific magnetite domains, in addition to infilling on a closer grid with the aim of converting existing Inferred mineral resources to Indicated mineral resources.

All RC drilling is carried out by Ausdrill North West Pty Ltd, and diamond drilling by DRC Drilling Pty Ltd, in accordance with guidelines and standards laid out in SIMEC Mining Exploration Data Capture and Validation Procedure QP51.001. Vertical and angled RC holes (typically dipping to the west) are drilled as perpendicular to the general easterly dip of the magnetite domains. Recent drilling has been conducted on nominal 50 m spaced east–west section lines, except where topographical terrain or mining constraints restrict access. All drill hole collars are surveyed using differential GPS (DGPS) collected by SIMEC survey personnel. 31% of the drill holes have down-the-hole surveys completed using either north-seeking gyroscopic, Eastman camera, or Ezishot, methods.

Further details on drilling are documented in the QAQC reports in Appendix 1.

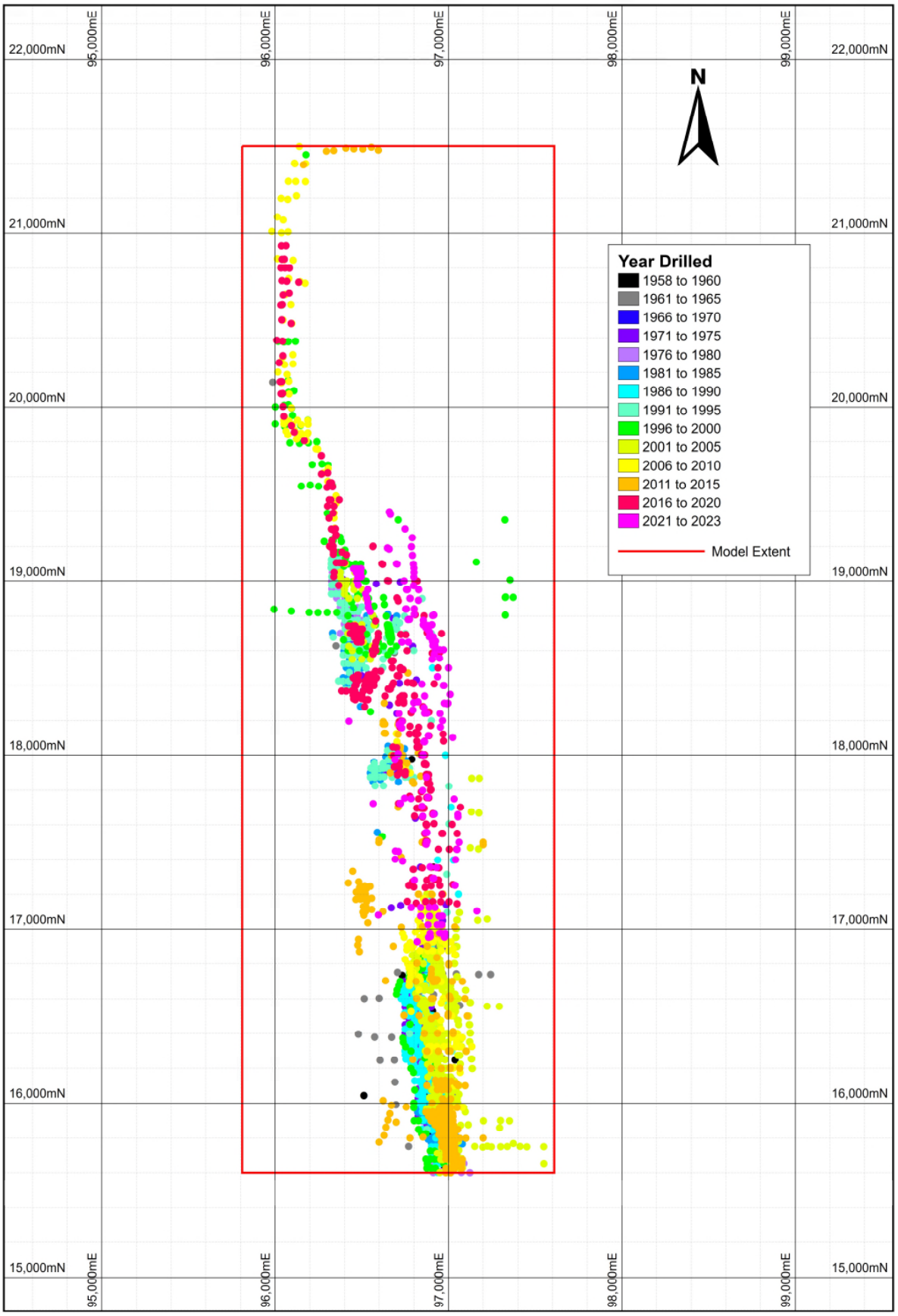


Figure 4.1 – Plan view over the Duchess South area showing the spatial and temporal location of completed drilling.

4.2 Field Sampling

SIMEC sample collection and dispatch routines have been developed over time with subsequent campaigns and change in drilling type. Details pertaining to this development can be found in Appendix 1. More than 55% of RC samples have been collected using either a rig -mounted 3-tier riffle splitter or cone splitter (Table 4.2).

Table 4.2 – Summary of primary sampling methods.

Sample Method	Description	Number of Samples	%
3TR	Rig-mounter 3-tier riffle splitter	15,671	14
GRB	Grab sample (wet sampling or insufficient material for spear)	331	<1
CONE	Rig-mounted cone splitter	49,662	44
HC	Half core	585	1
QC	Quarter core	787	1
WC	Whole core	517	<1
SPEAR	Speared sample (west sampling)	80	<1
N/A	Not recorded (historical sampling pre-2003)	45,336	40
Total		**112,939**	

Sampling in the most recent drilling campaign was carried out on RC drill holes in accordance with SIMEC's sampling procedures detailed in SIMEC Mining Exploration Data Capture and Validation Procedure QP51.001. Between 2 kg and 5 kg of rock-chip sample was collected from 2m length intervals of a nominal 30kg mass via a rig mounted cyclone and cone splitter into pre-numbered calico bags (Figure 4.1). Reject material was retained in ordered sequence for geological logging and verification.



Figure 4.1 – Photographs showing rig-mounted splitter setup (left) and RC chip samples in pre-numbered calico bags alongside corresponding reject material (right).

Diamond drill core is marked up for core recovery (typically 99% across holes and mineralised units) by comparing drillers depth markings against actual core length recovered. Core is halved by means of a diamond saw, and then usually sampled at 2m intervals, or smaller if honouring geological contacts. In some cases, core is quartered during cutting if material is required for further analysis, and in rare cases the entire drill core is sent for analysis. All core and chips are photographed prior to despatch to the laboratory.

Bagged RC samples were checked and collected in the field and prepared according to SIMEC procedures for dispatch to the Bureau Veritas (BV) laboratory in Whyalla for primary head sample analysis, and then further sub-sampling and compositing, performed by the laboratory under geological guidance, for secondary sample concentrate analysis (Table 4.3). The number of samples vary within each period, depending if the operational focus was on haematite (primary sample) or magnetite (primary and secondary sample) at the time.

Table 4.3 – Sample statistics for primary (head) and secondary composite (concentrate) samples.

Primary Sample			Secondary Composite Sample		
Sample Date Range	**Number of Samples**	**% Samples**	**Sample Date Range**	**Number of Samples**	**% Samples**
2022	12,428	11	2022-2023	3,629	18
2019-2021	30,854	27	2019-2021	5,028	25
2013-2018	10,127	9	2013-2018	17	<1
2004-2012	14,634	13	2004-2012	9,109	45
Pre-2004	21,238	19	Pre-2004	2,528	12
Unknown	23,658	21	-	-	-
Total	**112,939**		**Total**	**20,311**	
Sample Interval (m)	**Number of Intervals**	**% Intervals**	**Sample Interval (m)**	**Number of Intervals**	**% Intervals**
<2	4,111	4	<4	4,723	23
2	104,000	92	4	8,575	42
>2	4,828	4	4-8	1,200	6
-	-	-	8	5,459	27
-	-	-	>8	354	2
Total	**112,939**		**Total**	**20,311**	

4.3 Geological Logging

All RC sample piles are sieved, and chips collected in chip trays numbered to mimic the drilling depths and sample intervals. Logging of these is completed by members of the exploration geology team, referencing standarised logging codes. Sample intervals are initially selected based on an initial lithological log, with the final logging code assigned based on subsequent magnetic susceptibility measurements and completed XRF head analysis of the sample intervals.

4.4 QAQC Procedures

All drilling related to mineral resource definition undergoes a QAQC process as defined by SIMEC Mining Exploration Data Capture and Validation Procedure QP51.001. For the monitoring of cross-sample contamination field blanks of dolomite from the Ardrossan Dolomite Quarry are inserted at a rate of 1 in 15 samples. Since 2011, the accuracy of the analytical results is monitored with coarse (field) duplicates at a rate of 1 in 15 samples, and crusher duplicates at a rate of 1 in 25 samples. Since 2003, certified reference material (CRM) standards have been inserted at a rate of 1 in 25 to monitor the precision of the analytical process. Prior to 2003, no QAQC procedures were in place, but this sampling has subsequently been superceded by later post-2003 drilling and sampling campaigns.

All aspects of geological and analytical data are monitored, tracked, and reported on by a dedicated Principal Database Geologist. Regular discussions are held with the laboratory to discuss analytical performance on a fortnightly and monthly basis and includes reviews of inter-laboratory check analysis. Monitoring of sample QAQC is in effect on a permanent basis, with every batch of completed analysis being reviewed during import into the database. A full review of QAQC is enacted for every instance of a data cut-off for the purposes of mineral resource estimation. The Principal Database Geologist and Competent Person completed a laboratory inspection of BV Whyalla on 6 February 2023 and 2 May 2023.

A more detailed discussion of QAQC outcomes for this mineral resource update are presented in Section 5.

4.5 Laboratory Sampling and Analytical Procedures

Historically, all drill hole samples were submitted for chemical analysis at the OneSteel Laboratory Facility located at the Whyalla Steel Works. In 2001 the facility was taken over by Amdel Pty Ltd, which in turn was acquired by Bureau Veritas (BV) in 2007. In 2012, samples were submitted to Amdel/BV laboratory in Adelaide whilst a new BV laboratory was being constructed in Whyalla. From 2013 onwards, samples were prepared and analysed in this new BV laboratory.

Samples were submitted to the laboratory in batches to undergo sub-sampling and chemical analysis. A total of 9,767 samples from drilling in 2011–12 was submitted to Amdel's laboratory facility in Adelaide. In subsequent years a total of 48,885 samples was submitted to the BV laboratory in Whyalla.

Samples underwent a two-stage sample preparation and analysis process where primary (head) field samples undergo initial sorting and drying; weighing; crushing and pulverising, before chemical analysis using XRF analysis of lithium borate fusion discs (Figure 4.2), for the following primary analytes:

- Fe, SiO_2, Al_2O_3, Mn, TiO_2, CaO, MgO, K_2O, P, S, Na_2O, Ba, Cu, Pb, Zn and V
- Loss on Ignition (LOI)
- Saturation magnetisation analysis (SATMAGAN)

Secondary (concentrate) analysis was then undertaken on selected samples adhering to litho-geochemical magnetite mineralisation criteria as determined by the geologists. Reject crusher primary samples were physically composited to nominated intervals, split, and pulverised, before undergoing Davis Tube recovery (DTR) analysis to recover the magnetic and non-magnetic sample component for further XRF analysis. The result was three sets of XRF results via lithium borate fusion disc for:

- Fe, SiO_2, Al_2O_3, Mn, TiO_2, CaO, MgO, K_2O, P, S, Na_2O
- Loss on Ignition (LOI)
- Proportion of magnetic material (MASS RECOVERY)

representing the total sample grades, magnetic fraction grades, and non-magnetic fraction grades. The sample preparation of the magnetite samples had a range of composite lengths, as well as a varied DTR sample preparation method over the years. The two main sample preparation methods were:

- "DTR method" where samples were dry ground to P80 45µm using a rod/ball mill.
- "Grind Liberation Method (GLIB)" where samples were wet ground to P80 38µm using a rod mill only.

Analytical results were reported to SIMEC in completed batches. Laboratory QAQC included duplicates samples, blank samples, and CRM standard samples reported and monitored by dispatch and monthly between SIMEC and the laboratories.

Specific analytical procedures, preparation methods and detection limits for each analytical method and analyte can be found in "Iron Magnet and Duchess South Magnetite QA/QC Report December 2022", in Appendix 1.

Figure 4.3 shows a simplified flow chart for the current sampling and analytical procedures at BV in Whyalla.



Figure 4.2 – Photographs showing lithium borate fusion preparation (TOP) and XRF analysis (BOTTOM) at BV Whyalla.

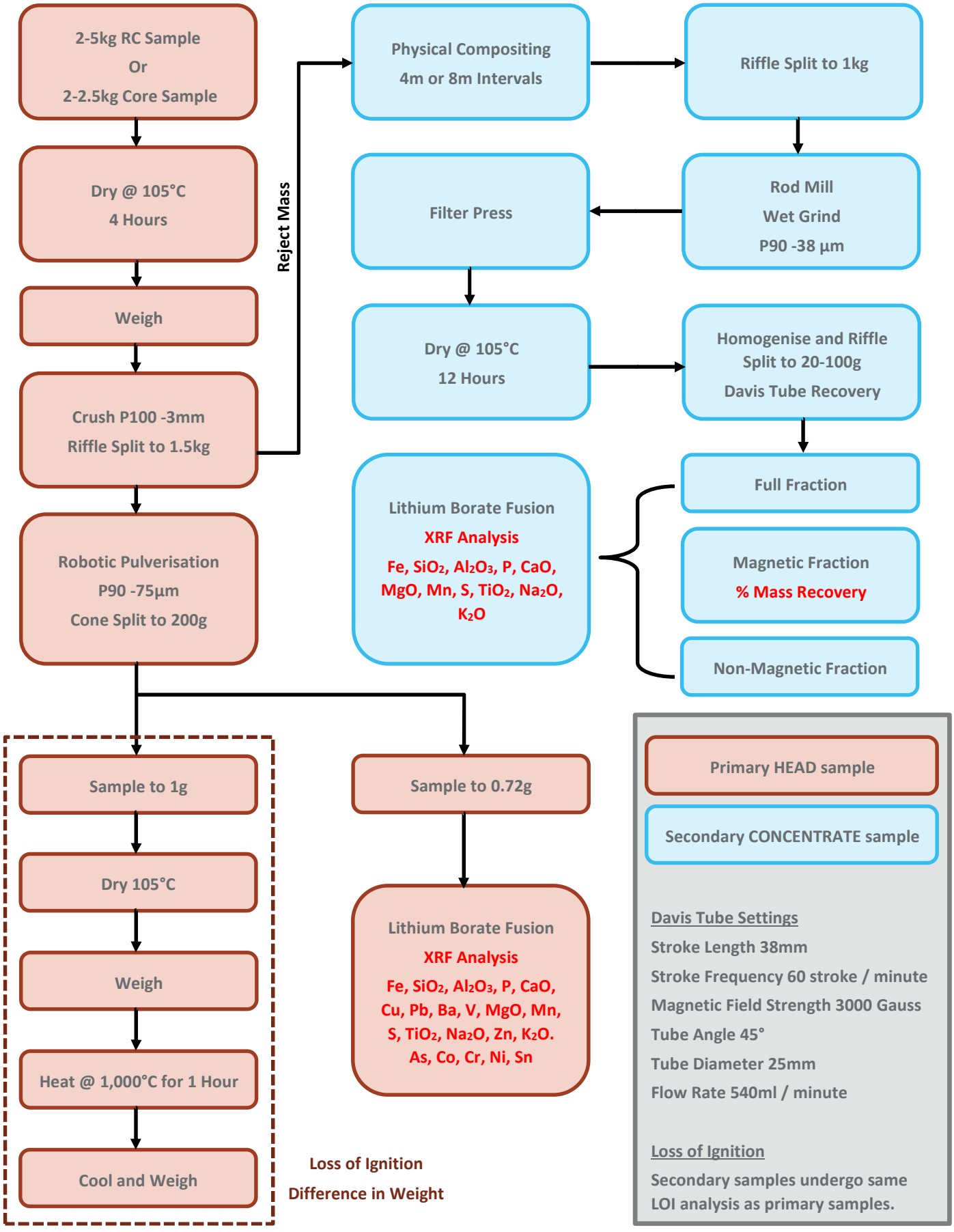


Figure 4.3 – Simplified current sample preparation and analytical flow sheet for sample analysis at BV Whyalla.

4.6 Density Measurements

Bulk density measurements prior to 2004 HAVE been captured using down-the-hole Surtron and Century geophysical wireline tools over the footprint of the Iron Duke haematite and Iron Magnet magnetite operation on <10cm intervals. Recent drilling over the southern part of the Duchess South area had density measurements using a Geovista tool, with measurements on 10cm intervals.

Archimedes methods (weight in air / weight in water) for density determination are made on selected non-contiguous intervals of available diamond drill core by the exploration field teams in the core yard.

4.7 Data Capture, Storage and Management

All exploration drilling data is stored and managed using acQuire relational databases. Several checks and validation steps are built into acQuire and routinely run to ensure data validity at key stages of drilling and sample management. Assay QAQC procedures are performed on the import of new assay results and monitored and reported from within acQuire.

Field data capture is directly recorded in tablets/spreadsheets and imported into acQuire, after which a verification check is run to ensure the data meets the import specifications. Sampling interval and dispatch information is generated by standard forms from acQuire. Geological logging is reviewed, validated, and edited if required, by senior geological personnel.

The acQuire database is maintained by the Principal Database Geologist, who “locks” the records once the data has been verified. The master database is backed up daily to separate data server with restricted access.

5 QAQC Analysis

Comprehensive QAQC has been undertaken on all data used in the latest mineral resource update, and reported on in detail in four separate reports in Appendix 1 as follows:

- 2003 to 2020 drilling: DSM Drilling QAQC Report 200430
- 2020 to 2022 drilling: DSM Drilling QAQC Report 211124
- 2022 drilling (14/11/2022 data cut-off): DSM Drilling QAQC Report 230113
- 2022 drilling (22/08/2023 data cut-off): DSM Drilling QAQC Report 230912

The section below summarises the QAQC outcomes for all three drilling periods. QAQC checks were performed on approximately 14% of all data submitted from 2003 onwards (Table 5.1), which comprised approximately 86% of the total available data.

Table 5.1 – Statistics for all QAQC samples submitted with primary samples from 2003 onwards.

	BV Whyalla (2003-2011)		Amdel Adelaide (2011-2012)		BV Whyalla (2013-2023)	
Type	**Count**	**%**	**Count**	**%**	**Count**	**%**
Primary Sample	10,700		10,460		53,409	
Field Duplicate	569	5.3	218	2.1	3,176	5.9
Field Blank	39	0.4	186	1.8	3,184	6.0
Standard	162	1.5	433	4.1	2,445	4.6
Total Field QAQC	**770**	**7.2**	**837**	**8.0**	**8,805**	**16.5**

Scatter plots of field duplicates for Fe from both Amdel Laboratory (pre-2013) and BV Whyalla (post-2012) show acceptable repeatability (Figure 5.1 and Figure 5.2), as does a scatter plot of primary sample Fe versus secondary sample Fe, prior to magnetic DTR concentration (Figure 5.3). There is a good agreement when comparing inter-laboratory check analysis of sample pulps (laboratory duplicates) across the analytes, with an example shown for Al_2O_3, Fe, and SiO_2 shown in Figure 5.4.

Although some variation in the performance of standards is evident, this is not deemed material as it demonstrates ongoing improvements in laboratory analytical processes over time. Examples of summary statistics for the standards for Fe and SiO_2 are shown in Table 5.2 and Table 5.3. The QAQC outcomes across the drilling campaigns demonstrate that the data is of sufficient quality to be used in mineral estimation and to inform the mineral resource classification.

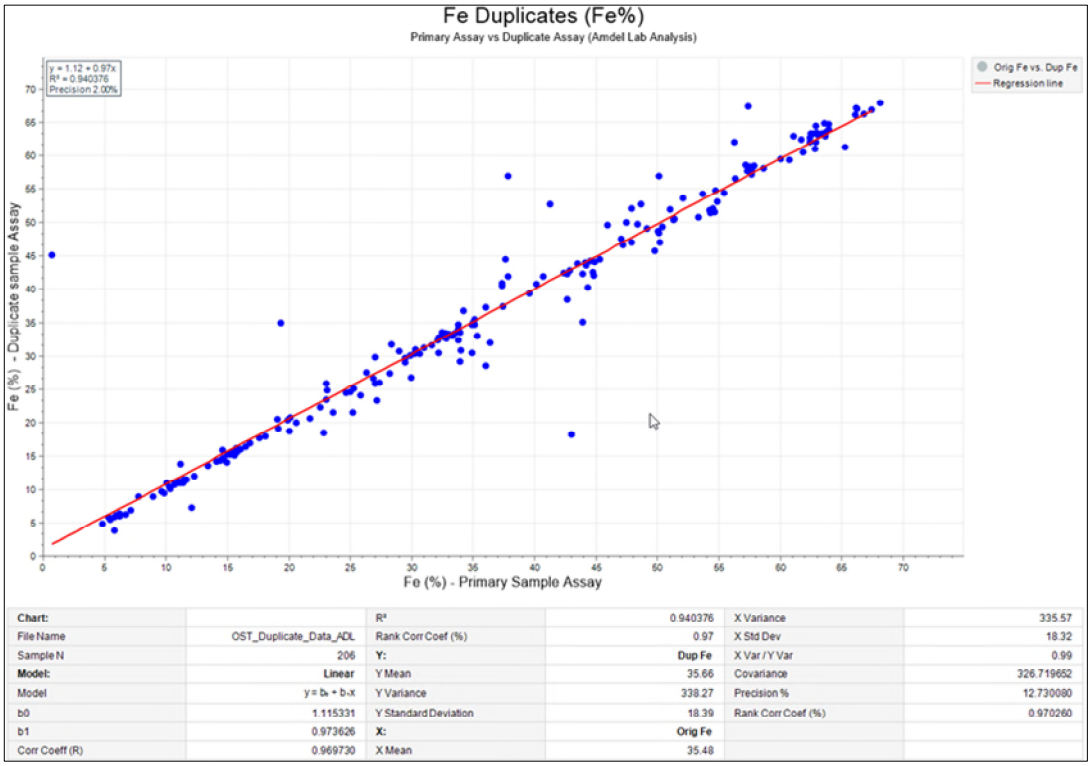


Chart:		R^2	0.940376	X Variance	335.57
File Name	OST_Duplicate_Data_ADL	Rank Corr Coef (%)	0.97	X Std Dev	18.32
Sample N	206	**Y:**	**Dup Fe**	X Var / Y Var	0.99
Model:	**Linear**	Y Mean	35.66	Covariance	326.719652
Model	$y = b_0 + b_1x$	Y Variance	338.27	Precision %	12.730080
b0	1.115331	Y Standard Deviation	18.39	Rank Corr Coef (%)	0.970260
b1	0.973626	**X:**	**Orig Fe**		
Corr Coeff (R)	0.969730	X Mean	35.48		

Figure 5.1 – Scatterplot of Fe (%) for field duplicates analysed at Amdel laboratory before 2013.

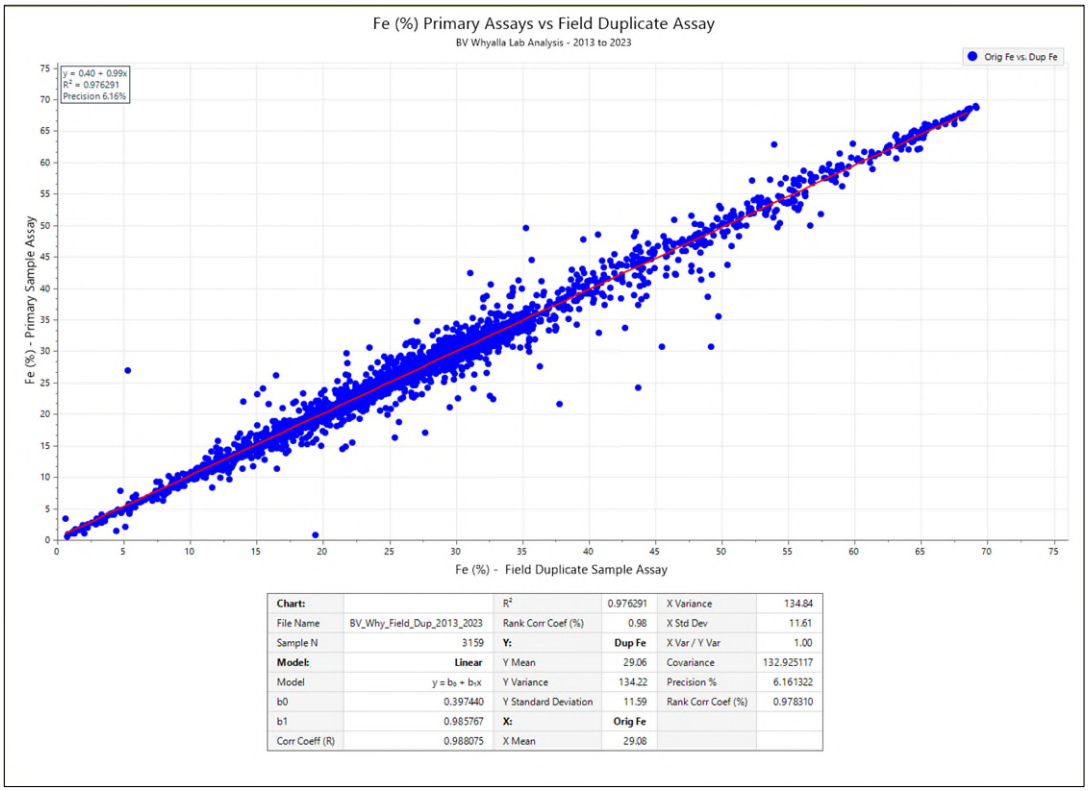


Chart:		R^2	0.976291	X Variance	134.84
File Name	BV_Why_Field_Dup_2013_2023	Rank Corr Coef (%)	0.98	X Std Dev	11.61
Sample N	3159	**Y:**	**Dup Fe**	X Var / Y Var	1.00
Model:	**Linear**	Y Mean	29.06	Covariance	132.925117
Model	$y = b_0 + b_1x$	Y Variance	134.22	Precision %	6.161322
b0	0.397440	Y Standard Deviation	11.59	Rank Corr Coef (%)	0.978310
b1	0.985767	**X:**	**Orig Fe**		
Corr Coeff (R)	0.988075	X Mean	29.08		

Figure 5.2 – Scatter plot of Fe (%) field duplicates analysed at BV Whyalla laboratory after 2012.

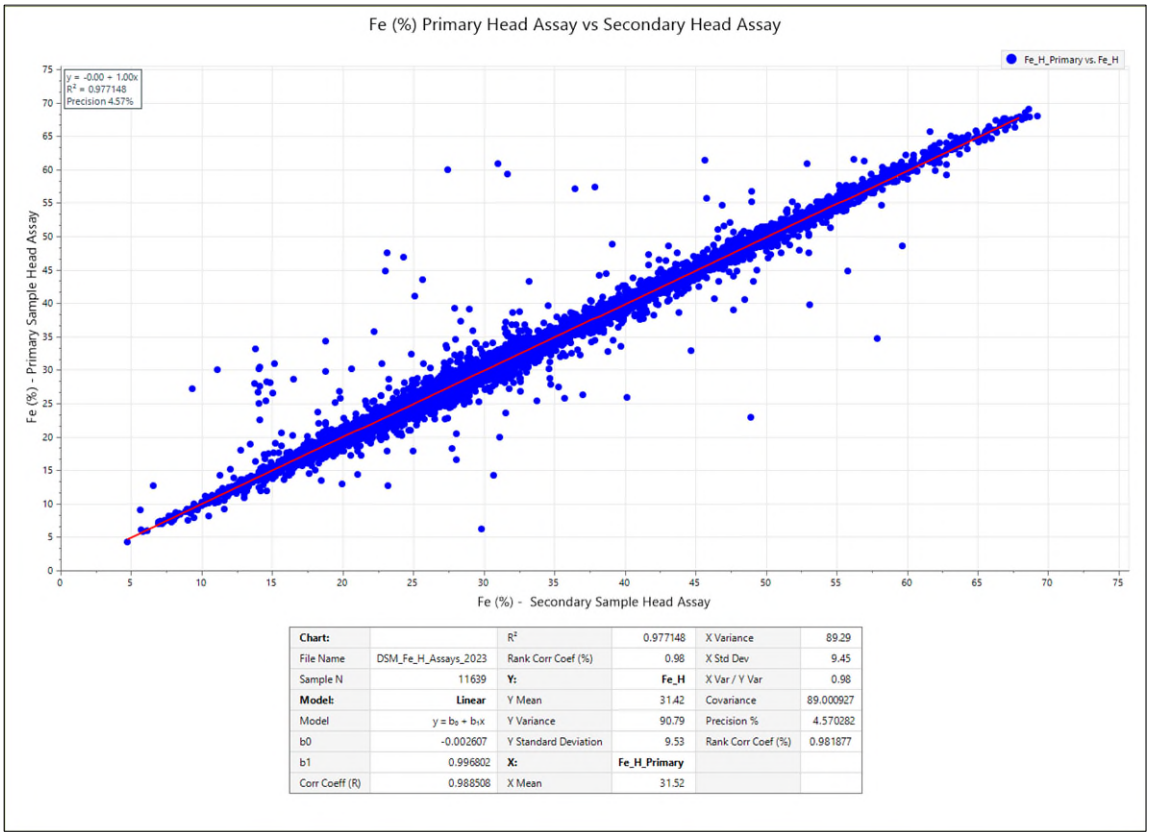


Chart:		R²	0.977148	X Variance	89.29
File Name	DSM_Fe_H_Assays_2023	Rank Corr Coef (%)	0.98	X Std Dev	9.45
Sample N	11639	Y:	Fe_H	X Var / Y Var	0.98
Model:	Linear	Y Mean	31.42	Covariance	89.000927
Model	$y = b_0 + b_1x$	Y Variance	90.79	Precision %	4.570282
b0	-0.002607	Y Standard Deviation	9.53	Rank Corr Coef (%)	0.981877
b1	0.996802	X:	Fe_H_Primary		
Corr Coeff (R)	0.988508	X Mean	31.52		

Figure 5.3 – Scatter plot of primary Fe assay versus secondary Fe assay, prior to DTR magnetic concentration.

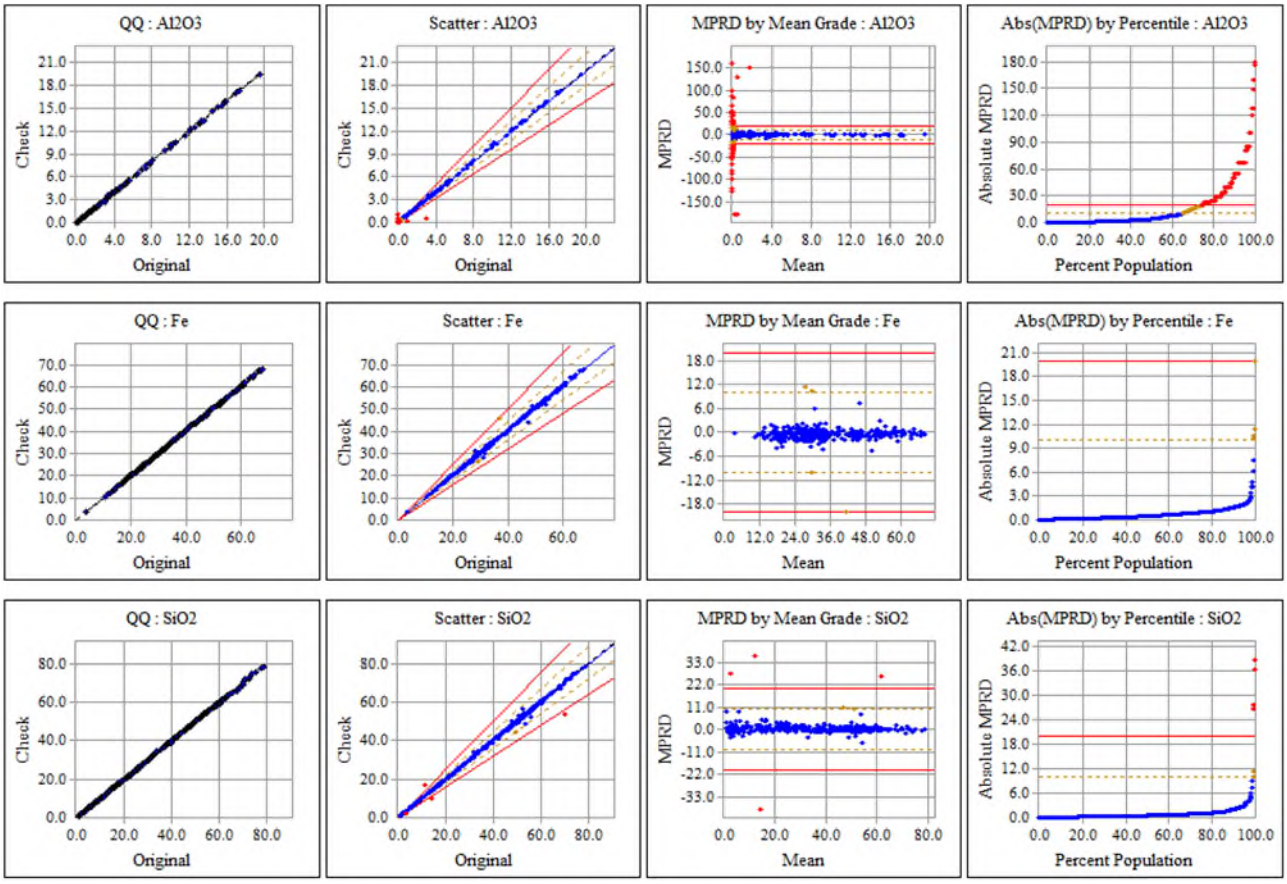


Figure 5.4 – Comparison of inter-laboratory pulp duplicate analysis for Al_2O_3, Fe and SiO_2.

Table 5.2 – Summary statistics for CRM standards for Fe as analysed by BV Whyalla (2003-2011;2013-2023).

Standard	No. of Assays	Certified Mean %	Assayed Mean %	Std. Deviation	MARD %	Relative Bias %	Absolute Bias %	Precision %
GIOP-15	113	50.70	50.58	0.19	0.36	0.25	0.12	0.36
GIOP-18	12	60.60	60.38	0.24	0.43	0.36	0.22	0.52
GIOP-19	23	63.50	63.12	0.28	0.69	0.61	0.38	0.87
GIOP-21	18	53.60	53.13	0.27	0.88	0.88	0.47	0.94
GIOP-24	16	64.40	64.04	0.37	0.61	0.57	0.36	0.78
GIOP-29	11	60.60	59.92	0.51	1.13	1.13	0.67	1.35
GIOP-32	2	30.20	30.05	0.03	0.50	0.50	0.15	0.30
GIOP-44	3	62.75	62.64	0.10	0.18	0.18	0.11	0.22
GIOP-52	17	56.70	56.57	0.30	0.47	0.22	0.13	0.54
GIOP-53	5	56.78	56.72	0.07	0.14	0.11	0.06	0.16
GIOP-55	184	62.80	62.68	0.10	0.20	0.19	0.12	0.26
GIOP-57	1	54.00	54.11	-	0.20	-0.20	-0.11	0.22
GIOP-63	9	52.46	52.49	0.28	0.42	-0.06	-0.03	0.44
GIOP-64	11	56.32	56.35	0.20	0.27	-0.06	-0.03	0.30
GIOP-75	9	57.23	56.94	0.33	0.58	0.51	0.29	0.66
GIOP-76	12	59.20	59.06	0.31	0.46	0.24	0.14	0.54
GIOP-93	4	30.04	30.13	0.04	0.30	-0.30	-0.09	0.18
GIOP-104	861	29.83	29.81	0.12	0.32	0.06	0.02	0.19
GIOP-110	59	33.21	33.18	0.13	0.32	0.09	0.03	0.21
GIOP-111	109	33.35	33.27	0.13	0.37	0.25	0.08	0.24
GIOP-113	607	32.11	32.01	0.12	0.39	0.32	0.10	0.25
GIOP-129	53	37.56	32.36	0.10	0.54	0.53	0.20	0.40
GIOP-132	25	43.12	43.11	0.14	0.25	0.03	0.01	0.22
GIOP-133	33	45.48	45.40	0.10	0.24	0.17	0.08	0.21
GIOP-135	123	53.51	53.45	0.15	0.23	0.11	0.06	0.24
GIOP-139	1	22.43	22.33	-	0.45	0.45	0.10	0.20
GIOP-141	90	63.23	63.19	0.11	0.14	0.06	0.04	0.17
GIOP-142	88	56.58	56.49	0.10	0.19	0.16	0.09	0.22

MARD = mean absolute relative difference. For an assay of 50.56%, a MARD = 0.36% is interpreted as one standard deviation error of ±0.36% relative to the assayed mean of 50.56%

Relative Bias = relative accuracy of results to a known value. For an assay of 50.56%, a bias = +0.27% is interpreted as all duplicate samples within the dataset assaying less than 0.27% relative to the assayed mean value of 50.56%.

Absolute Bias = absolute accuracy to a known value. For an assay of 50.56%%, an absolute bias is interpreted as, on average, duplicate samples will assay as 50.42% (50.56% minus bias of +0.27% of 50.56%).

Precision = absolute precision to a known value to within two standard deviations. For an assay of 50.56%, the absolute precision is interpreted as an assay returning 50.56%, has a 95% probability of being between 50.19% and 50.93%.

Table 5.3 – Summary statistics for CRM standards for SiO_2 as analysed by BV Whyalla (2003-2011;2013-2023).

Standard	No. of Assays	Certified Mean %	Assayed Mean %	Std. Deviation	MARD %	Relative Bias %	Absolute Bias %	Precision %
GIOP-15	113	20.10	20.13	0.19	0.76	-0.15	-0.03	0.31
GIOP-18	12	4.74	4.72	0.04	0.74	0.43	0.02	0.07
GIOP-19	23	3.44	3.52	0.06	2.22	-2.15	-0.08	0.16
GIOP-21	18	7.61	7.75	0.34	1.83	-1.78	-0.14	0.28
GIOP-24	16	2.69	2.78	0.04	3.44	-3.44	-0.10	0.19
GIOP-29	11	6.07	6.13	0.18	1.87	-0.96	-0.06	0.23
GIOP-32	2	50.00	50.23	0.02	0.45	-0.45	-0.23	0.45
GIOP-44	3	4.55	4.61	0.02	1.38	-1.38	-0.06	0.13
GIOP-52	17	5.84	5.85	0.02	0.35	-0.15	-0.01	0.04
GIOP-53	5	5.69	5.68	0.02	0.31	0.09	0.01	0.04
GIOP-55	184	4.08	4.10	0.02	0.60	-0.46	-0.02	0.05
GIOP-57	1	7.42	7.42	-	0.07	-0.07	-0.01	0.01
GIOP-63	9	10.89	10.86	0.08	0.50	0.24	0.03	0.11
GIOP-64	11	8.07	8.06	0.06	0.54	0.15	0.01	0.09
GIOP-75	9	5.76	5.75	0.04	0.58	0.25	0.01	0.07
GIOP-76	12	4.02	4.02	0.04	0.70	-0.04	0.00	0.06
GIOP-93	4	50.32	50.06	0.13	0.53	0.53	0.26	0.53
GIOP-104	861	52.59	52.65	0.14	0.23	-0.11	-0.06	0.24
GIOP-110	59	50.09	50.03	0.15	0.24	0.11	0.06	0.24
GIOP-111	109	48.26	48.41	0.12	0.33	-0.30	-0.15	0.32
GIOP-113	607	48.98	49.03	0.12	0.22	-0.11	-0.05	0.21
GIOP-129	53	19.93	20.02	0.14	0.69	-0.44	-0.09	0.28
GIOP-132	25	16.33	16.31	0.05	0.22	0.12	0.02	0.07
GIOP-133	33	14.80	14.87	0.08	0.54	-0.47	-0.07	0.16
GIOP-135	123	9.63	9.62	0.03	0.29	0.11	0.01	0.06
GIOP-139	1	53.76	53.85	-	0.17	-0.17	-0.09	0.18
GIOP-141	90	3.55	3.55	0.04	0.76	-0.16	-0.01	0.05
GIOP-142	88	6.70	6.72	0.03	0.40	-0.24	-0.02	0.05

MARD = mean absolute relative difference. For an assay of 20.14%, a MARD = 0.72% is interpreted as one standard deviation error of ±0.72% relative to the assayed mean of 20.14%

Relative Bias = relative accuracy of results to a known value. For an assay of 20.14%, a bias = -0.2% is interpreted as all duplicate samples within the dataset assaying more than 0.2% relative to the assayed mean value of 20.14%.

Absolute Bias = absolute accuracy to a known value. For an assay of 20.14%%, an absolute bias is interpreted as, on average, duplicate samples will assay as 20.18% (20.14% plus bias of 0.2% of 20.14%).

Precision = absolute precision to a known value to within two standard deviations. For an assay of 20.14%, the absolute precision is interpreted as an assay returning 20.14%, has a 95% probability of being between 19.99% and 20.29%.

6 Data Import and Validation

6.1 Overview

Drilling data up to the cut-off date of ***22 August 2023*** was exported from the acQuire database by the Principal Database Geologist, as .csv format files, in two batches as summarised in Table 6.1.

Table 6.1 – Summary of data export from the acQuire database.

Assay Data Batch		
Export File Name	**No. of Records**	**Description**
DS230822col.csv	2,185	Drillhole collar information
DS230822sur.csv	18,370	Drillhole survey information
DS230822geo.csv	85,675	Drillhole geological information
DS230822ass.csv	112,939	Partial Head assay information[1]
DS230822combinedass.csv	120,791	Complete head assay information
DS230822magass.csv	20,311	Composite sample DTR/GLIB assay information
Density Data Batch		
Export File Name	**No. of Records**	**Description**
DS230822sg_col.csv	30	Collar information for Archimedes density[2]
DS230822sg _sur.csv	336	Survey information for Archimedes density[2]
DS230822sg _geo.csv	1,637	Geological information for Archimedes density[2]
DS230822sg_data.csv	1,935	Archimedes density data[2]
DS230822ssd _col.csv	209	Collar information for wireline probe density
DS230822ssd _sur.csv	11,032	Survey information for wireline probe density
DS230822ssd _geo.csv	13,477	Geological information for wireline probe density
DS230822ssd_data.csv	309,832	Wireline probe (short-spaced) density data

[1]Partial head assay information only used for checking purposes

[2]Archimedes density only considered as a backup for density assignment in cases where estimation suspected not to be possible

The data includes 2,185 drill hole records and associated downhole survey records; multi-element XRF assay results for primary samples and secondary DTR/GLIB secondary composite sample analysis results; and geological logging records, covering the extent of the Southern Middleback Ranges resource area (Figure 4.1).

Data filtering was executed at the acQuire database level, to facilitate:

- Removal of duplicated drill holes
- Removal of drill holes outside the mineral resource update model extents
- Removal of drilling with no RL or azimuth or dip information or collar information
- Removal of drillholes where all sample intervals >10m in length and no geological information recorded
- Removal of drill holes with no sampling or assay information and no geological information
- Removal of drillhole intervals from the DTR/GLIB assay files for sample intervals >10m

- Removal of drillhole intervals from the head assay files for sample intervals >10m

The data are located within the coordinates 6,315,600N to 6,321,500N, and 695,810E to 697,610E, on the AMG66 Zone 53 Grid System. Estimation is performed in a local mine grid, so during export, drill hole collar coordinates are truncated by subtracting 6,300,000 from AMG66N, and 600,000 from AMG66E.

In addition to the data validation techniques applied in acQuire, additional validation steps are performed on the data export by means of spatial visual validation of drill hole location, azimuths, dips, and depths drilled using Micromine software initially, and then LeapFrog software during the creation of the geological model used as the base for the estimation

Exported .csv data is imported into Vulcan to create two primary database files:

- Naïve head and concentrate database (***dcs_0823.ddh.isis***)
- Wireline short-spaced density database (***dcs_0823.ssd.isis***)

An Archimedes density database was not considered in this update due to the limitation of the data in addition to changes implemented in the density estimation approach using wireline data only.

Each Vulcan database is validated using a specific tool that checks for duplicate drill hole identifiers, duplicate drill hole XYZ collar coordinates, and duplicate and overlapping intervals in the survey, geology, and assay tables. In cases of apparent inconsistencies (e.g., common XYZ collar coordinates but different drill hole identifier and different azimuth) the database was manually cross-checked against both the .csv export, and the original acQuire record to resolve any inconsistencies.

6.1.1 Collar Records

Approximately 25% of the drill holes were drilled after 2013 and were typically drilled to target definition and/or infill of the magnetite resource. The remaining drilling executed over various historical campaigns (Figure 4.1) targeted both haematite and magnetite mineralisation.

Drilling was pre-dominantly RC with an average depth of 137m (Figure 6.1) and collared from various elevations on naturally topography, waste dump surfaces, or mining surfaces.

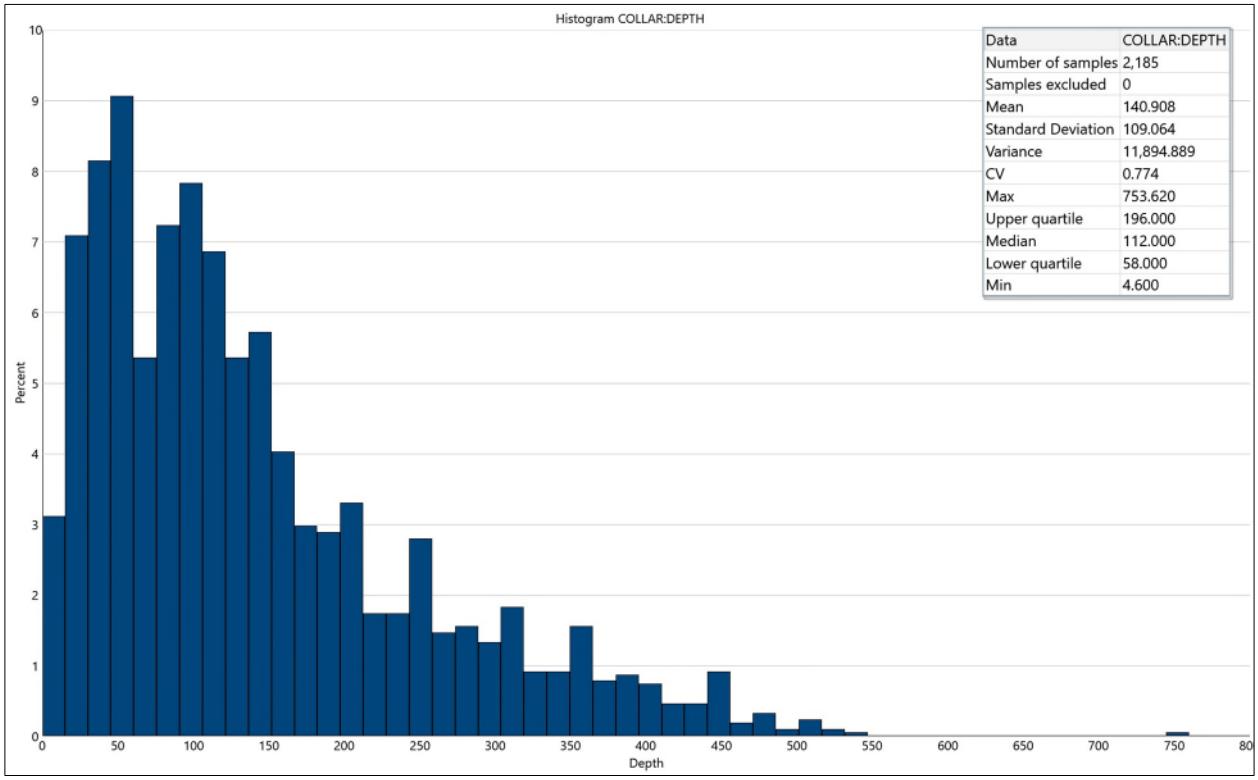


Figure 6.1 – Distribution of drilling depths (in metres) across the Duchess South area.

6.1.2 Survey Records

Drilling was predominantly on an east (90°) west (270°) azimuth (Figure 6.2). Most drill holes are either vertically or steeply dipping at angles of 60° to 70° (Figure 6.3).

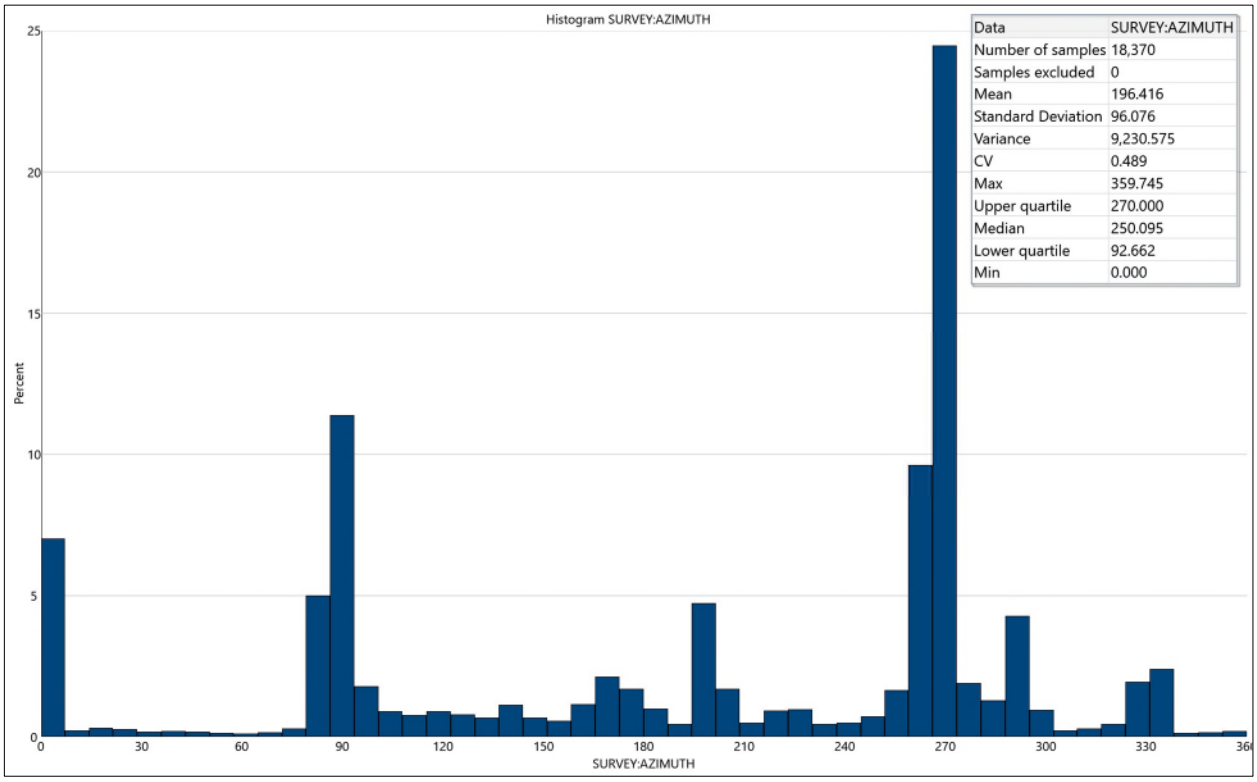


Figure 6.2 – Distribution of drilling azimuths (clockwise from north 0°) across the Duchess South area.

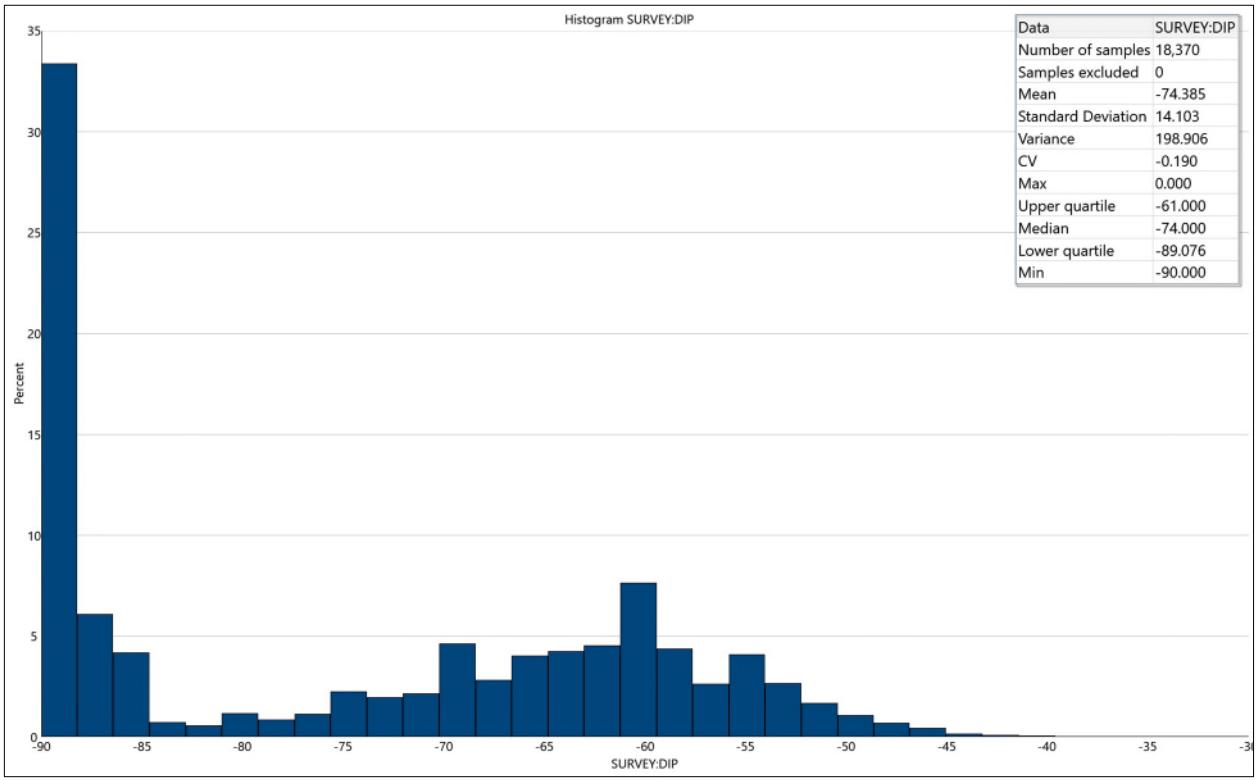


Figure 6.3 – Distribution of drilling dips (inclination from the horizontal) across the Duchess South area.

6.1.3 Geological Logging Records

Geological logging was recorded for a total of 85,675 intervals. The records include a combination of historical and current logging codes across several descriptors that primarily capture the litho-geochemical codes, although not all descriptors are utilised. The LITH1 is the most important descriptor, capturing the primary litho-geochemical identity of the logged interval (Table 6.2).

Table 6.2 – Summary of logged geological intervals, and geological codes and descriptors used.

Logging Descriptor	Count of Unique Codes	Count of Records	% Of Total Intervals
LITH1	83	85,675	100
LITH2	69	13,051	15
MIN1	33	56,028	65
MIN2	38	44,557	52
MIN3	36	26,051	30
HARDNESS	33	44,708	52
COLOUR1	116	73,625	86
COLOUR2	94	41,899	49
COLOUR3	31	5,897	7
GSIZE	7	36,041	42
WEATHER	12	46,312	54
OX	6	9,246	11

6.1.4 Assay Records

Assay data are recorded in two tables: head assay table (H_ASSAY) and the concentrate assay table (C_ASSAY).

The data for H_ASSAY table is the ***DS230822combinedass.csv*** export. This table is a combination of the primary head assay results, as well as the secondary head assay results for some older generation drill holes. The magnetite horizons in these older drill holes were only sampled for DTR/GLIB analysis, and in these cases, there is an incomplete primary head assay record. This was corrected by populating the “missing” primary head assays with the secondary head assay for the corresponding interval, from the full sample fraction prior to any DTR magnetic separation.

In cases where there were overlapping primary and secondary sample intervals, priority was always given to the primary head sample interval.

In cases where there is a partial overlap resulting in a gap in the primary head assay interval, then the secondary head interval is used to populate that gap.

If a gap exists in both primary and secondary head assay intervals, then that gap is honoured as a non-sampled interval.

Approximately 7% of the final head assay samples are comprised of sample intervals from the secondary head assays prior to DTR/GLIB analysis.

The merging of primary and secondary head assays is illustrated in Figure 6.4.

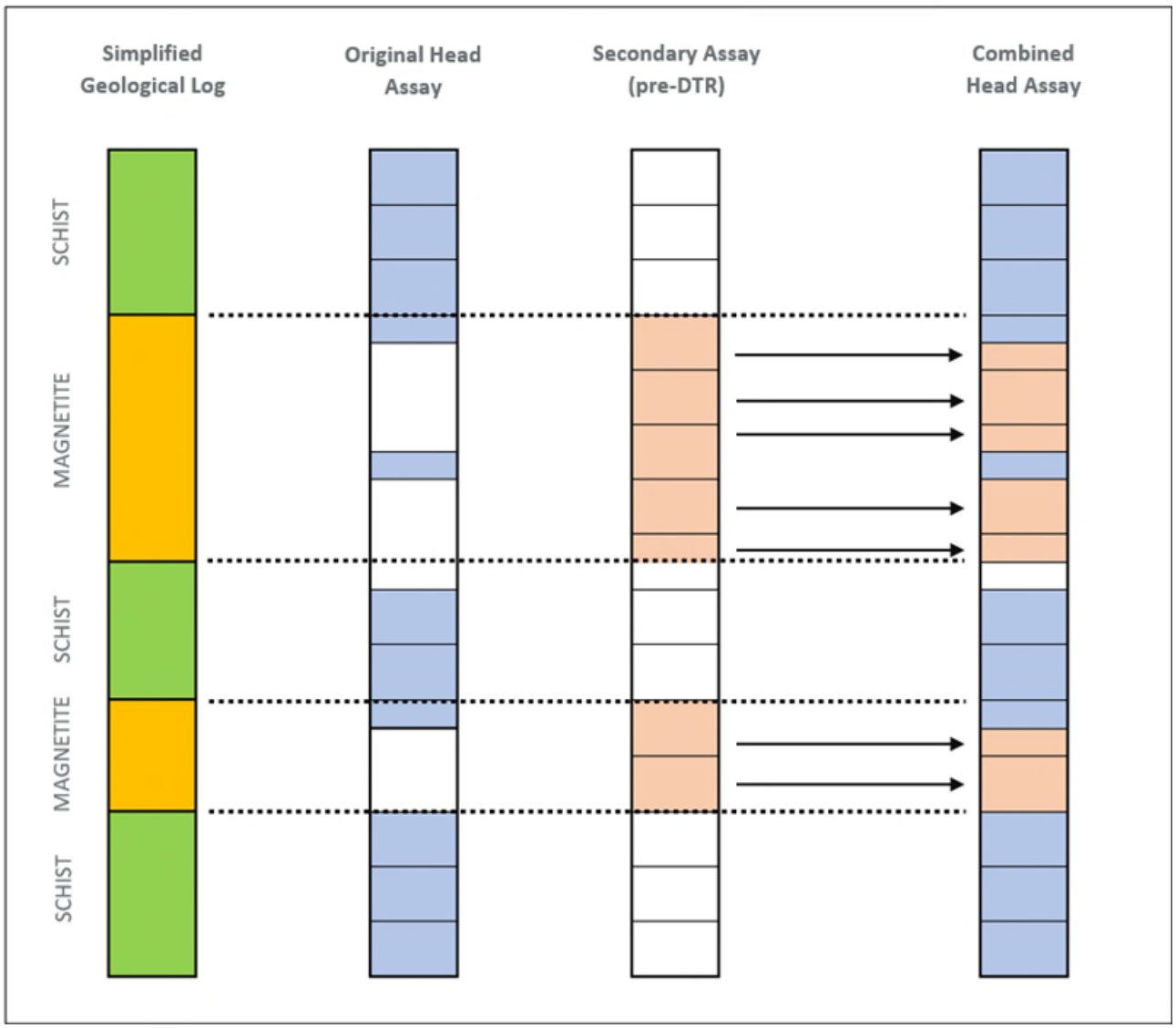


Figure 6.4 – Schematic representation of the combining of primary head and secondary head assays.

The H_ASSAY table comprises records for sampling interval and XRF assay result for Fe, SiO_2, Al_2O_3, Mn, TiO_2, CaO, MgO, K_2O, P, S, Na_2O, Ba, Cu, Pb, Zn and V, in addition to the determination of Loss on Ignition (LOI). LOI can manifest as either a positive, zero or negative value (Fe_3O_4 oxidising to Fe_2O_3), so for the purposes of simplification a factor of 10 was added to all LOI database values (minimum LOI = -8.97). The factor was subtracted upon completion of the final LOI estimate. More than 85% of the sample intervals are 2m in length (Figure 6.5).

The C_ASSAY table comprises records for sampling interval and assay result for Fe, SiO_2, Al_2O_3, Mn, TiO_2, CaO, MgO, K_2O, P, S, and Na_2O, in addition to the determination of Loss on Ignition (LOI) and mass recovery from DTR analysis. Analysis of LOI was treated the same as the H_ASSAY data. Although a DTR sample interval undergoes XRF analysis for the head (full sample fraction), magnetic fraction, and non-magnetic fraction, only the magnetic fraction is imported into database and used in estimation. There is a clear population split in the modal sample intervals (Figure 6.6), with the southern third of the deposit south of 17,225mN predominantly sampled at 4m interval lengths (Figure 6.7) and the northern two thirds of the deposit north of 17,225mN predominantly sampled at 8m interval lengths (Figure 6.8).

Although all lithologies were sampled for concentrate analysis to varying degrees, the most important were the magnetite hosts, amphibolitised dykes, BIF, basal sequence, and eastern shear zone.

The spatial distribution of the two dominant C_ASSAY sample lengths is shown in Figure 6.9.

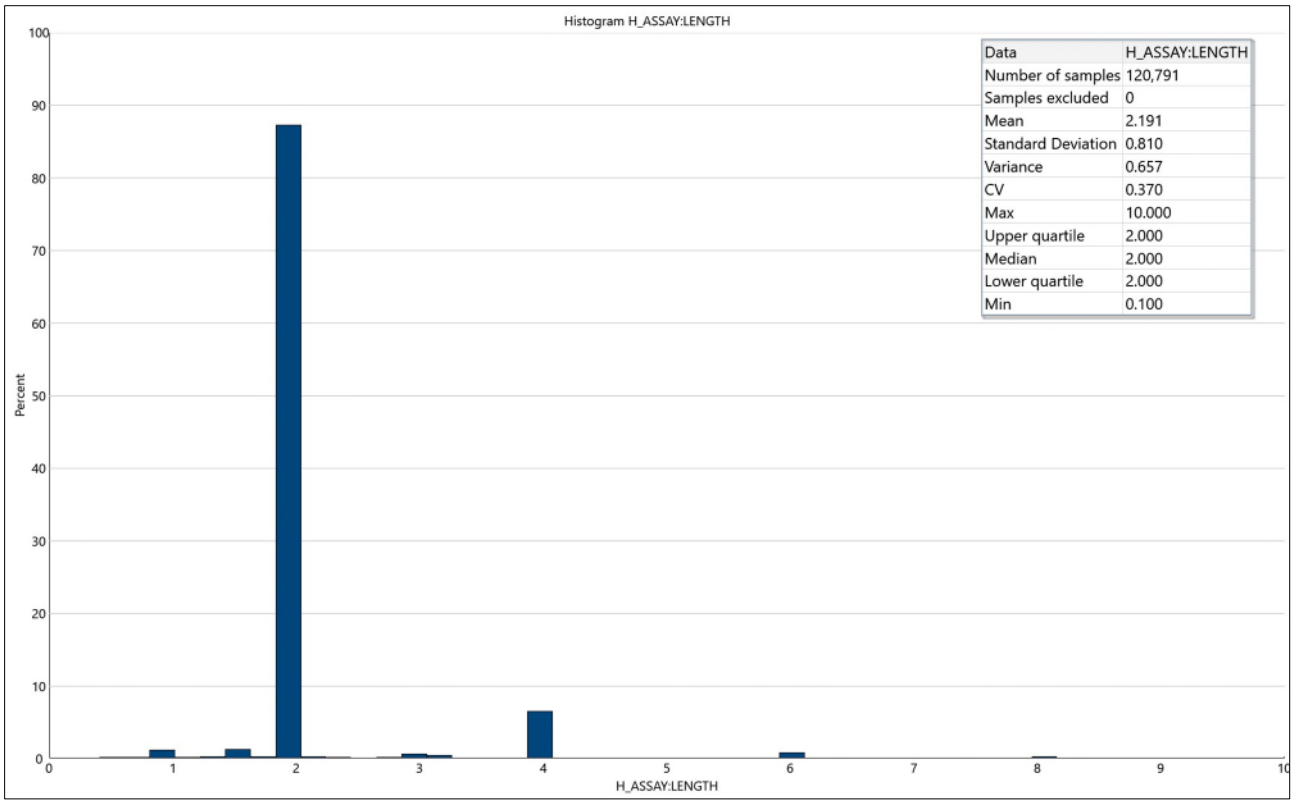


Figure 6.5 – Distribution of sample lengths for primary head assays (H_ASSAY) XRF analysis.

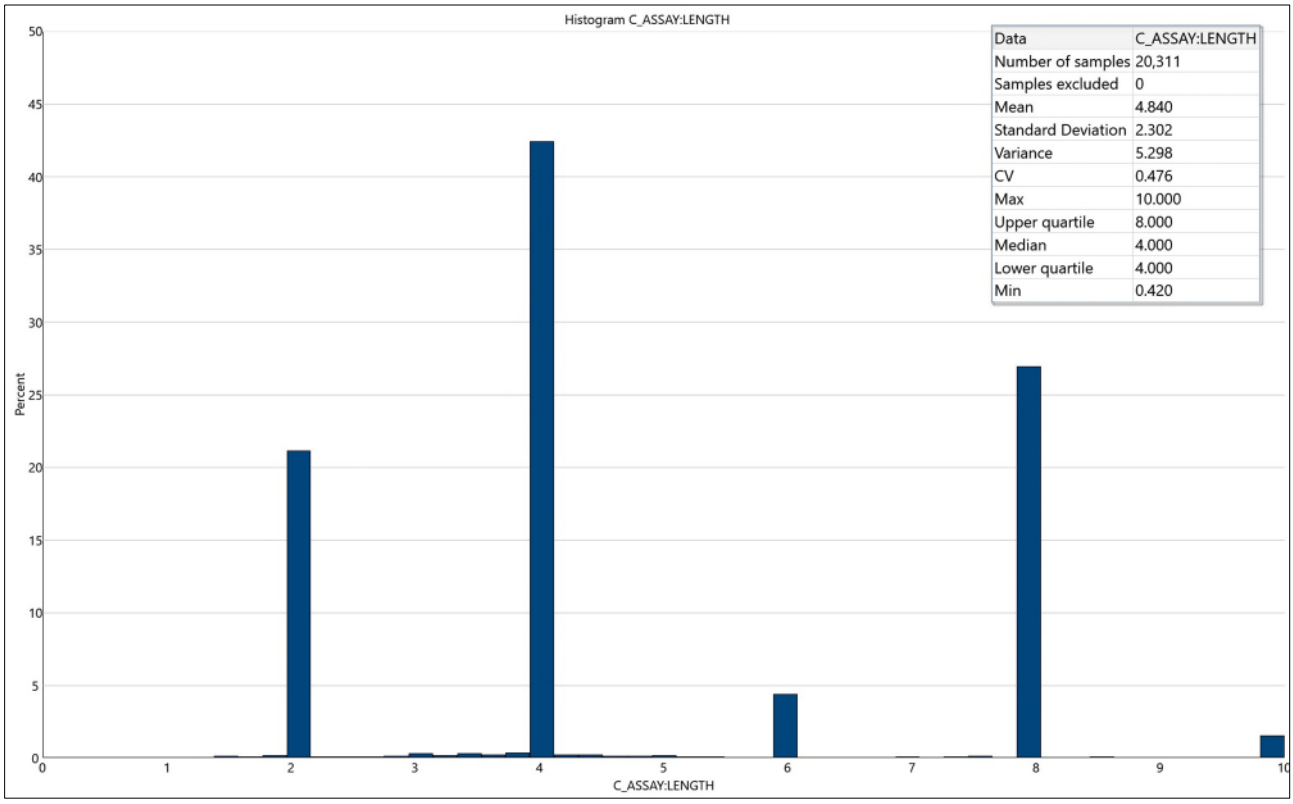


Figure 6.6 – Distribution of sample lengths for secondary concentrate assays (C_ASSAY) DTR and XRF analysis.

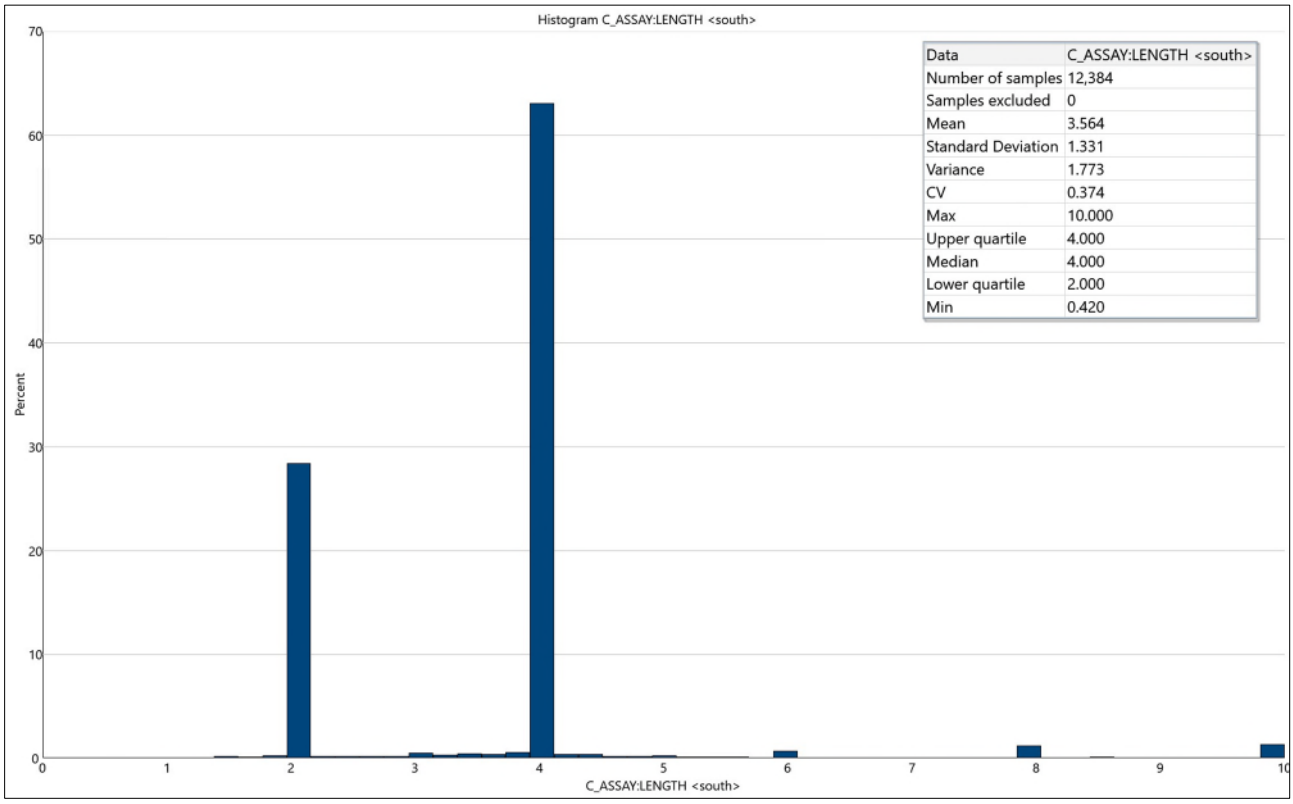


Figure 6.7 – Distribution of sample lengths for secondary concentrate assays (C_ASSAY) DTR and XRF analysis south of coordinate 17,225mN.

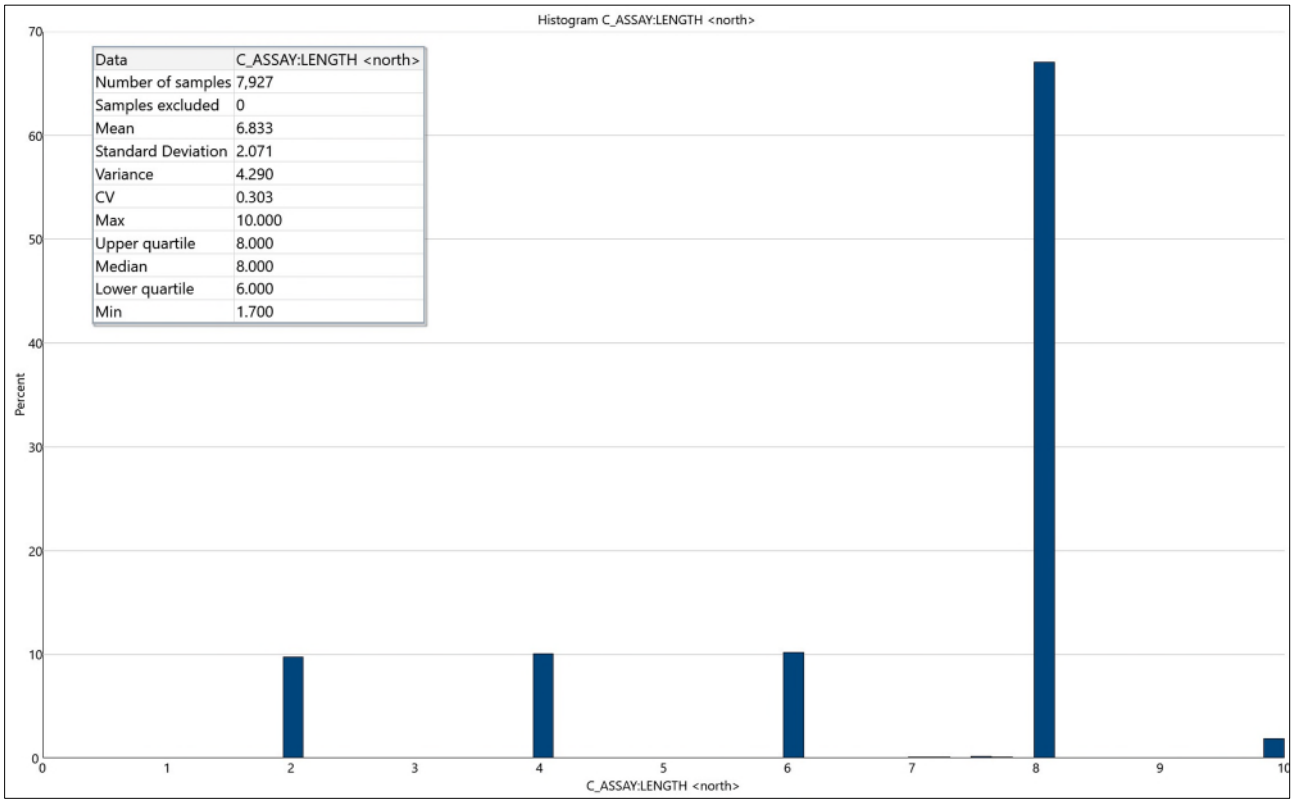


Figure 6.8 - Distribution of sample lengths for secondary concentrate assays (C_ASSAY) DTR and XRF analysis north of coordinate 17,225mN.

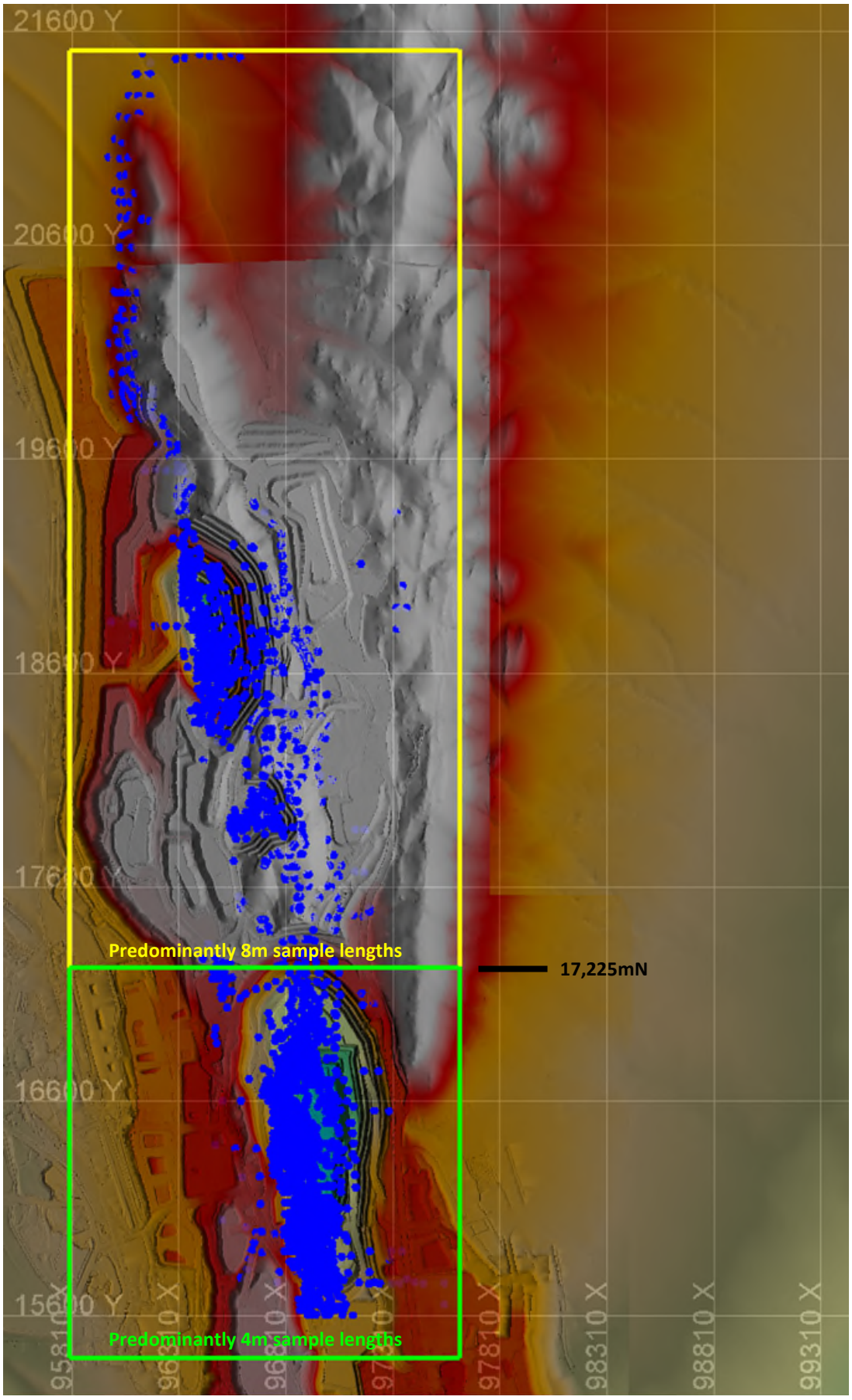


Figure 6.9 – Plan view of the Duchess South area showing 1 July 2023 topographic surface, all drillhole collar locations (blue) and the areas of predominantly 4m and 8m C_ASSAY sample Intervals.

RC sample recovery is recorded by means of a visual assessment of the volume of material exiting the rig-mounted cyclone. A summary of the estimated recoveries where recorded are shown in Table 6.3.

Table 6.3 – RC sample recovery for 2m drilling intervals.

Recovery	Count of Samples	% of Total
0 – 20%	686	1
20 – 40%	2,105	10
40 – 60%	55,065	64
60 – 80%	5,867	7
80 – 100%	175	<1
Not recorded	20,595	25
Total	85,647	

Most drilling in the Duchess South area occurs in dry conditions, with <1% of samples being recorded returning as moist or wet. Table 6.4 summaries the estimated moisture conditions for RC samples.

Table 6.4 – Estimated moisture conditions for RC sampling

Condition	Count of Samples	% of Total
Dry	62,368	73
Moist	1,184	1
Wet	1,065	1
Not recorded	21,030	25
Total	85,647	

6.1.5 Density Records

Density data for the deposit comes from two sources:

- 1,935 non-contiguous diamond drill core samples typically at sampling intervals of 15cm to 40cm from 30 diamond core drill holes, determined by Archimedes method, located in the central and northern third of the deposit.
- 309,832 contiguous short-spaced gamma density probe (SSD) samples typically at 10cm intervals from 208 RC drill holes, located mostly in the southern third of the deposit over the footprint of the Magnet Pit, and at a wider spacing in the northern part of the deposit.

Figure 6.10 shows the spatial distribution of density data. The frequency distribution of sample intervals for the Archimedes and SSD data are shown in Figure 6.11 and Figure 6.12 respectively, and the distribution of density values in Figure 6.13 and Figure 6.14.

The Archimedes data was not considered for density estimation due to:

- Paucity of coverage.
- Small non-contiguous sampling nature that cannot be composited across unsampled intervals.

In addition, an updated approach to estimation of density using SSD data at the Chieftain West deposit indicated that estimation using SSD data alone would be sufficient at the Duchess South deposit.

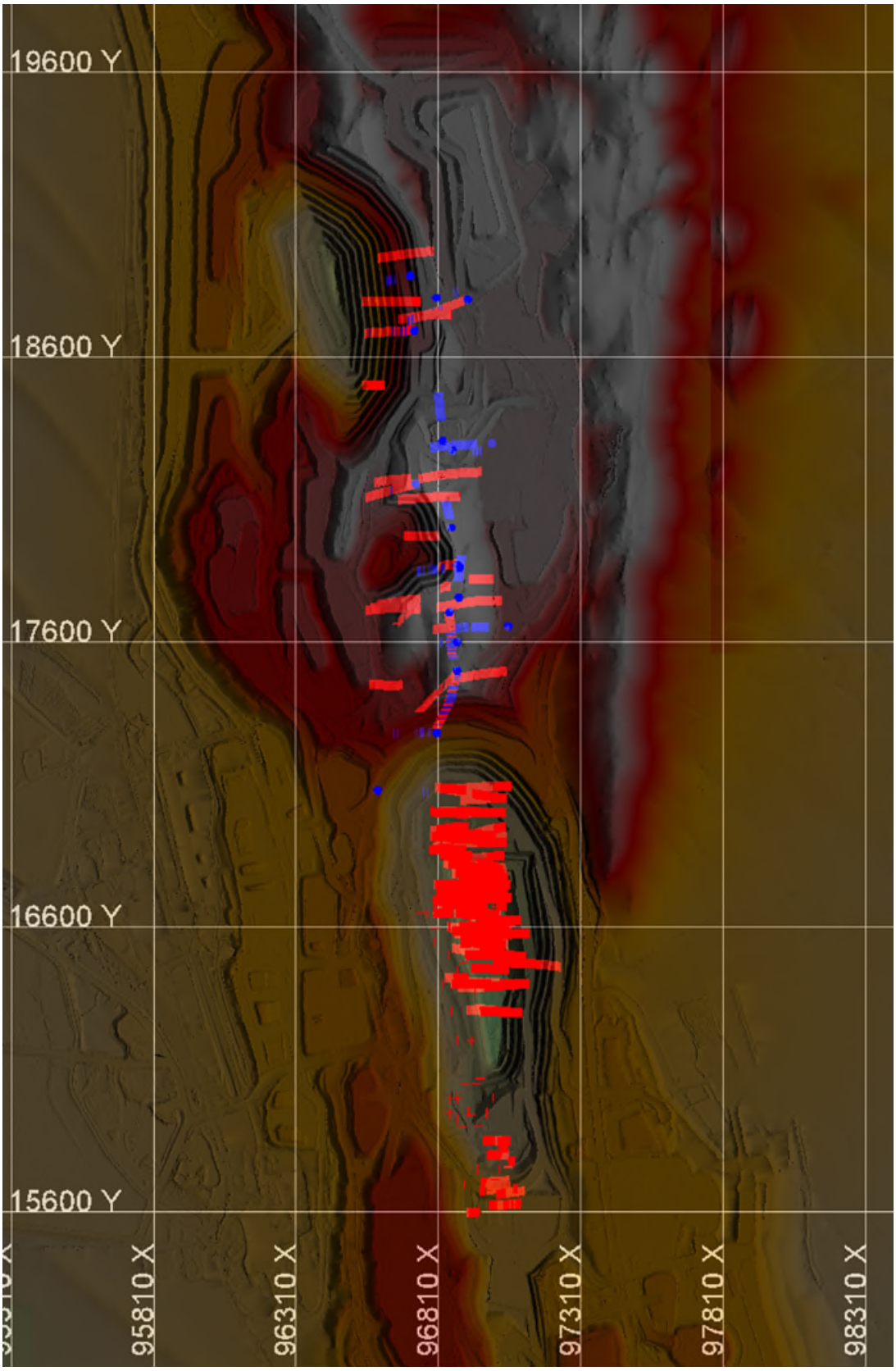


Figure 6.10 – Plan view of the Duchess South area showing 1 July 2023 topographic surface and distribution of Archimedes density data (blue) and SSD wireline density data (red).

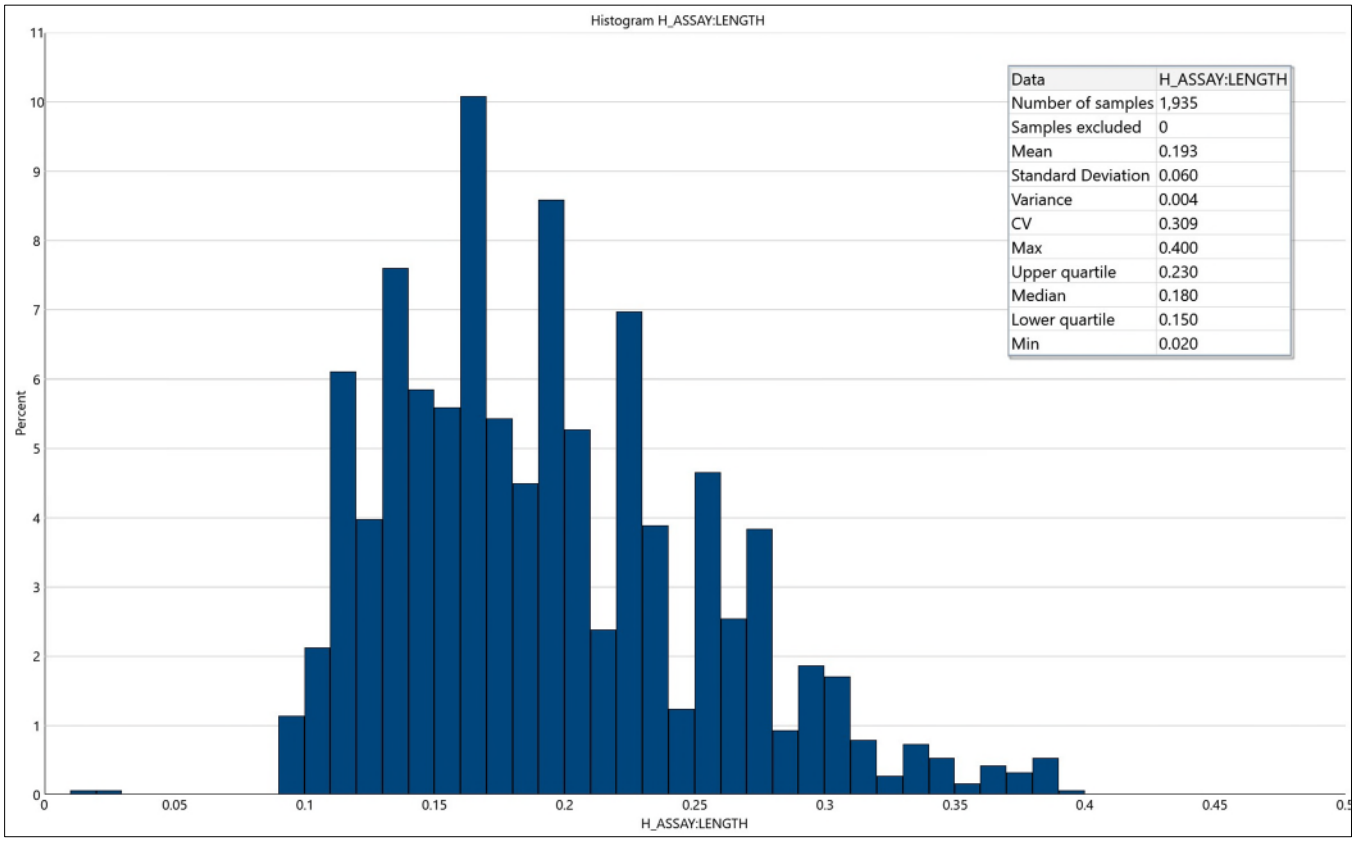


Figure 6.11 – Frequency distribution of Archimedes density sample lengths.

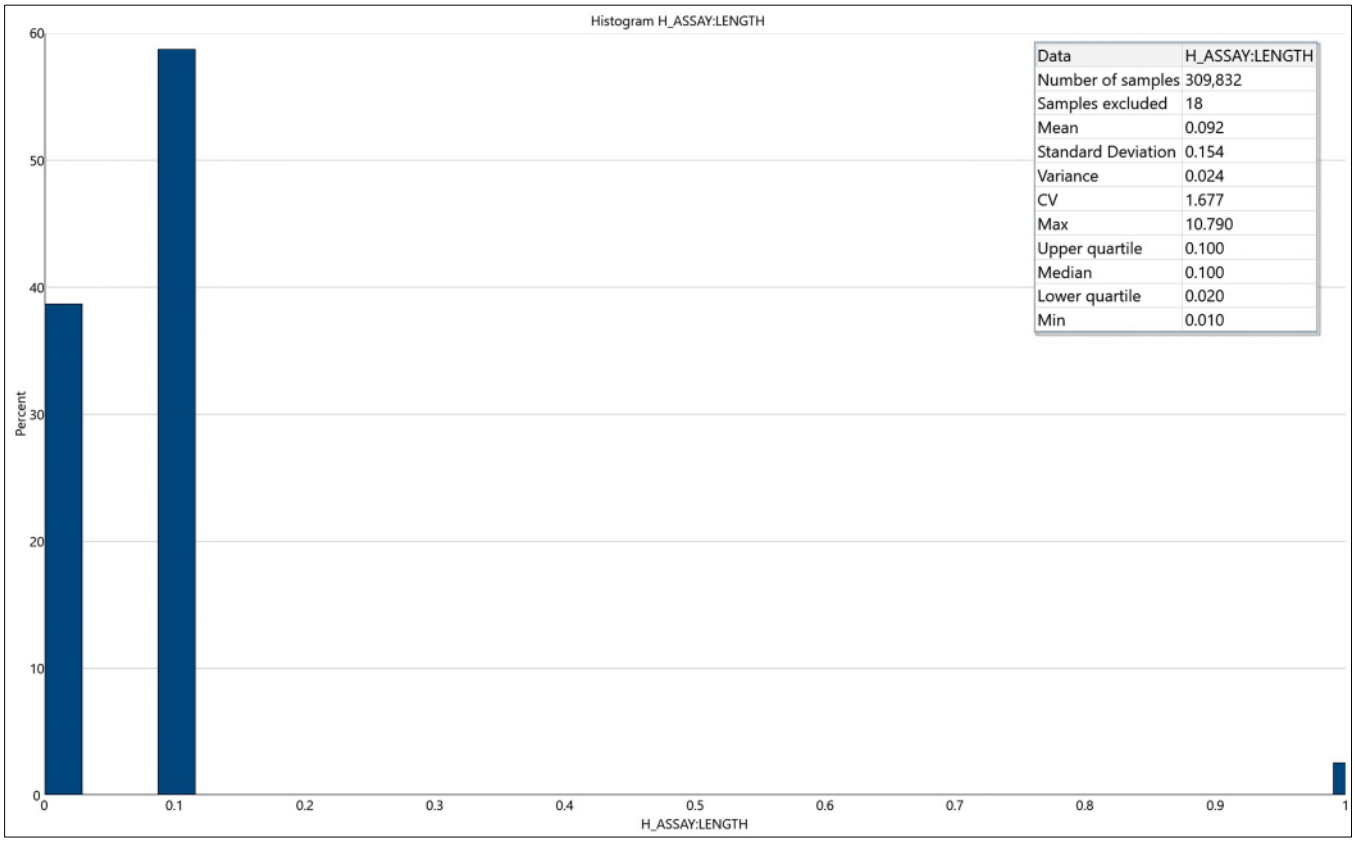


Figure 6.12 – Frequency distribution of SSD density sample lengths.

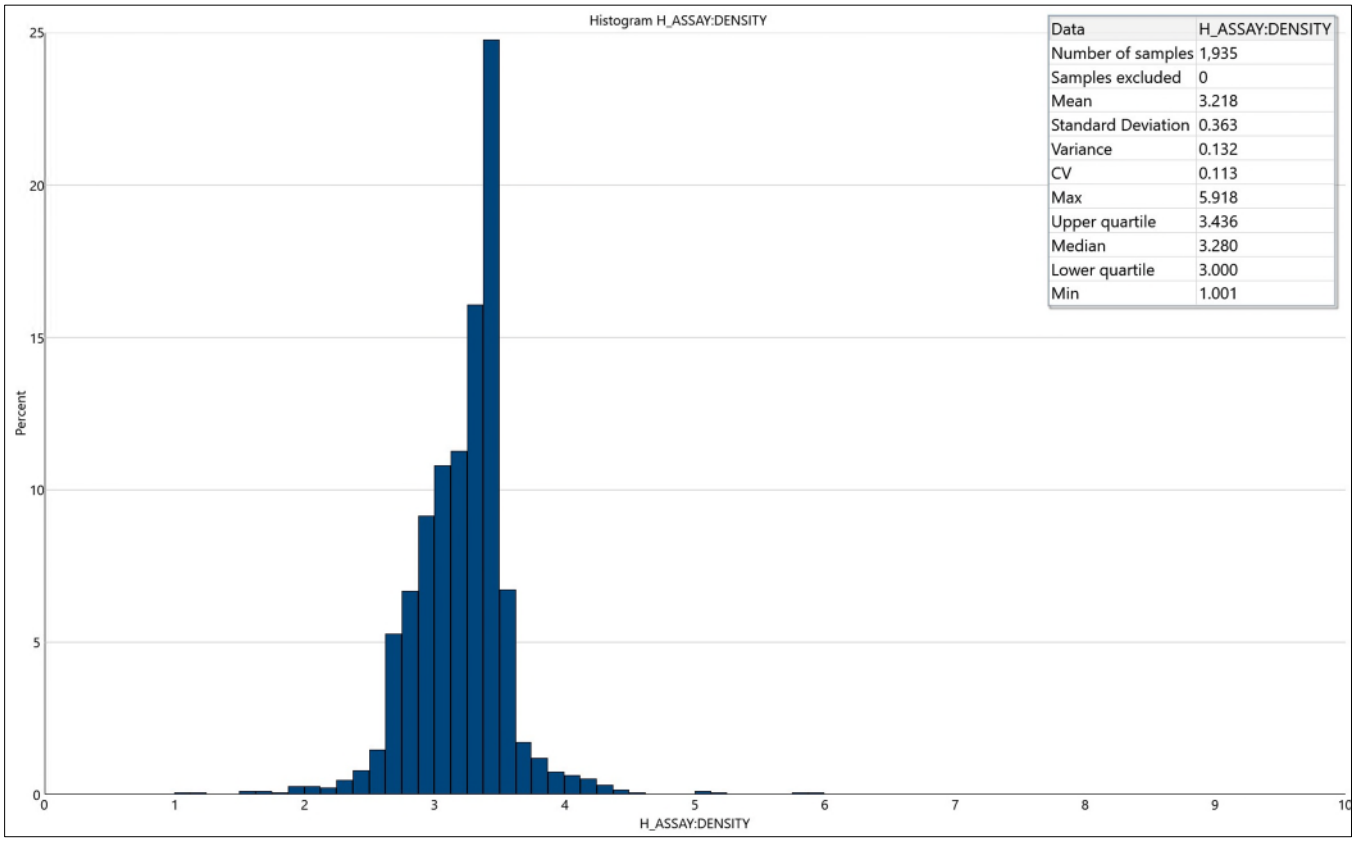


Figure 6.13 – Frequency distribution of density values from the Archimedes data.

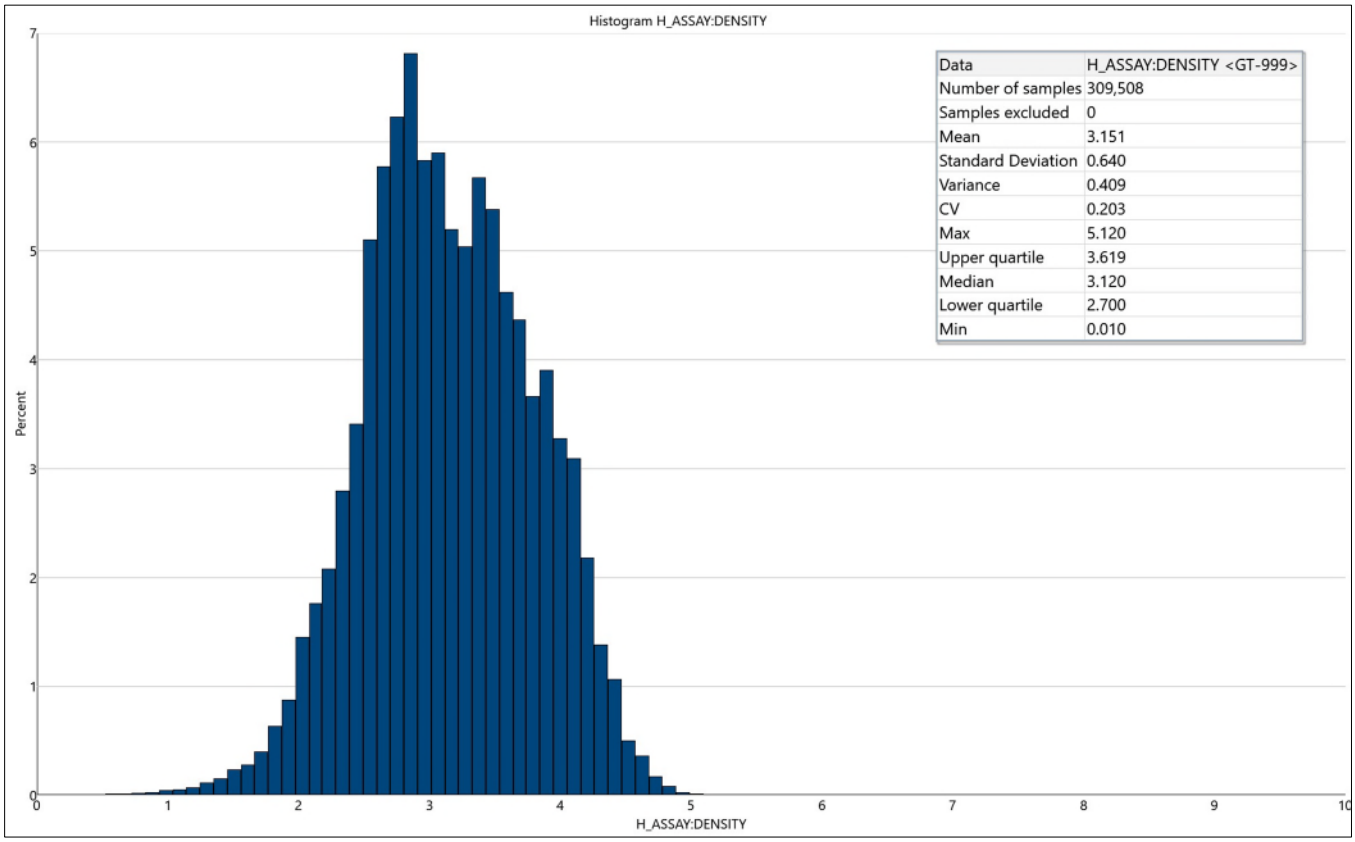


Figure 6.14 – Frequency distribution of density values from the SSD data.

6.1.6 Assay Detection Limits

Detection limits for the various analytes have varied over the decades that drill hole samples have been collected over the Duchess South area. In acQuire, modern assays reported as below analytical detection are stored as the detection limit preceded by a negative symbol. For example, for an analyte with a detection limit of 0.01%, an assay reported as below analytical detection is stored as -0.01. Some older drillhole assays that were reported as below analytical detection limit are stored as 0 (zero).

Assay records in acQuire are exported to .csv format as stored. During import to a Vulcan database, a script is used to set assays reported as below analytical detection, to half-detection. Assays reported with a "non-zero" detection limit are multiplied by -0.5, whilst those reported with a "zero" detection limit are set to half the current detection limits of the laboratory, as illustrated in Figure 6.15. The script is run on both the H_ASSAY and C_ASSAY tables of the Vulcan database, then checked with the Database Geologist to ensure it matches the intended outcome.

```
if (k2o_h gt -999) then
  if (k2o_h eq 0) then
    k2o_h = 0.0005
  endif
  if (k2o_h lt 0) then
    k2o_h = k2o_h * -0.5
  endif
endif
if (mgo_h gt -999) then
  if (mgo_h eq 0) then
    mgo_h = 0.005
  endif
  if (mgo_h lt 0) then
    mgo_h = mgo_h * -0.5
  endif
endif
if (mn_h gt -999) then
  if (mn_h eq 0) then
    mn_h = 0.005
  endif
  if (mn_h lt 0) then
    mn_h = mn_h * -0.5
  endif
endif
if (na2o_h gt -999) then
  if (na2o_h eq 0) then
    na2o_h = 0.0005
  endif
  if (na2o_h lt 0) then
    na2o_h = na2o_h * -0.5
  endif
endif
if (p_h gt -999) then
  if (p_h eq 0) then
    p_h = 0.0005
  endif
  if (p_h lt 0) then
    p_h = p_h * -0.5
  endif
endif
```

Figure 6.15 – Extract from a script used to set half-detection limits for H_ASSAY analytes reported as below detection limit using either a "zero" or "non-zero" detection limit value,

The current detection limits for the XRF4 analysis suite at BV Whyalla are (in percentage):

Fe (0.01)	SiO_2 (0.01)	Al_2O_3 (0.01)	Mn (0.01)	TiO_2 (0.005)	Cao (0.01)
MgO (0.01)	K_2O (0.002)	P (0.002)	S (0.002)	Na_2O (0.02)	Cu (0.001)
Pb (0.002)	Zn (0.002)	Ba (0.002)	V (0.002)	As (0.001)	Co (0.001)
Cr (0.001)	Ni (0.001)	Sn (0.001)			

7 Geological Modelling and Domaining

7.1 Methodology

Prior to an update of the geological model of the Duchess South area, a full review of de-surveyed downhole XRF, SATMAGAN and DTR/GLIB assays and lithology logs was completed using ioGas software. This enabled the geochemical validation of current geological logging practices and the recalibration of historical logging practices, leading to the simplification of decades of subjective geological logging across the deposit. The major changes that resulted from this work, and the recent additional drilling data acquired, were:

- Definition of standarised litho-geochemical modelling criteria
- Simplification of the magnetite mineralised domains
- Improved characterisation of internal schist (SCH), shear zone (ESZ) and the overlying oxidised banded iron formation (BIF) units.

Lenses of magnetite carbonate (MTC) and magnetite talc (MTT) beneath the depleted Iron Duchess haematite deposit were reclassified as magnetite silica (MTS) based on geochemistry, as well as newer observations from recent drilling in the area. This has resulted in a well constrained continuous body of MTS mineralisation trending north-northwest (NNW) from the Iron Magnet Pit in the south to Iron Duchess Pit in the north.

Following earlier reviews of the inability for traditional wireframing techniques to capture the observed geometry of geological units, implicit modelling techniques using LeapFrog software were used to develop robust geological models that better reflected the geological and geochemical data gathered from drilling activities. The use of this software ensures that:

- model updates are achieved faster than traditional methods
- models reflect geological interpretations that are more data driven and less subjective
- model wireframe boundaries are contiguous
- model wireframes aren't biased as is the case with traditional sectional methods

Modelling in LeapFrog was completed using a category selection tool that assigns downhole composites a lithological interval. This selection was based on the standarised litho-geochemical classification criteria (Table 7.1) developed in ioGas from a complete review of all available drilling data, as well as experience and understanding gathered from exploration, mining, and metallurgical activities during several years of operations.

Lithological units within LeapFrog were modelled using in-built erosion, intrusion, vein, and deposit tools, but strictly guided using geological controls such as structural trends, polylines, and points, where required. Recent geotechnical and metallurgical diamond drill holes, and open pit mining exposures have been used to validate the interpretations. Model wireframes for resource estimation are verified by checking for crossovers, intersections, openings, and duplicate points, with changes made where necessary to obtain acceptable wireframe continuity and geometry.

The final geological model is reviewed by the Superintendent Exploration Geology, Superintendent Mine Geology, Mine Technical Services Manager, Chief Geologist, and Competent Person for the reporting of mineral resources, prior to its use in estimation.

The disposition of, and relationship between, lithological domains modelled in LeapFrog are shown in Figure 7.1.

Table 7.1 – Lithogeochemical classification criteria guidelines for Duchess South.

LITH	Description	Fe%	Fe_3O_4%	SiO_2%	Al_2O_3%	MgO%	CaO%	LOI%	TiO_2%	Mn%	S%
AMP	Amphibolitised Dykes	15–30%	<5%	35–55%	5–20%	~5%	~1%	~8%	0.5–3%		
CGS	Cook Gap Schist	<10%	<5%	~70%	~10%	~1.5%	~0.5%	~4%	~0.3%		
SCH	Internal "Schist"	15–25%	~10%	55–80%	<1%	3-10%		~3%		>0.15	>0.1
HEO	Haematite	>47%	<5%	$SiO_2 + Al_2O_3$ <14%			1–7%				
HEC	Haematite carbonate	35–50%	5–20%	~10%	<1%	~7%	~7%	~13%			
BIF	Banded Iron Formation	10–45%	<5%	20–90%	<5%	<1%	<1%	1–7%			
MBF	Magnetite Banded Iron Formation	10–45%	5-25%	30–80%	<5%	<1%	<1%	<4%			
HBF	Haematite Banded Iron Formation	10–45%	<5%	30–80%	<5%	>2%	>1%	>4%			
MTS	Magnetite Silica	~30%	>25%	~50%		~2.5%	~1%	~0.3%			
MTC	Magnetite Carbonate	>40%	30–50%	15–40%	<1%	~7.5%	~6.5%	~9%		>0.4%	
BSQ	Basal Sequence	~20%	<10%	~45%	<1%	~7.5%	~2.5%	~6%		~0.4%	>1%
DOM	Katunga Dolomite	~10%	<3%	10–20%		~20%	~10%	~20%			
MSU	Magnetite Sulphide	~20%	>10%	<45%							>1%
GRT	Basement Granite	~5%	<1%	~70%	~14%	<1%	<1%	~1%	0.25%		

AMP - amphibolised dyke (often dolerite). Typically, massive micro-crystalline intrusive dykes and sills. Principally composed of chlorite after hornblende with lesser amounts of fine-grained plagioclase feldspar.

CGS - moderately foliated chlorite-quartz-lenticle schist. Eastern contact to all mineralised rocks at Duchess South.

SCH - conformable quartz-chlorite-amphibole unit. Internal to Middleback Iron Formation. Sometimes locally mineralised.

HEC - alteration/weathering product of primary magnetite carbonate mineralisation, with carbonate as dolomite and ankerite as veins and breccia fill.

BIF - laminated chemical sediment composed of alternating bands of quartz and weathered iron oxides, goethite and hematite after magnetite, haematite, and iron silicate minerals.

MBF - transitional BIF containing between 5% and 20% magnetite. Typically observed at the base of the overlying oxidised BIF and transitional to magnetite mineralisation.

HBF - non-magnetic partially iron-enriched alteration halo surrounding the haematite mineralisation at the Iron Duchess Pit.

BSQ - transitional unit of dolomite, amphibolite schist, semi-massive sulphides (pyrite + pyrrhotite), chert and lesser magnetite mineralisation. Western contact to all mineralised rocks at Duchess South.

DOM – massive grey to pink coloured impure dolomite containing appreciable amounts of ankerite and calcite, and minor amounts of siderite. Locally some minor occurrences of sulphide veining.

GRT - equigranular quartz-orthoclase-muscovite granitic rock.

MTS - magnetite mineralisation comprising of alternating magnetite-rich silica-poor, and magnetite-poor silica-rich, banding at centimetre scale. Typically, comprises of 45% magnetite and 55% fine grained quartz.

MTC - magnetite mineralisation with carbonate as dolomite and ankerite veins and breccia fill. Source of the highest-grade magnetite ore.

MSU - magnetite mineralisation with pyrite and pyrrhotite. Hosted within the BSQ.

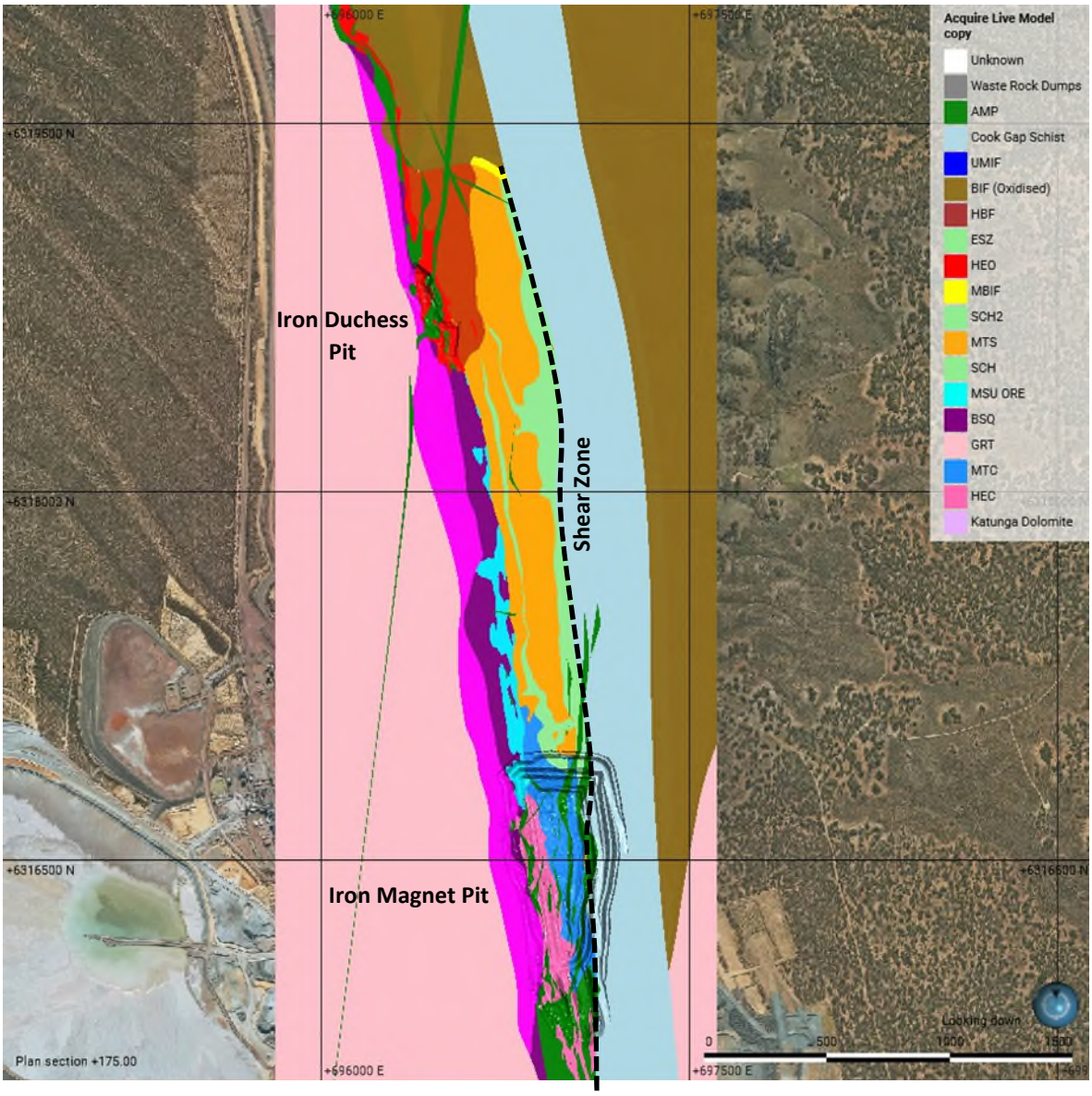


Figure 7.1 – Plan view at the +175mRL of the Duchess South area showing the major lithological units of the geological model.

7.2 Magnetite Domains

The main magnetite domains in the Duchess South area are:

- MTS: magnetite silica
- MTC: magnetite carbonate
- MSU: magnetite sulphide

7.2.1 Magnetite Silica (MTS)

MTS is the dominant magnetite-host domain in the Duchess South area. It is a massive semi-tabular unit and is typically composed on 45% magnetite and 55% fine-grained quartz, with lesser amounts of carbonate and other silicate minerals. MTS was modelled as a continuous body with a strike length of ~2.5 km (Figures 7.2). It dips moderately to steeply at 80° to the east. MTS is dissected with at least two lenses of conformable “schist” (SCH) that form internal waste to the main body of magnetite mineralisation, although they are sometimes locally mineralised with economic concentrations of magnetite and are often also described as “altered MTS”.

North of 18,600N there is a decrease in SATMAGAN from >25% to >15%, and increasing abundance of silica, although mass recovery values still exceed 20%. The variation in composition north and south of 18,600 N may be due to either an alteration halo surrounding the haematite mineralisation (MBF) immediately west of the MTS unit in the vicinity of the Iron Duchess Pit, or to lateral and vertical compositional variation of the primary banded iron formation (BIF) host rock.

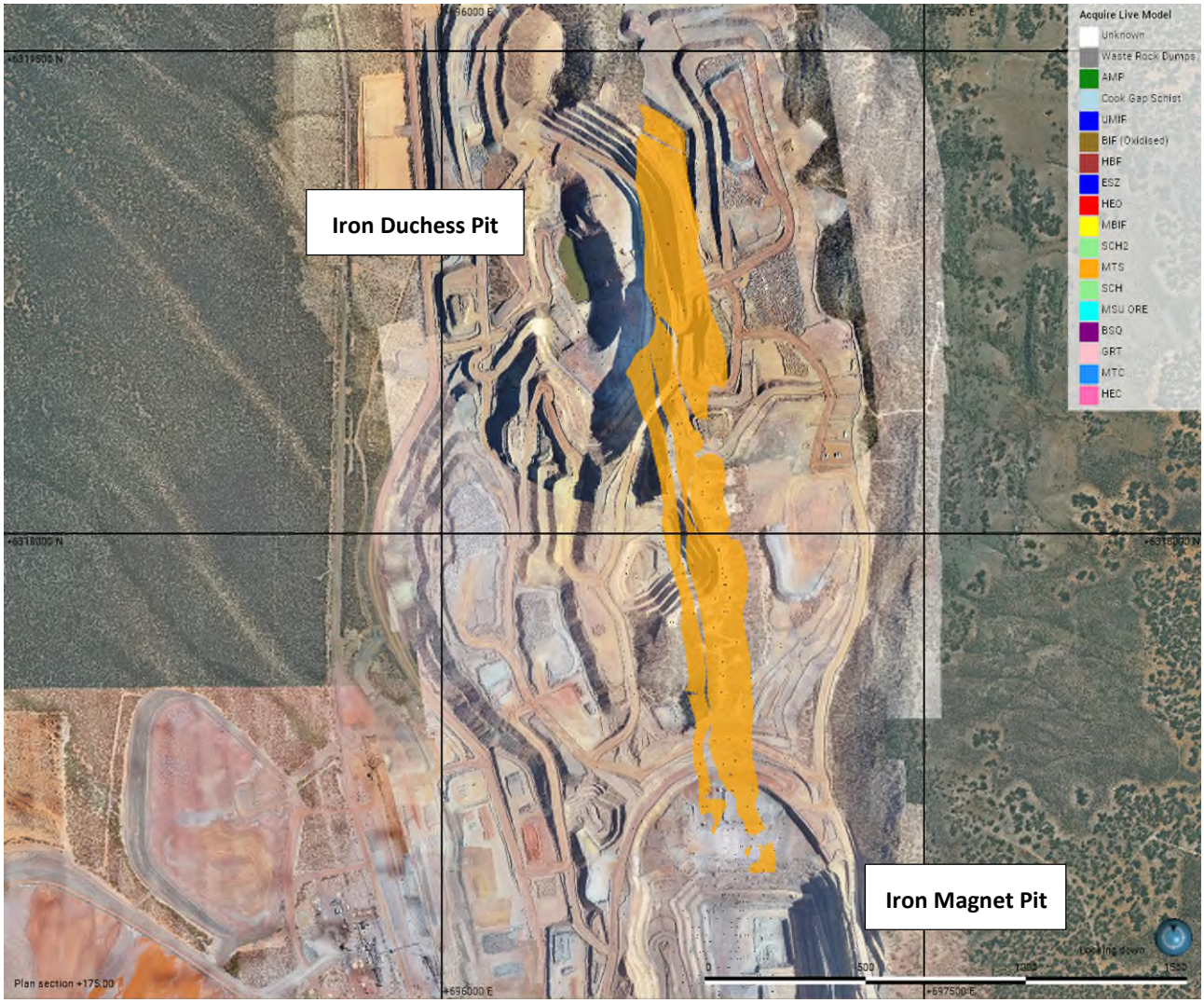


Figure 7.2 – Plan view of the Duchess South area showing the footprint of the MTS at the 165mRL, relative to the Iron Magnet Pit (magnetite mining operation) and the Iron Duchess Pit (haematite mining operation).

7.2.2 Magnetite Carbonate (MTC)

MTC is the highest-grade magnetite domain and has been a major source of ore from the Magnet Pit over the years. There is evidence for significant structural control of MTC and it is restricted to the footprint of the Magnet Pit (Figure 7.3). North of the Magnet Pit it appears to pinch out, after which only MTS is present (Figure 3.4). MTC is composed of magnetite mineralisation with carbonate as dolomite and ankerite veins and breccia fill. MTC is typically composed of >40% Fe, between 15 to 40% SiO_2, and elevated MgO (~7.5%) and CaO (~6.5%).

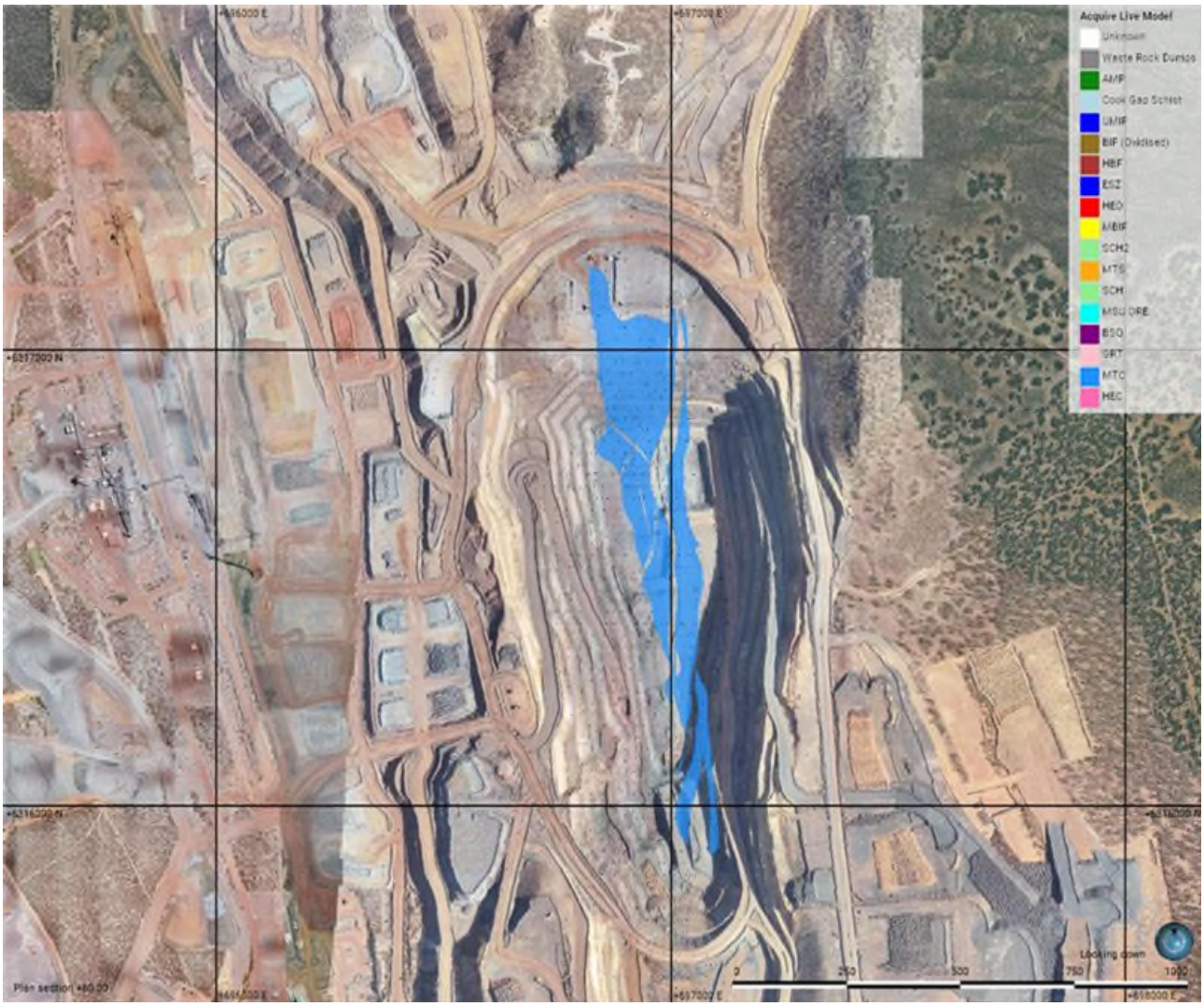


Figure 7.3 – Plan view of the Duchess South area showing the footprint of the MTC at the 60mRL, relative to the Iron Magnet Pit (magnetite mining operation).

7.2.3 Magnetite Sulphide (MSU)

The Magnetite Sulphide Unit (MSU) is a magnetite unit with elevated mass recovery and S%, and whilst not a primary magnetite ore source, it represents a significant volume of material. It is located at the contact of the Basal Sequence (BSQ) and the MTS, at the transition between barren lower carbonate-rich dolomite rocks and higher iron rich rocks of the Middleback Iron Formation. There is evidence of strong structural influences and control as the MSU often contains visible pyrite and/or pyrrhotite in chip samples, core samples and in exposures in the west wall of the Iron Magnet Pit. The MSU is less continuous than other magnetite domains, and typically manifests as discontinuous discrete lenses with variable length and width along the strike of the Duchess South area (Figure 7.4).

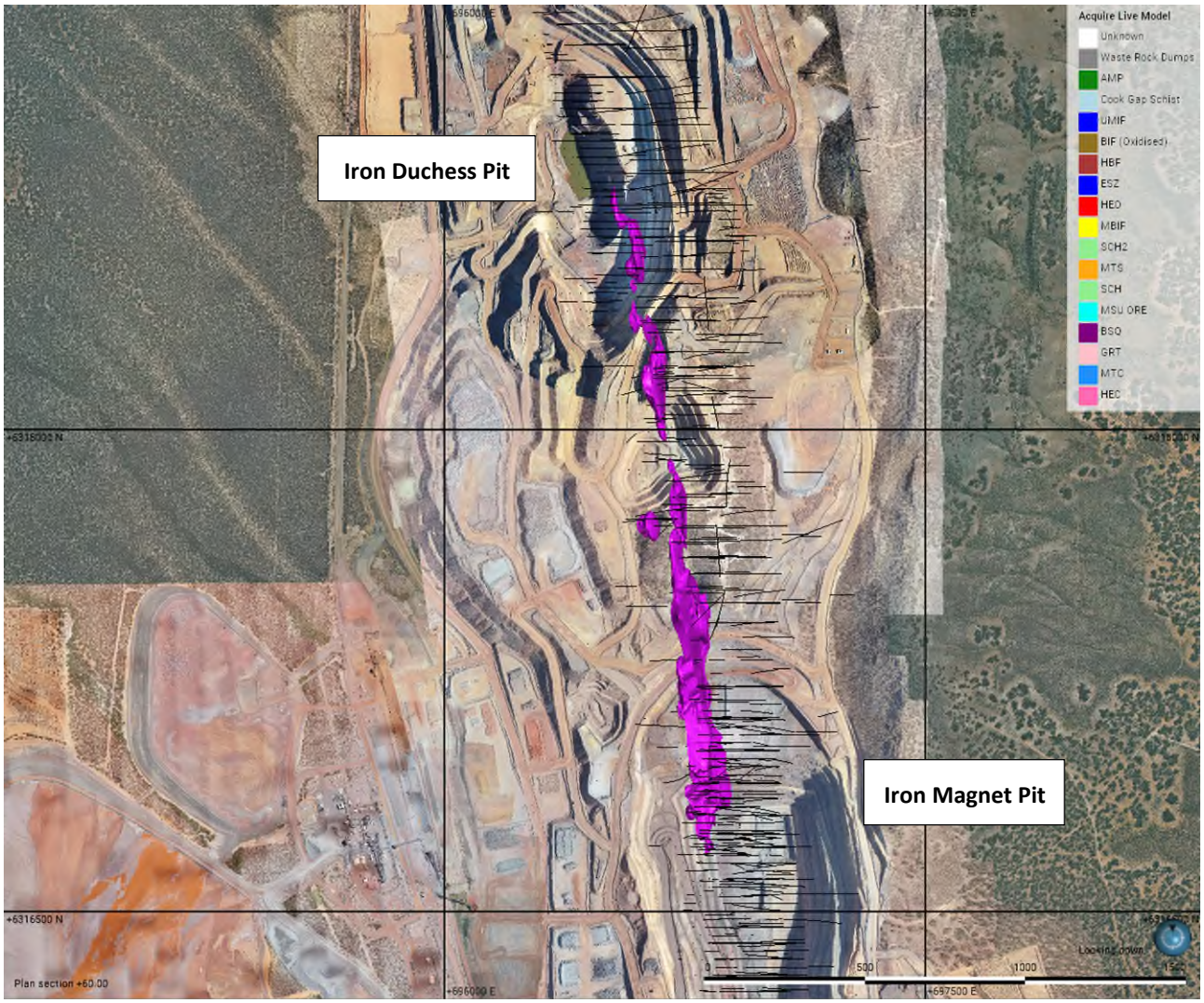


Figure 7. 4 – Plan view of the Duchess South area showing the footprint of the MSU at the 60mRL, relative to the Iron Magnet Pit (magnetite mining operation) and the Iron Duchess Pit (haematite mining operation).

7.2.4 Magnetite BIF (MBF)

The Magnetite Banded Iron Formation / Magnetite BIF (MBF) is a highly discontinuous, thin, and patchy unit hosted within the overlying BIF that may be beneficiated by high-intensity magnetic separation in the future. It is composed of transitional BIF containing between 5% and 20% magnetite. It is typically observed at the base of the overlying oxidised BIF and transitional to magnetite mineralisation and is probably a weathering and alteration product of magnetite. It has a general paucity of drilling intersections, and is modelled as a thin discontinuous, lens-like domain (Figure 7.5).

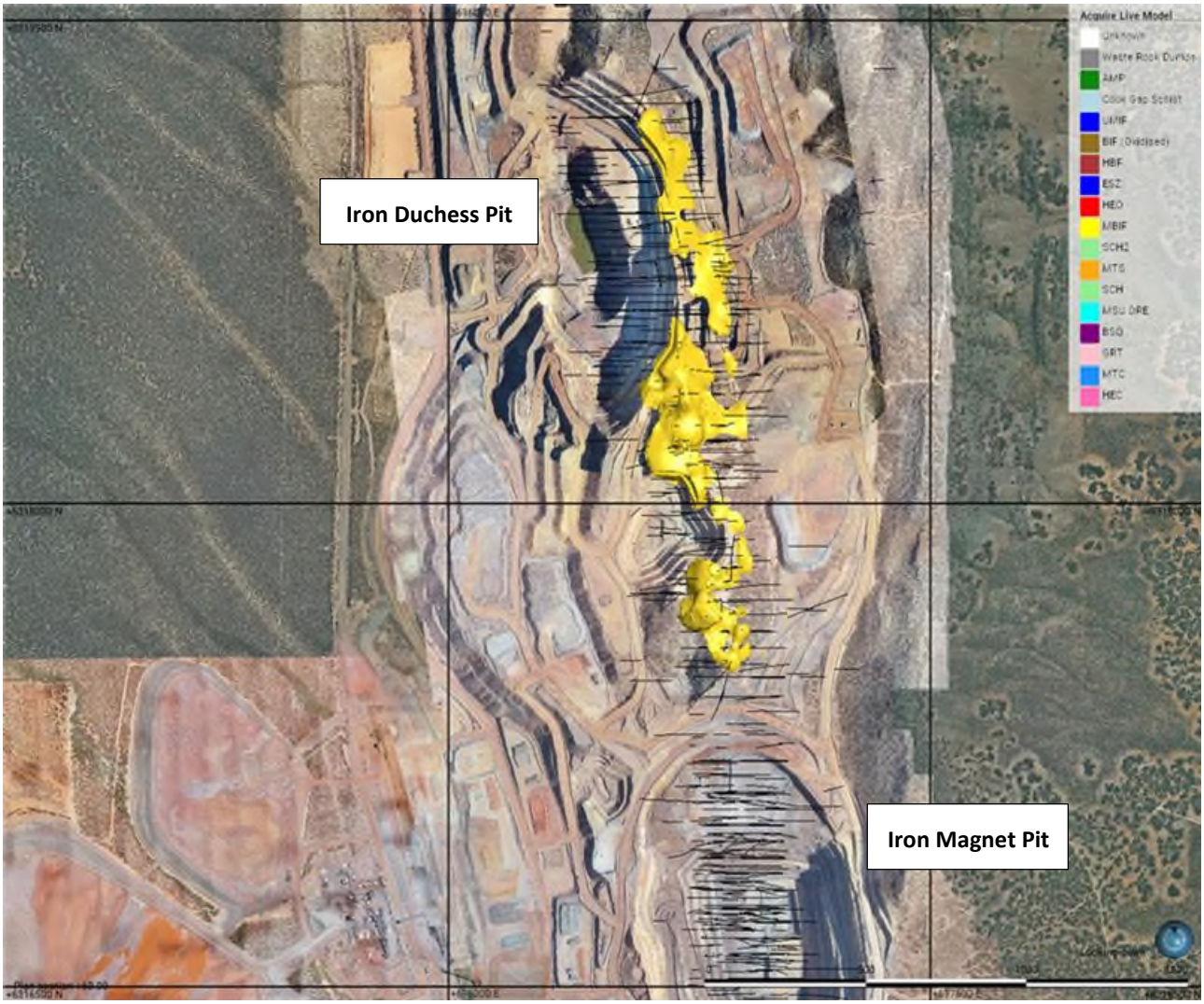


Figure 7. 5 – Plan view of the Duchess South area showing the footprint of the MBF at the 60mRL, relative to the Iron Magnet Pit (magnetite mining operation) and the Iron Duchess Pit (haematite mining operation).

Figure 7.6 to Figure 7.11 show the disposition of the major magnetite host domains (MTS, MTC and MSU) relative to other lithological domains of the geological model.

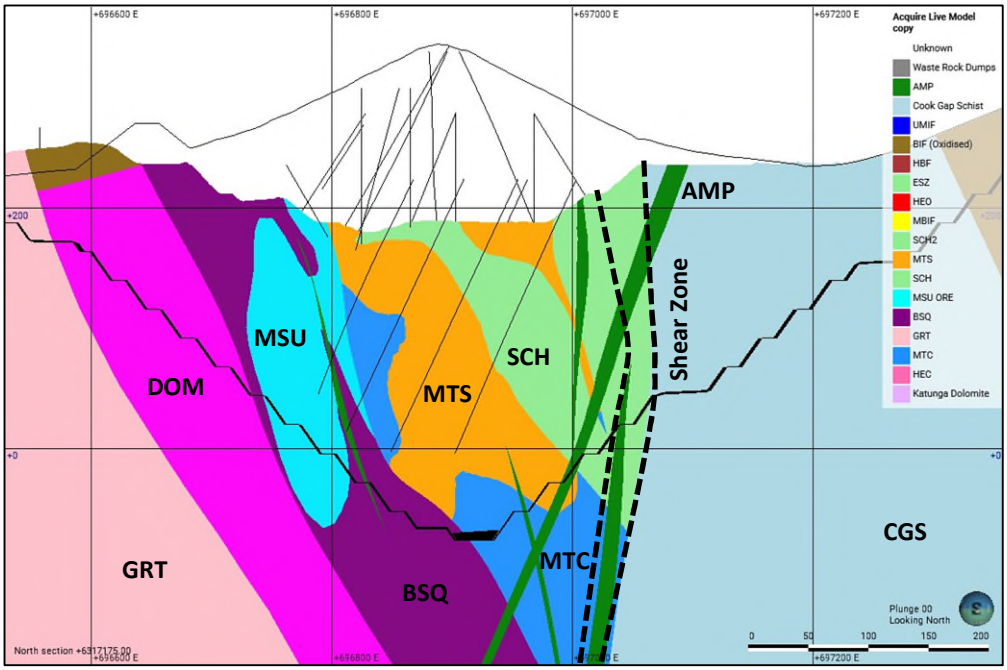


Figure 7.6 – Cross section at 17,175mN looking north through the Duchess South area in the vicinity of the Magnet Pit showing, showing the disposition and relationships between the major lithological units. Refer to Table 7.1 for lithological codes.

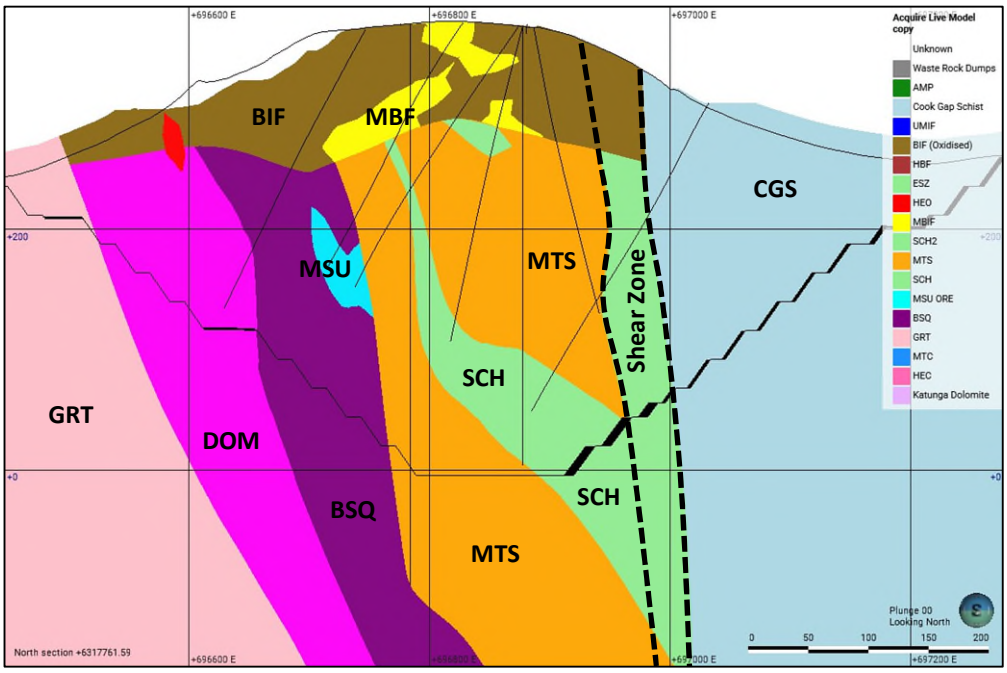


Figure 7.7 – Cross section at 17,750mN looking north through the Duchess South area showing, showing the disposition and relationships between the major lithological units. Refer to Table 7.1 for lithological codes.

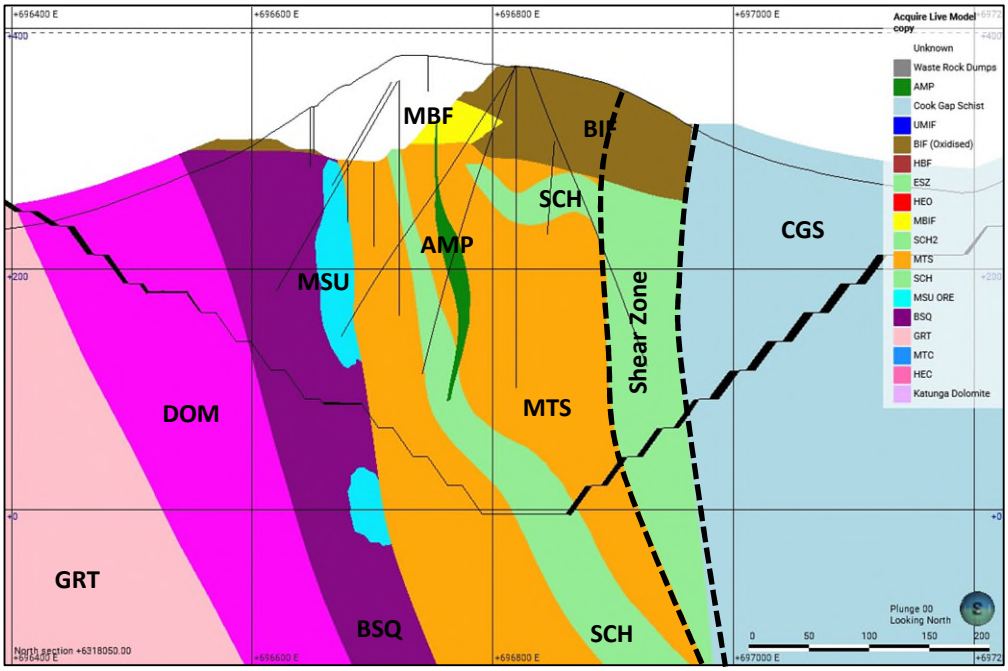
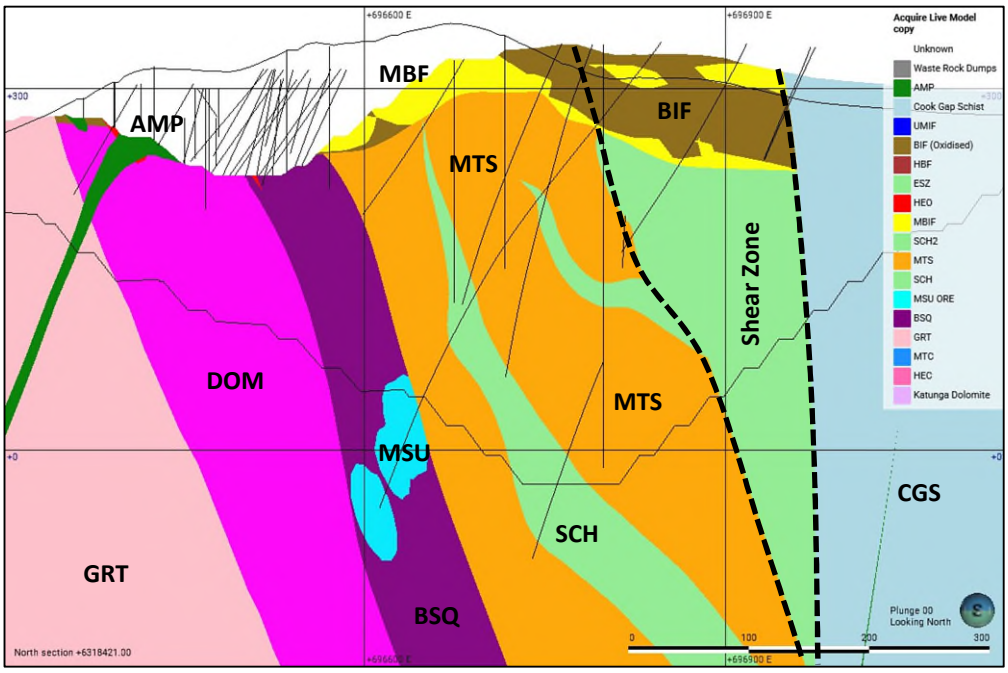


Figure 7.8 – Cross section at 18,050mN looking north through the Duchess South area in the vicinity of the depleted Duchess South Pit, showing the disposition and relationships between the major lithological units. Refer to Table 7.1 for lithological codes.



SCH

Figure 7.9 – Cross section at 18,421mN looking north through the Duchess South area in the vicinity of the Duchess Pit, showing the disposition and relationships between the major lithological units. Refer to Table 7.1 for lithological codes.

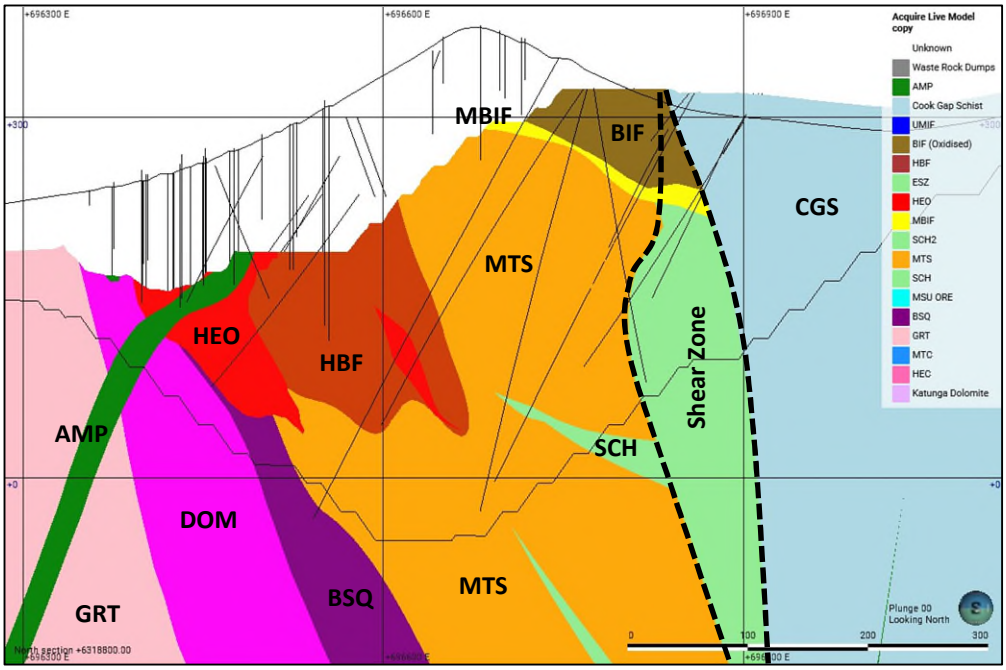


Figure 7.10 – Cross section at 18,800mN looking north through the Duchess South area in the vicinity of the Duchess Pit, showing the disposition and relationships between the major lithological units. Refer to Table 7.1 for lithological codes.

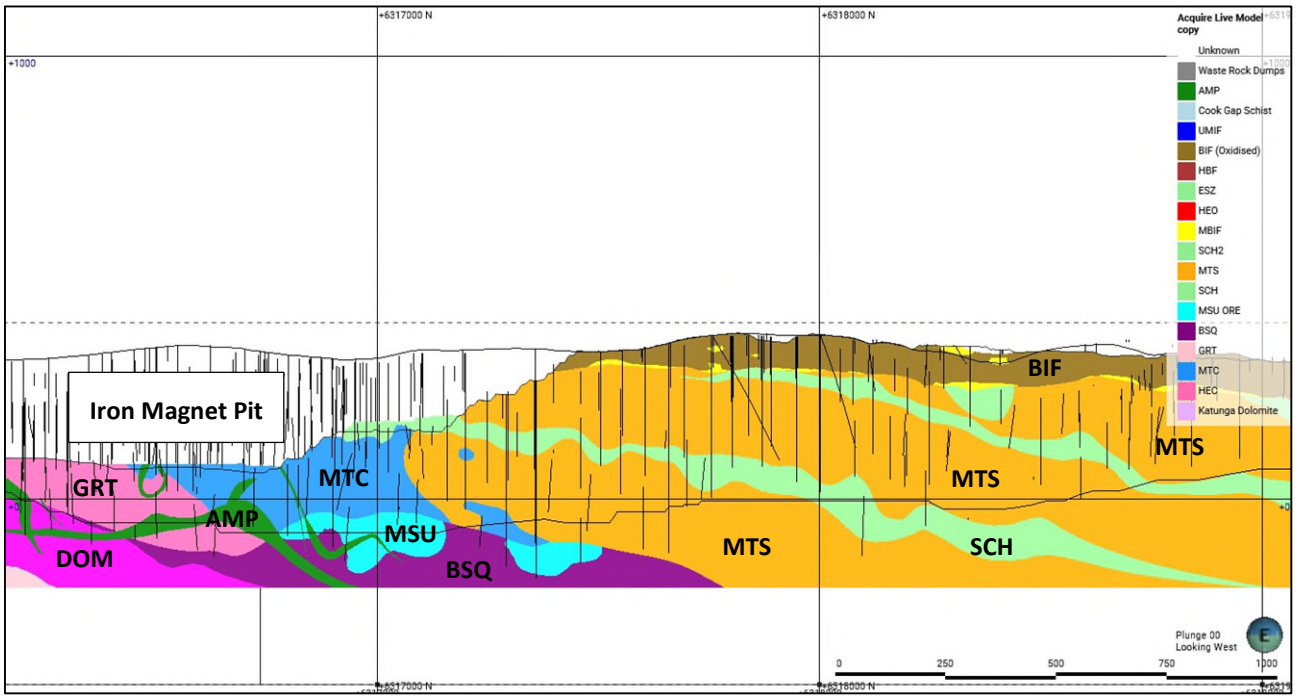


Figure 7.11 – Longitudinal section at 96900mE looking west through the Duchess South area, showing the disposition and relationships between the major lithological units. Refer to Table 7.1 for lithological codes.

7.3 Non-Magnetite Domains

7.3.1 Amphibolitised Dykes (AMP)

Non-mineralised amphibolitised dykes (AMP) of varying strike length and thickness crosscut the Duchess South area and are modelled as barren post-mineralisation features. In the south of the area, AMP is more abundant having a strong spatial association with the MTC, which in turn has a significant structural control. North of the Magnet Pit at the confluence of the major western and eastern shear zone structures, MTC is no longer present and thus there is significantly less AMP emplacement.

7.3.2 Cook Gap Schist (CGS) and Eastern Shear Zone (ESZ)

The CGS is a moderately foliated chlorite-quartz-lenticle schist, barren of magnetite mineralisation, with a typical geochemical composition of Fe < 10%, SiO_2 ~70%, Al_2O_3 ~10%, and TiO_2 ~ 0.3%. Due to its green colour, it is often mistakenly identified as AMP, however its felsic nature (~70% SiO_2) is in sharp contrast to the intermediate composition of AMP (SiO_2 < 55%). The CGS forms the eastern contact to all mineralised rocks at Duchess South.

The contact between CGS and the mineralised rocks immediately to the west is faulted, manifesting as a strongly foliated and altered shear zone (ESZ) with variable thickness along its strike. Locally the ESZ can be mineralised in places with low to marginal mass recovery grades, but there are insufficient drilling intercepts for this unit to be estimated with any confidence. Locally, the ESZ can show elevated P% and S% values.

7.3.3 Schist (SCH)

Internal to MTS mineralisation, there are multiple lenses of highly foliated silicate facies iron formation that are grouped and modelled as SCH. Geochemically, the present as a quartz-chlorite-amphibole unit with moderate Fe grades, elevated S% and MgO. Locally, these units have appreciable magnetite content to the point that part of the resource is hosted within these units, be at a much smaller volume than MTS.

7.3.4 Banded Iron Formation (BIF)

A BIF unit composed principally of SiO2 ~ 55% and Fe ~30% is modelled as a variable thickness overlying weathered and oxidised capping to the entire Duchess South area. Localised iron enrichment and depletion is associated with late-stage faulting.

7.3.5 Haematite Banded Iron Formation (HBF)

The HBF is a non-magnetic alteration halo surrounding the primary haematite mineralisation (HEO) at the Iron Duchess Pit. This unit is uneconomic with typical Fe grades of 30–40%. It is relatively elevated in MgO (5–15%), which is what differentiates it from the overlying oxidised BIF (< 1% MgO).

7.3.6 Basal Sequence (BSQ)

The Basal Sequence (BSQ) is a transitional unit marking the commencement of chemical sedimentation with the formation of the Katunga Dolomite and sulphide-facies Iron formation. The BSQ forms the western contact to all mineralised rocks at Duchess South. It includes lenses of dolomite, amphibolite schist, semi-massive sulphide (pyrite + pyrrhotite), chert and magnetite mineralisation. It's upper contact with the mineralised units is thought to be structural and closely related to the western shear zone. The BSQ generally contains >1% S associated with pyrite.

7.3.7 Granite (GRT)

The basement to the Middleback Ranges is equigranular quartz-orthoclase-muscovite granite. In places, it presents as a quartz-augen gneiss. Its position is interpreted from limited drilling, and exposures during mining in the Magnet and Duchess pits.

7.3.8 Katunga Dolomite (DOM)

The Katunga Dolomite is the lower most unit of the Hutchison Group Metasediments and marks the commencement of chemical sedimentation. It is typically a massive grey crystalline dolomite and where near high-grade haematite mineralisation is blood red due to haematite staining (e.g., Iron Duchess Pit). It is almost entirely dolomite but is observed on occasion to contain appreciable amounts of ankerite, calcite and lesser amounts of siderite. Occasionally some samples assay at higher S% due to localised occurrences of cm-thick sulphide veining.

7.3.9 Haematite (HEO)

Haematite (HEO) of sufficient high grade (Fe > 55% and Al_2O_3+SiO_2 < 14%) for direct shipping ore (DSO) occurs as discontinuous structurally controlled lenses immediately west of MTS, often in contact with amphibolitised dykes, in the vicinity of the Duchess Pit. Strike lengths vary from a few metres to over 100m, and widths from sub-metre to 100m, with thicker zones of mineralisation associated with multiple stacked lenses.

At depth HEO is observed to transition to magnetite proto-ores, such as the depleted magnetite-rich haematite carbonate ores (HEC) mined at the Iron Duke Pit, and then eventually to MTC.

7.3.10 Haematite-Carbonate (HEC)

Haematite-carbonate (HEC) mineralisation is a transitional ore type that is principally composed of haematite, magnetite, and carbonate (dolomite & ankerite). It is found down dip of shallow high-grade haematite mineralisation and up dip/above high-grade magnetite mineralisation. HEC may be treated as either a magnetite or haematite ore feed type as it satisfies both direct shipping ore grades (Fe > 55% and Al_2O_3+SiO_2 < 14%) and mass recovery >15%.

7.3.11 Structure

Locally, some moderate complexity in haematite and magnetite domain geometry occurs due to faulting and folding but is usually only evident at the close-spaced production grade control drilling scale. Large scale structural information from mapping and diamond drilling are incorporated into the geological model in the form of trends imposed during modelling. These trends are utilised by dynamically orientating search neighbourhoods during later estimation.

8 Data Compositing

8.1 Assays

Prior to compositing Vulcan drill hole file ***dcs_0823.dhd.isis*** was flagged (backtagged) against the geological model described in Section 7, using a GEOZONE code as shown in Table 8.1.

Table 8.1 – GEOZONE backtagging codes and sample compositing.

Lithological Code	GEOZONE Code	Description	2m Composite	4m or 8m Composite
AMP	10	Amphibolitised Dyke	Yes	Yes
BIF	20	Banded iron formation	Yes	Yes
HEO	30	Haematite	Yes	-
HEC	32	Haematite carbonate	Yes	Yes
HBF	37	Haematite banded iron formation	Yes	-
MTS	40	Magnetite silica	Yes	Yes
MTC	43	Magnetite carbonate	Yes	Yes
SCH	46	Schist	Yes	Yes
MBF	47	Magnetite banded iron formation	Yes	Yes
MSU	48	Magnetite sulphide	Yes	Yes
BSQ	70	Basal sequence	Yes	Yes
DOM	71	Katunga Dolomite	Yes	Yes
ESZ	75	Eastern shear zone	Yes	Yes
CGS	80	Cook Gap Schist	Yes	-
GRT	90	Granite	Yes	-

Samples were then composited as follows:

- Head assays (H_ASSAY) – 2m lengths
- Concentrate assays (C_ASSAY) – 4m lengths in the south, and 8m lengths in the north

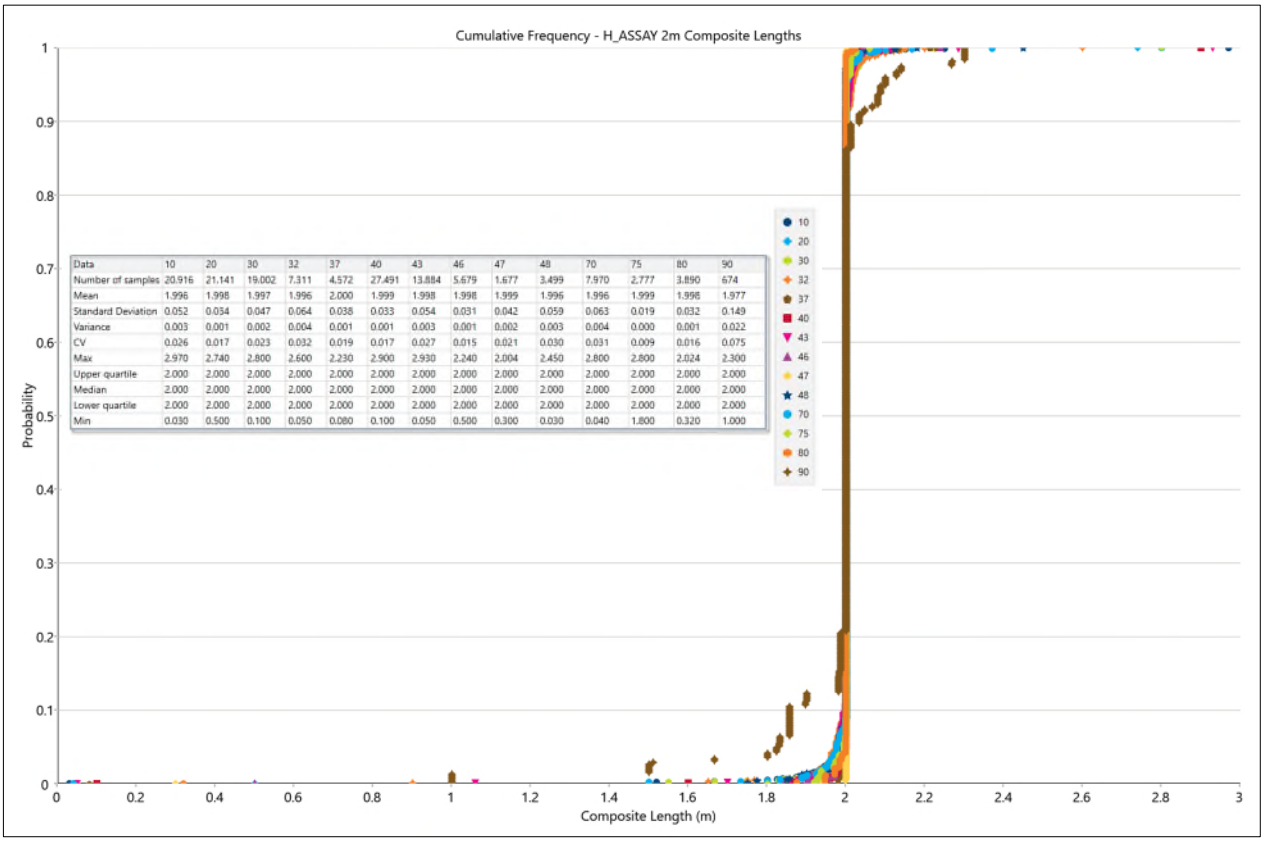
The compositing routine honoured the flagged geological boundaries, and so residual length composites were included in the final sample composite file. A value of -999 was used to represent missing or non-sampled intervals but excluded from compositing. If no composite was possible, a value of -999 was retained as the resultant interval value. The composites were flagged against the geological model as a final check to ensure every sample had a valid geological model code.

The resulting sample composite files for estimation were:

- ***dsmdcs_0823_h.2m.isis*** **-** estimation of 2m length head assays
- ***dsmdcs_0823_c.48m.isis*** **-** estimation of 4m length and 8m length concentrate assays

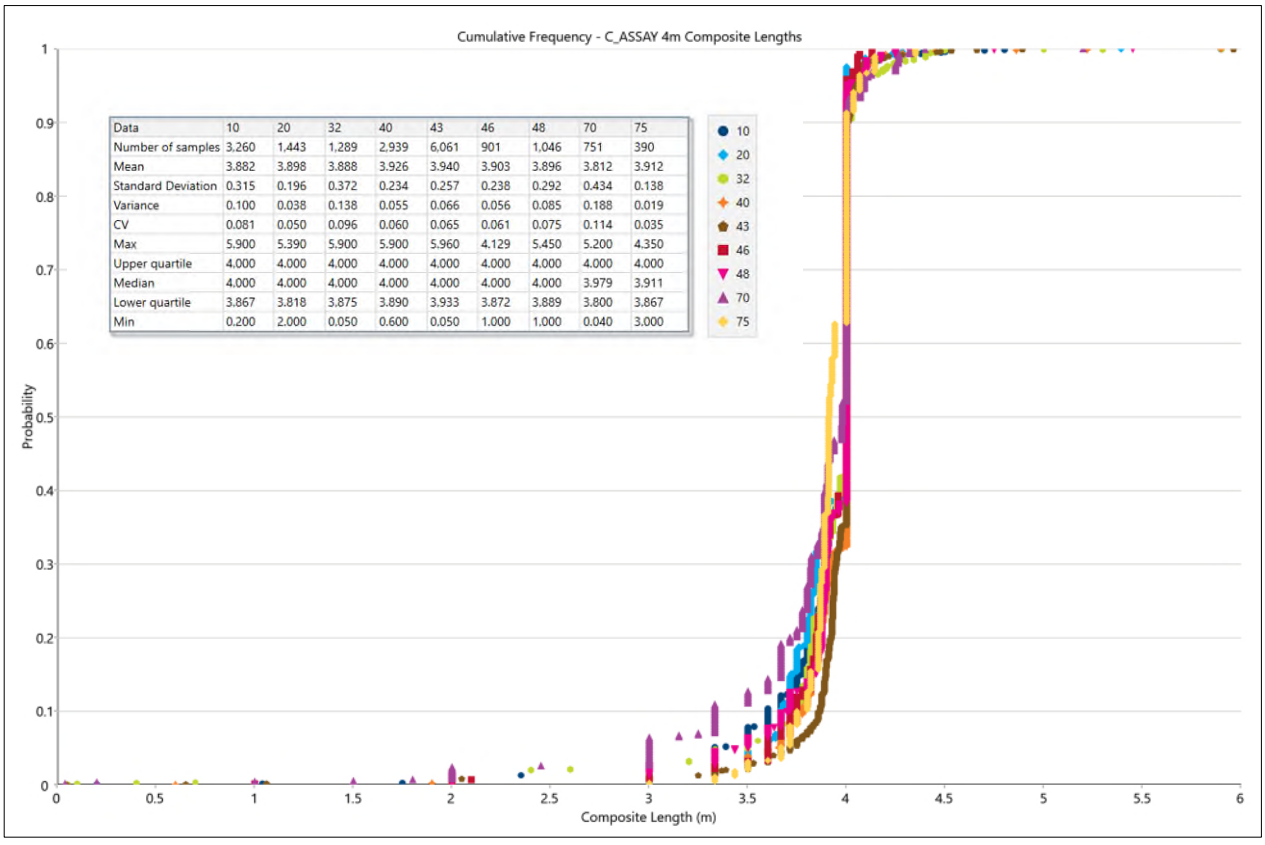
In the case of concentrate assays (C_ASSAY), only GEOZONE's 10, 20, 32, 40, 43, 46, 47, 48, 70, 71 and 75 were sufficiently sampled and considered for compositing (Table 8.1). The distribution of the resulting composite lengths is shown in Figure 8.1 to Figure 8.3.

No capping or top cutting was implemented at the database level. The influence of very high or extreme values were dealt with using a spatial high yield technique during estimation, discussed in Section 10.



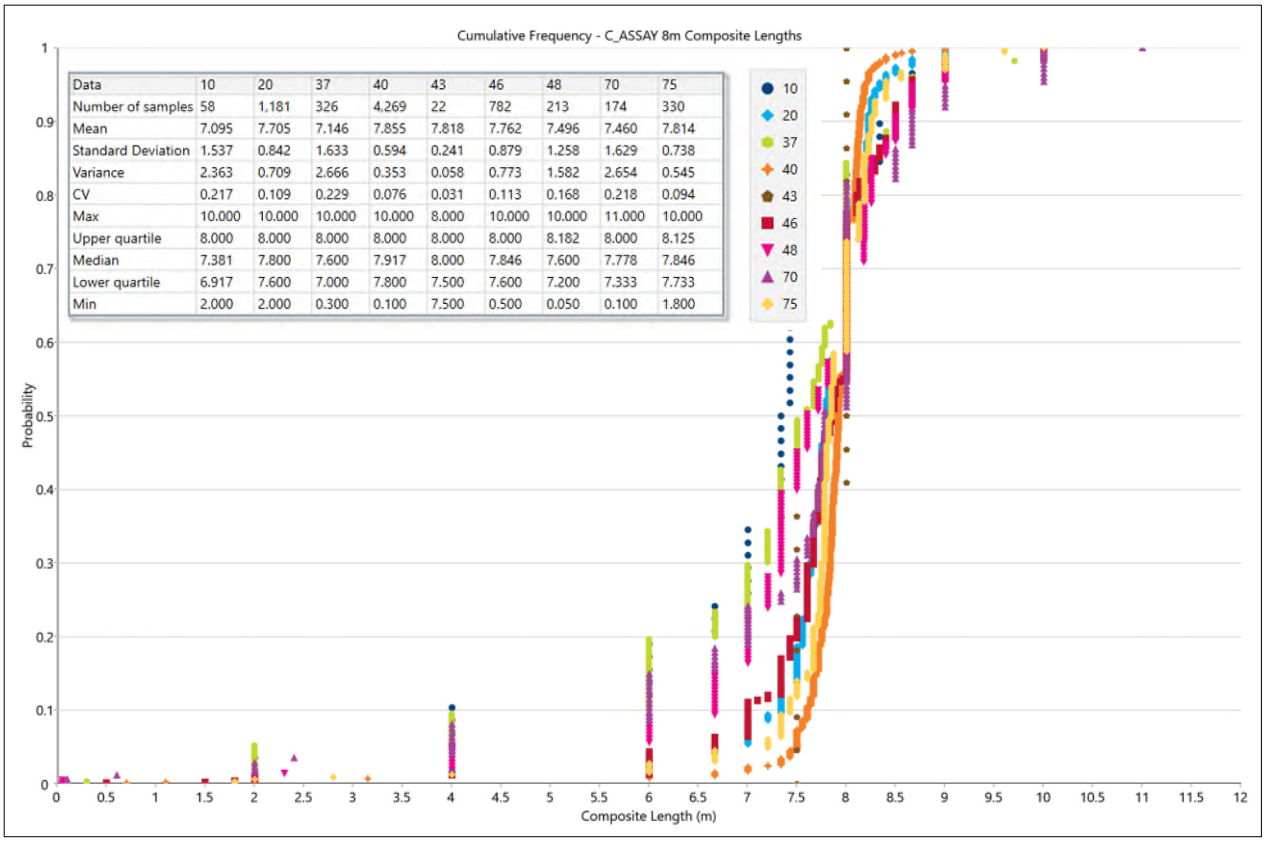
Data	10	20	30	32	37	40	43	46	47	48	70	75	80	90
Number of samples	20.916	21.141	19.002	7.311	4.572	27.491	13.884	5.679	1.677	3.499	7.970	2.777	3.890	674
Mean	1.996	1.998	1.997	1.996	2.000	1.999	1.998	1.998	1.999	1.996	1.996	1.999	1.998	1.977
Standard Deviation	0.052	0.034	0.047	0.064	0.038	0.033	0.054	0.031	0.042	0.059	0.063	0.019	0.032	0.149
Variance	0.003	0.001	0.002	0.004	0.001	0.001	0.003	0.001	0.002	0.003	0.004	0.000	0.001	0.022
CV	0.026	0.017	0.023	0.032	0.019	0.017	0.027	0.015	0.021	0.030	0.031	0.009	0.016	0.075
Max	2.970	2.740	2.800	2.600	2.230	2.900	2.930	2.240	2.004	2.450	2.800	2.800	2.024	2.300
Upper quartile	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Median	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Lower quartile	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Min	0.030	0.500	0.100	0.050	0.080	0.100	0.050	0.500	0.300	0.030	0.040	1.800	0.320	1.000

Figure 8.1 – Cumulative frequency distribution of H_ASSAY 2m composite lengths for all domains across the deposit.



Data	10	20	32	40	43	46	48	70	75
Number of samples	3.260	1,443	1,289	2.939	6.061	901	1,046	751	390
Mean	3.882	3.898	3.888	3.926	3.940	3.903	3.896	3.812	3.912
Standard Deviation	0.315	0.196	0.372	0.234	0.257	0.238	0.292	0.434	0.138
Variance	0.100	0.038	0.138	0.055	0.066	0.056	0.085	0.188	0.019
CV	0.081	0.050	0.096	0.060	0.065	0.061	0.075	0.114	0.035
Max	5.900	5.390	5.900	5.900	5.960	4.129	5.450	5.200	4.350
Upper quartile	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Median	4.000	4.000	4.000	4.000	4.000	4.000	4.000	3.979	3.911
Lower quartile	3.867	3.818	3.875	3.890	3.933	3.872	3.889	3.800	3.867
Min	0.200	2.000	0.050	0.600	0.050	1.000	1.000	0.040	3.000

Figure 8.2 - Cumulative frequency distribution of C_ASSAY 4m composite lengths for major GEOZONE domains in the southern third of the deposit.



Data	10	20	37	40	43	46	48	70	75
Number of samples	58	1,181	326	4,269	22	782	213	174	330
Mean	7.095	7.705	7.146	7.855	7.818	7.762	7.496	7.460	7.814
Standard Deviation	1.537	0.842	1.633	0.594	0.241	0.879	1.258	1.629	0.738
Variance	2.363	0.709	2.666	0.353	0.058	0.773	1.582	2.654	0.545
CV	0.217	0.109	0.229	0.076	0.031	0.113	0.168	0.218	0.094
Max	10.000	10.000	10.000	10.000	8.000	10.000	10.000	11.000	10.000
Upper quartile	8.000	8.000	8.000	8.000	8.000	8.000	8.182	8.000	8.125
Median	7.381	7.800	7.600	7.917	8.000	7.846	7.600	7.778	7.846
Lower quartile	6.917	7.600	7.000	7.800	7.500	7.600	7.200	7.333	7.733
Min	2.000	2.000	0.300	0.100	7.500	0.500	0.050	0.100	1.800

Figure 8.3 - Cumulative frequency distribution of C_ASSAY 8m composite lengths for major GEOZONE domains in the northern two thirds of the deposit.

8.2 DTR versus GLIB Assay

Mass recovery and concentrate assaying was performed on samples derived from one of two preparation methods, discussed in Section 4.5, namely:

- "DTR method": samples were dry ground to P80 45µm using a rod/ball mill.
- "Grind Liberation Method (GLIB)": samples were wet ground to P80 38µm using a rod mill.

A comparison between the two methods shows that mass recovery assay is higher and SiO_2 assay lower for the DTR preparation method, with respect to those obtained using the GLIB preparation method (Table 8.2, Figure 8.4, and Figure 8.5). It can be shown that this is not a consequence of sample bias but rather one of geological setting, more specifically the transition from carbonate to silicate dominated gangue north of the Magnet Pit.

Table 8.2 – Statistics for DTR and GLIB sample preparation composites in magnetite domains.

	DTR MassRec %	GLIB MassRec %	DTR SiO_2 %	GLIB SiO_2 %
Count	10,321	6,593	10,321	6,593
Mean	37.25	30.78	3.43	10.72
Std. Deviation	17.654	11.795	4.397	5.415
Min	1.27	0.30	0.005	0.083
Max	93.25	68.03	50.53	37.13
Median	37.22	32.71	1.46	9.66
Lower Quartile	22.63	22.16	0.51	6.77
Upper Quartile	50.23	40.08	4.91	14.32

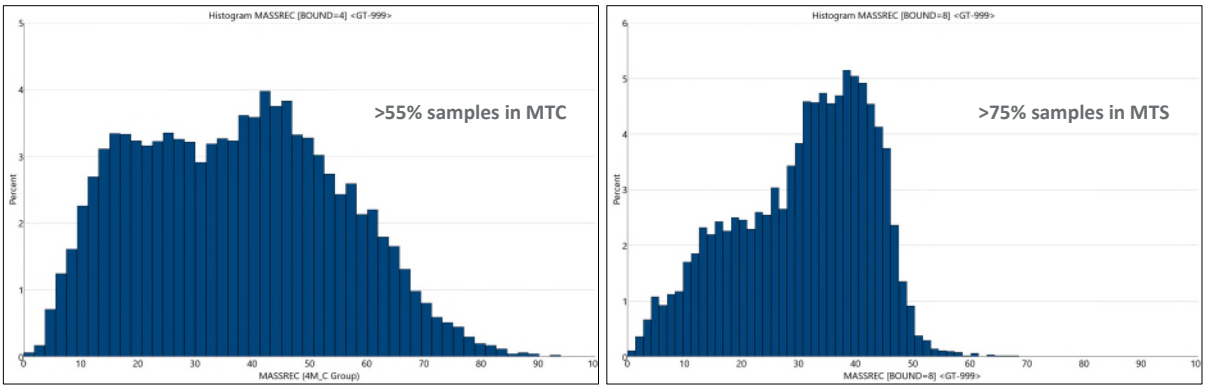


Figure 8.4 – Distribution of mass recovery assays from DTR (LEFT) samples in magnetite domains with carbonate dominant gangue, and GLIB (RIGHT) samples in magnetite domains with silicate dominant gangue.

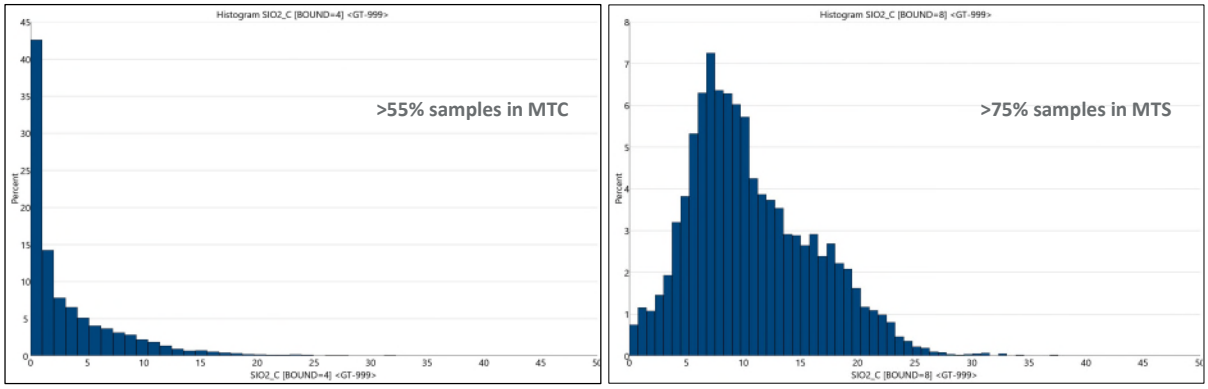


Figure 8.5 – Distribution of SiO_2 assays from DTR (LEFT) samples in magnetite domains with carbonate dominant gangue, and GLIB (RIGHT) samples in magnetite domains with silicate dominant gangue.

Samples used in the DTR preparation method were obtained almost exclusively from within the Iron Magnet Pit, which is dominated by MTC magnetite ore and carbonate gangue mineralogy and characterised by higher mass recovery and low SiO_2 content. Samples used in the GLIB preparation method, however, are collected almost exclusively from MTS magnetite mineralisation which occurs with silicate dominant gangue mineralogy and is characterised by slightly lower mass recovery but higher SiO_2 content (Table 7.1), which dominates north of the Magnet Pit (Figure 7.1). The differences observed in grade are thus largely a spatial geological phenomenon, and not a sampling one (Figure 8.6).

For estimation, there was no distinction made between DTR and GLIB samples based purely on sample preparation method. A natural distinction, however, does occur due to sample support (Figure 8.2 and Figure 8.3), geological domain control and hard domain boundaries used during estimation, in addition to their discrete spatial location (Figure 6.9) which correspond very closely to the spatial distribution of the MTC and carbonate gangue mineralogy, and the MTS and silicate dominant gangue mineralogy (Figure 3.4).

8.3 Density

Vulcan drill hole file ***dcs_0823.ssd.isis*** was flagged against the geological and weathering profile model using the same method described in Section 8.1 and composited to 2m to create the sample composite file ***dsmdcs_0823_ssd.d2m.isis*** using the same procedure as that used for the head assays. These density composites were joined to the head assays using common drillhole "from" and "to" intervals to create a database suitable for regression analysis and estimation (Section 9.2.3).

The naïve distribution of density values for the various GEOZONE domains are shown in Figure 8.7 and Figure 8.8.

The Archimedes density data was not used to inform the estimates for the reasons discussed in Section 6.1.5.

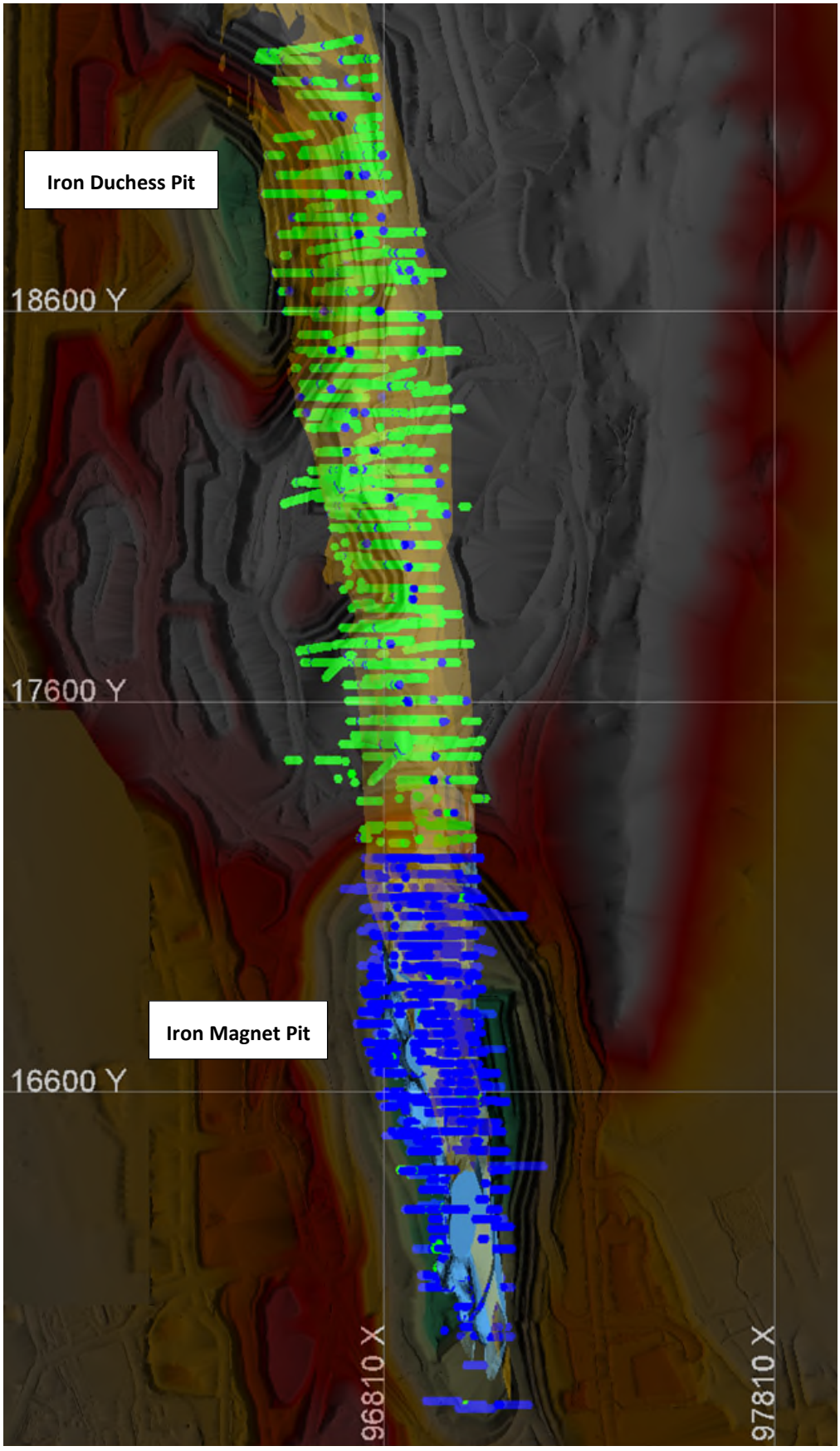
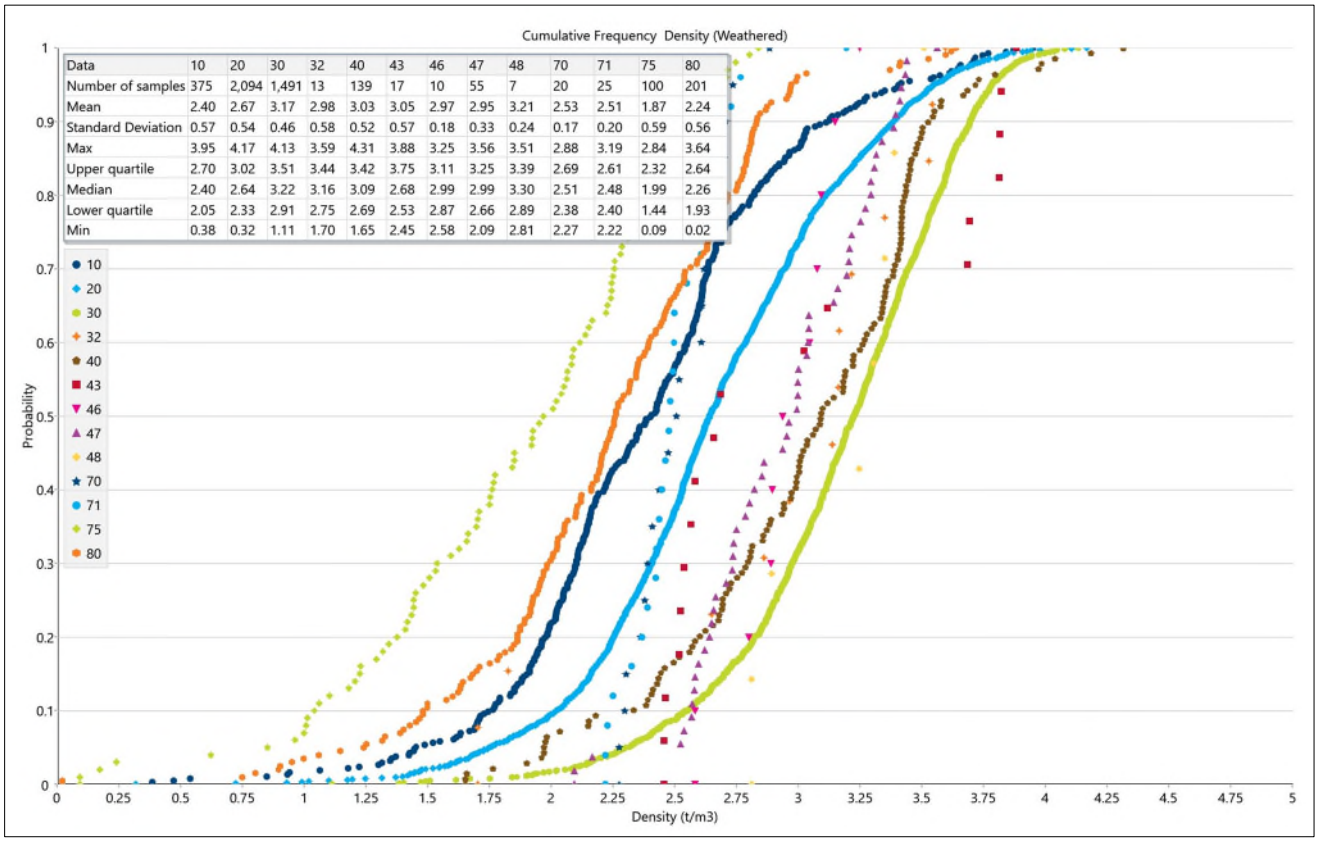
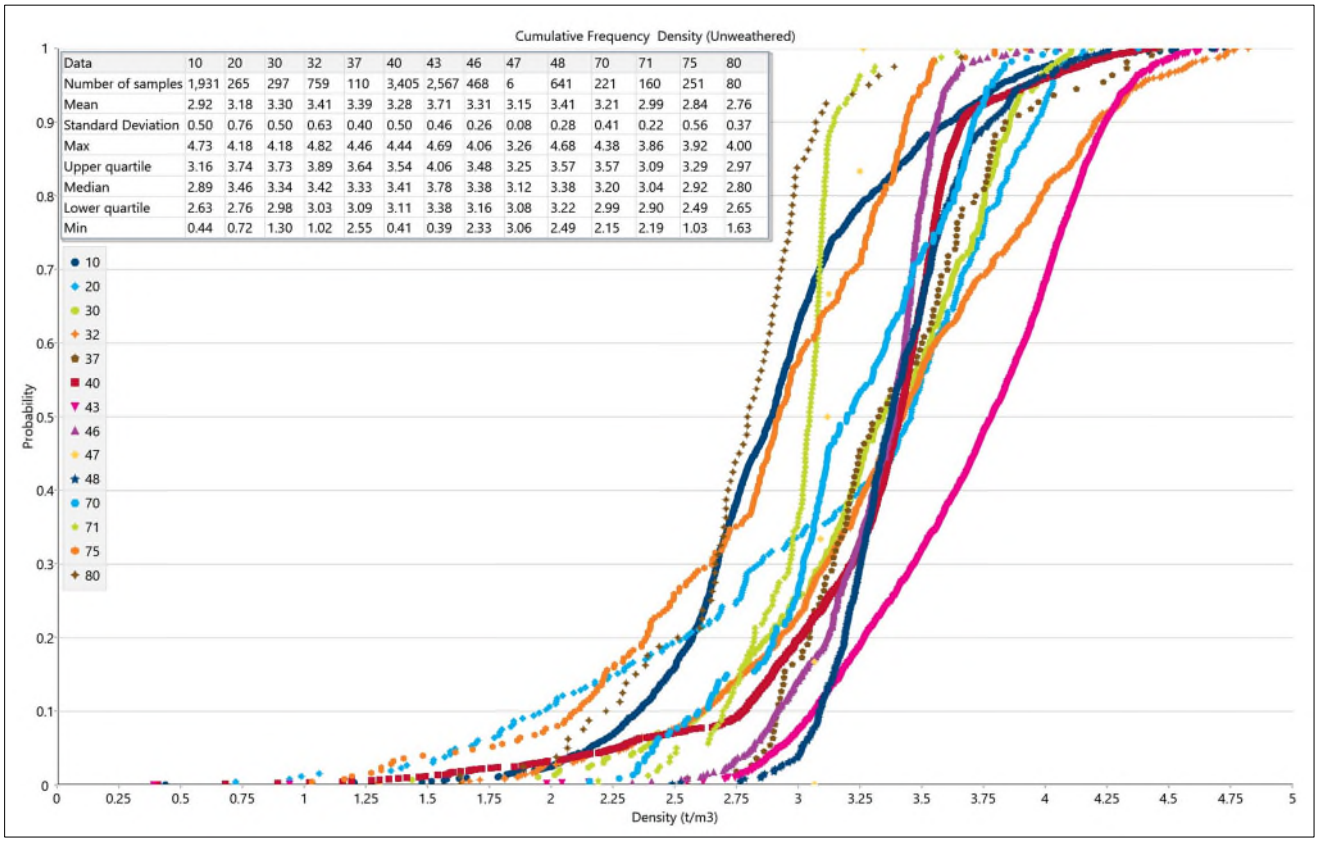


Figure 8.6 – Plan view of the Duchess South area showing the position of DTR (blue) samples and GLIB (green) samples relative to the MTC (light blue) domain and MTS (orange) domain. The MTC plunges beneath the MTS at the northern edge of the Iron Magnet Pit.



Data	10	20	30	32	40	43	46	47	48	70	71	75	80
Number of samples	375	2,094	1,491	13	139	17	10	55	7	20	25	100	201
Mean	2.40	2.67	3.17	2.98	3.03	3.05	2.97	2.95	3.21	2.53	2.51	1.87	2.24
Standard Deviation	0.57	0.54	0.46	0.58	0.52	0.57	0.18	0.33	0.24	0.17	0.20	0.59	0.56
Max	3.95	4.17	4.13	3.59	4.31	3.88	3.25	3.56	3.51	2.88	3.19	2.84	3.64
Upper quartile	2.70	3.02	3.51	3.44	3.42	3.75	3.11	3.25	3.39	2.69	2.61	2.32	2.64
Median	2.40	2.64	3.22	3.16	3.09	2.68	2.99	2.99	3.30	2.51	2.48	1.99	2.26
Lower quartile	2.05	2.33	2.91	2.75	2.69	2.53	2.87	2.66	2.89	2.38	2.40	1.44	1.93
Min	0.38	0.32	1.11	1.70	1.65	2.45	2.58	2.09	2.81	2.27	2.22	0.09	0.02

Figure 8.7 – Distribution of density values for 2m composites in the weathered zone of the geological domains.



Data	10	20	30	32	37	40	43	46	47	48	70	71	75	80
Number of samples	1,931	265	297	759	110	3,405	2,567	468	6	641	221	160	251	80
Mean	2.92	3.18	3.30	3.41	3.39	3.28	3.71	3.31	3.15	3.41	3.21	2.99	2.84	2.76
Standard Deviation	0.50	0.76	0.50	0.63	0.40	0.50	0.46	0.26	0.08	0.28	0.41	0.22	0.56	0.37
Max	4.73	4.18	4.18	4.82	4.46	4.44	4.69	4.06	3.26	4.68	4.38	3.86	3.92	4.00
Upper quartile	3.16	3.74	3.73	3.89	3.64	3.54	4.06	3.48	3.25	3.57	3.57	3.09	3.29	2.97
Median	2.89	3.46	3.34	3.42	3.33	3.41	3.78	3.38	3.12	3.38	3.20	3.04	2.92	2.80
Lower quartile	2.63	2.76	2.98	3.03	3.09	3.11	3.38	3.16	3.08	3.22	2.99	2.90	2.49	2.65
Min	0.44	0.72	1.30	1.02	2.55	0.41	0.39	2.33	3.06	2.49	2.15	2.19	1.03	1.63

Figure 8.8 – Distribution of density values for 2m composites in the unweathered zone of the geological domains.

9 Exploratory Data Analysis

The economics of haematite and magnetite from a mineral resource perspective depend largely on a combination of Fe and SiO_2 head assays, mass recovery and the Fe and SiO_2 concentrate grades of the recovered mass, and density, in 6 of the 15 geological domains. Exhaustive exploratory data analysis (EDA) using summary statistics, histograms and scatter plots was undertaken on all analytes across all geological domains. Only those critical to the mineral resource are discussed here.

9.1 Head Assays (_h)

Head assays encompass all XRF analysis prior to DTR concentration and consists of Fe, SiO_2, Al_2O_3, Mn, TiO_2, CaO, MgO, K_2O, P, S, Na_2O, Ba, Cu, Pb, Zn, V, LOI_10 and SATMAGAN. The summary statistics for all analytes across the 15 GEOZONE domains are shown in Table 9.1. LOI_10 is LOI plus a constant of 10 as described in Section 6.1.4.

The strong relationship between Fe and SiO_2 are noticeable features across all the domains, with a typical example from GEOZONE 40 shown in Figure 9.1 and Figure 9.2. Locally, some strong relationships between other elements are observed, for example between Al_2O_3 and TiO_2 in GEOZONE 40 and Fe and MgO in GEOZONE 43 (magnetite carbonate) shown in Figure 9.3.

Variable name	AL2O3_H	CAO_H	FE_H	K2O_H	LOI_H	MGO_H	MN_H	NA2O_H	S_H	SIO2_H	TIO2_H
AL2O3_H	1.000	0.162	-0.219	0.508	0.389	0.364	0.291	0.494	0.061	-0.235	0.842
CAO_H	0.162	1.000	0.020	0.212	0.359	-0.005	0.135	0.241	0.023	-0.262	0.151
FE_H	-0.219	0.020	1.000	-0.193	-0.121	-0.216	-0.072	-0.221	-0.133	-0.771	-0.192
K2O_H	0.508	0.212	-0.193	1.000	0.090	0.129	0.061	0.451	0.002	-0.031	0.433
LOI_H	0.389	0.359	-0.121	0.090	1.000	0.579	0.603	0.093	0.298	-0.440	0.298
MGO_H	0.364	-0.005	-0.216	0.129	0.579	1.000	0.307	0.146	0.243	-0.338	0.322
MN_H	0.291	0.135	-0.072	0.061	0.603	0.307	1.000	0.093	0.182	-0.264	0.181
NA2O_H	0.494	0.241	-0.221	0.451	0.093	0.146	0.093	1.000	0.020	-0.006	0.349
S_H	0.061	0.023	-0.133	0.002	0.298	0.243	0.182	0.020	1.000	-0.052	0.021
SIO2_H	-0.235	-0.262	-0.771	-0.031	-0.440	-0.338	-0.264	-0.006	-0.052	1.000	-0.197
TIO2_H	0.842	0.151	-0.192	0.433	0.298	0.322	0.181	0.349	0.021	-0.197	1.000



Figure 9.1 – Correlation matrix for the major analytes in GEOZONE 40. The strong negative correlation between Fe and SiO_2 is a feature of all the key GEOZONE domains.

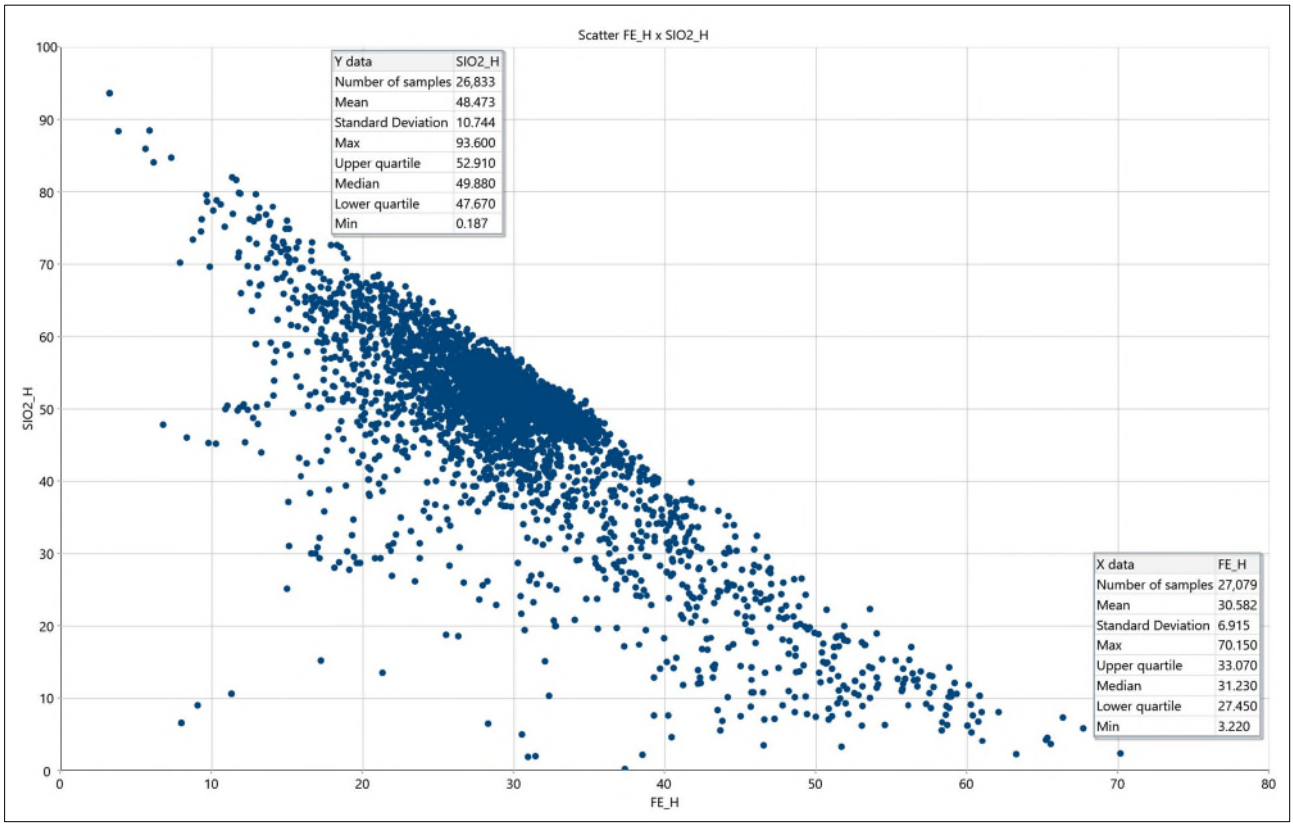


Figure 9.2 – Scatter plot showing the strong relationship between Fe and SiO_2 in GEOZONE 40 (magnetite silica).

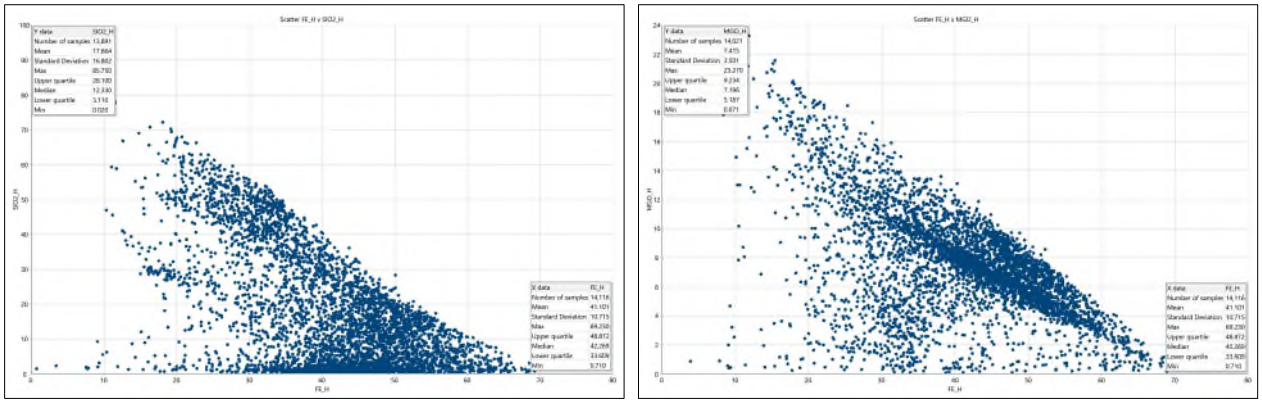


Figure 9.3 – Scatter plot showing the relationship between Fe and SiO_2 (LEFT) and Fe and MgO (RIGHT) in GEOZONE 43 (magnetite carbonate).

Table 9.1 – Summary statistics for 2m _h composites by GEOZONE domain

	GEOZONE 10 - AMP					GEOZONE 20 - BIF				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	14,802	0.001	32.130	10.776	6.104	18,853	0.001	36.260	3.284	5.383
Ba	4,676	0.001	0.546	0.019	0.044	7,940	0.001	0.330	0.003	0.009
CaO	14,890	0.005	51.181	1.222	2.886	18,849	0.005	30.713	0.268	1.193
Cu	8,135	0.001	0.263	0.012	0.018	11,055	0.001	0.157	0.004	0.006
Fe	14,966	0.100	69.680	26.592	14.407	19,006	0.100	69.500	28.727	15.242
FeSAT	1,044	0.500	65.300	6.755	10.428	5,422	0.500	19.600	2.636	1.394
K_2O	14,038	0.001	6.302	0.222	0.482	17,248	0.001	5.100	0.065	0.209
LOI_10	14,783	7.560	54.100	18.411	4.535	18,820	7.090	57.150	14.519	3.818
MgO	14,871	0.005	29.840	9.440	6.611	18,849	0.005	22.110	0.896	2.439
Mn	14,944	0.005	16.800	0.607	0.634	18,941	0.005	30.421	0.152	0.503
Na_2O	11,630	0.001	4.520	0.230	0.380	14,913	0.001	2.988	0.083	0.148
P	14,804	0.002	0.724	0.082	0.060	18,853	0.001	1.600	0.041	0.042
Pb	4,676	0.001	0.070	0.005	0.006	7,940	0.001	3.010	0.002	0.036
S	14,820	0.001	19.900	0.115	0.667	18,853	0.001	6.809	0.050	0.136
SiO_2	14,811	0.050	94.240	29.488	14.653	18,860	0.050	99.440	49.262	24.411
TiO_2	14,780	0.001	6.070	1.207	0.851	18,853	0.001	7.504	0.290	0.603
V	4,675	0.001	0.164	0.020	0.015	7,940	0.001	0.210	0.004	0.008
Zn	14,409	0.001	1.599	0.024	0.036	17,852	0.001	0.778	0.007	0.012

	GEOZONE 30 - HEO					GEOZONE 32 - HEC				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	18,842	0.005	27.100	2.224	3.029	6,620	0.001	24.430	2.341	3.408
Ba	2,920	0.001	0.093	0.003	0.005	1,778	0.001	0.070	0.009	0.009
CaO	18,844	0.005	25.600	0.538	1.411	6,788	0.005	28.700	4.064	5.049
Cu	9,642	0.001	0.312	0.010	0.015	3,634	0.001	0.476	0.015	0.022
Fe	18,947	0.100	70.240	59.576	9.696	6,904	4.100	69.970	51.633	13.421
FeSAT	485	0.500	30.100	2.140	2.162	31	1.710	14.240	4.851	2.828
K_2O	16,521	0.001	3.278	0.031	0.096	6,287	0.001	2.362	0.023	0.069
LOI_10	18,822	8.400	49.020	13.706	3.071	6,620	8.920	53.900	17.781	7.128
MgO	18,840	0.005	22.450	1.172	2.488	6,784	0.020	23.360	4.832	4.298
Mn	18,939	0.005	17.000	0.217	0.469	6,885	0.005	5.330	0.371	0.321
Na_2O	10,559	0.001	1.571	0.062	0.100	5,750	0.001	1.026	0.055	0.069
P	18,842	0.001	2.900	0.067	0.079	6,620	0.002	0.592	0.059	0.041
Pb	2,920	0.001	0.026	0.003	0.003	1,778	0.001	0.070	0.008	0.007
S	18,841	0.001	13.280	0.036	0.181	6,637	0.001	19.802	0.203	1.020
SiO_2	18,842	0.050	88.848	6.391	8.261	6,625	0.120	61.700	6.086	8.183
TiO_2	18,827	0.001	5.400	0.207	0.407	6,620	0.001	3.977	0.293	0.495
V	2,920	0.001	0.154	0.011	0.012	1,778	0.001	0.240	0.019	0.020
Zn	18,073	0.001	0.376	0.009	0.016	6,341	0.001	0.317	0.008	0.011

Table 9.1 (cont.) – Summary statistics for 2m _h composites by GEOZONE domain

GEOZONE 37 - HBF						GEOZONE 40 - MTS				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	4,233	0.005	20.810	1.564	3.659	26,831	0.001	16.320	0.552	1.744
Ba	2,649	0.001	0.037	0.001	0.003	21,018	0.001	0.508	0.002	0.011
CaO	4,233	0.005	13.950	0.604	1.261	26,831	0.005	26.130	1.014	1.266
Cu	2,730	0.001	11.470	0.009	0.220	21,468	0.001	0.532	0.002	0.005
Fe	4,233	1.100	68.400	28.622	12.485	27,079	3.220	70.150	30.582	6.915
FeSAT	1,293	0.500	38.400	4.341	4.465	19,739	0.700	77.900	28.328	10.502
K_2O	4,169	0.001	1.689	0.024	0.087	25,934	0.001	6.737	0.030	0.164
LOI_10	4,233	8.108	37.200	12.916	3.196	26,764	6.240	49.490	10.991	2.496
MgO	4,233	0.005	25.300	6.528	6.049	26,824	0.005	21.370	4.737	3.465
Mn	4,233	0.005	1.690	0.139	0.213	26,957	0.005	3.577	0.111	0.142
Na_2O	4,105	0.005	1.304	0.066	0.076	25,530	0.001	4.521	0.061	0.180
P	4,233	0.001	0.694	0.060	0.053	26,835	0.001	0.679	0.054	0.032
Pb	2,649	0.001	0.038	0.002	0.002	21,018	0.001	1.271	0.002	0.014
S	4,233	0.001	7.650	0.049	0.230	26,831	0.001	9.330	0.125	0.329
SiO_2	4,233	0.970	97.700	46.725	21.043	26,833	0.187	93.600	48.473	10.744
TiO_2	4,233	0.001	3.490	0.184	0.512	26,813	0.001	3.780	0.076	0.258
V	2,649	0.001	0.110	0.006	0.008	21,018	0.001	0.055	0.002	0.004
Zn	4,184	0.001	0.166	0.007	0.009	26,103	0.001	1.838	0.003	0.019

GEOZONE 43 - MTC						GEOZONE 46 - SCH				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	13,872	0.001	17.040	1.858	2.944	5,612	0.001	16.708	0.768	2.229
Ba	2,954	0.001	0.115	0.007	0.009	4,310	0.001	0.266	0.002	0.009
CaO	14,021	0.010	48.590	4.949	5.735	5,615	0.010	25.869	0.760	1.140
Cu	3,793	0.001	0.201	0.008	0.014	4,365	0.001	0.163	0.003	0.004
Fe	14,116	0.710	69.230	41.101	10.715	5,700	5.445	66.800	26.566	6.577
FeSAT	1,298	1.350	83.300	43.998	18.076	4,078	0.500	63.800	12.900	8.210
K_2O	13,410	0.001	1.069	0.015	0.048	5,443	0.001	5.251	0.037	0.181
LOI_10	13,822	7.460	57.322	18.081	7.234	5,608	7.640	48.860	11.061	2.449
MgO	14,021	0.071	23.270	7.415	3.501	5,615	0.040	22.360	7.295	4.177
Mn	14,096	0.003	3.410	0.403	0.378	5,688	0.005	12.700	0.224	0.246
Na_2O	12,880	0.001	3.922	0.041	0.068	5,388	0.001	3.015	0.087	0.235
P	13,860	0.001	0.766	0.079	0.044	5,612	0.001	0.528	0.055	0.030
Pb	2,954	0.001	0.070	0.007	0.009	4,310	0.001	0.274	0.003	0.006
S	13,878	0.001	9.900	0.144	0.412	5,612	0.001	17.507	0.237	0.573
SiO_2	13,891	0.020	85.750	17.664	16.802	5,612	1.099	88.360	51.376	9.766
TiO_2	13,852	0.001	3.630	0.206	0.400	5,612	0.001	3.655	0.085	0.274
V	2,954	0.001	0.100	0.007	0.008	4,310	0.001	0.055	0.003	0.005
Zn	13,659	0.001	0.650	0.005	0.007	5,514	0.001	0.957	0.004	0.022

Table 9.1 (cont.) – Summary statistics for 2m _h composites by GEOZONE domain

GEOZONE 47 - MBF						GEOZONE 48 - MSU				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	2,508	0.005	18.000	0.811	2.213	3,983	0.001	15.040	0.929	2.028
Ba	2,155	0.001	0.128	0.002	0.005	2,558	0.001	0.220	0.003	0.008
CaO	2,508	0.005	8.190	0.202	0.465	3,992	0.010	47.250	3.274	4.536
Cu	2,252	0.001	0.126	0.003	0.004	2,685	0.001	0.100	0.005	0.005
Fe	2,508	3.800	67.500	30.783	8.356	3,992	5.400	61.800	28.023	8.752
FeSAT	1,548	1.700	35.400	9.345	5.046	1,946	0.700	70.400	19.753	11.954
K_2O	2,337	0.001	2.080	0.036	0.124	3,874	0.001	2.827	0.049	0.178
LOI_10	2,508	8.960	25.050	12.543	1.821	3,983	8.290	53.000	15.458	6.106
MgO	2,508	0.005	19.100	1.412	2.505	3,992	0.050	21.200	7.887	3.929
Mn	2,508	0.005	2.980	0.128	0.197	3,992	0.001	3.770	0.332	0.344
Na_2O	2,258	0.005	2.359	0.067	0.150	3,758	0.001	3.269	0.076	0.173
P	2,508	0.001	1.300	0.050	0.055	3,983	0.001	1.160	0.029	0.035
Pb	2,155	0.001	0.044	0.002	0.002	2,558	0.001	0.127	0.004	0.006
S	2,508	0.001	9.980	0.066	0.334	3,983	0.001	20.933	1.967	2.772
SiO_2	2,508	1.630	92.230	50.460	12.303	3,983	0.520	85.240	40.658	17.611
TiO_2	2,508	0.002	3.510	0.090	0.299	3,983	0.001	3.018	0.134	0.314
V	2,155	0.001	0.052	0.002	0.005	2,558	0.001	0.050	0.004	0.005
Zn	2,362	0.001	0.086	0.003	0.005	3,948	0.001	0.846	0.006	0.031

GEOZONE 70 - BSQ						GEOZONE 71 - DOM				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	3,817	0.005	28.840	3.850	5.371	3,278	0.005	24.250	5.442	5.685
Ba	2,323	0.001	0.130	0.005	0.013	1,442	0.001	0.140	0.007	0.013
CaO	3,817	0.005	40.960	2.923	4.698	3,290	0.005	31.140	10.444	10.437
Cu	2,558	0.001	0.369	0.006	0.010	2,062	0.001	0.170	0.009	0.011
Fe	3,819	0.660	65.640	25.887	12.677	3,290	0.100	65.800	18.637	13.152
FeSAT	1,022	0.500	41.800	8.679	7.360	211	0.500	20.300	2.261	2.139
K_2O	3,639	0.001	8.193	0.181	0.552	3,001	0.001	8.591	0.325	0.880
LOI_10	3,817	8.950	54.100	18.058	7.457	3,278	9.470	56.780	30.877	13.787
MgO	3,817	0.005	29.490	8.024	5.570	3,290	0.070	38.830	12.583	7.657
Mn	3,819	0.005	6.090	0.442	0.458	3,290	0.020	13.230	0.671	0.753
Na_2O	3,432	0.001	3.266	0.161	0.357	2,560	0.001	3.927	0.171	0.352
P	3,817	0.001	0.567	0.040	0.043	3,278	0.001	0.623	0.037	0.040
Pb	2,323	0.001	0.830	0.004	0.026	1,442	0.001	0.186	0.004	0.007
S	3,817	0.001	30.800	1.677	3.020	3,278	0.001	15.943	0.223	0.733
SiO_2	3,817	0.436	96.060	37.944	20.704	3,278	0.050	80.000	21.633	18.409
TiO_2	3,817	0.001	4.090	0.428	0.650	3,278	0.001	3.383	0.513	0.643
V	2,323	0.001	0.200	0.009	0.013	1,442	0.001	0.180	0.009	0.011
Zn	3,662	0.001	1.840	0.020	0.079	3,164	0.001	1.500	0.016	0.044

Table 9.1 (cont.) – Summary statistics for 2m _h composites by GEOZONE domain

GEOZONE 75 - ESZ						GEOZONE 80 - CGS				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	2,675	0.005	18.670	1.588	3.236	3,193	0.010	27.290	9.365	4.399
Ba	2,234	0.001	0.336	0.005	0.018	2,513	0.001	1.161	0.027	0.046
CaO	2,675	0.010	17.930	0.745	1.218	3,193	0.005	27.900	0.910	2.126
Cu	2,353	0.001	0.066	0.004	0.006	2,880	0.001	0.212	0.008	0.016
Fe	2,675	3.110	53.270	22.428	7.480	3,193	0.640	67.010	11.309	8.739
FeSAT	2,118	0.500	54.500	11.255	8.369	1,303	0.500	29.600	1.989	1.734
K_2O	2,649	0.001	4.921	0.104	0.372	3,193	0.001	5.149	0.900	0.911
LOI_10	2,675	8.210	39.500	11.568	2.806	3,193	8.720	39.400	14.620	2.857
MgO	2,675	0.100	19.610	4.368	3.235	3,193	0.005	21.570	3.528	4.350
Mn	2,675	0.005	3.020	0.272	0.181	3,193	0.005	13.820	0.176	0.330
Na_2O	2,532	0.005	2.599	0.103	0.190	3,096	0.001	3.390	0.408	0.636
P	2,675	0.001	0.587	0.042	0.048	3,193	0.001	0.400	0.035	0.031
Pb	2,234	0.001	0.054	0.003	0.005	2,513	0.001	0.158	0.005	0.006
S	2,675	0.001	11.830	0.273	0.486	3,193	0.001	10.500	0.108	0.366
SiO_2	2,675	4.820	91.500	58.674	14.503	3,193	0.680	97.920	63.142	16.280
TiO_2	2,675	0.002	4.573	0.183	0.461	3,193	0.005	7.631	0.453	0.461
V	2,234	0.001	0.057	0.004	0.006	2,513	0.001	0.084	0.009	0.008
Zn	2,639	0.001	0.181	0.005	0.010	3,193	0.001	0.160	0.011	0.011

GEOZONE 90 - GRT					
Variable	Count	Min	Max	Mean	StdDev
Al_2O_3	360	0.310	27.030	9.442	5.690
Ba	152	0.001	0.130	0.028	0.027
CaO	360	0.010	29.650	1.150	2.909
Cu	206	0.001	1.840	0.041	0.163
Fe	410	1.150	61.571	14.113	13.418
FeSAT	4	1.400	1.600	1.475	0.083
K_2O	356	0.005	9.480	2.155	1.942
LOI_10	360	10.510	45.900	15.335	3.849
MgO	360	0.020	18.040	1.874	3.099
Mn	404	0.005	7.240	0.229	0.712
Na_2O	327	0.005	4.230	0.525	0.848
P	360	0.005	0.220	0.026	0.024
Pb	152	0.001	0.030	0.004	0.003
S	360	0.005	0.750	0.041	0.055
SiO_2	360	7.960	92.080	61.983	17.120
TiO_2	360	0.005	2.515	0.367	0.414
V	152	0.001	0.050	0.008	0.009
Zn	356	0.001	0.200	0.012	0.015

The distribution of Fe and SiO_2 in the key domains of 30 (HEO), 32 (HEC), 40 (MTS), 43 (MTC), 46 (SCH), 48 (MSU), and 75 (ESZ) are shown in Figure 9.4 to Figure 9.10.

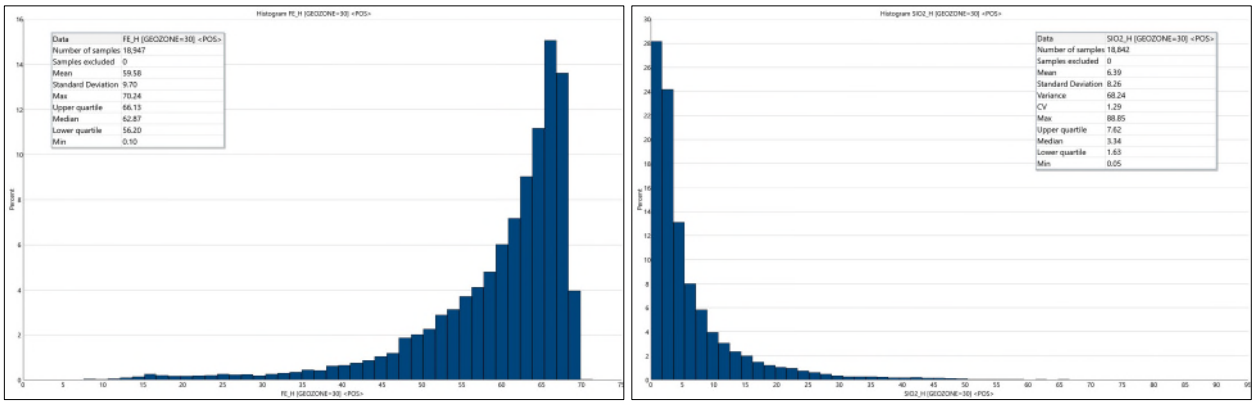


Figure 9.4 – Distribution of Fe (LEFT) and SiO_2 (RIGHT) for GEOZONE 30.

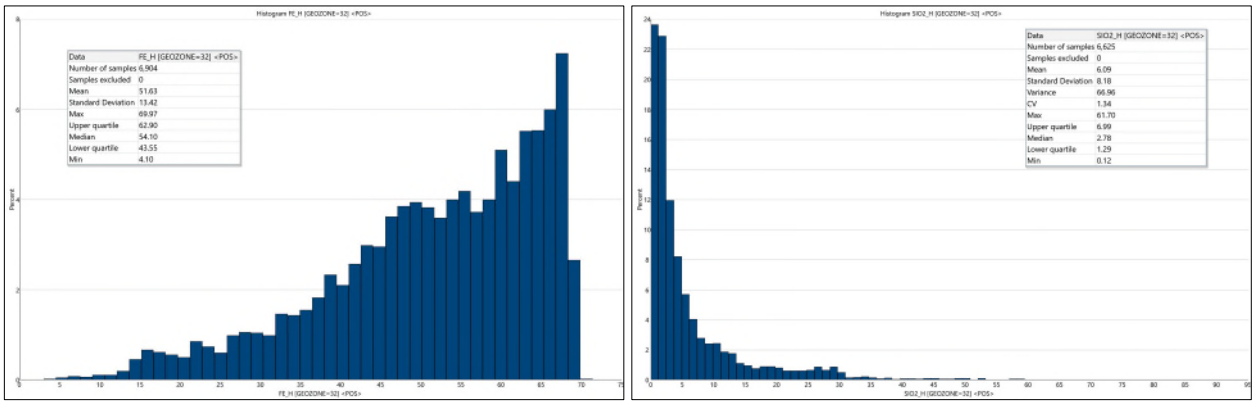


Figure 9.5 – Distribution of Fe (LEFT) and SiO_2 (RIGHT) for GEOZONE 32.

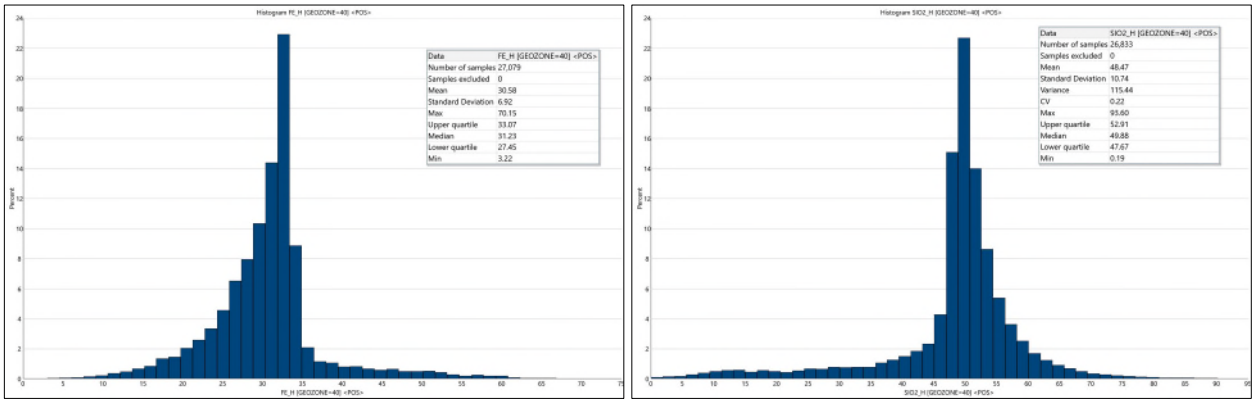


Figure 9.6 – Distribution of Fe (LEFT) and SiO_2 (RIGHT) for GEOZONE 40.

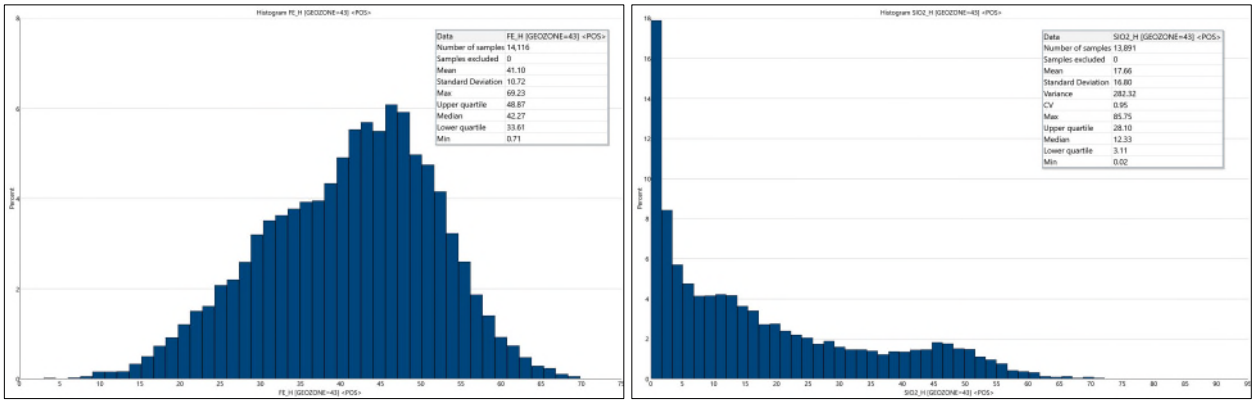


Figure 9.7 – Distribution of Fe (LEFT) and SiO_2 (RIGHT) for GEOZONE 43.

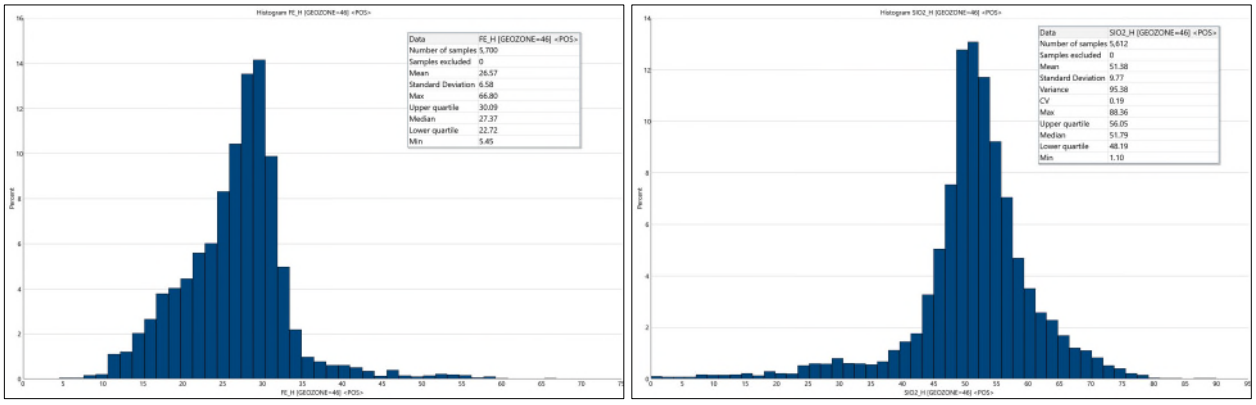


Figure 9.8 – Distribution of Fe (LEFT) and SiO_2 (RIGHT) for GEOZONE 46.

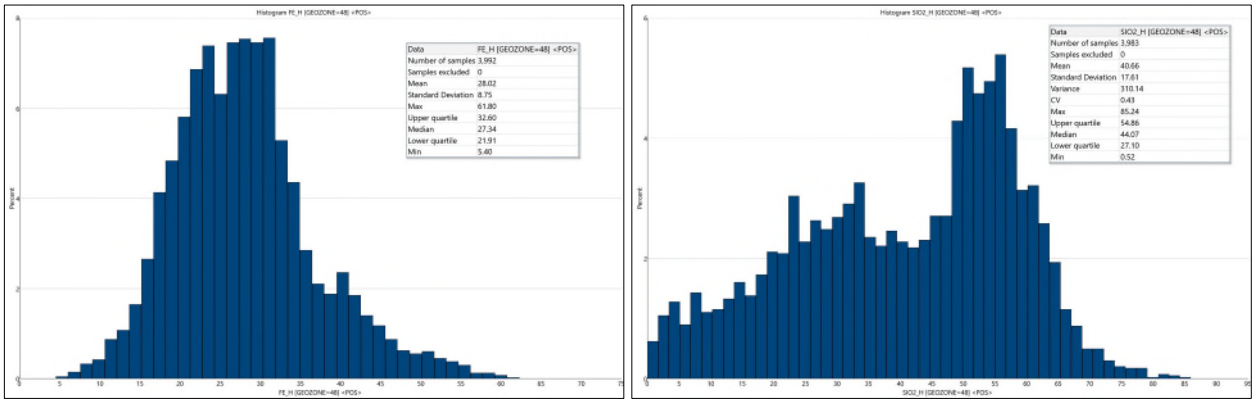


Figure 9.9 – Distribution of Fe (LEFT) and SiO_2 (RIGHT) for GEOZONE 48.

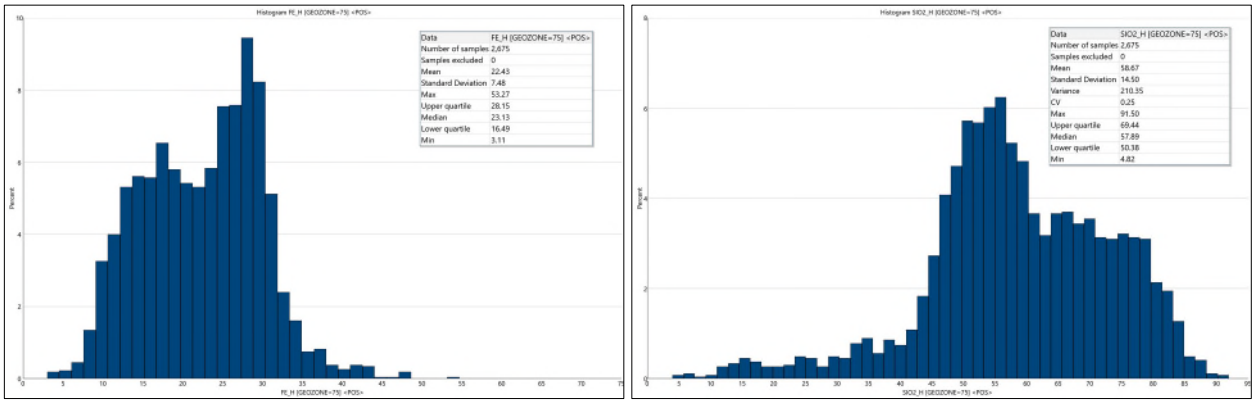


Figure 9.10– Distribution of Fe (LEFT) and SiO_2 (RIGHT) in GEOZONE 75.

Elevated S% is a key feature of the BSQ 70 domain, and the nearby MSU 48 magnetite domain, as shown in Figure 9.11.

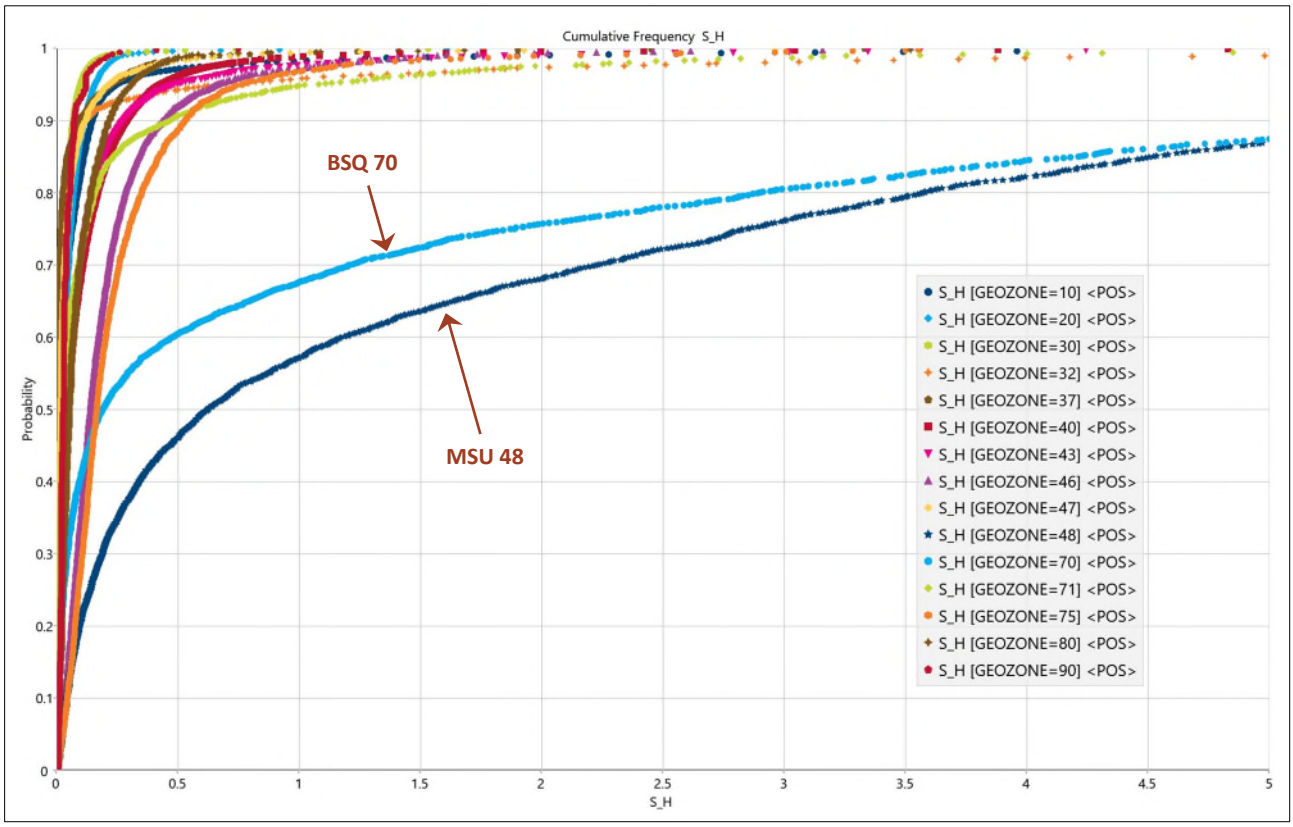


Figure 9.11 – Cumulative frequency plot comparing naïve distribution of head S grades for all geological domains for the 2M_H composites. The distributions for BSQ 70 and MSU 48 are annotated for clarity.

9.2 Concentrate Assays (_c)

Concentrate assays encompass all XRF analysis after DTR concentration and consists of Fe, SiO_2, Al_2O_3, Mn, TiO_2, CaO, MgO, K_2O, P, S, Na_2O, LOI_10 and mass recovery, across 10 of the 15 geological domains. As discussed earlier (Section 6.1.4) the concentrate sample intervals are grouped into two sets of predominantly 4m lengths (4M_C), and another of predominantly 8m lengths (8M_C) and shown in Figure 9.12. There is a strong spatial association between the composite length, geological domain and sample preparation method discussed in Section 8.2.

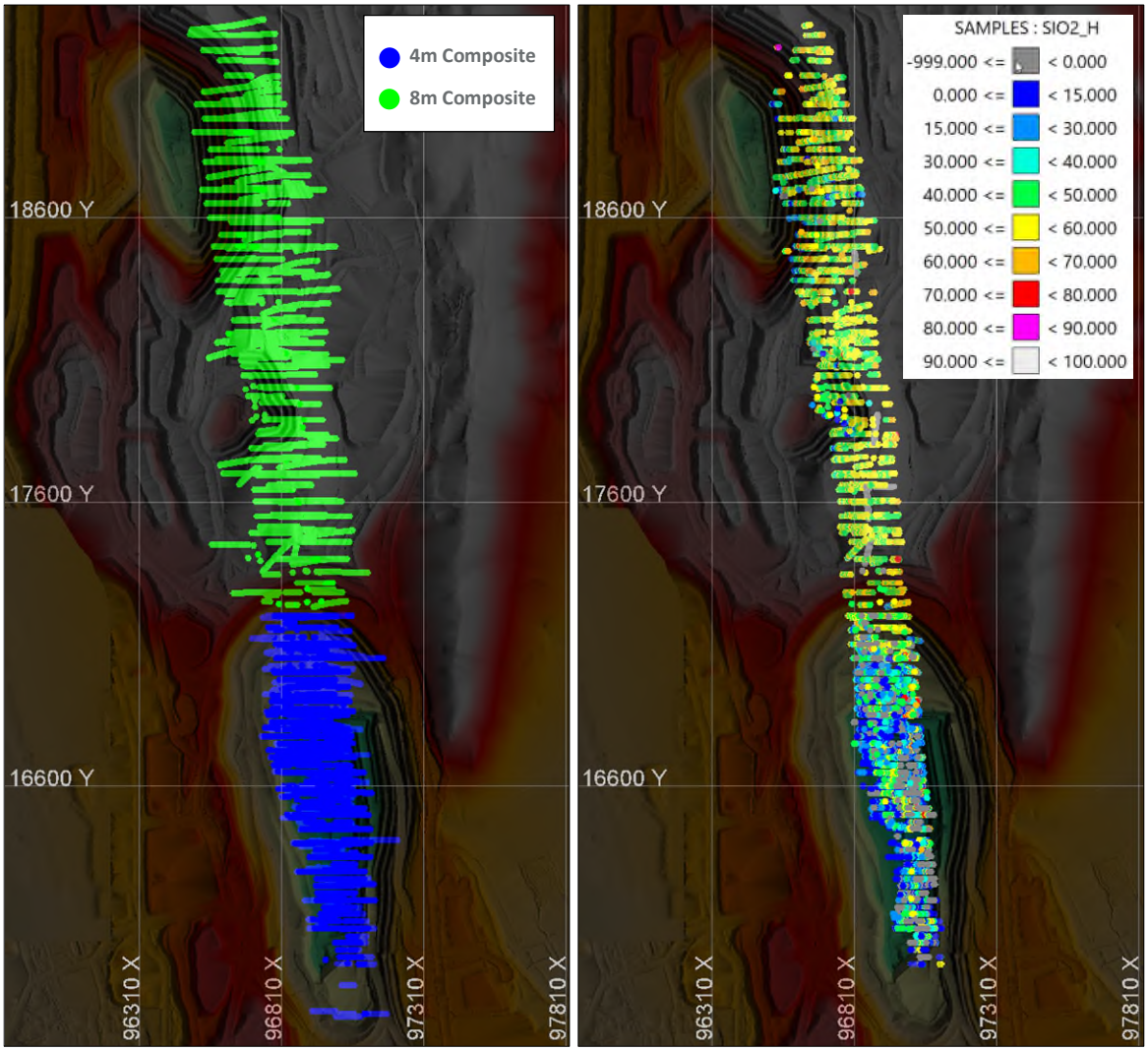


Figure 9.12 – Plan view of the Duchess South area showing the location of concentrate composite samples (LEFT) and the close spatial relationship to head assay SiO_2 grade (RIGHT) which reflects the transition from carbonate-dominant gangue (lower SiO_2) to silica-dominant gangue (higher SiO2).

The grades of concentrate assays are a function of the natural mineral grain sizes and grinding regime used during sample preparation for DTR analysis. These determine how much silica and other gangue minerals entrapped and entrained with magnetite, are liberated for XRF analysis after DTR. Mass recovery is the proportion of magnetic material recorded from DTR analysis but does not equate precisely to the proportion of magnetite. This is because small grains of the gangue mineral assemblages not fully liberated from magnetite may still report to the DTR magnetic stream, and conversely small grains of magnetite may report with the gangue mineral assemblages to the non-magnetic DTR stream. At very high mass recovery values, the variability of the concentrate grades is lower, implying more complete liberation of magnetite from the gangue mineral assemblages. For this reason, the observed relationship between mass recovery and the concentrate grades are poor across all the geological domains. An example from the MTS 40 domain is shown in Figure 9.13 to Figure 9.16, and the resulting strong correlation between Fe and SiO_2 concentrate grades is shown in Figure 9.17 and Figure 9.18.

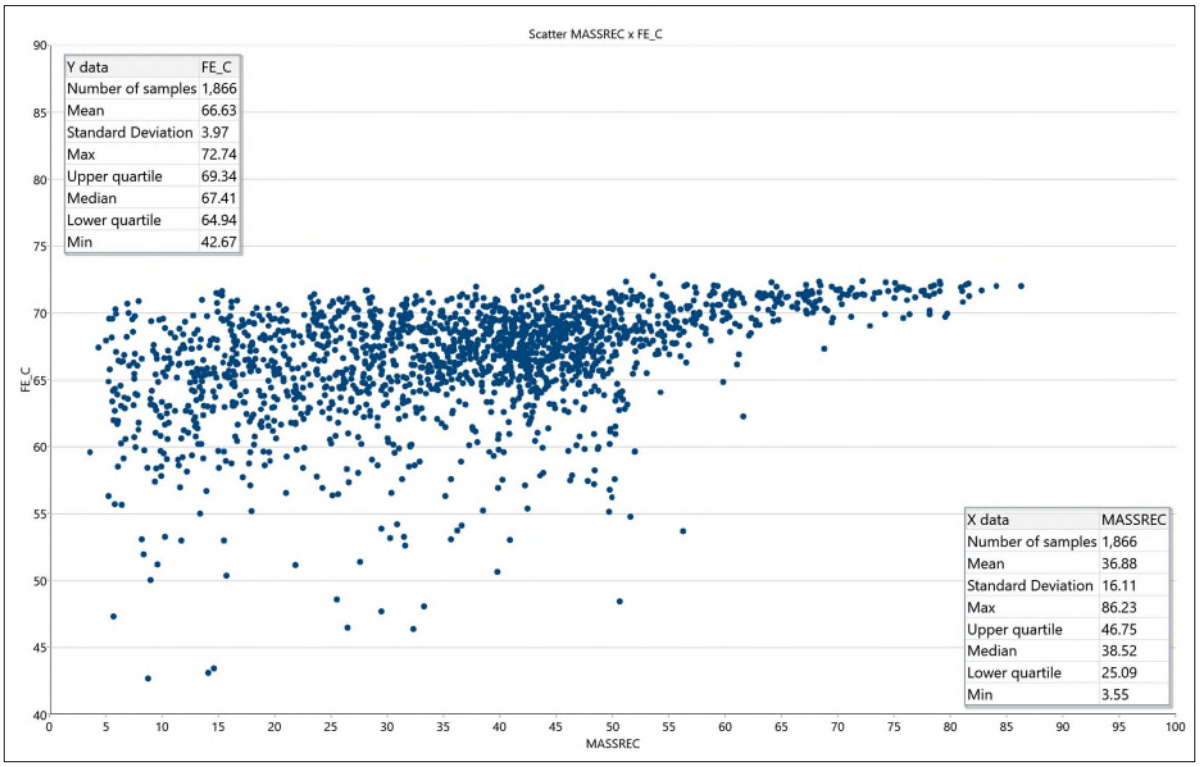


Figure 9.13 – Scatter plot showing the diffuse and poor relationship between mass recovery and Fe concentrate grade in GEOZONE 40 for the 4M_C composite group.

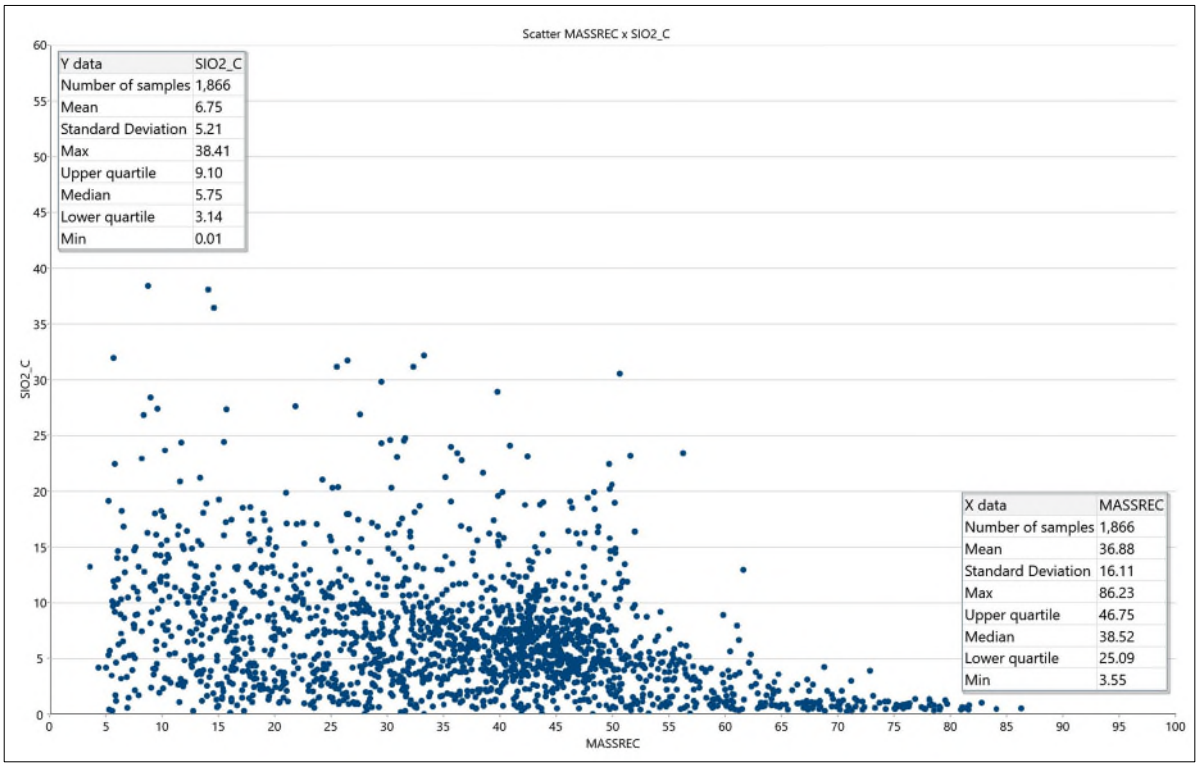


Figure 9.14 - Scatter plot showing the diffuse and poor relationship between mass recovery and SiO_2 concentrate grade in GEOZONE 40 for the 4M_C composite group.

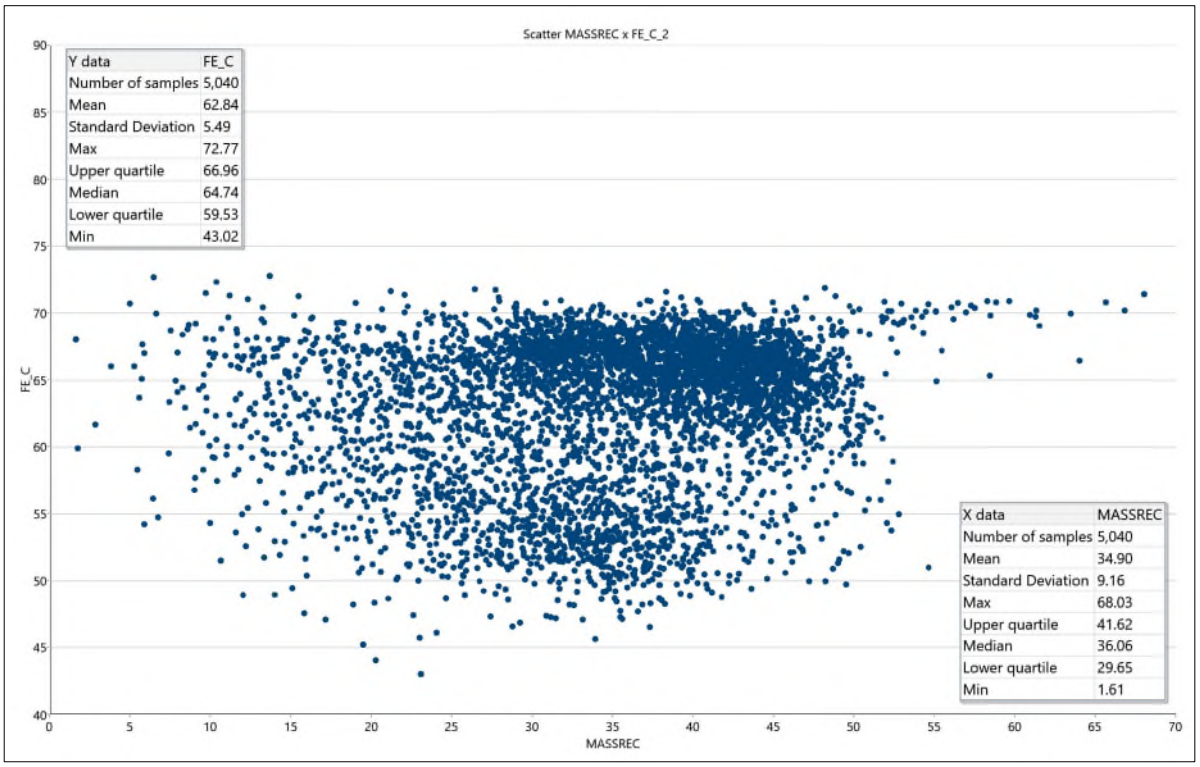


Figure 9.15 - Scatter plot showing the diffuse and poor relationship between mass recovery and Fe concentrate grade in GEOZONE 40 for the 8M_C composite group.

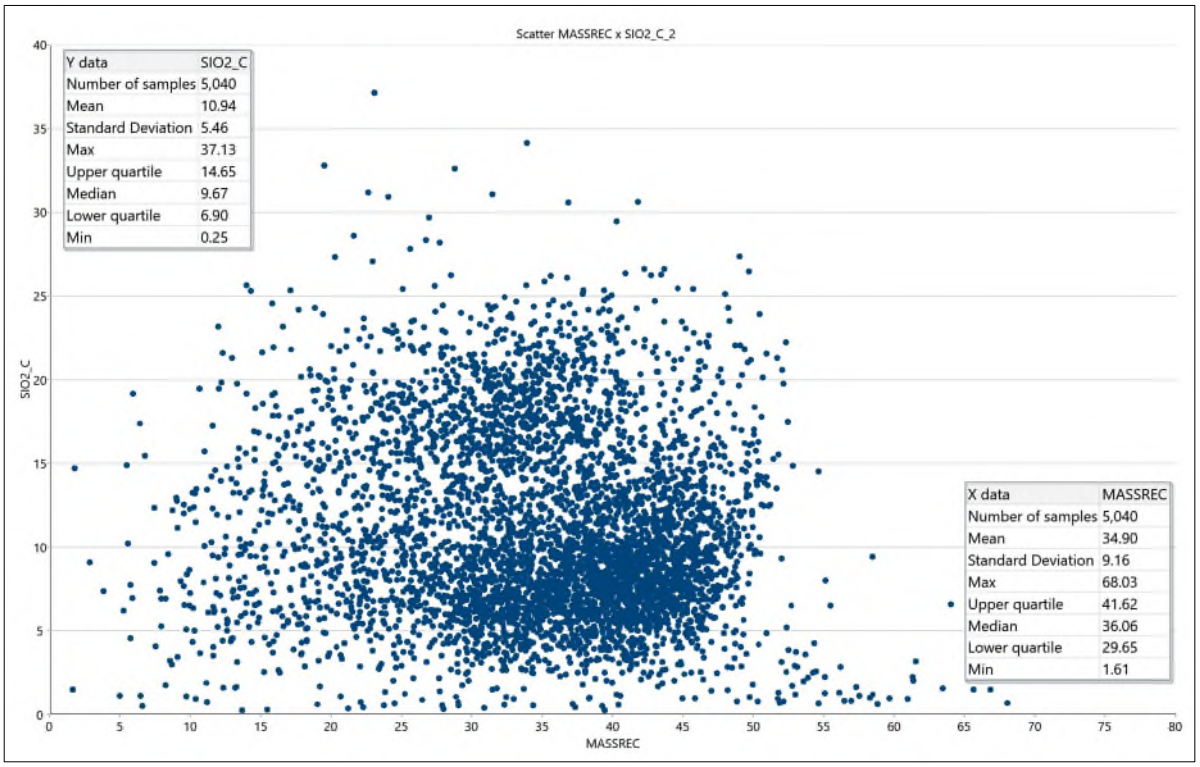


Figure 9.16 - Scatter plot showing the diffuse and poor relationship between mass recovery and SiO_2 concentrate grade in GEOZONE 40 for the 8M_C composite group.

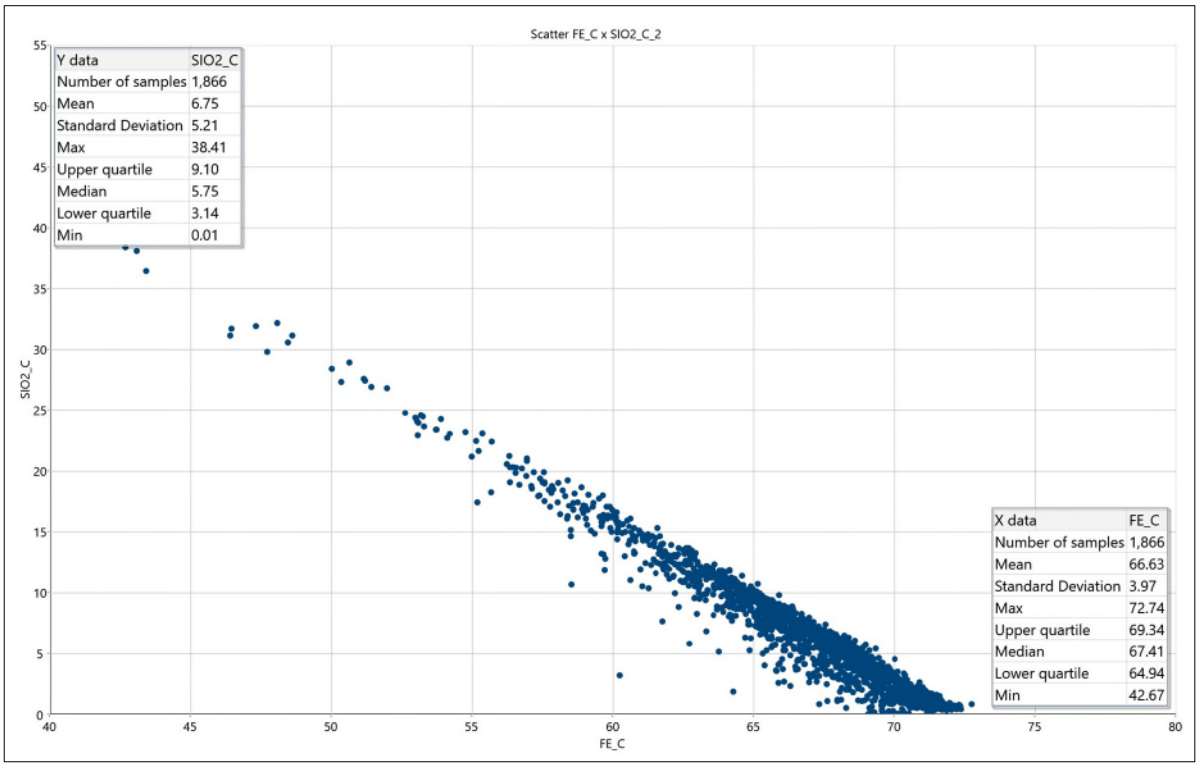


Figure 9.17 – Scatter plot showing the strong relationship between concentrate Fe and SiO_2 grades in GEOZONE 40 for the 4M_C composite group.

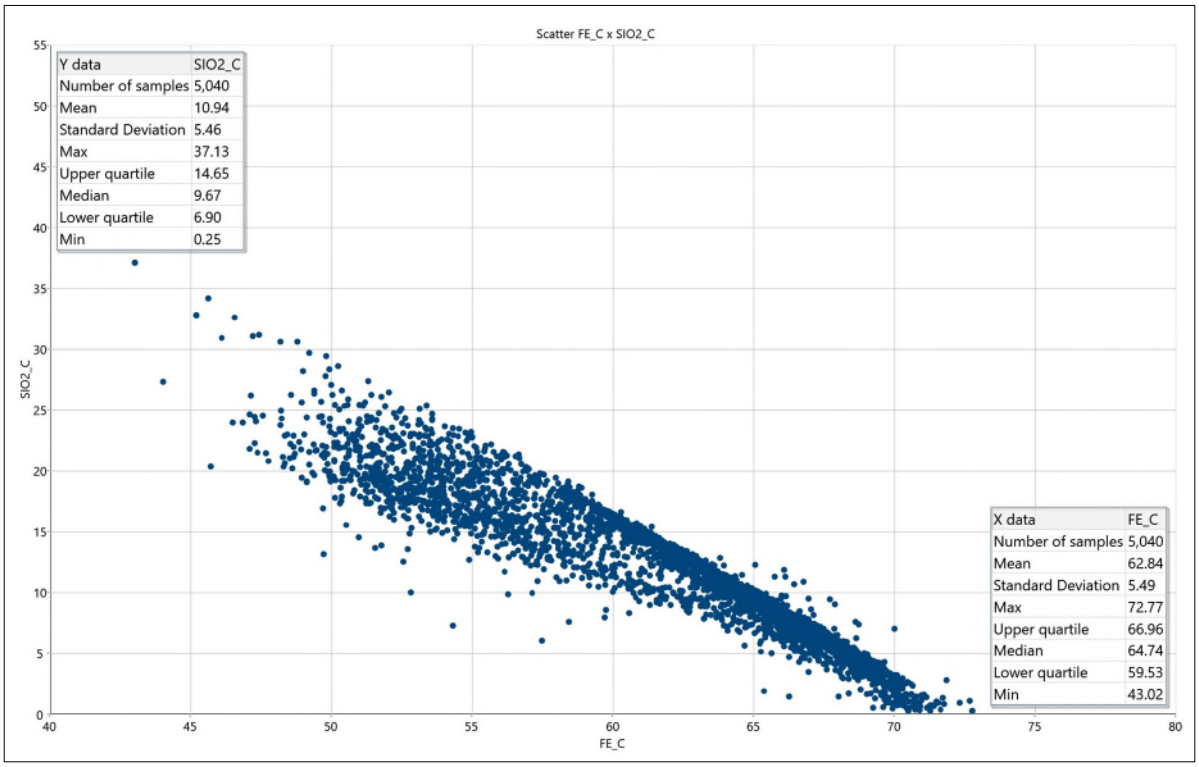


Figure 9.18 – Scatter plot showing the strong relationship between concentrate Fe and SiO_2 grades in GEOZONE 40 for the 8M_C composite group.

The poor correlations between mass recovery and remaining concentrate grade analytes in GEOZONE 40 are summarised in Figure 9.19 and Figure 9.20.

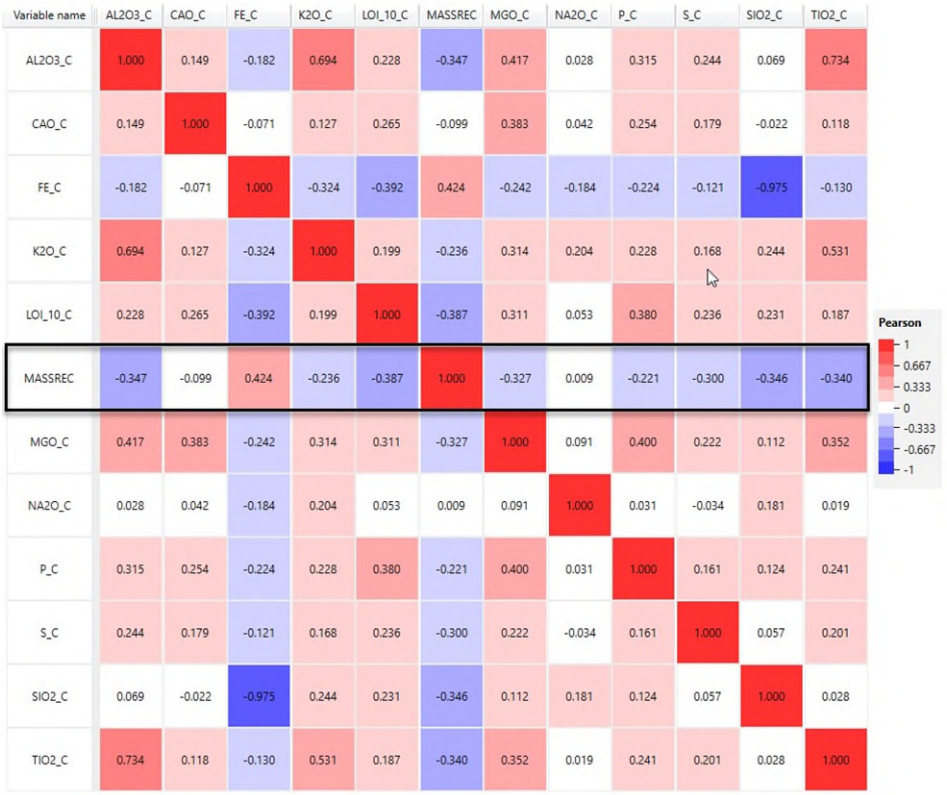


Figure 9.19 – Correlation matrix for mass recovery and concentrate analytes for GEOZONE 40 4M_C composites.

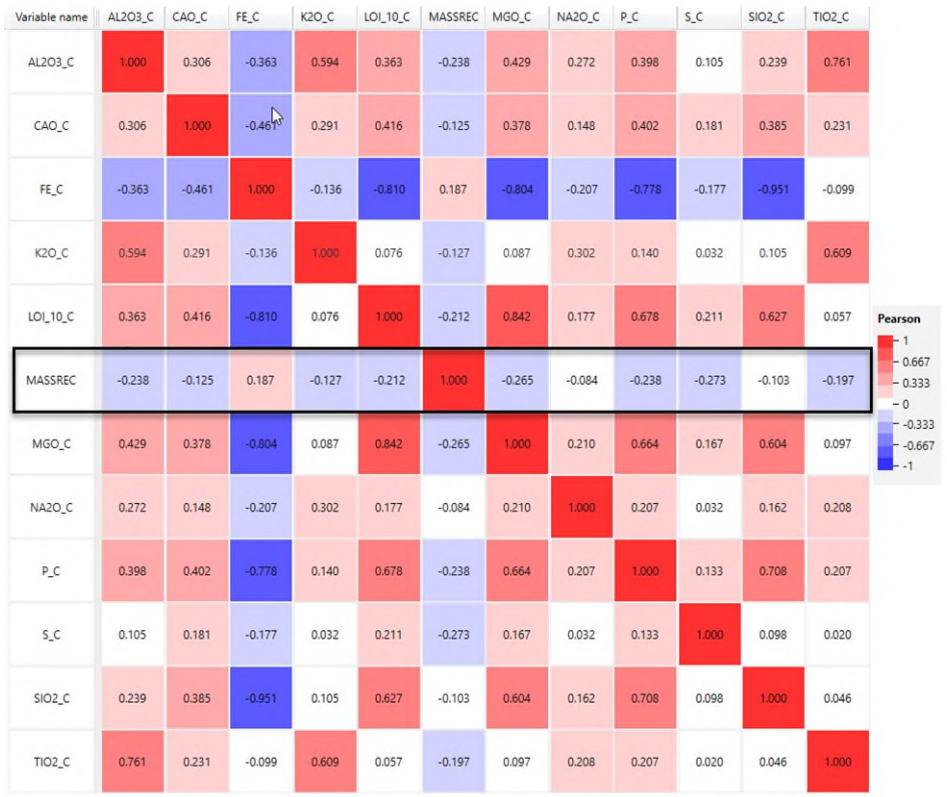


Figure 9.20 – Correlation matrix for mass recovery and concentrate analytes for GEOZONE 40 8M_C composites.

9.2.1 4M_C Group

The summary statistics for all analytes across the 10 GEOZONE domains for the 4m composite group are shown in Table 9.3. LOI_10 is LOI plus a constant of 10 as described in Section 6.1.4. In the magnetite domains, mass recovery, Fe and SiO_2 concentrate grades are critical features. Their distribution in the key magnetite and related domains of 40 (MTS), 43 (MTC), 46 (SCH), 48 (MSU), 70 (BSQ), and 75 (ESZ) are shown in Figure 9.21 to Figure 9.38.

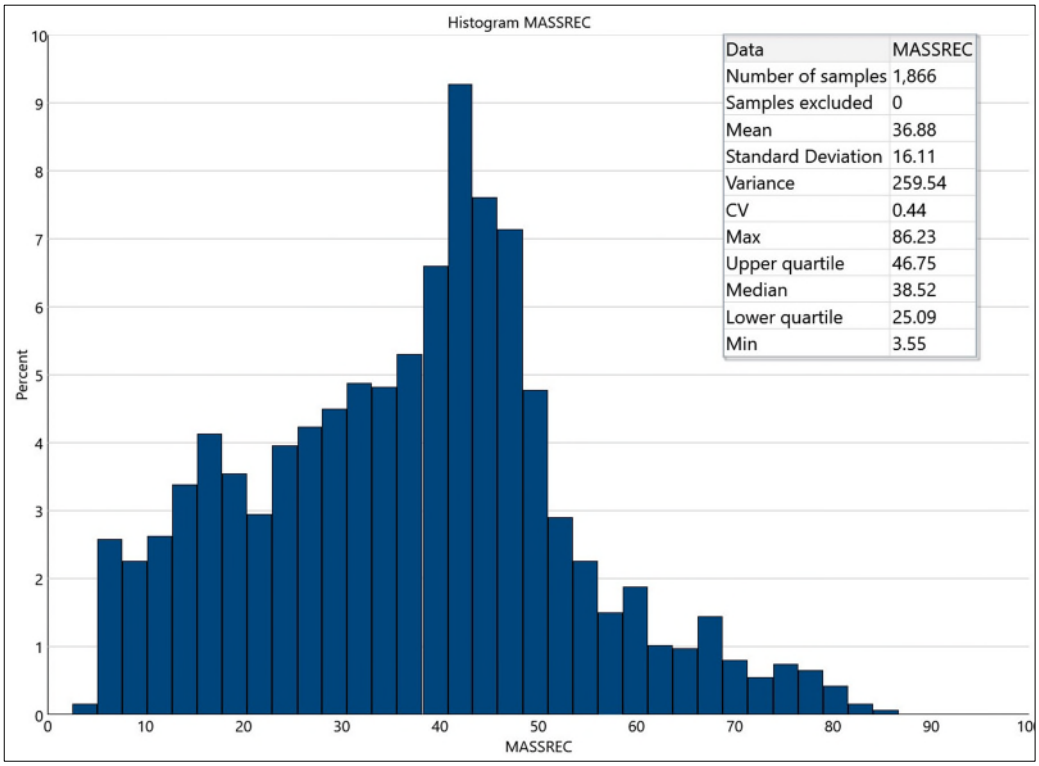


Figure 9.21 – Distribution of mass recovery in GEOZONE 40 for the 4M_C composites.

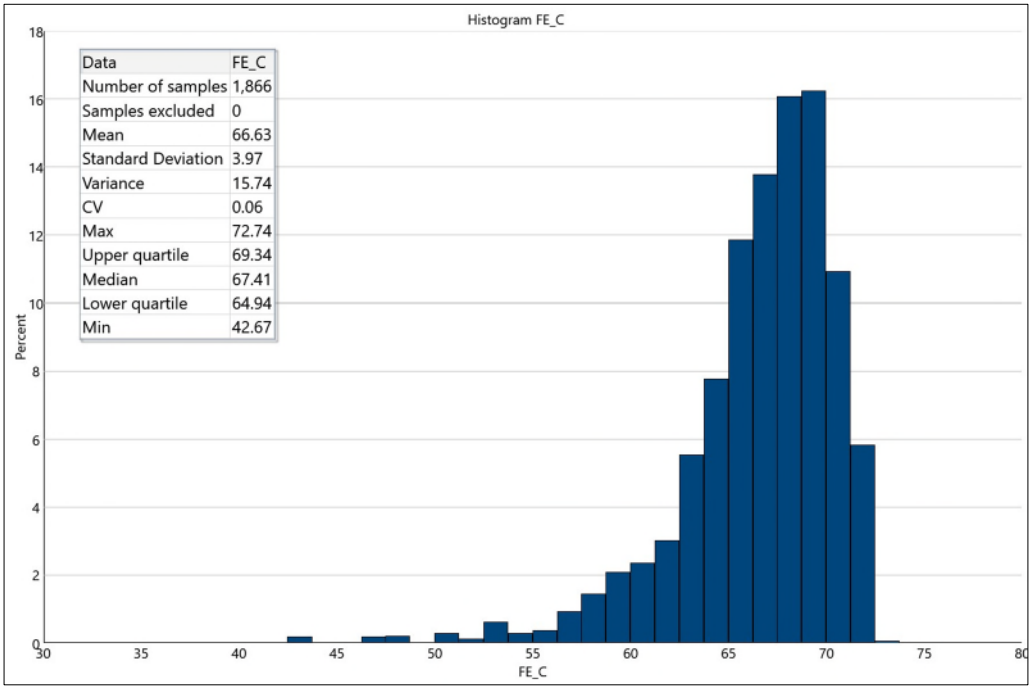


Figure 9.22 – Distribution of concentrate Fe in GEOZONE 40 for the 4M_C composites.

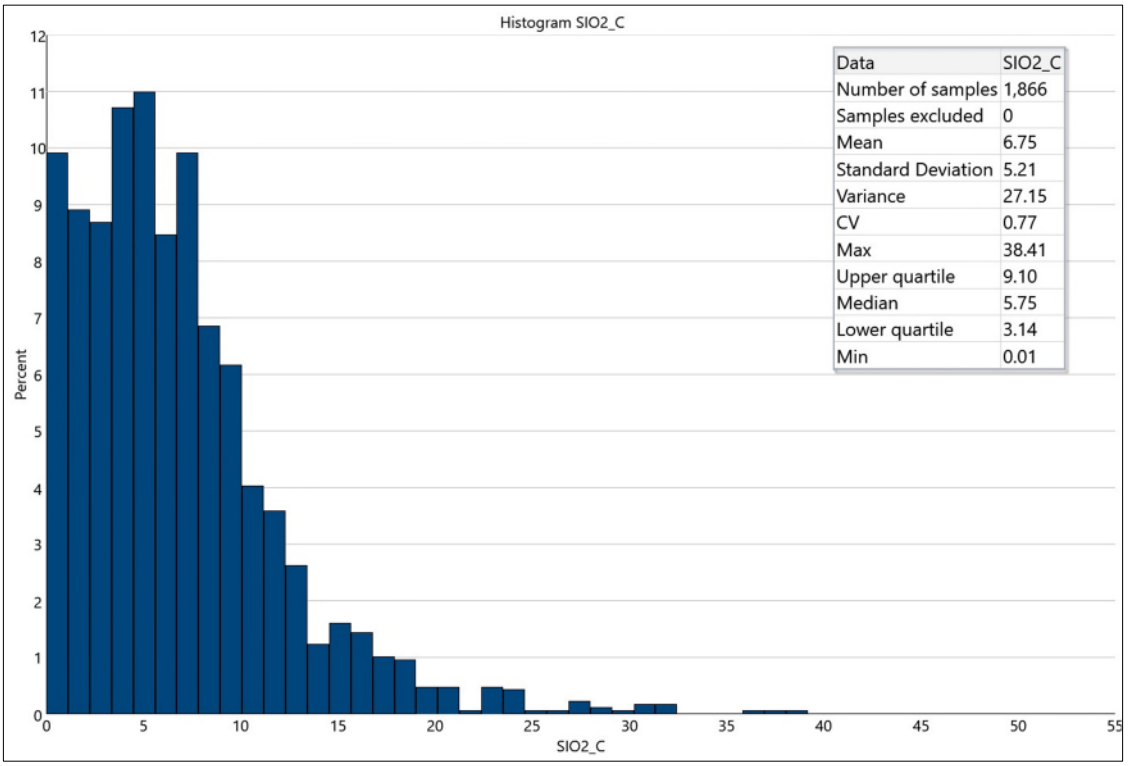


Figure 9.23 – Distribution of concentrate SiO_2 in GEOZONE 40 for the 4M_C composites.

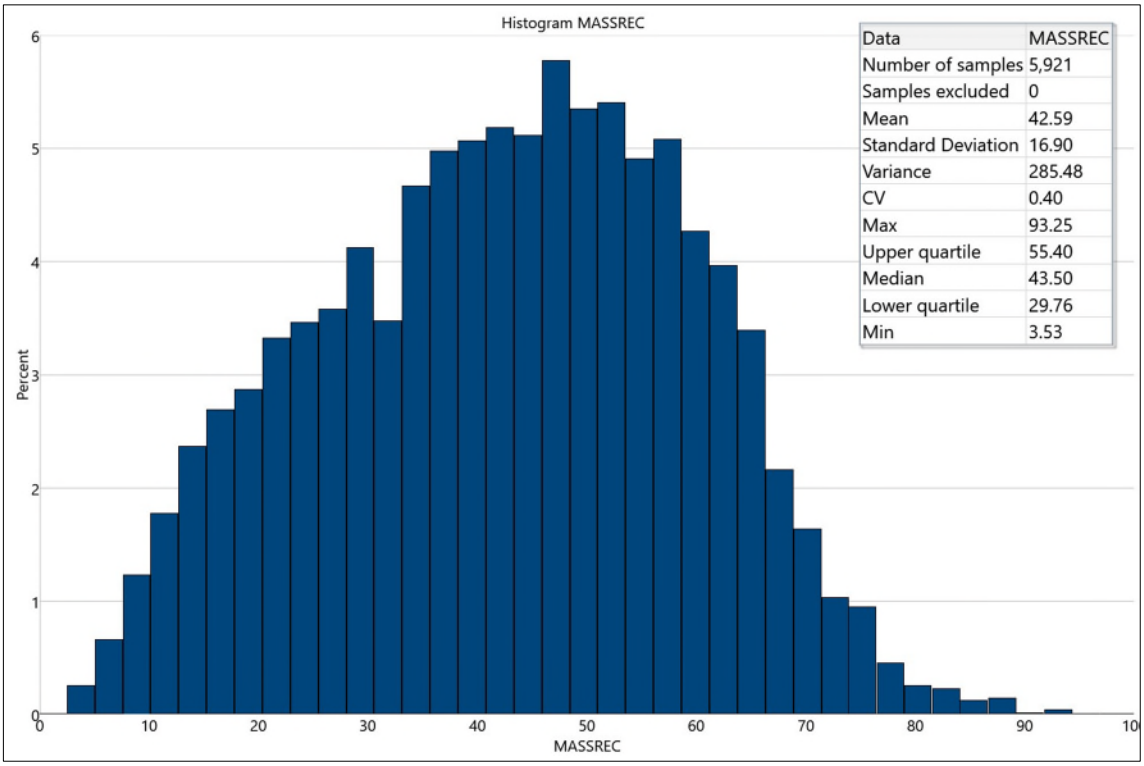


Figure 9.24 – Distribution of mass recovery in GEOZONE 43 for the 4M_C composites.

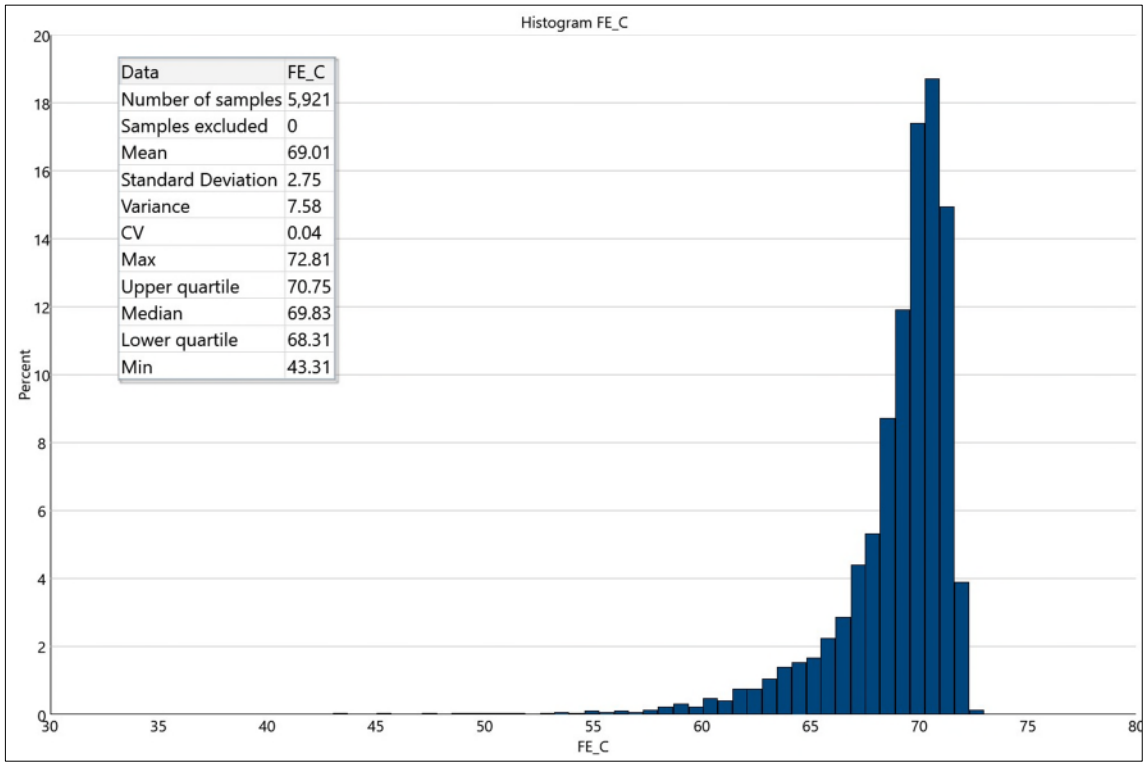


Figure 9.25 – Distribution of concentrate Fe in GEOZONE 43 for the 4M_C composites.

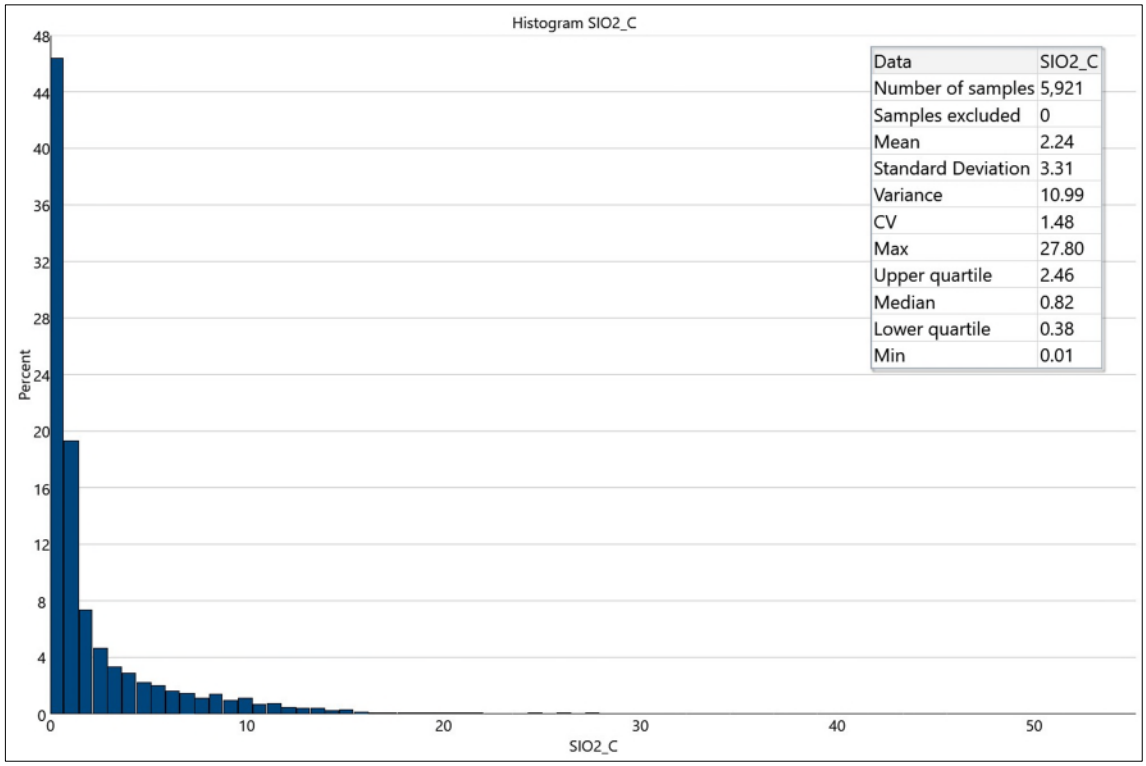


Figure 9.26 – Distribution of concentrate SiO_2 in GEOZONE 43 for the 4M_C composites.

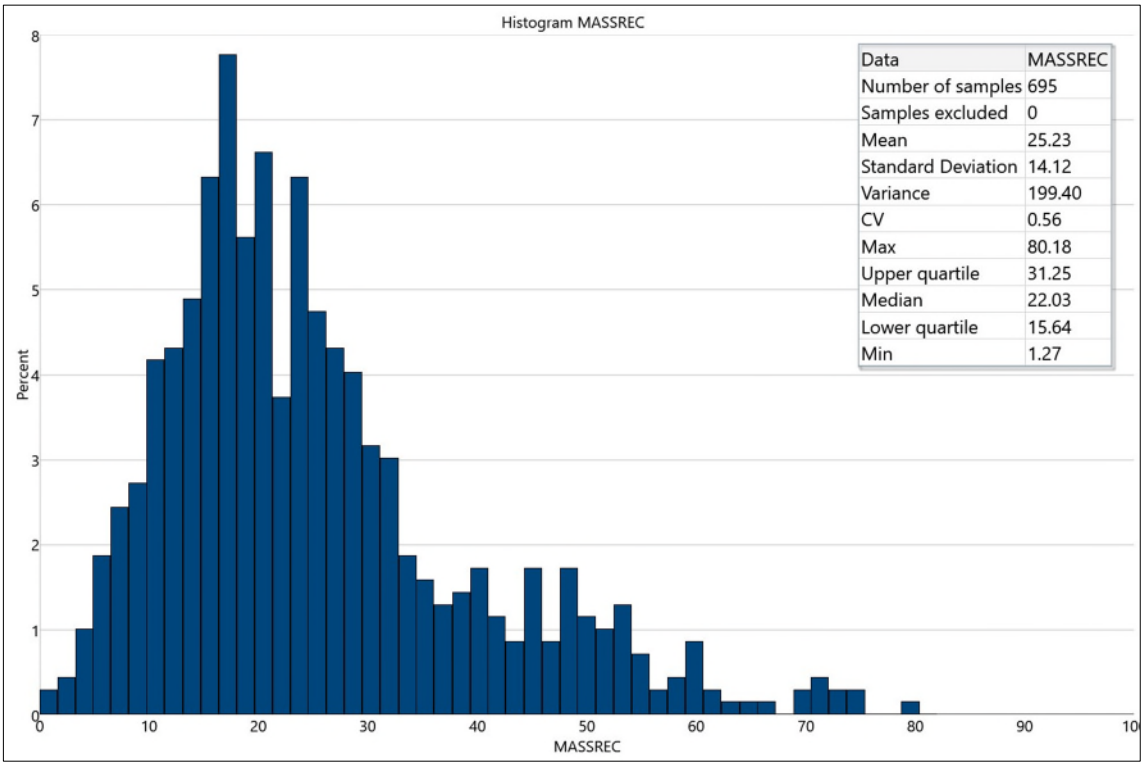


Figure 9.27 – Distribution of mass recovery in GEOZONE 46 for the 4M_C composites.

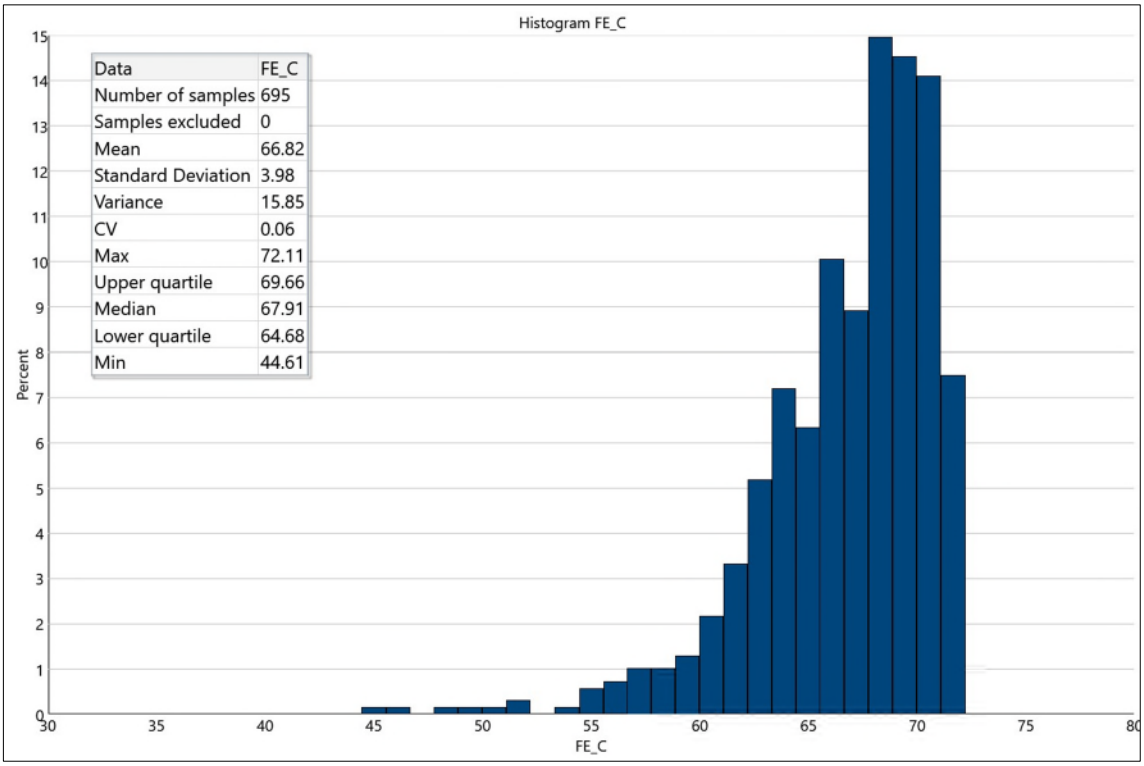


Figure 9.28 – Distribution of concentrate Fe in GEOZONE 46 for the 4M_C composites.

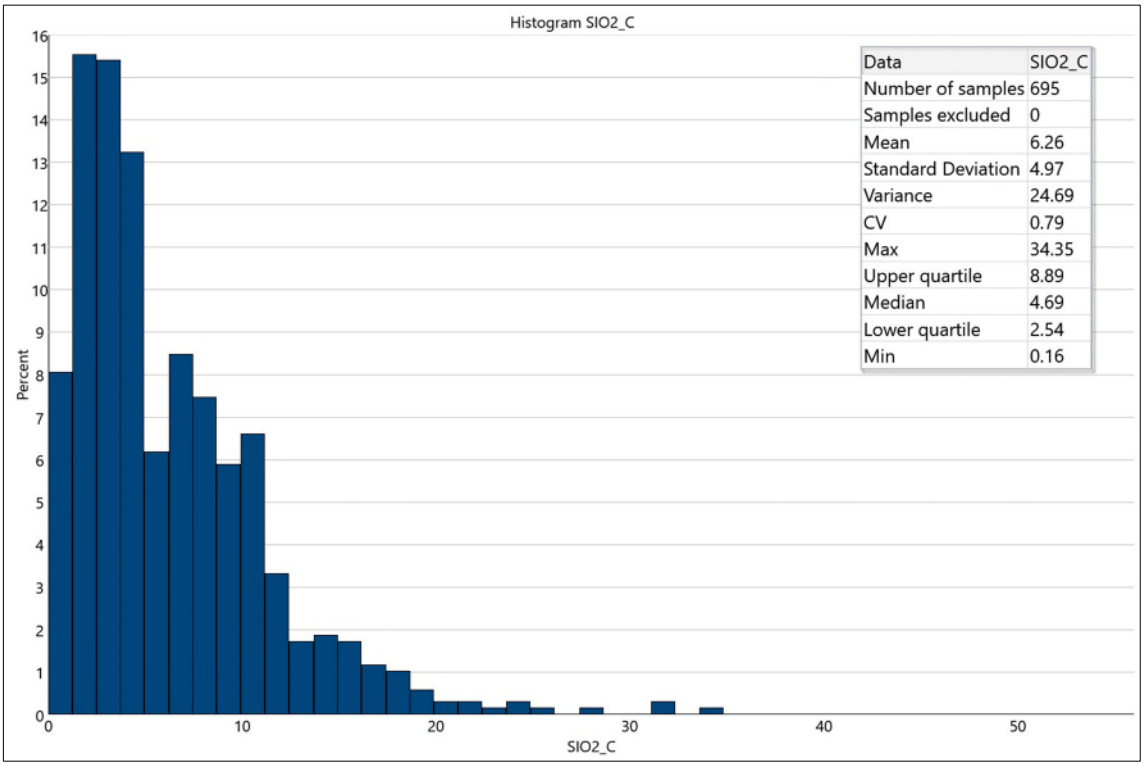


Figure 9.29 – Distribution of concentrate SiO_2 in GEOZONE 46 for the 4M_C composites.

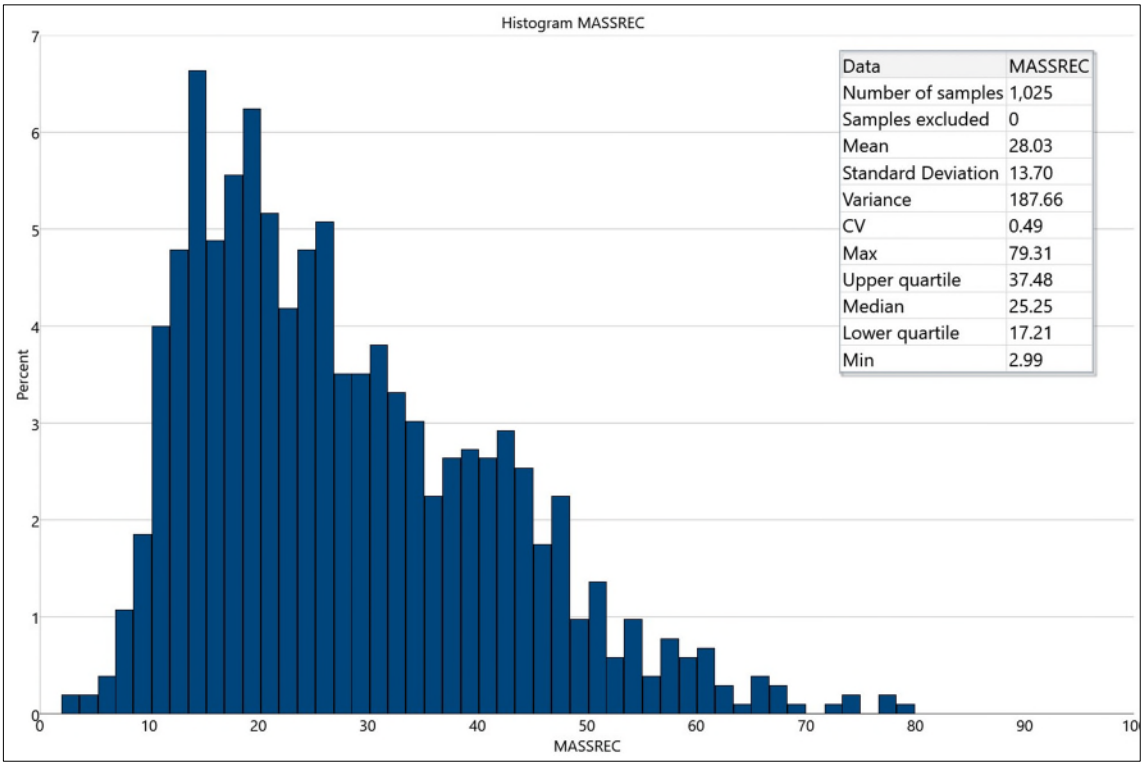


Figure 9.30 – Distribution of mass recovery in GEOZONE 48 for the 4M_C composites.

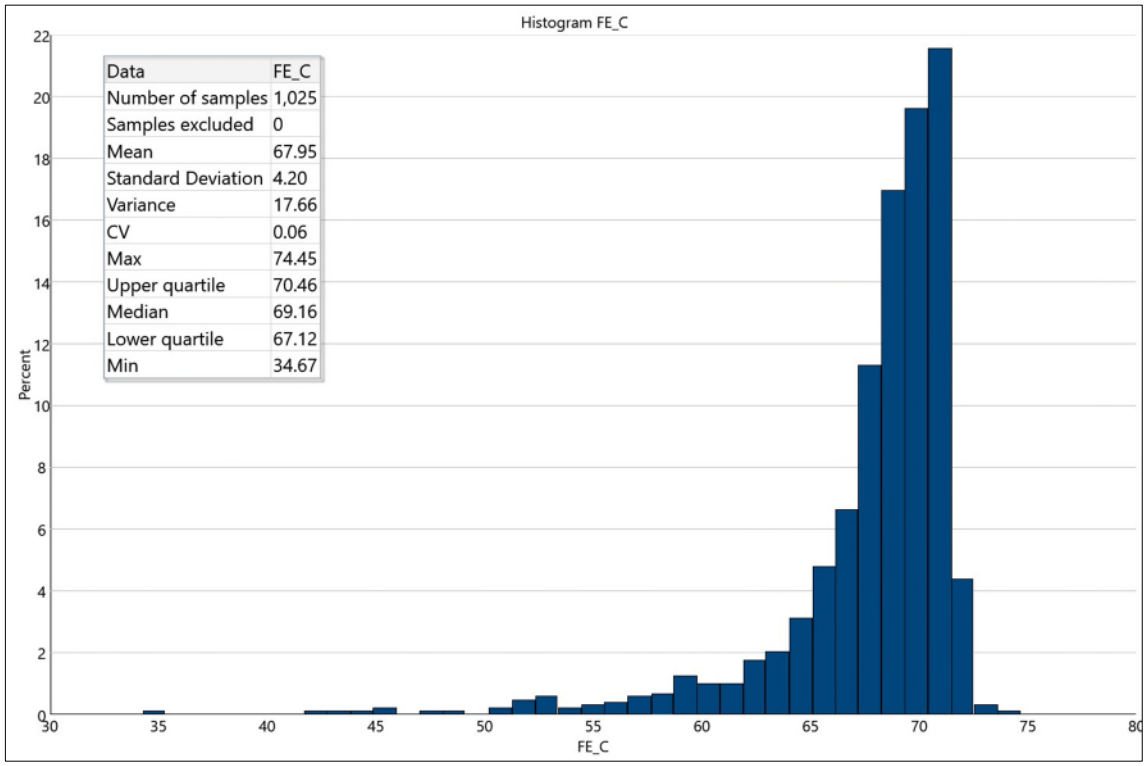


Figure 9.31 – Distribution of concentrate Fe in GEOZONE 48 for the 4M_C composites.

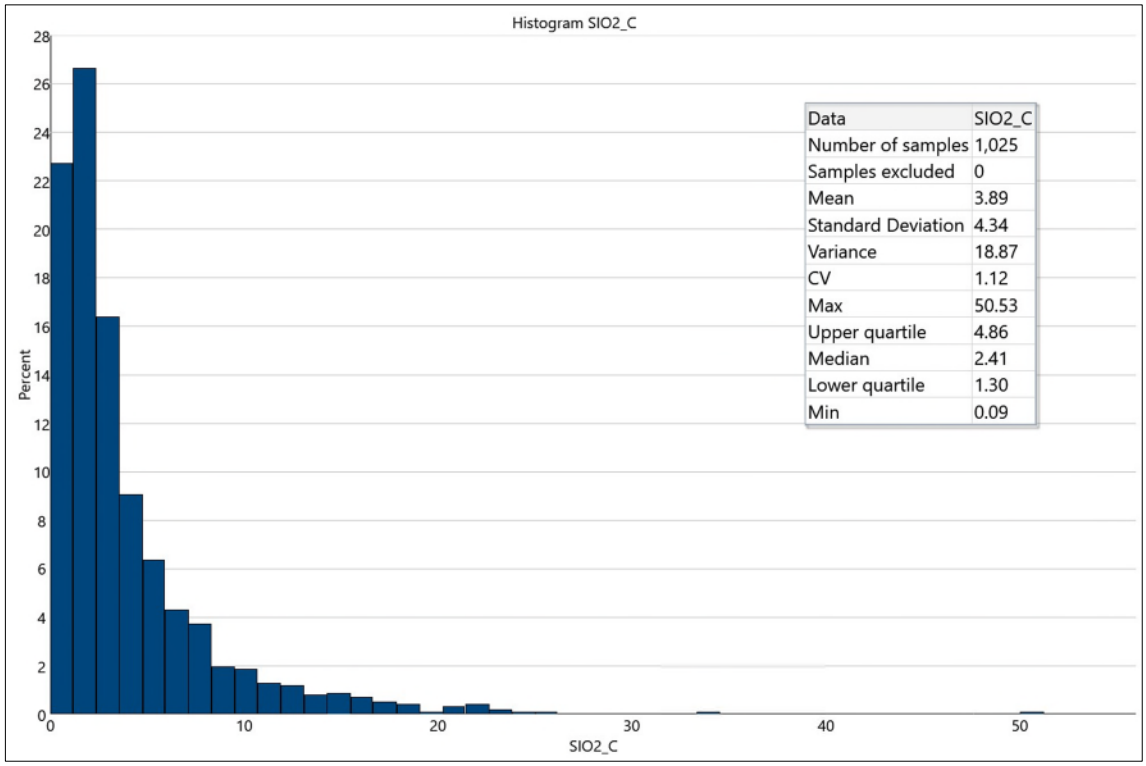


Figure 9.32 – Distribution of concentrate SiO_2 in GEOZONE 48 for the 4M_C composites.

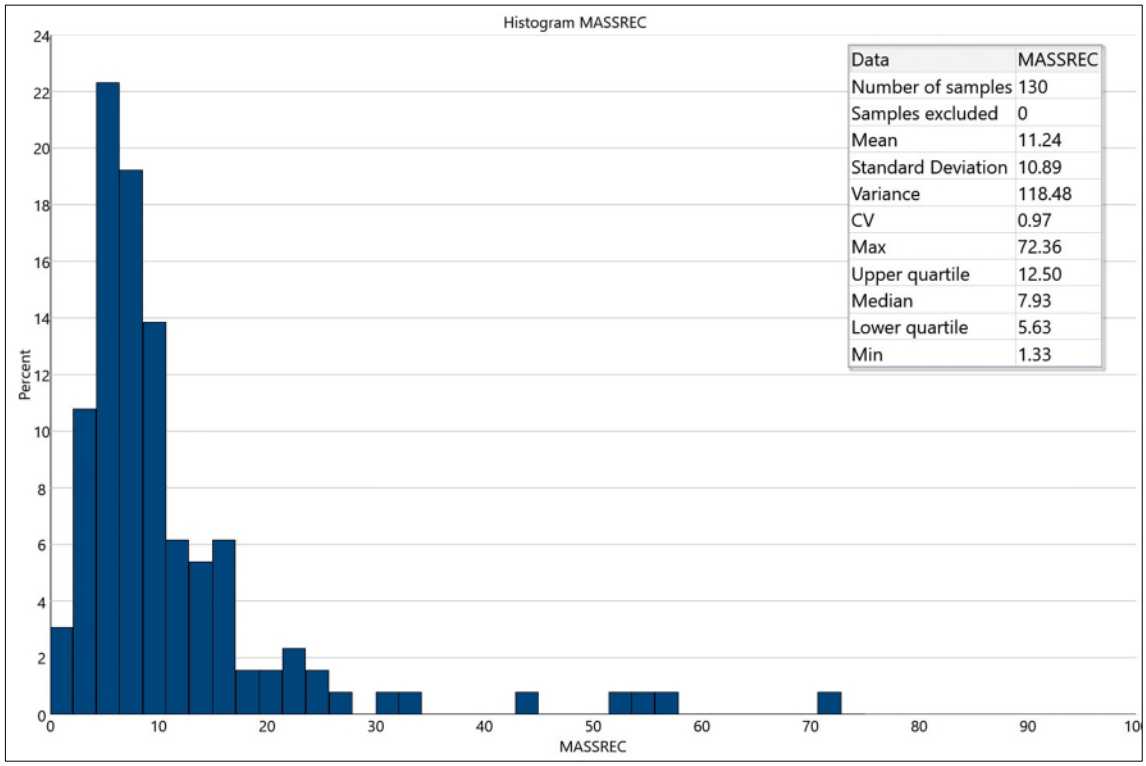


Figure 9.33 – Distribution of mass recovery in GEOZONE 70 for the 4M_C composites.

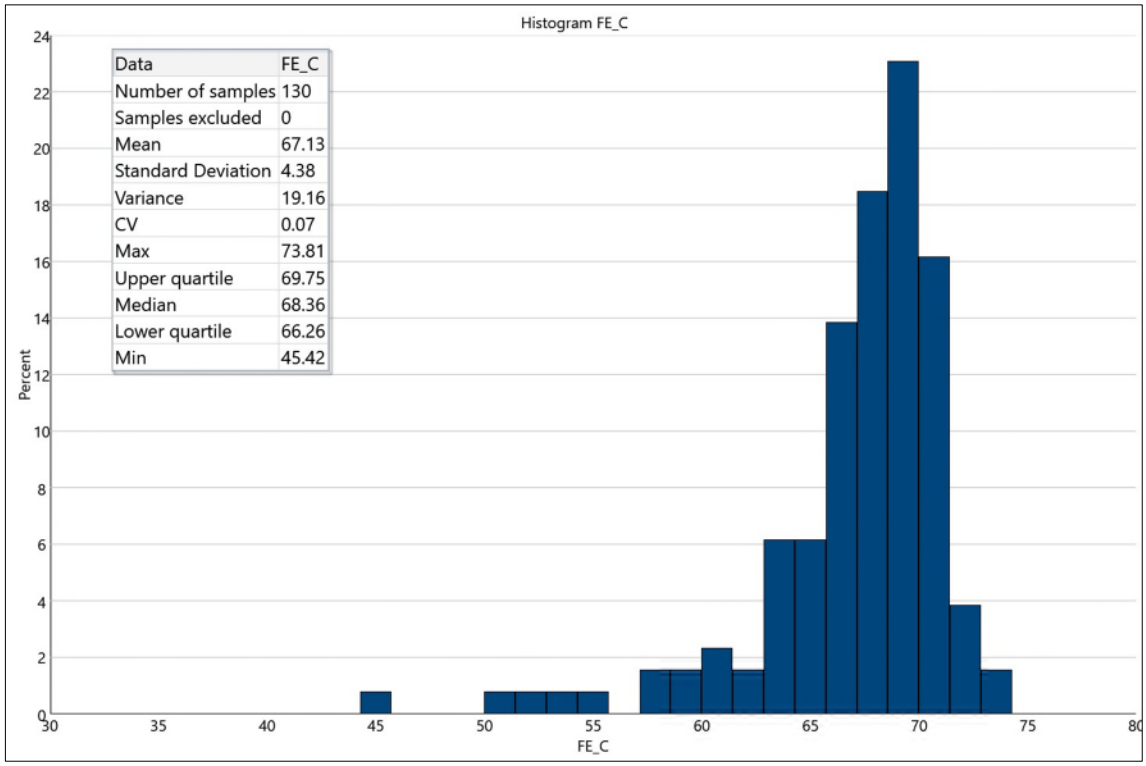


Figure 9.34 – Distribution of concentrate Fe in GEOZONE 70 for the 4M_C composites.

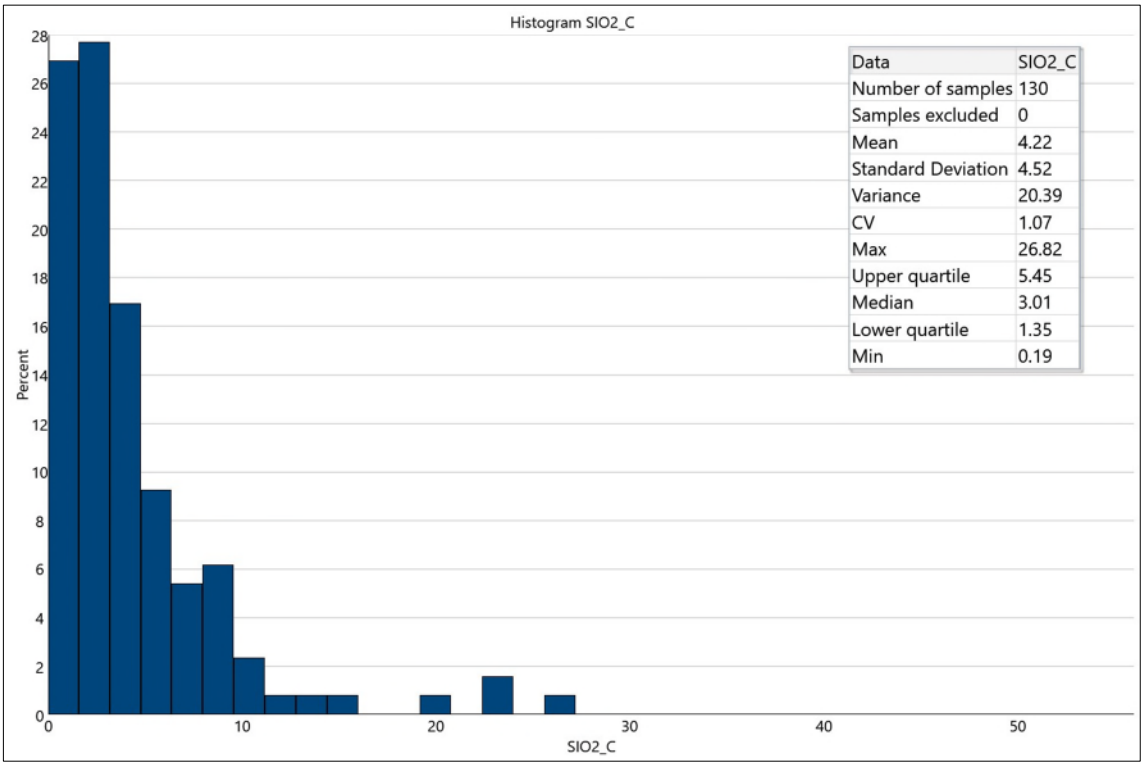


Figure 9.35 – Distribution of concentrate SiO_2 in GEOZONE 70 for the 4M_C composites.

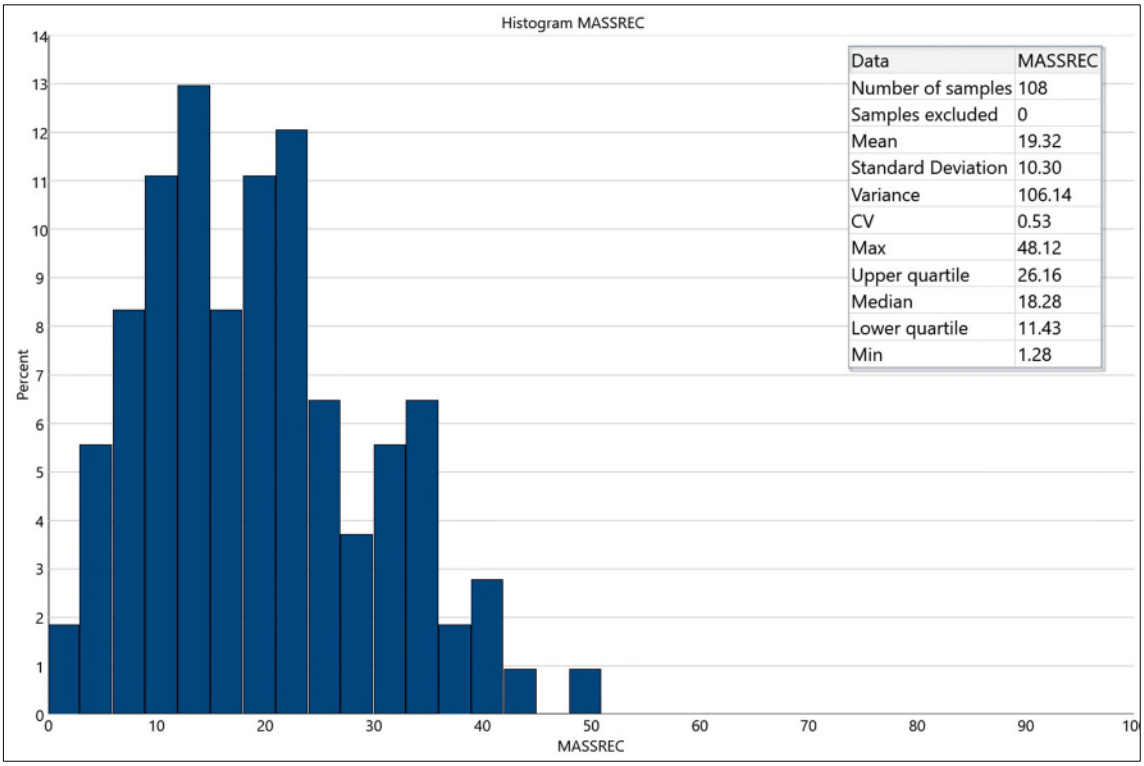


Figure 9.36 – Distribution of mass recovery in GEOZONE 75 for the 4M_C composites.

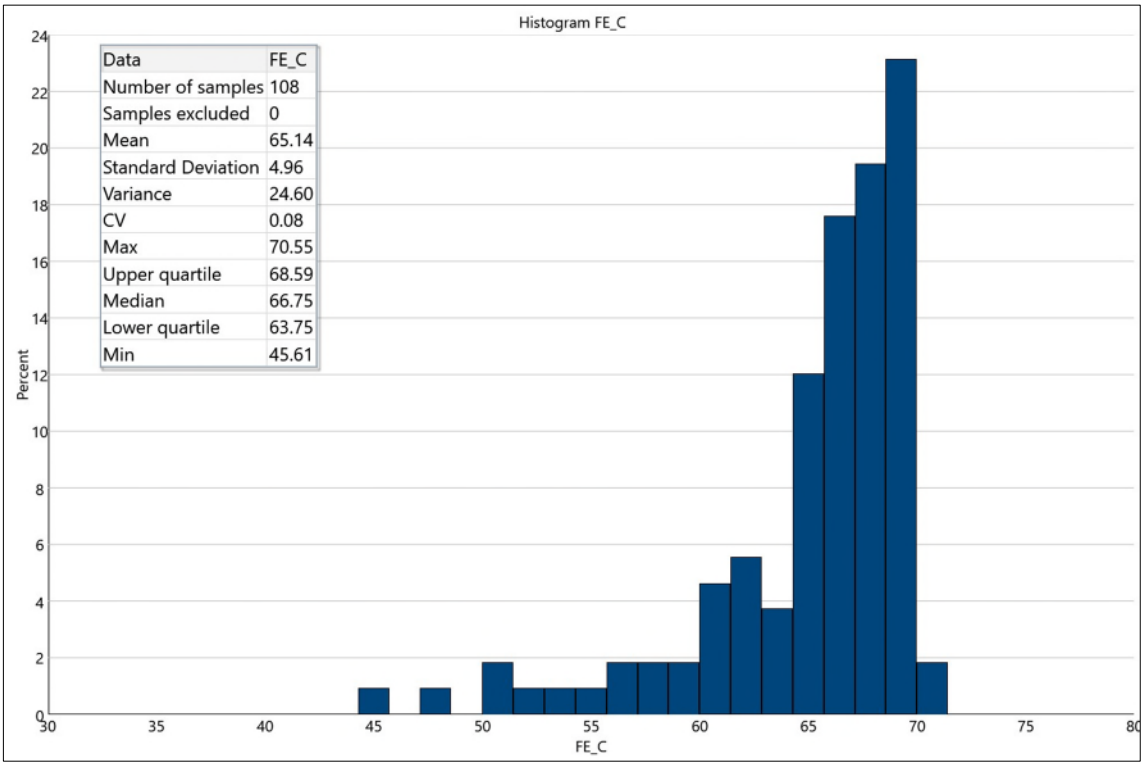


Figure 9.37 – Distribution of concentrate Fe in GEOZONE 75 for the 4M_C composites.

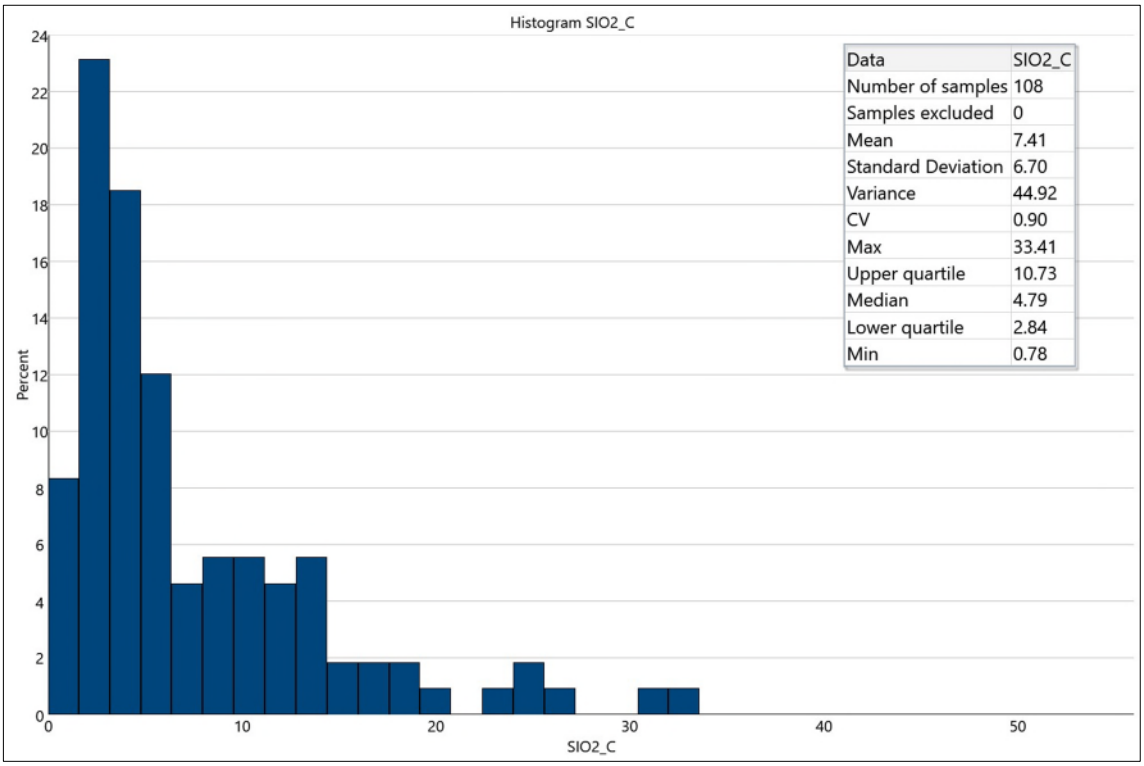


Figure 9.38 – Distribution of concentrate SiO_2 in GEOZONE 75 for the 4M_C composites.

As described in Section 7.2.3 GEOZONE 75 (MSU) is a magnetite sulphide domain with high S content attributable to pyrite and pyrrhotite. Figure 9.39 shows a comparison between concentrate S grades for magnetite domains GEOZONE 40, 43, 46, 48, 75 and the immediate footwall domains of the MSU (DOM71 and BSQ 75).

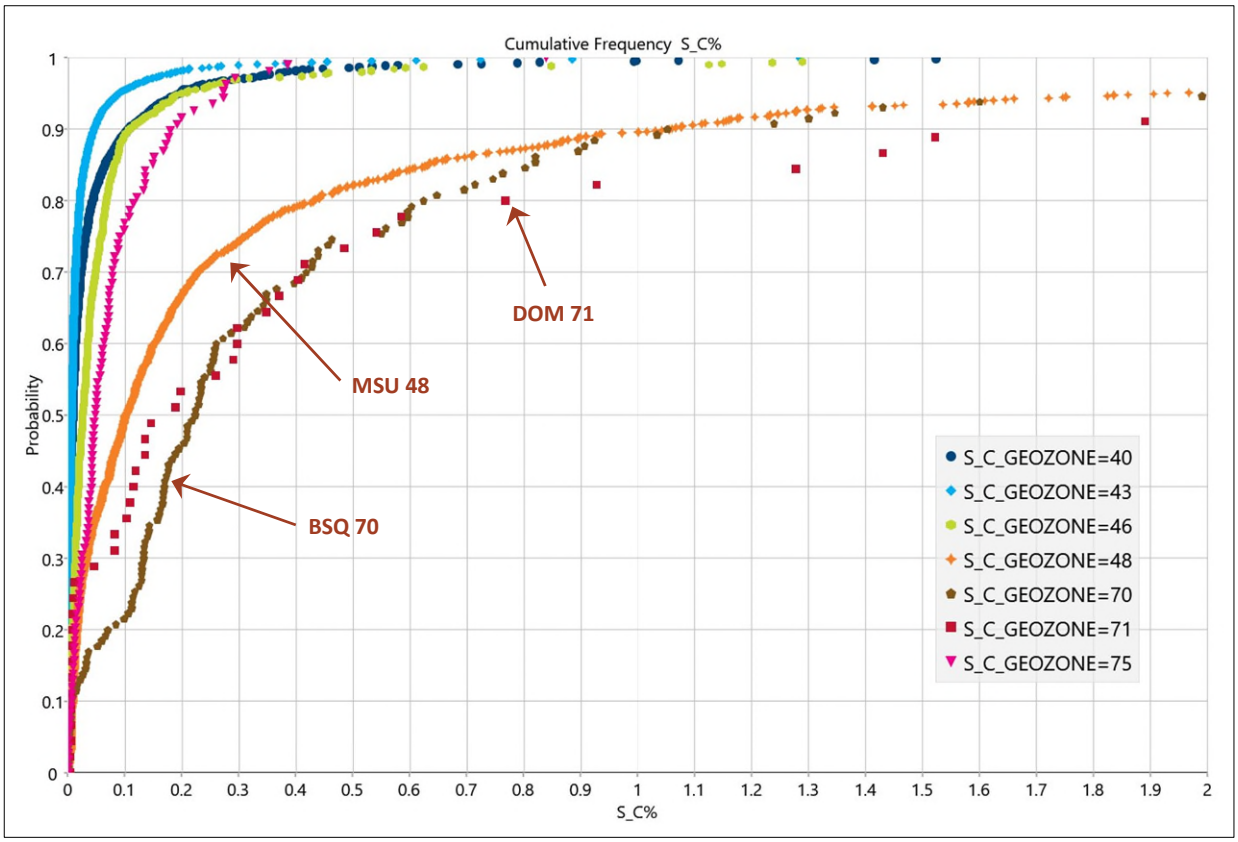


Figure 9.39 – Cumulative frequency plot comparing naïve distribution of concentrate S grades for magnetite domains GEOZONES 40, 43, 46, 48, 75 and the Katunga Dolomite (71) and Basal Sequence (70) domains for the 4M_C composites. Statistics for DOM 71 should be treated with caution due to the very low sample count.

Table 9.2 summarises the statistics for concentrate S grades in key domains for the 4M_C composite group.

Table 9.2 – Naïve statistics for concentrate S in GEOZONES 40, 43, 46, 48, 75, 70 and 71 for the 4M_C composites.

Domain	Count	Min	Max	Mean	StdDev	P10	P25	P50	P75	P90
40 MTS	1,866	0.001	2.693	0.047	0.146	0.001	0.005	0.009	0.031	0.105
43 MTC	5,917	0.001	3.456	0.026	0.096	0.002	0.005	0.007	0.031	0.046
46 SCH	695	0.001	4.042	0.075	0.271	0.005	0.010	0.026	0.059	0.108
48 MSU	1,025	0.001	15.495	0.456	1.255	0.008	0.021	0.101	0.312	1.058
75 ESZ	108	0.001	0.839	0.081	0.107	0.007	0.013	0.048	0.091	0.182
70 BSQ	130	0.001	7.528	0.510	0.918	0.005	0.116	0.223	0.507	1.052
71 DOM	45	0.004	7.138	0.693	1.363	0.005	0.010	0.168	0.527	2.820

* 70 BSQ and 71 DOM are non-magnetite domains forming the immediate footwall of the MSU GEOZONE 48 domain. Statistics for 71 DOM should be treated with caution due to the small number of samples.

Table 9.3 – Summary statistics for 4M_C composites by GEOZONE domain

GEOZONE 10 - AMP						GEOZONE 20 - BIF				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	722	0.005	5.480	0.253	0.528	210	0.005	0.260	0.017	0.030
CaO	722	0.010	3.222	0.311	0.461	210	0.010	0.530	0.066	0.082
Fe	724	37.820	72.180	67.099	4.697	210	50.170	72.250	66.707	3.852
K_2O	722	0.001	0.174	0.006	0.014	210	0.001	0.022	0.002	0.002
LOI_10	701	4.280	28.200	8.449	1.779	210	6.310	10.920	8.602	1.099
MASSREC	724	0.340	89.470	26.676	16.570	210	6.120	91.770	37.243	18.622
MgO	722	0.049	9.910	0.729	0.766	210	0.005	1.780	0.270	0.190
Mn	722	0.001	0.411	0.022	0.034	210	0.001	0.203	0.014	0.020
Na_2O	722	0.001	0.148	0.015	0.015	210	0.001	0.042	0.012	0.006
P	722	0.001	1.900	0.078	0.200	210	0.001	0.745	0.016	0.072
S	722	0.030	40.360	4.181	5.876	210	0.160	27.970	5.787	5.114
SiO_2	722	0.001	2.224	0.080	0.197	210	0.001	0.206	0.008	0.019
TiO_2	722	0.005	5.480	0.253	0.528	210	0.005	0.260	0.017	0.030
GEOZONE 32 - HEC						**GEOZONE 40 – MTS**				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	706	0.005	1.980	0.149	0.230	1,866	0.005	1.870	0.068	0.163
CaO	706	0.010	5.840	0.475	0.511	1,866	0.005	1.520	0.089	0.125
Fe	706	58.220	72.000	69.059	1.487	1,866	42.670	72.740	66.630	3.967
K_2O	706	0.001	0.040	0.003	0.003	1,866	0.001	0.103	0.004	0.007
LOI_10	691	6.720	12.600	9.453	1.012	1,850	6.140	13.600	7.421	0.793
MASSREC	706	1.600	84.120	21.376	13.585	1,866	3.550	86.230	36.881	16.110
MgO	706	0.005	2.300	0.492	0.358	1,866	0.010	4.090	0.400	0.331
Mn	706	0.001	0.217	0.018	0.025	1,828	0.001	0.570	0.018	0.029
Na_2O	706	0.001	0.070	0.011	0.007	1,866	0.001	0.100	0.010	0.009
P	706	0.001	2.225	0.066	0.239	1,866	0.001	2.693	0.047	0.146
S	706	0.040	7.140	0.618	0.723	1,866	0.005	38.410	6.753	5.211
SiO_2	706	0.001	1.584	0.050	0.112	1,866	0.001	1.300	0.044	0.125
TiO_2	706	0.005	1.980	0.149	0.230	1,866	0.005	1.870	0.068	0.163

Table 9.3 (cont.) – Summary statistics for 4M_C composites by GEOZONE domain

GEOZONE 43 - MTC						GEOZONE 46 – SCH				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	5,921	0.005	6.892	0.115	0.282	695	0.005	2.976	0.074	0.186
CaO	5,921	0.005	16.784	0.446	0.613	695	0.005	1.470	0.075	0.113
Fe	5,921	43.313	72.810	69.012	2.754	695	44.607	72.112	66.821	3.981
K_2O	5,921	0.001	0.198	0.004	0.009	695	0.001	0.057	0.003	0.004
LOI_10	5,916	5.780	21.868	7.949	1.133	687	5.940	11.090	7.189	0.636
MASSREC	5,921	3.530	93.250	42.591	16.896	695	1.265	80.180	25.228	14.121
MgO	5,921	0.010	9.975	0.578	0.493	695	0.020	5.075	0.765	0.635
Mn	5,920	0.001	1.137	0.020	0.031	680	0.001	0.275	0.035	0.054
Na_2O	5,921	0.001	0.198	0.012	0.011	695	0.001	0.065	0.011	0.008
P	5,917	0.001	3.456	0.026	0.102	695	0.001	4.042	0.075	0.271
S	5,921	0.005	27.804	2.241	3.315	695	0.160	34.353	6.264	4.968
SiO_2	5,921	0.001	1.197	0.038	0.086	695	0.001	1.210	0.031	0.087
TiO_2	5,921	0.005	6.892	0.115	0.282	695	0.005	2.976	0.074	0.186
GEOZONE 48 - MSU						**GEOZONE 70 - BSQ**				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	1,025	0.005	3.528	0.114	0.248	130	0.005	3.980	0.317	0.516
CaO	1,025	0.005	11.210	0.270	0.683	130	0.005	3.630	0.303	0.508
Fe	1,025	34.672	74.450	67.952	4.202	130	45.420	73.810	67.132	4.377
K_2O	1,025	0.001	0.348	0.005	0.016	130	0.001	0.491	0.012	0.045
LOI_10	1,024	5.426	19.615	7.517	1.499	124	4.834	11.240	7.263	1.266
MASSREC	1,025	2.990	79.311	28.029	13.699	130	1.330	72.357	11.236	10.885
MgO	1,025	0.035	7.450	0.726	0.782	130	0.130	4.660	0.953	0.748
Mn	1,020	0.001	0.504	0.028	0.048	129	0.001	0.415	0.051	0.086
Na_2O	1,025	0.001	0.086	0.006	0.006	130	0.001	0.052	0.007	0.007
P	1,025	0.001	15.495	0.456	1.255	130	0.001	7.528	0.510	0.918
S	1,025	0.090	50.528	3.885	4.344	130	0.190	26.820	4.224	4.515
SiO_2	1,025	0.001	1.490	0.052	0.128	130	0.001	1.795	0.161	0.273
TiO_2	1,025	0.005	3.528	0.114	0.248	130	0.005	3.980	0.317	0.516

Table 9.3 (cont.) – Summary statistics for 4M_C composites by GEOZONE domain

	GEOZONE 71 - DOM					GEOZONE 75 – ESZ				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	45	0.110	2.772	0.814	0.658	108	0.005	1.560	0.388	0.335
CaO	45	0.060	6.336	0.924	1.088	108	0.030	1.608	0.190	0.252
Fe	45	44.020	69.950	60.093	7.605	108	45.608	70.550	65.136	4.960
K_2O	45	0.002	0.491	0.039	0.079	108	0.001	0.076	0.014	0.017
LOI_10	43	7.265	18.006	9.716	1.734	103	6.020	11.500	7.629	0.954
MASSREC	45	3.000	25.623	11.056	5.141	108	1.280	48.120	19.321	10.302
MgO	45	0.360	5.970	2.020	1.353	108	0.108	2.730	0.701	0.422
Mn	45	0.005	0.095	0.037	0.022	108	0.001	0.203	0.042	0.048
Na_2O	45	0.001	0.048	0.015	0.011	108	0.001	0.050	0.011	0.008
P	45	0.004	7.138	0.693	1.363	108	0.001	0.839	0.081	0.107
S	45	0.430	31.812	9.830	8.666	108	0.780	33.411	7.408	6.702
SiO_2	45	0.025	2.290	0.333	0.479	108	0.005	0.739	0.152	0.151
TiO_2	45	0.110	2.772	0.814	0.658	108	0.005	1.560	0.388	0.335

9.2.2 8M_C Group

The summary statistics for all analytes across the 10 GEOZONE domains for the 8m composite group are shown in Table 9.4. The distribution of mass recovery, Fe and SiO_2 concentrate grades in the key magnetite and related domains of 40 (MTS), 43 (MTC), 46 (SCH), 48 (MSU), 70 (BSQ) and 75 (ESZ) are shown in Figure 9.40 to Figure 9.57.

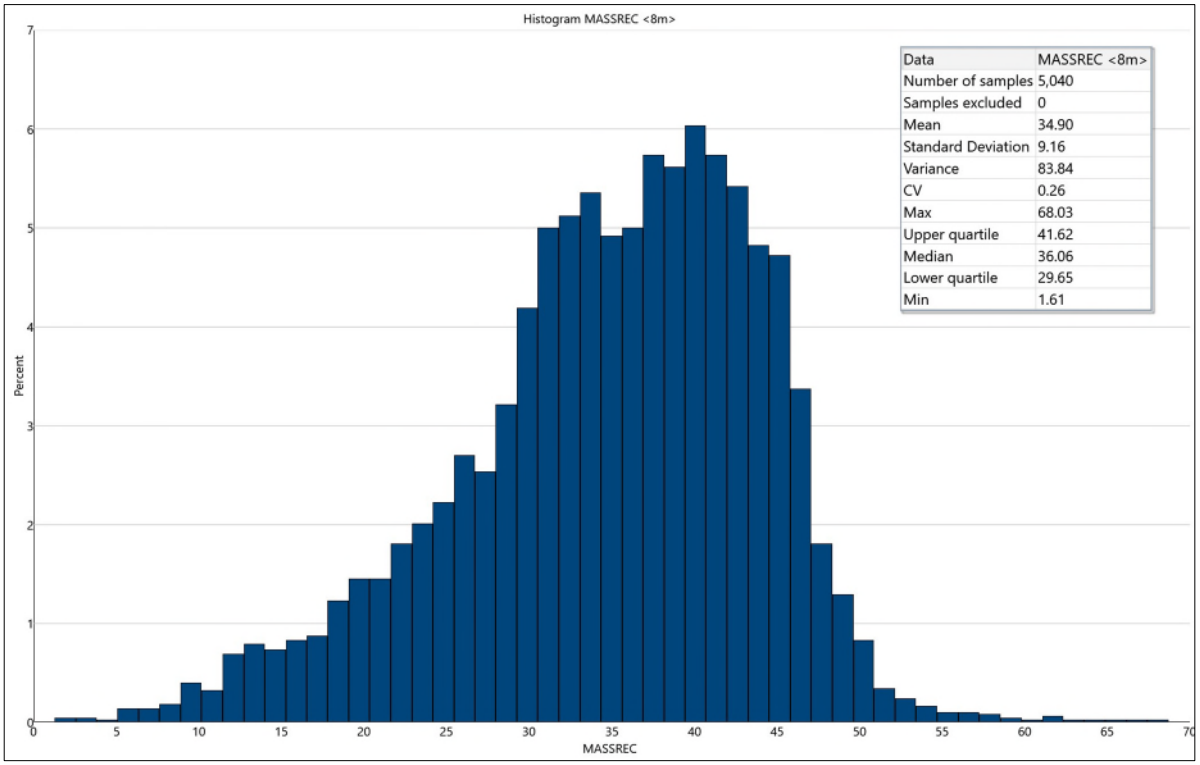


Figure 9.40 – Distribution of mass recovery in GEOZONE 40 for the 8M_C composites.

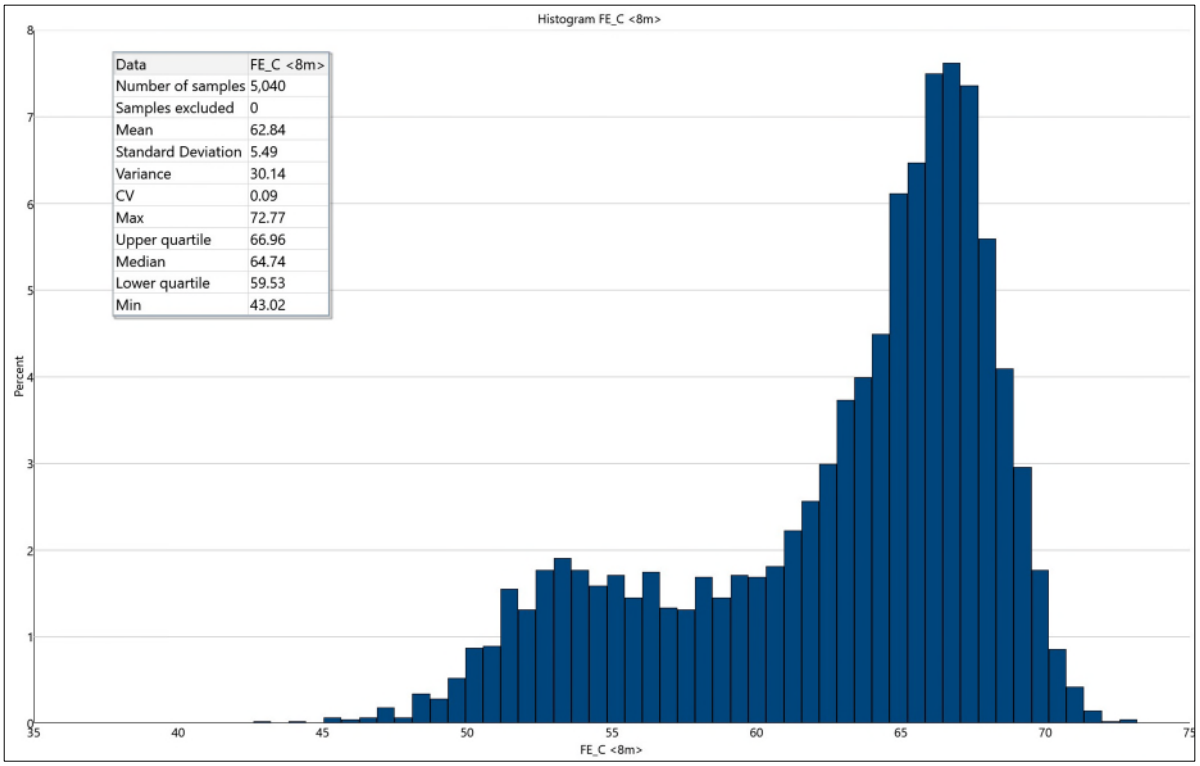


Figure 9.41 – Distribution of concentrate Fe in GEOZONE 40 for the 8M_C composites.

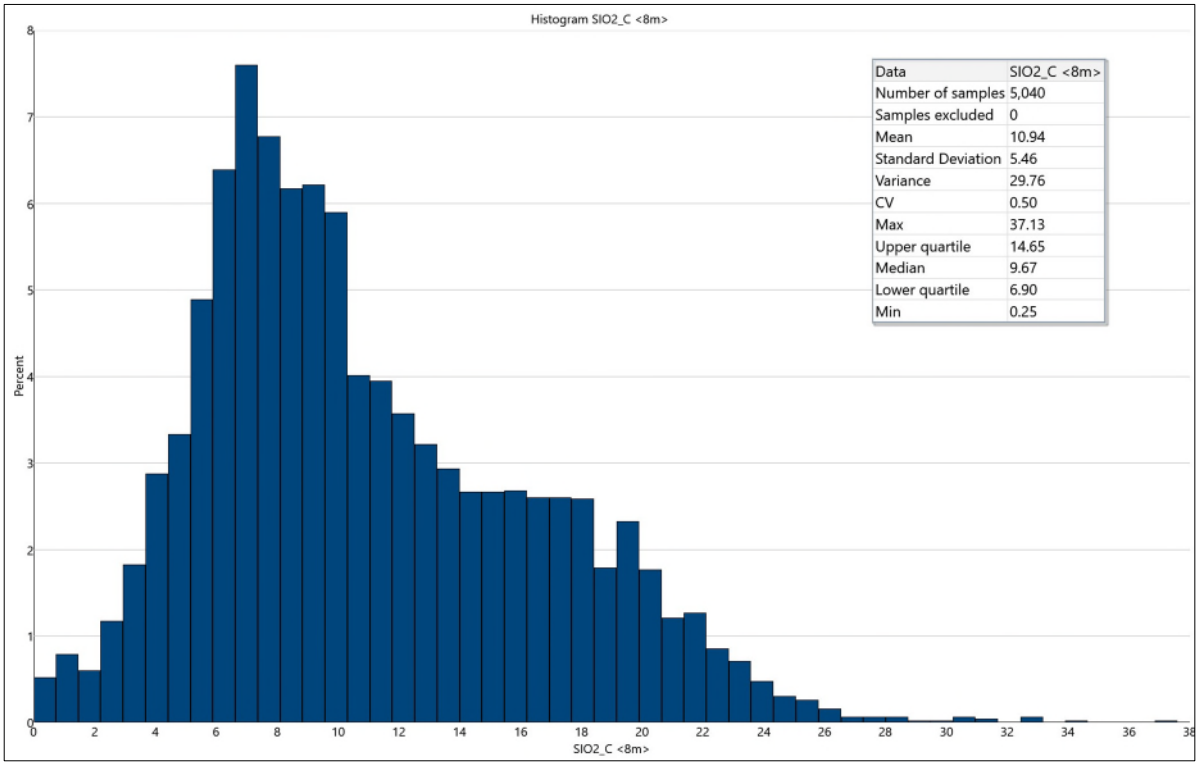


Figure 9.42 – Distribution of concentrate SiO_2 in GEOZONE 40 for the 8M_C composites.

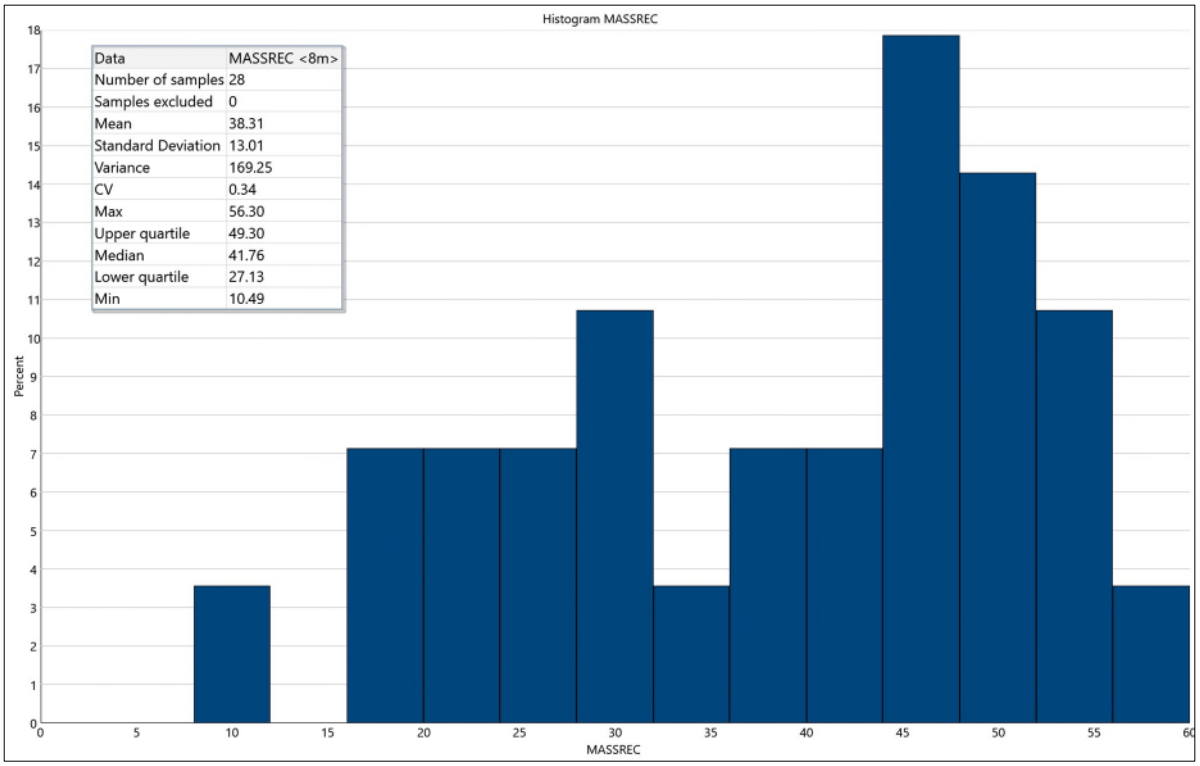


Figure 9.43 – Distribution of mass recovery in GEOZONE 43 for the 8M_C composites.

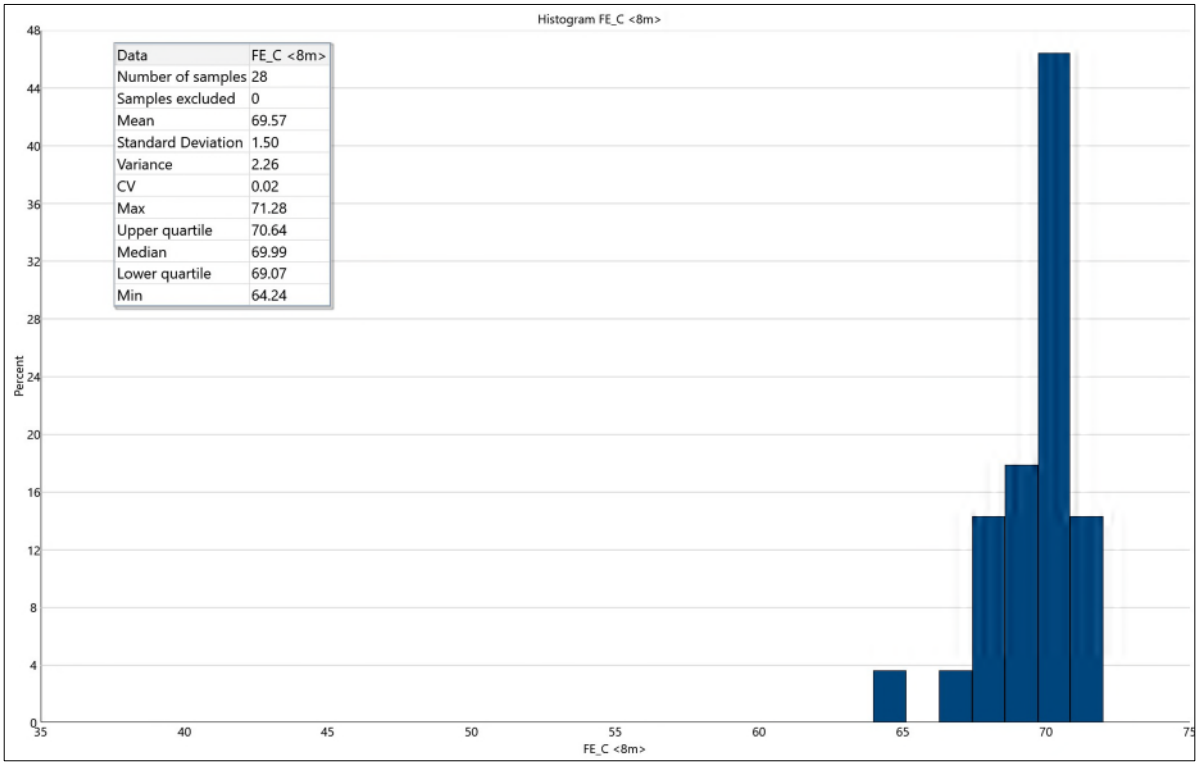


Figure 9.44 – Distribution of concentrate Fe in GEOZONE 43 for the 8M_C composites.

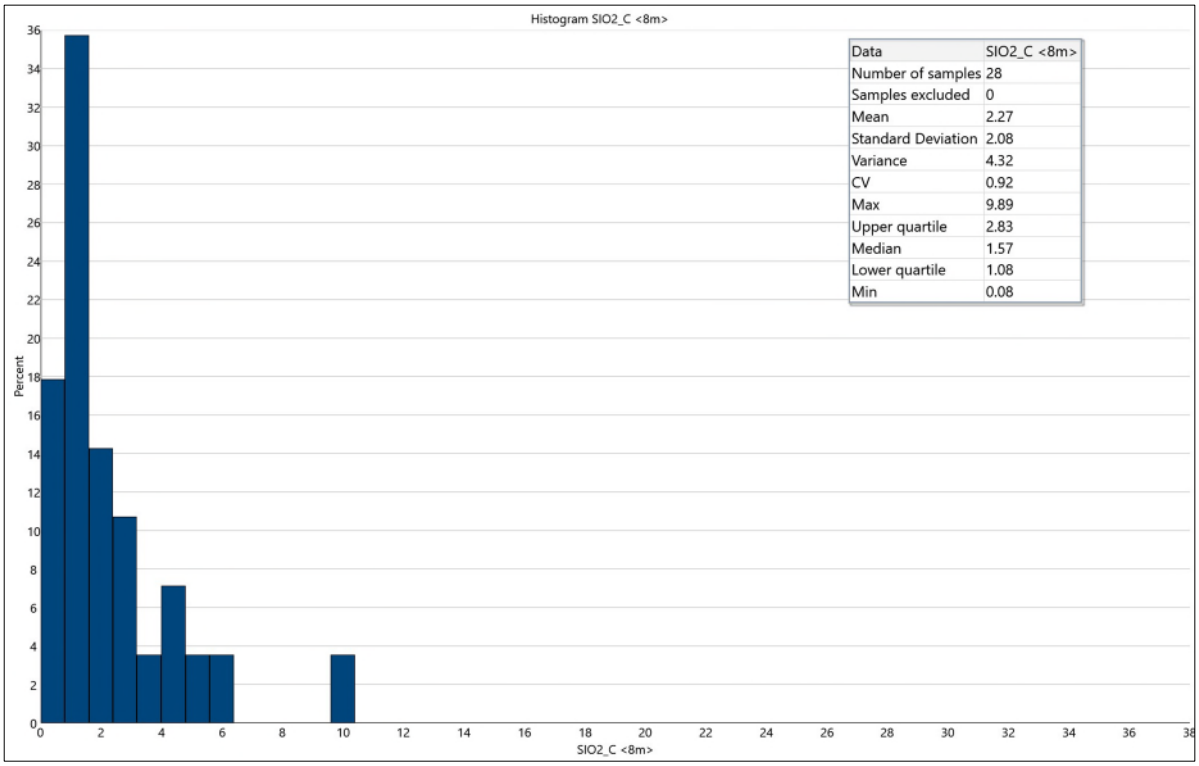


Figure 9.45 – Distribution of concentrate SiO_2 in GEOZONE 43 for the 8M_C composites.

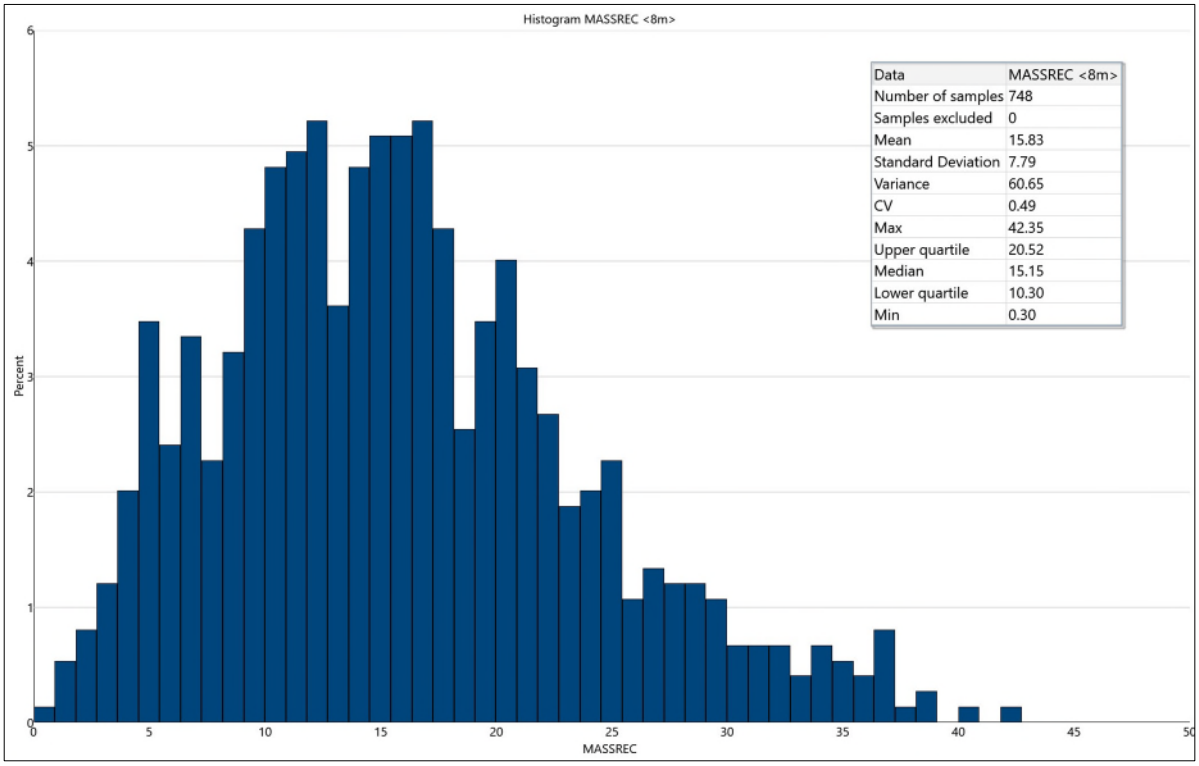


Figure 9.46 – Distribution of mass recovery in GEOZONE 46 for the 8M_C composites.

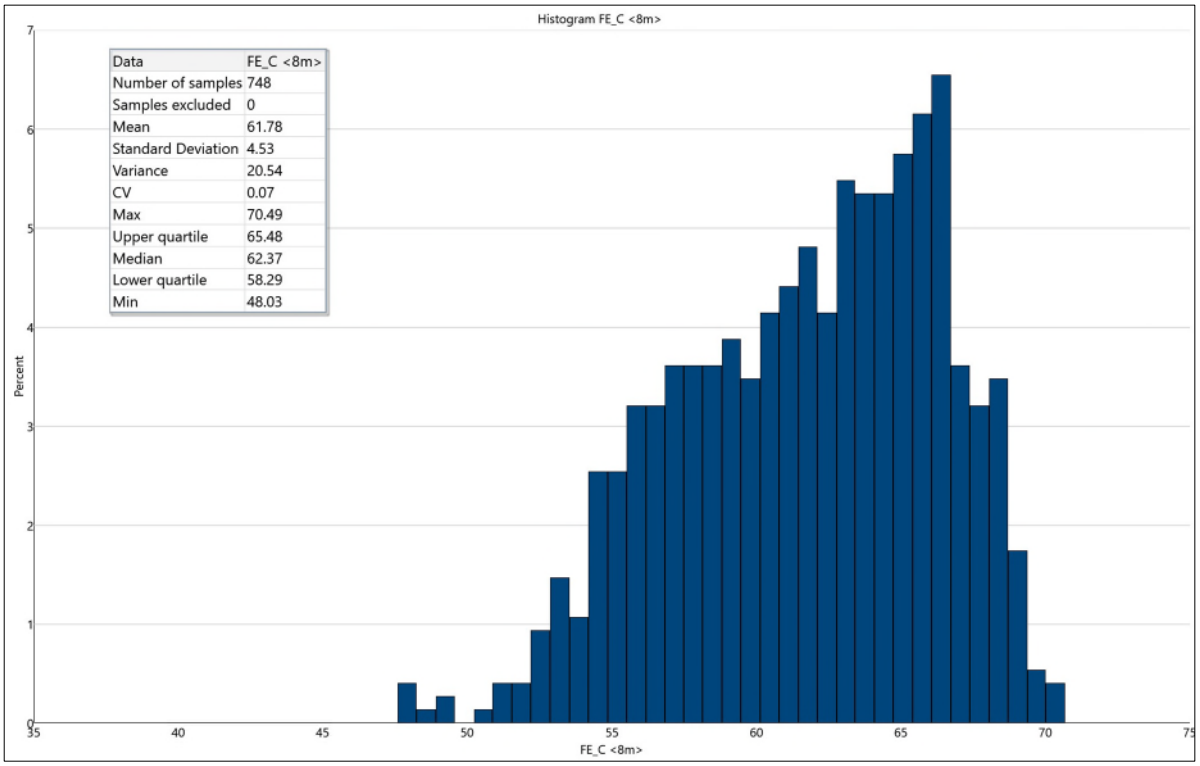


Figure 9.47 – Distribution of concentrate Fe in GEOZONE 46 for the 8M_C composites.

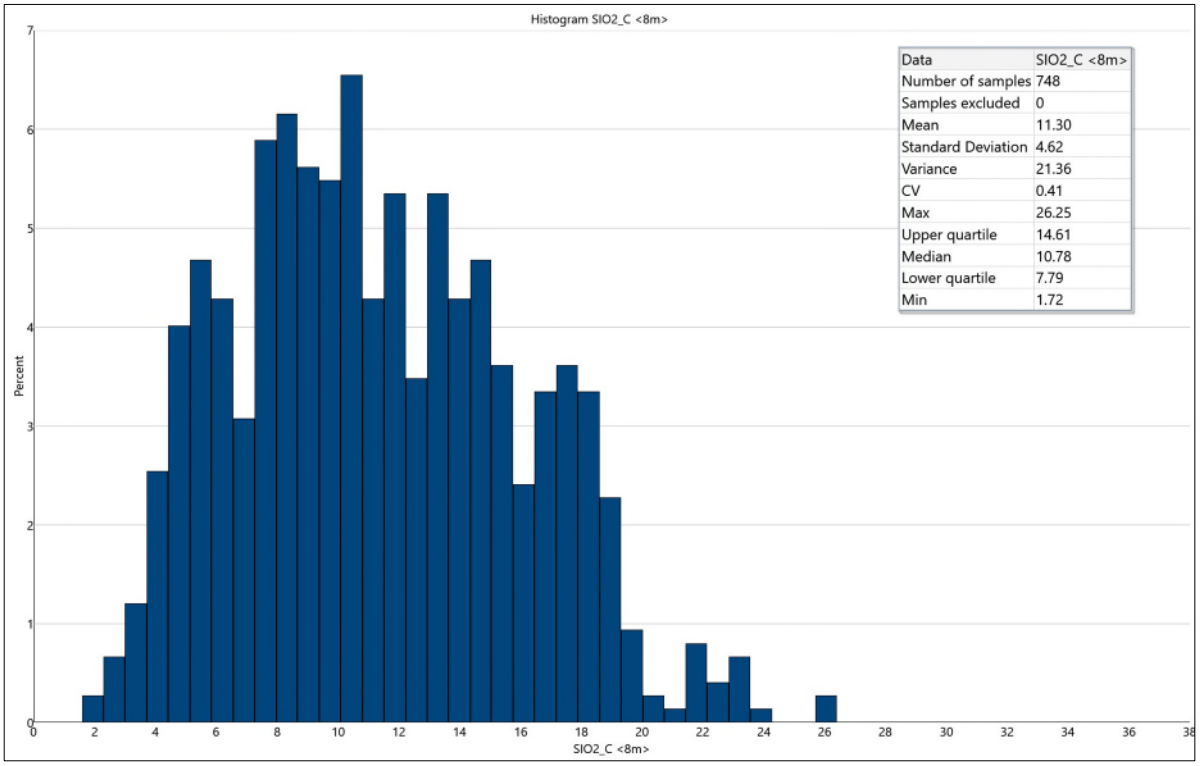


Figure 9.48 – Distribution of concentrate SiO_2 in GEOZONE 46 for the 8M_C composites.

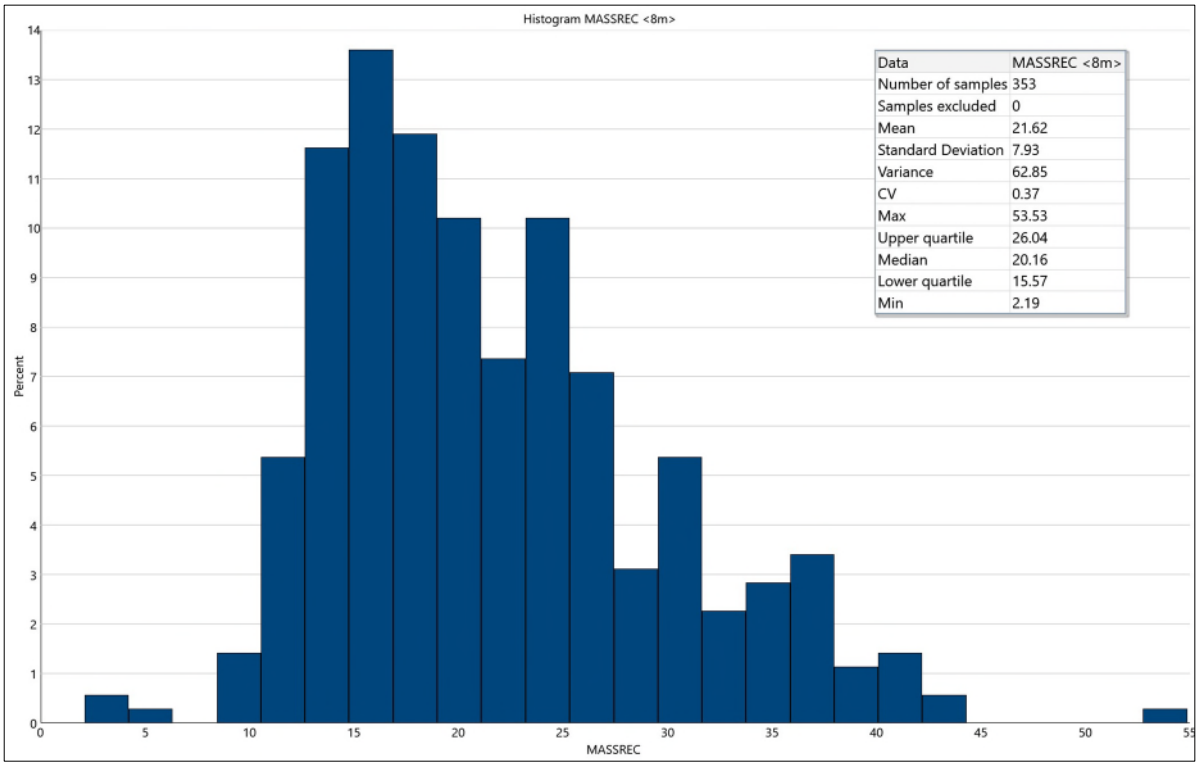


Figure 9.49 – Distribution of mass recovery in GEOZONE 48 for the 8M_C composites.

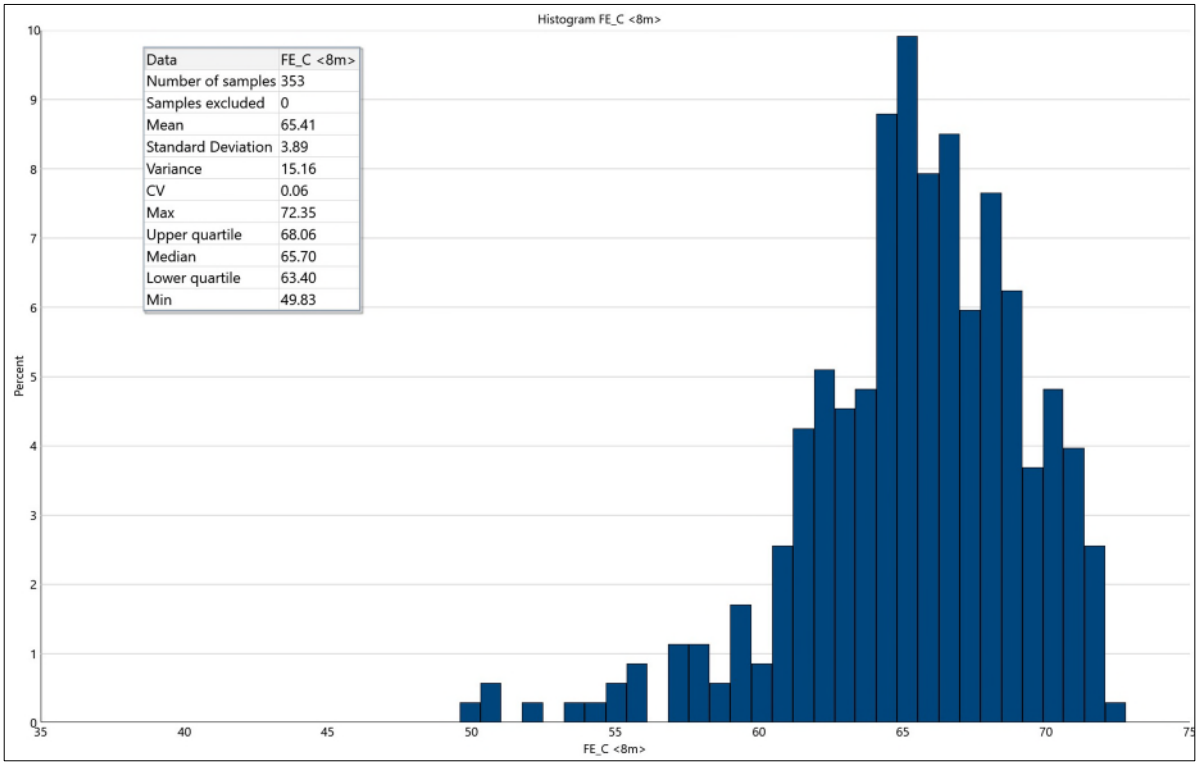


Figure 9.50 – Distribution of concentrate Fe in GEOZONE 48 for the 8M_C composites.

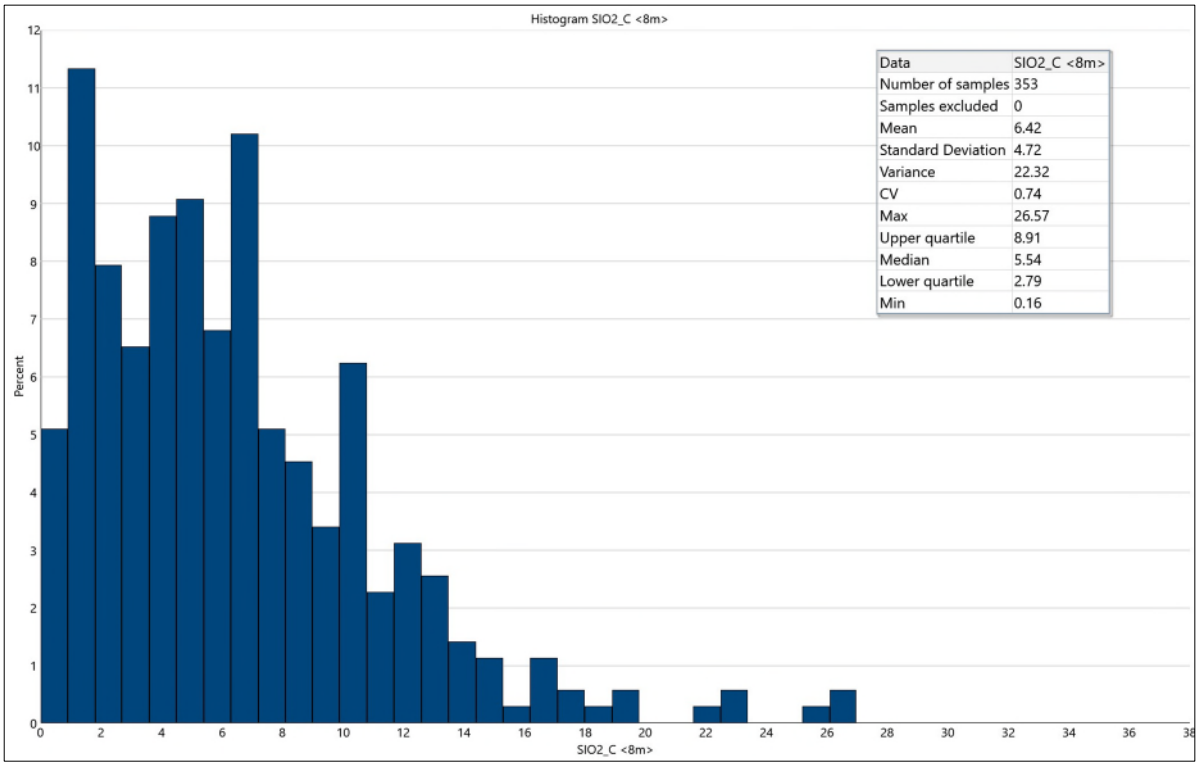


Figure 9.51 – Distribution of concentrate SiO_2 in GEOZONE 48 for the 8M_C composites.

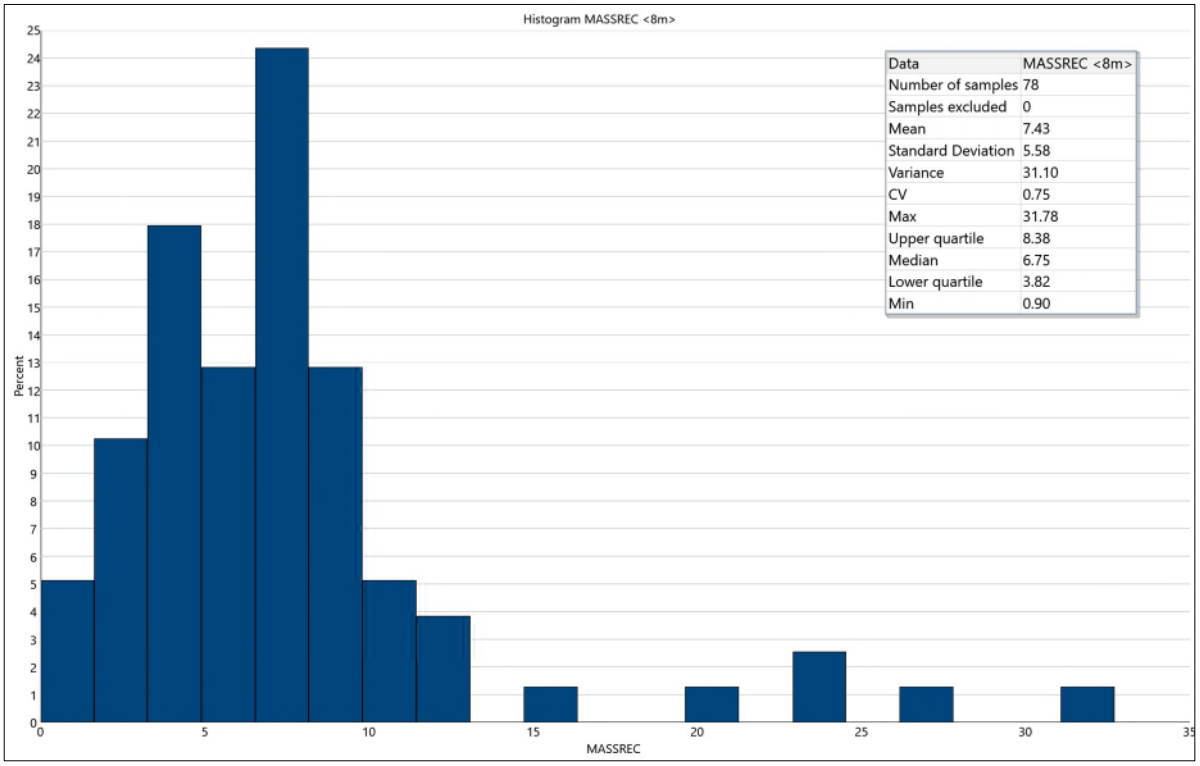


Figure 9.52 – Distribution of mass recovery in GEOZONE 70 for the 8M_C composites.

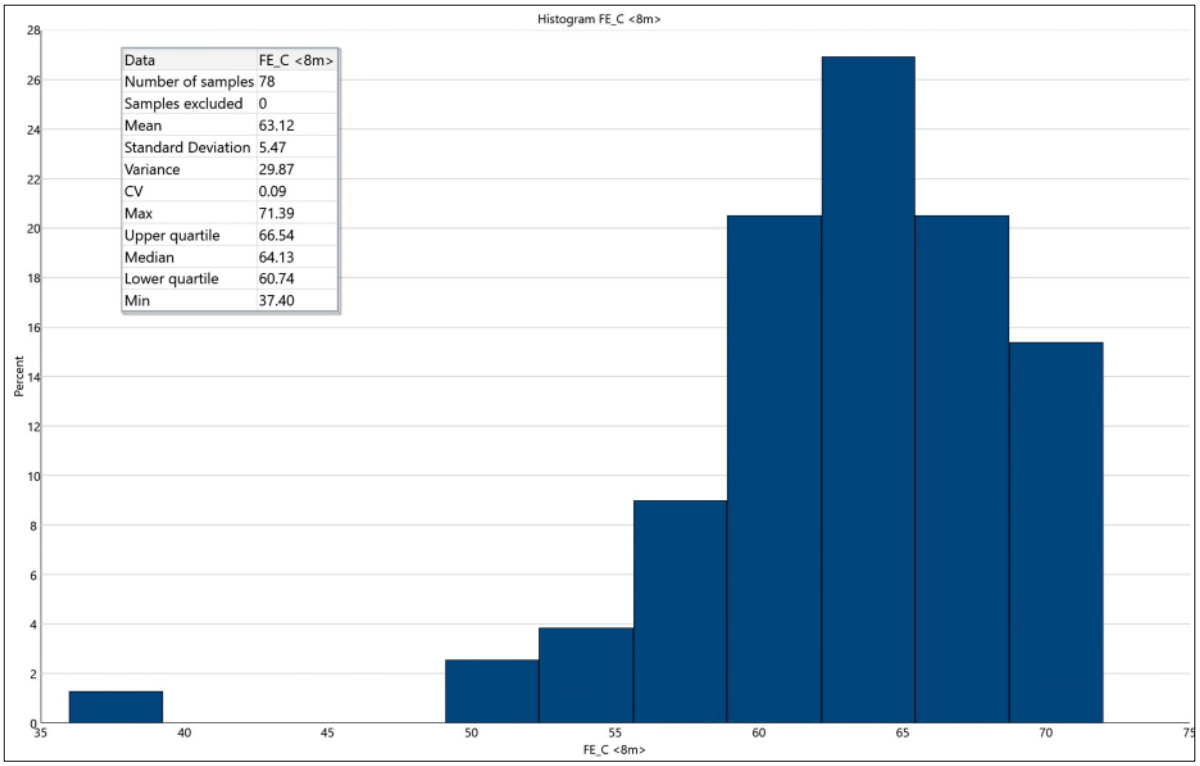


Figure 9.53 – Distribution of concentrate Fe in GEOZONE 70 for the 8M_C composites.

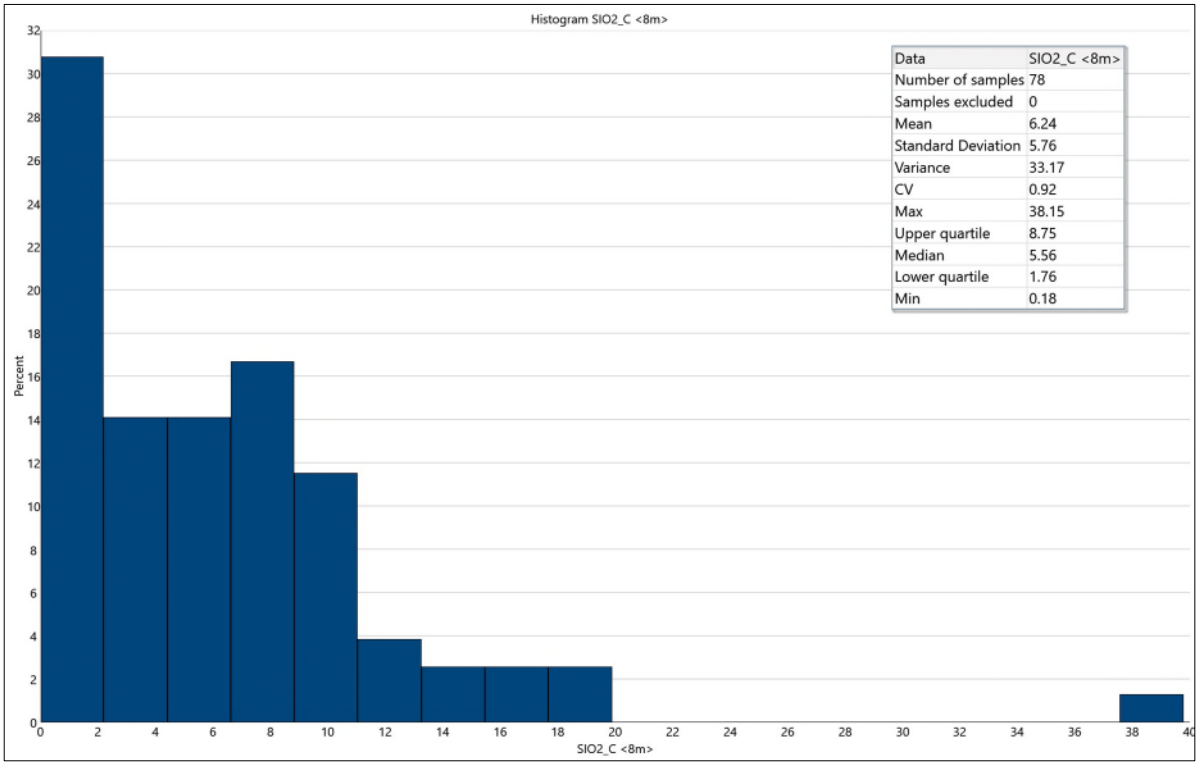


Figure 9.54 – Distribution of concentrate SiO_2 in GEOZONE 70 for the 8M_C composites.

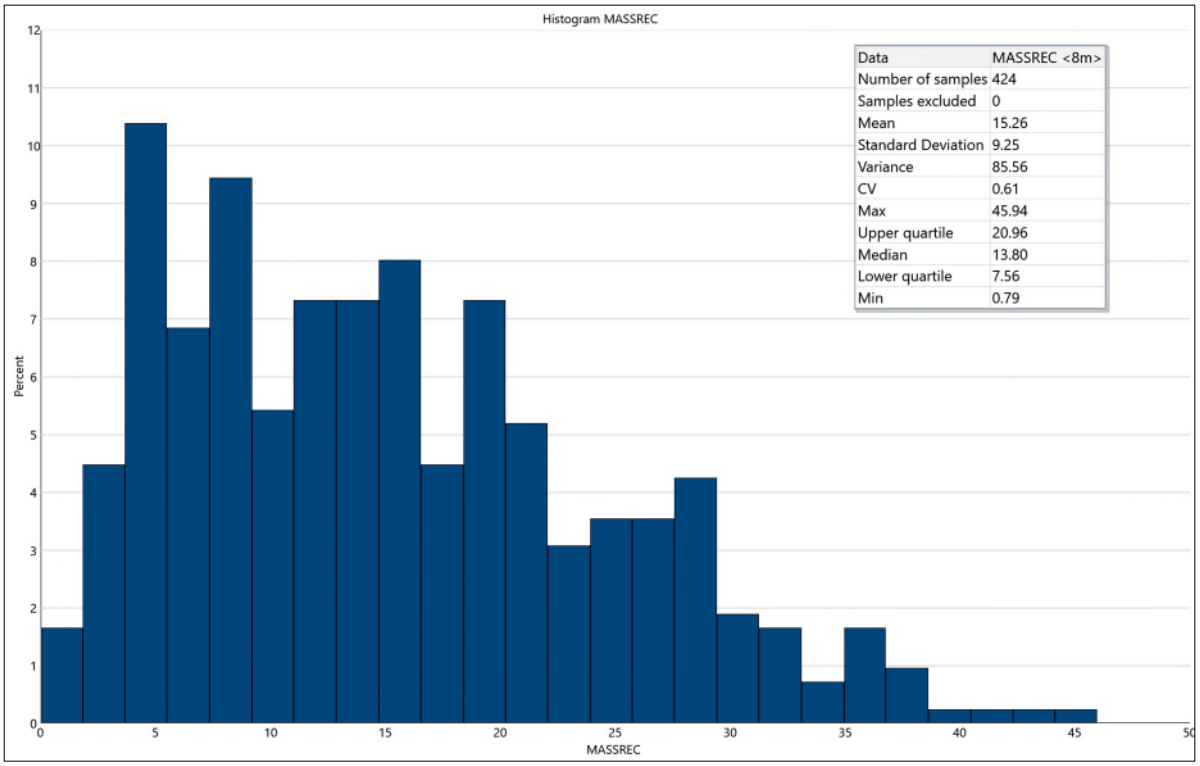


Figure 9.55 – Distribution of mass recovery in GEOZONE 75 for the 8M_C composites.

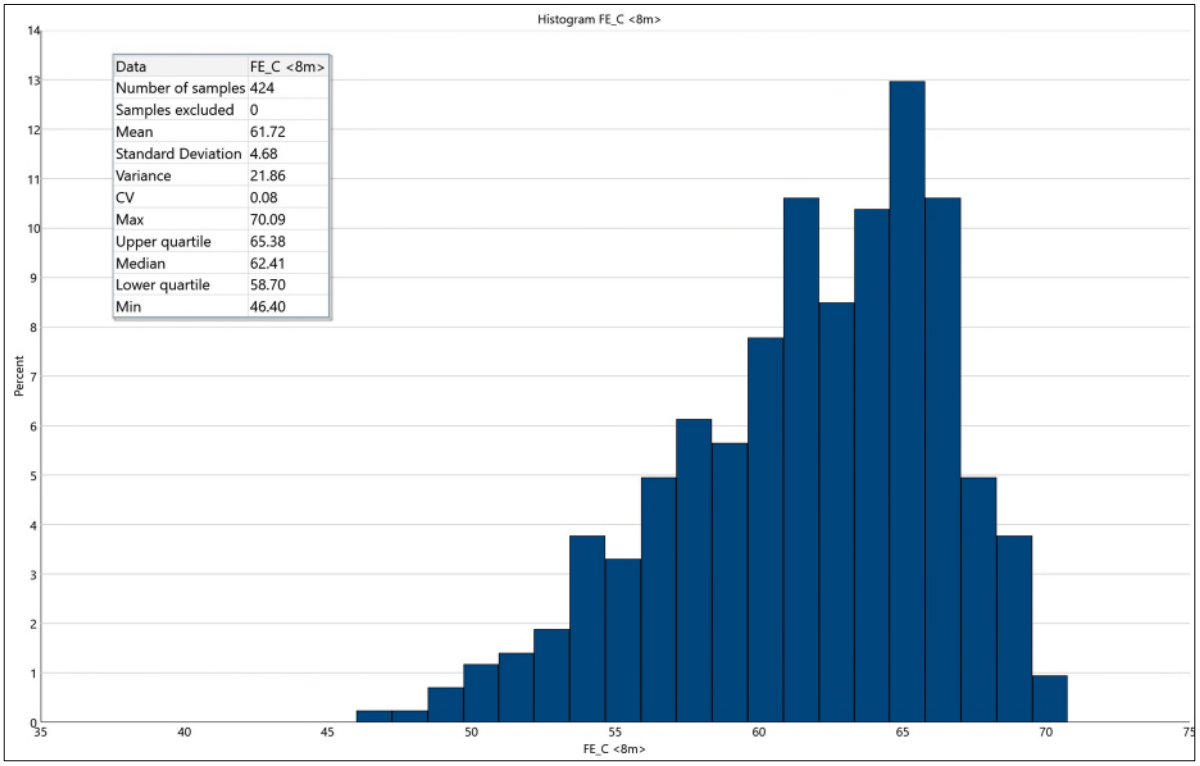


Figure 9.56 – Distribution of concentrate Fe in GEOZONE 75 for the 8M_C composites.

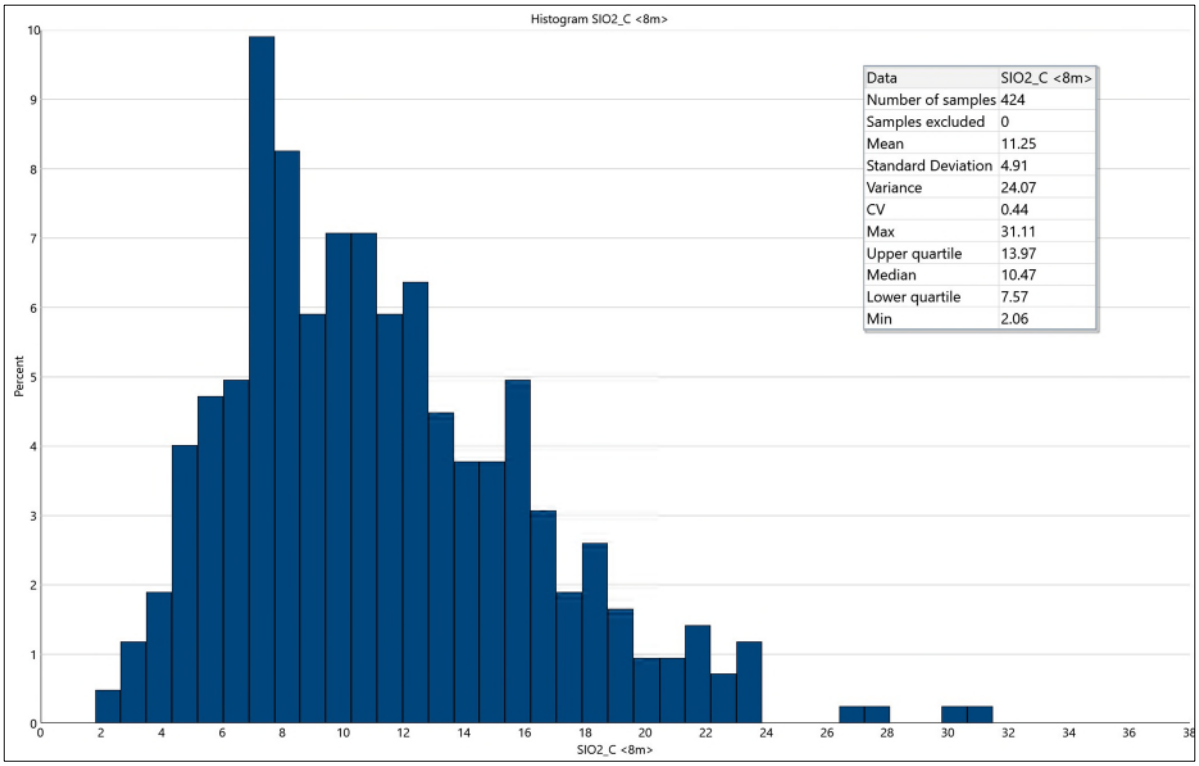


Figure 9.57 – Distribution of concentrate SiO_2 in GEOZONE 75 for the 8M_C composites.

Figure 9.58 and Table 9.5 shows a comparison between concentrate S grades for magnetite domains GEOZONE 40, 43, 46, 48, 75 and the immediate footwall domain of the MSU (BSQ GEOZONE 70).

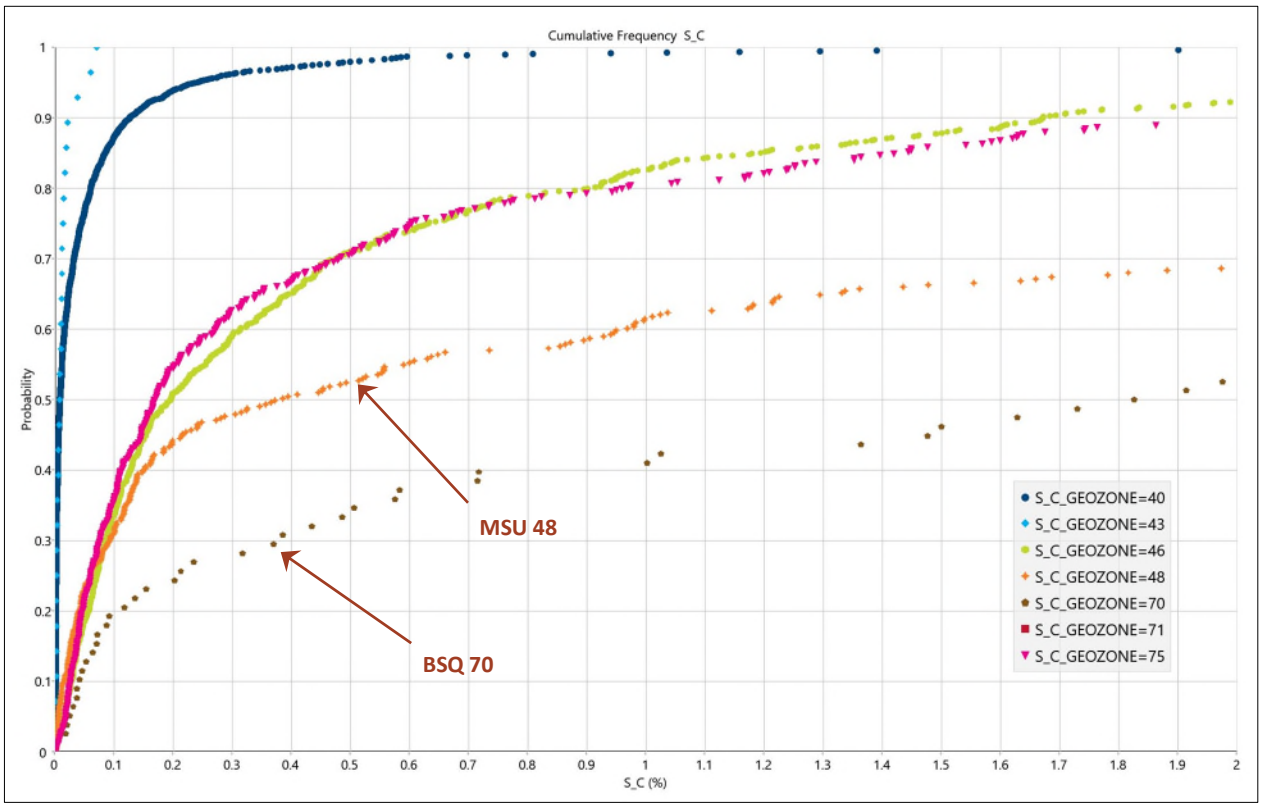


Figure 9.58 – Cumulative frequency plot comparing concentrate S grades for magnetite domains GEOZONES 40, 43, 46, 48, 75 and the basal sequence domain GEOZONE 70 for the 8M_C composites.

Table 9.5 – Naïve summary statistics for concentrate S in GEOZONES 40,43,46,48,75 and 70 for the 8M_C composites.

Domain	Count	Min	Max	Mean	StdDev	P10	P25	P50	P75	P90
40 MTS	5,040	0.001	8.940	0.063	0.266	0.001	0.002	0.008	0.045	0.126
43 MTC	28	0.001	0.071	0.013	0.017	0.002	0.003	0.008	0.014	0.025
46 SCH	748	0.001	8.087	0.586	0.971	0.058	0.070	0.196	0.632	1.671
48 MSU	353	0.001	18.390	2.112	3.135	0.016	0.060	0.379	3.115	7.438
75 ESZ	424	0.001	9.361	0.745	1.434	0.026	0.060	0.168	0.603	2.178
70 BSQ	78	0.003	11.650	2.771	3.007	0.041	0.208	1.826	4.280	8.924
71 DOM	14	2.336	11.890	6.419	2.819	2.476	3.390	6.210	7.980	9.446

* 70 BSQ and 71 DOM are non-magnetite domain forming the immediate footwall of the MSU GEOZONE 48 domain. Statistics for 71 DOM should be treated with caution due to the small number of samples.

Elevated S (>0.1%) occurs within the un-mineralised footwall Basal Sequence (BSQ GEOZONE 75), and the volumetrically smaller magnetite sulphide (MSU GEOZONE 48) domains. Locally elevated S occurs within the internal schist (SCH GEOZONE 46), and the Eastern Shear Zone (ESZ GEOZONE 75) domains and is associated with major structures interpreted at the contact between domains (Figure 9.59).

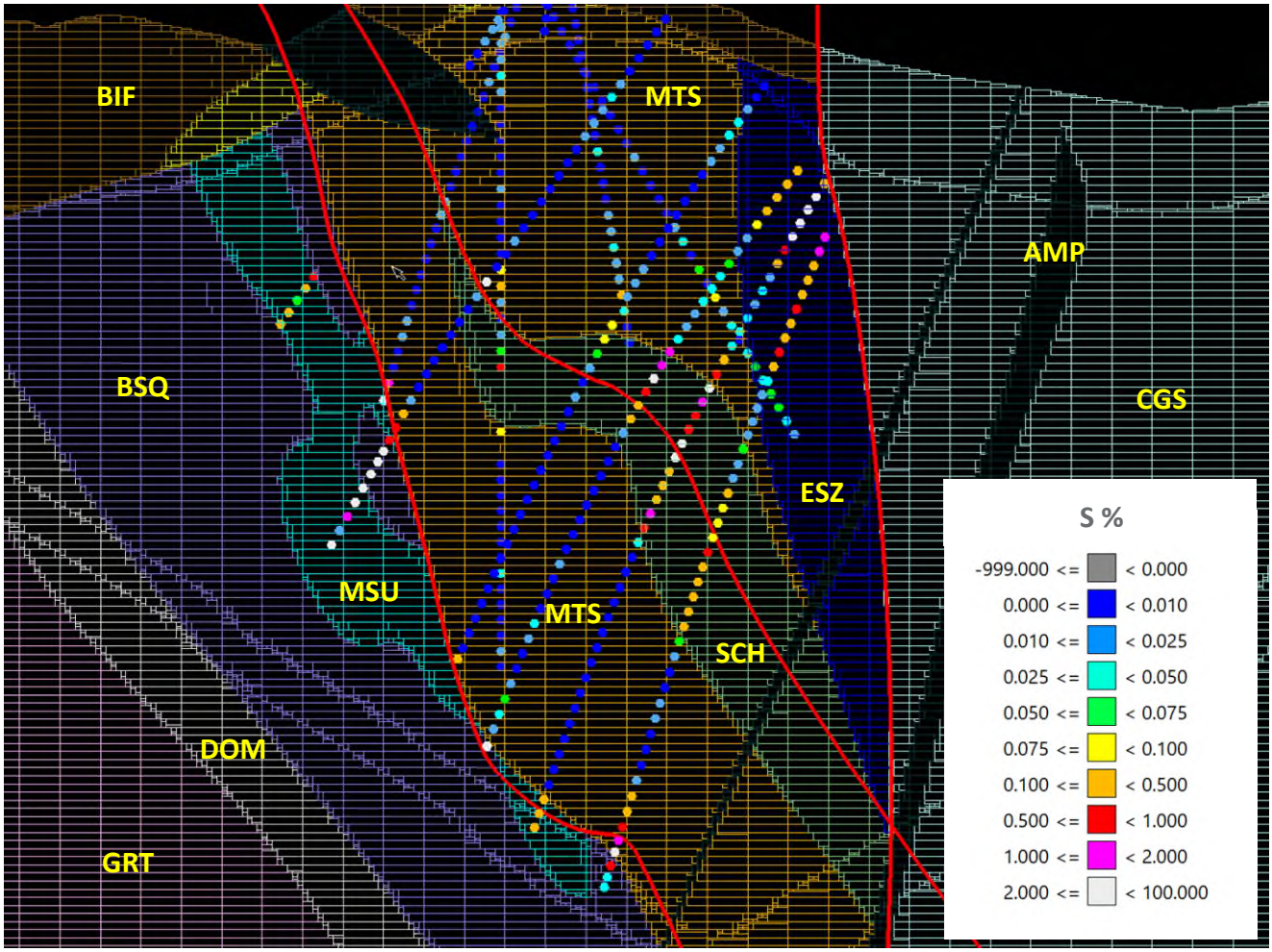


Figure 9.59 – Cross section at 17,481mN looking north through the Duchess South area, showing the typical occurrence and association of elevated concentrate S% grades in domains MSU (48) and BSQ (70), and locally at the structural contacts (red lines) of the ESZ (75) and SCH (46). Blocks are coloured on domain code and samples on S%.

Table 9.4 – Summary statistics for 8M_C composites by GEOZONE domain

GEOZONE 10 - AMP						GEOZONE 20 - BIF				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	58	0.005	7.094	0.565	1.025	167	0.005	0.990	0.069	0.138
CaO	58	0.030	1.342	0.344	0.319	167	0.005	1.240	0.080	0.143
Fe	58	47.744	69.247	63.040	4.682	167	42.597	69.820	58.146	6.565
K_2O	58	0.001	0.243	0.031	0.051	167	0.001	0.038	0.005	0.006
LOI_10	56	5.676	12.410	7.302	1.225	143	5.972	12.150	8.292	1.335
MASSREC	58	0.300	42.600	19.747	12.866	167	0.260	39.577	6.763	6.426
MgO	58	0.040	5.239	0.796	1.083	167	0.005	3.080	0.396	0.571
Mn	58	0.025	0.370	0.119	0.087	167	0.005	0.500	0.170	0.099
Na_2O	58	0.001	0.555	0.058	0.104	167	0.001	0.550	0.048	0.083
P	58	0.002	0.083	0.014	0.012	167	0.001	0.079	0.022	0.011
S	58	0.001	10.640	0.217	1.381	167	0.001	0.394	0.037	0.058
SiO_2	58	0.565	27.277	9.741	4.831	167	0.005	39.650	16.933	9.033
TiO_2	58	0.001	7.159	0.488	1.066	167	0.001	0.869	0.036	0.115
GEOZONE 40 - MTS						**GEOZONE 43 – MTC**				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	5,040	0.005	3.640	0.071	0.169	28	0.005	0.512	0.133	0.113
CaO	5,040	0.005	2.675	0.147	0.173	28	0.148	1.473	0.507	0.385
Fe	5,040	43.015	72.770	62.838	5.490	28	64.235	71.282	69.574	1.502
K_2O	5,040	0.001	0.170	0.003	0.007	28	0.001	0.006	0.001	0.001
LOI_10	5,040	4.176	16.500	7.635	1.303	28	6.330	8.196	7.003	0.493
MASSREC	5,040	1.610	68.030	34.904	9.156	28	10.493	56.303	38.306	13.010
MgO	5,040	0.005	8.810	1.125	1.610	28	0.007	0.613	0.344	0.195
Mn	5,040	0.005	0.896	0.071	0.071	28	0.050	0.180	0.098	0.045
Na_2O	4,997	0.001	0.720	0.017	0.039	28	0.001	0.113	0.024	0.040
P	5,040	0.001	0.112	0.012	0.010	28	0.001	0.010	0.005	0.003
S	5,040	0.001	8.940	0.063	0.266	28	0.001	0.071	0.013	0.017
SiO_2	5,040	0.250	37.131	10.940	5.456	28	0.083	9.885	2.267	2.077
TiO_2	5,040	0.001	2.022	0.029	0.089	28	0.002	0.421	0.063	0.094

Table 9.4 (cont.) – Summary statistics for 8M_C composites by GEOZONE domain

GEOZONE 46 - SCH						GEOZONE 48– MSU				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	748	0.005	1.188	0.123	0.134	353	0.005	1.215	0.080	0.124
CaO	748	0.010	2.880	0.245	0.241	353	0.005	1.960	0.242	0.269
Fe	748	48.026	70.490	61.782	4.532	353	49.830	72.350	65.415	3.894
K_2O	748	0.001	0.083	0.004	0.006	353	0.001	0.177	0.004	0.011
LOI_10	742	4.806	11.884	7.627	1.100	353	5.130	18.909	8.273	2.452
MASSREC	748	0.300	42.350	15.831	7.788	353	2.190	53.533	21.624	7.928
MgO	748	0.040	6.140	1.522	1.289	353	0.027	3.062	0.561	0.453
Mn	748	0.020	1.050	0.117	0.083	353	0.020	0.375	0.079	0.043
Na_2O	743	0.001	0.918	0.023	0.054	347	0.001	0.248	0.018	0.035
P	748	0.001	0.071	0.015	0.009	353	0.001	0.047	0.004	0.004
S	748	0.001	8.087	0.586	0.971	353	0.001	18.390	2.112	3.135
SiO_2	748	1.720	26.250	11.295	4.622	353	0.159	26.567	6.421	4.725
TiO_2	748	0.001	0.726	0.046	0.081	353	0.002	0.624	0.032	0.059
GEOZONE 70 - BSQ						**GEOZONE 75 - ESZ**				
Variable	Count	Min	Max	Mean	StdDev	Count	Min	Max	Mean	StdDev
Al_2O_3	78	0.005	1.570	0.134	0.201	424	0.005	6.451	0.190	0.512
CaO	78	0.012	2.400	0.357	0.442	424	0.017	1.074	0.185	0.203
Fe	78	37.395	71.390	63.124	5.466	424	46.403	70.090	61.721	4.676
K_2O	78	0.001	0.043	0.006	0.007	424	0.001	0.175	0.007	0.012
LOI_10	70	2.951	22.860	9.329	4.268	414	3.419	15.590	7.793	1.479
MASSREC	78	0.900	31.780	7.429	5.577	424	0.790	45.940	15.260	9.250
MgO	78	0.040	4.635	0.758	0.805	424	0.060	5.962	1.190	1.313
Mn	78	0.060	0.316	0.143	0.064	424	0.020	0.500	0.148	0.094
Na_2O	77	0.001	0.283	0.047	0.060	423	0.001	0.365	0.036	0.065
P	78	0.001	0.029	0.006	0.004	424	0.001	0.075	0.014	0.011
S	78	0.003	11.650	2.771	3.007	424	0.001	9.361	0.745	1.434
SiO_2	78	0.180	38.150	6.241	5.759	424	2.060	31.114	11.245	4.906
TiO_2	78	0.005	3.733	0.098	0.423	424	0.004	3.965	0.082	0.296

9.2.3 Density

As discussed in Section 8.3, the 2m short-spaced density composites (***dsm_0823_ssd.d2m.isis***) were merged with the 2m head assay composites (***dsm_0823_h.2m.isis***) to create a new database ***dsm_0823_ssdh.2m.isis***. Merging was done on common drill hole name, sample coordinate, and sample "from" and "to" depth such that each of the 15,708 density measurements had at least Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, P, S, SiO_2, and TiO_2 head assay values, which typically constitute >99% of the sum of the sample constituents.

The resulting data was subject to multiple linear regression to predict (estimate) density at those composite sample locations that had no density value after the merging described above. Multiple linear regression was identified as the preferred technique using the above analytes on the assumption that the sample mass is the sum of the individual assay constituents. This assumption was tested in both a typical moderately to strongly weathered domain such as BIF

20, as well as the unweathered MTS 40 domain. The distribution of the total of the analytes, for those assay intervals reported by the laboratory during assaying (Figure. 60 and Figure. 61) shows that these analytes represent 100% of the sample mass, within acceptable tolerance limits of ±5%.

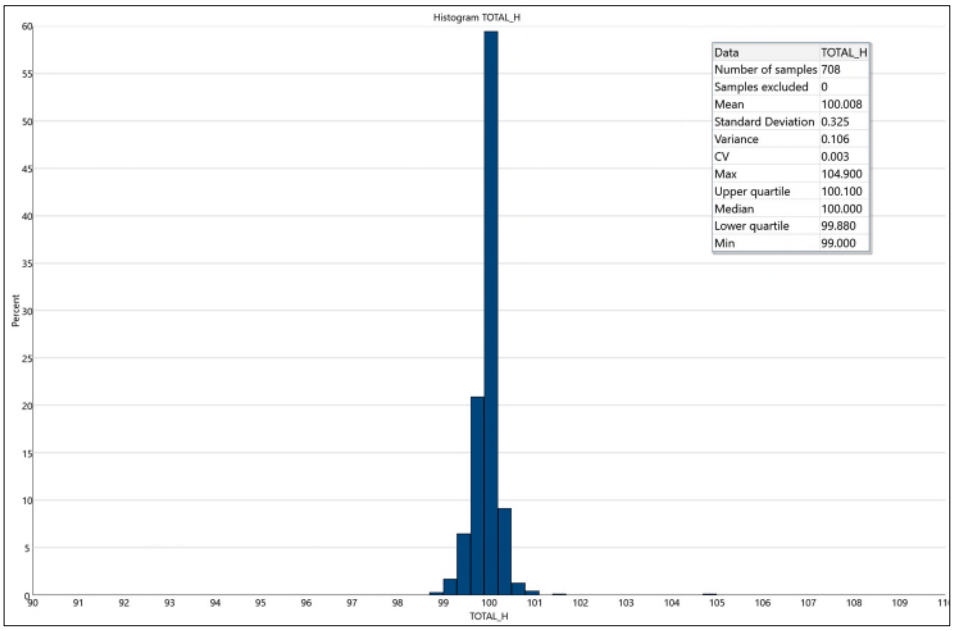


Figure 9.60 – Distribution of SUM Fe+SiO_2+Al_2O_3+CaO+Fe+K_2O+LOI+MgO+Mn+Na_2O+P+S+SiO_2+TiO_2 in composites from the weathered BIF 20 domain.

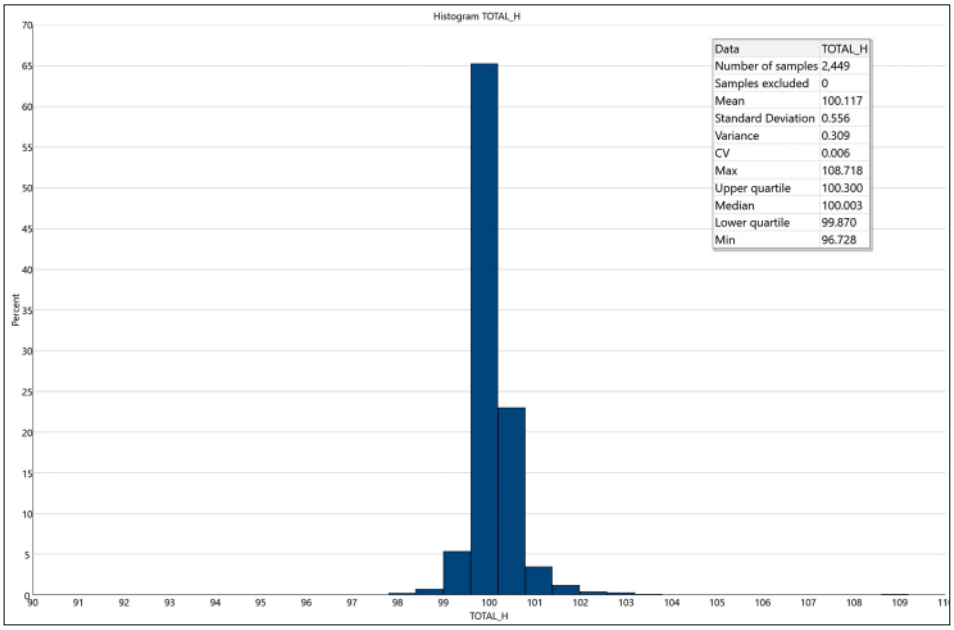


Figure 9.61 – Distribution of SUM Fe+SiO_2+Al_2O_3+CaO+Fe+K_2O+LOI+MgO+Mn+Na_2O+P+S+SiO_2+TiO_2 in composites from the unweathered MTS 40 domain.

Regression was undertaken strictly on a domain and weathered zone basis. Initially, all available analytes were considered and tested, but it was found through iterative testing that linear combinations of Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, S, SiO_2, and TiO_2 (the major analytes) provided the best linear prediction for density for most domains. Whilst P was present in almost all the sample considered, it was found that it didn't improve the regression models significantly, and sometimes led to overfitting of the models with poorer density predictions, and was thus excluded from modelling in all but three domains

Some domains where older generations of drilling had no Na_2O assay were tested, and it was found that using less samples that included Na_2O provided a better regression prediction for density, than using more samples that excluded Na_2O (Figure 9.62).

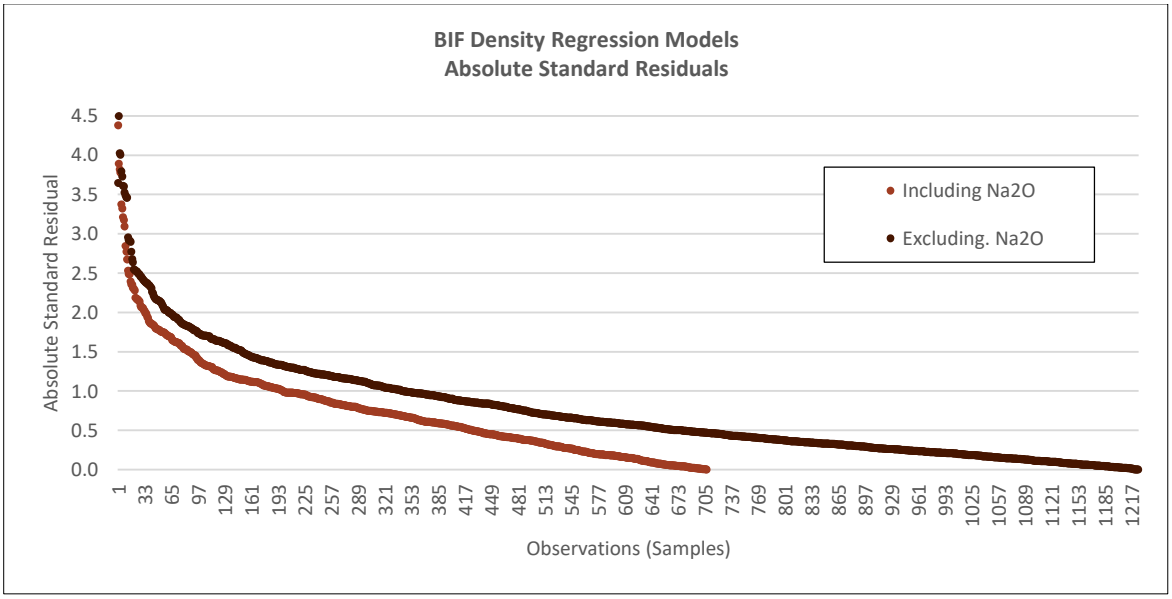


Figure 9.62 – Comparison of absolute standard residual values between observed and predicted density using two regression models for the BIF 20 domain. Using less samples that includes an Na_2O assay produces lower absolute residuals, and thus a better regression model, than using more data without an Na_2O assay.

For more than half the domains, there was too few data to generate reliable regression modelling in the weathered zone of the domains, and in these cases the unweathered regression equation was factored by 0.85, which is the assumed factor between weathered and unweathered density. BIF 20 was the only domain in which models for the weathered and unweathered portions of the domain used different combinations of analytes.

Regression modelling was performed iteratively relying on several techniques to gauge the appropriateness of the model. The effect of multivariate outliers on the regression was adjusted for by using a combination of the Cook's Distance technique accounting for both the leverage and residual of each observation, and the magnitude of the absolute standard residual values, prior to deriving the final models (Figure 9.63).

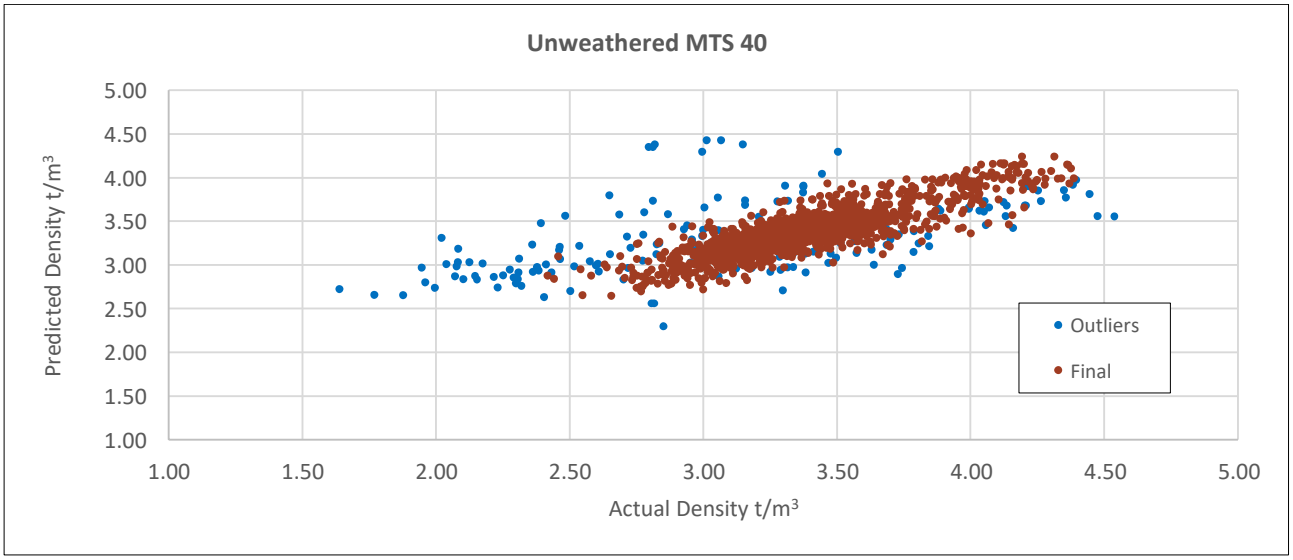


Figure 9.63 – Multiple linear regression model for unweathered MTS 40 showing the model prior to, and after, the removal of multivariate outliers (blue). In this example, the correlation of actual density to the multiple assays used to predict density improves from 0.75 to 0.85 once the outliers are removed.

Lower and upper values were enforced in the very few cases where the model predictions resulted in unrealistically low or high estimates, and a global minimum of 1.5 t/m^3 and maximum of 5.0 t/m^3 was applied across all domains (Figure 9.64). The limits used at both the local domain and global level are based on statistics of actual SSD data, in addition to limits used in previous model updates over preceding years.

```
* DOMAIN ESZ 75
if (GEOZONE eq 75) then
  if (weather eq 0) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = 8.007 - 0.073*al2o3_h + 0.039*cao_h - 0.049*fe_h - 0.084*k2o_h - 0.107*loi_h - 0.041*mgo_h + 0.519*mn_h - 2.489*na2o_h + 0.027*s_h - 0.055*sio2_h + 0.297*tio2_h
      if (e_density lt 1.98) then
        e_density = 1.98
      endif
    endif
  endif
  if (weather eq 1) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = (8.007 - 0.073*al2o3_h + 0.039*cao_h - 0.049*fe_h - 0.084*k2o_h - 0.107*loi_h - 0.041*mgo_h + 0.519*mn_h - 2.489*na2o_h + 0.027*s_h - 0.055*sio2_h + 0.297*tio2_h) * 0.85
    endif
  endif
endif

* DOMAIN CSG 80
if (GEOZONE eq 80) then
  if (weather eq 0) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = 35.634 - 0.27*al2o3_h - 0.32*cao_h - 0.453*fe_h - 0.367*k2o_h - 0.377*loi_h - 0.321*mgo_h - 1.849*mn_h - 1.625*na2o_h + 0.113*s_h - 0.329*sio2_h - 1.017*tio2_h
      if (e_density lt 2.46) then
        e_density = 2.46
      endif
    endif
  endif
  if (weather eq 1) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = (35.634 - 0.27*al2o3_h - 0.32*cao_h - 0.453*fe_h - 0.367*k2o_h - 0.377*loi_h - 0.321*mgo_h - 1.849*mn_h - 1.625*na2o_h + 0.113*s_h - 0.329*sio2_h - 1.017*tio2_h) * 0.85
    endif
  endif
endif

* GLOBAL MIN/MAX LIMITS
if (e_density lt 1.5 or e_density gt 5.0) then
  e_density = -999
endif
```

Figure 9.64 – Example of the application of local domain and global limits on predicted density.

The major parameters for the regression models are listed in Table 9.6. No regression modelling for MBF 47 and GRT 90 domains was possible due to a lack of representative samples. The final density regression models for each domain are shown in Figure 9.65 to Figure 9.80.

Table 9.6 – Major parameters for density regression models.

Domain	Analytes Used in Regression	Weathered	Unweathered
AMP 10	Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, S, SiO_2, TiO_2	Factored x 0.85	Yes
BIF 20	Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, P, S, SiO_2, TiO_2, Zn	-	Yes
BIF 20	Al_2O_3, Ba, CaO, Cu, Fe, K_2O, LOI, MgO, Mn, Na_2O, P, Pb, S, SiO_2, TiO_2, V, Zn	Yes	-
HEO 30	Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, S, SiO_2, TiO_2	Yes	Yes
HEC 32	Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, S, SiO_2, TiO_2	Factored x 0.85	Yes
HBF 37	Al_2O_3, Ba, CaO, Cu, Fe, K_2O, LOI, MgO, Mn, Na_2O, P, Pb, S, SiO_2, TiO_2, V, Zn	Factored x 0.85	Yes
MTS 40	Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, S, SiO_2, TiO_2	Yes	Yes
MTC 43	Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, S, SiO_2, TiO_2	Factored x 0.85	Yes
SCH 46	Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, S, SiO_2, TiO_2	Factored x 0.85	Yes
MSU 48	Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, S, SiO_2, TiO_2	Factored x 0.85	Yes
BSQ 70	Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, S, SiO_2, TiO_2	Yes	Yes
DOM 71	Al_2O_3, Ba, CaO, Cu, Fe, K_2O, LOI, MgO, Mn, Na_2O, P, Pb, S, SiO_2, TiO_2, V, Zn	Factored x 0.85	Yes
ESZ 75	Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, S, SiO_2, TiO_2	Factored x 0.85	Yes
CGS 80	Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, S, SiO_2, TiO_2	Factored x 0.85	Yes

* BIF 20 uses different combinations of analytes for weathered and unweathered zones.

* MBF 47 uses 2.59 t/m^3 for weathered zone and 2.77 t/m^3 for unweathered zone based on values from geologically similar BIF 20 domain.

* GRT 90 uses assumed density of 2.30 t/m^3 for weathered zone and 2.70 t/m^3 for unweathered zone.

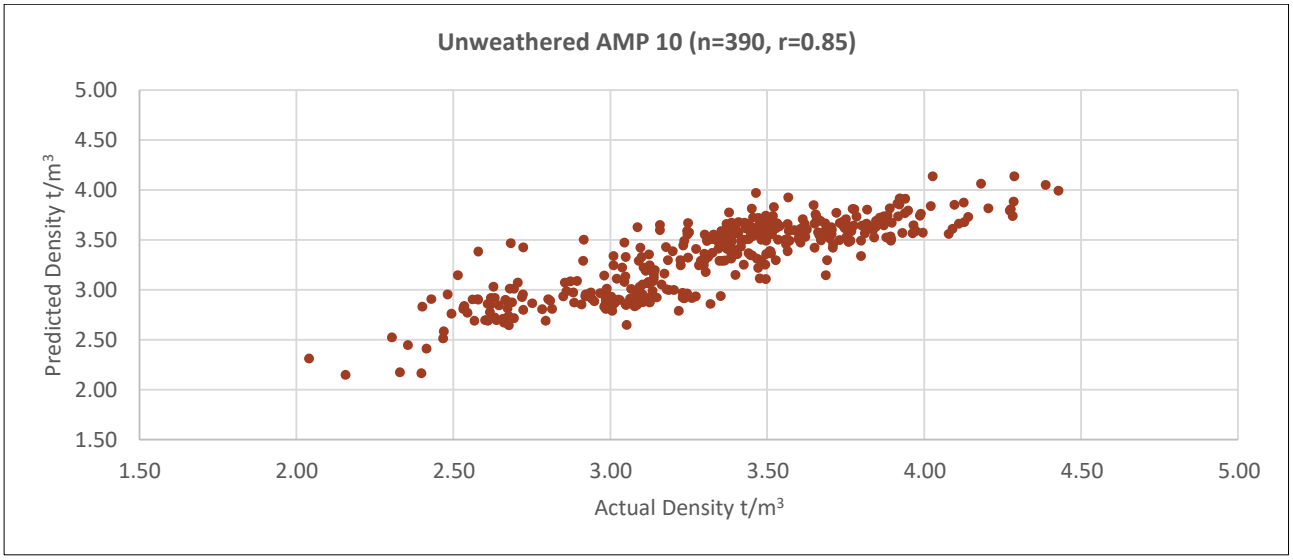


Figure 9.65 – Multiple linear regression model for density in unweathered AMP 10.

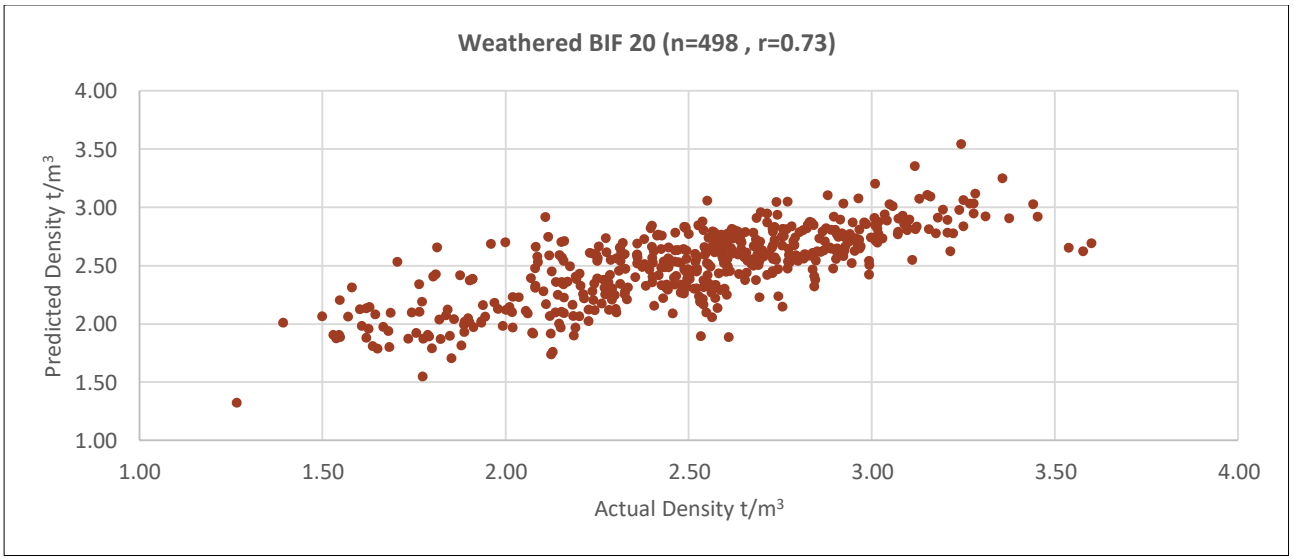


Figure 9.66 – Multiple linear regression model for density in weathered BIF 20.

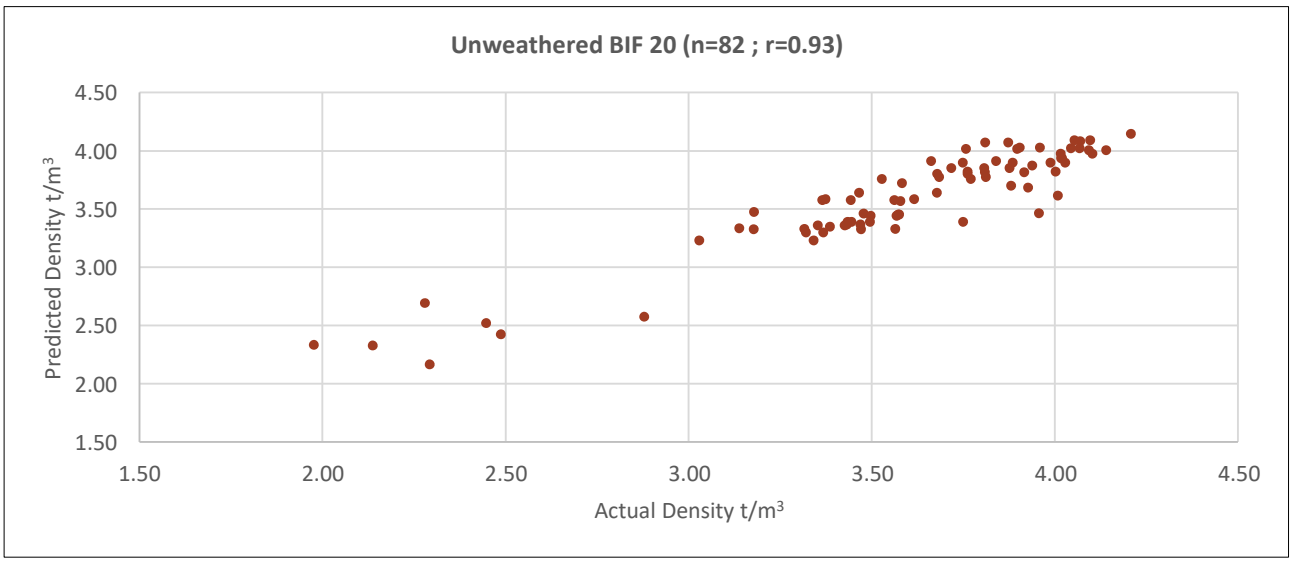


Figure 9.67 – Multiple linear regression model for density in unweathered BIF 20.

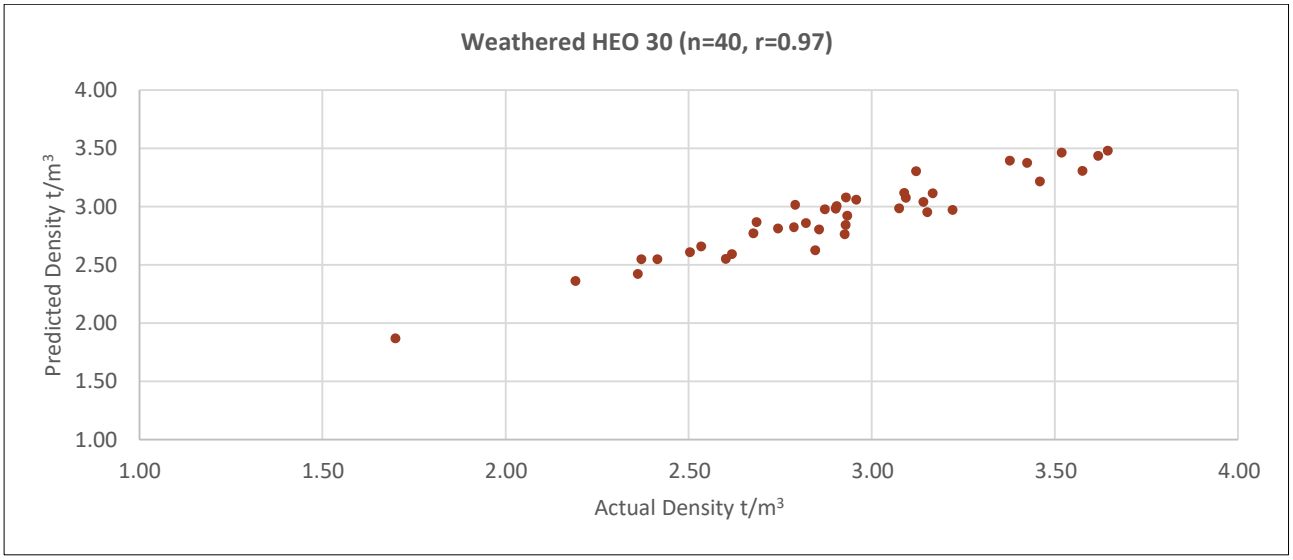


Figure 9.68 – Multiple linear regression model for density in weathered HEO 30.

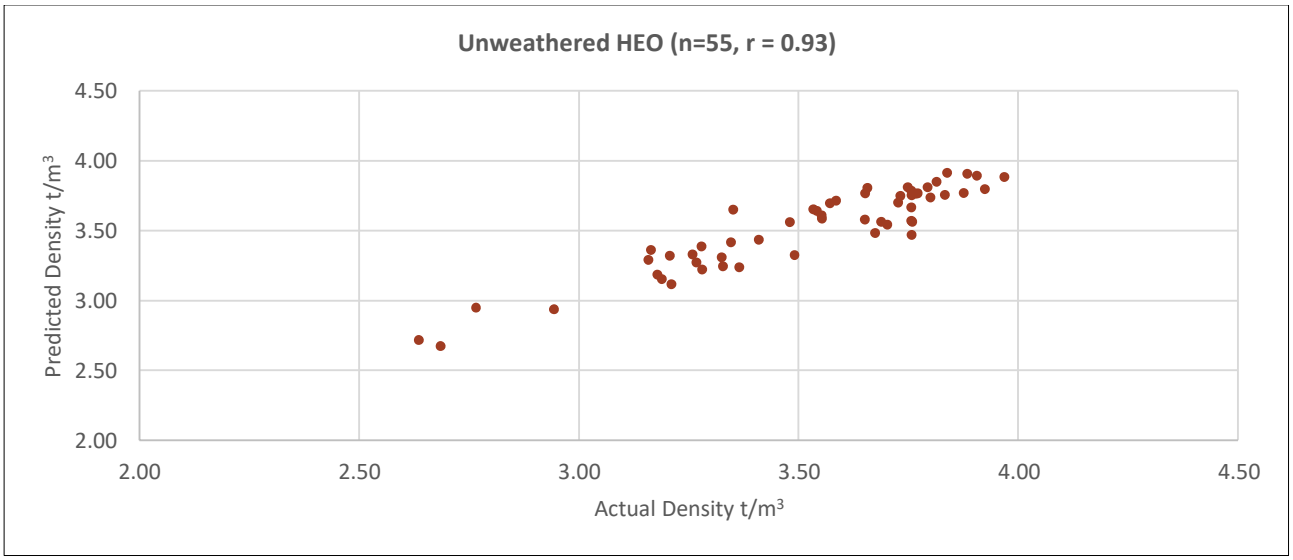


Figure 9.69 – Multiple linear regression model for density in unweathered HEO 30.

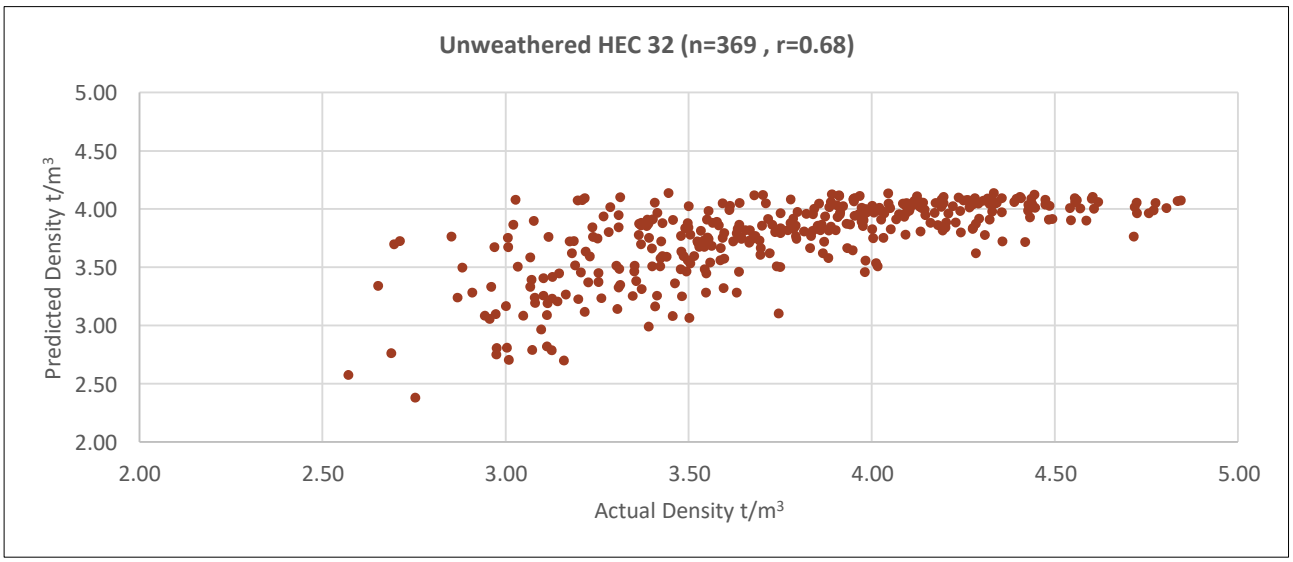


Figure 9.70 – Multiple linear regression model for density in unweathered HEC 32.

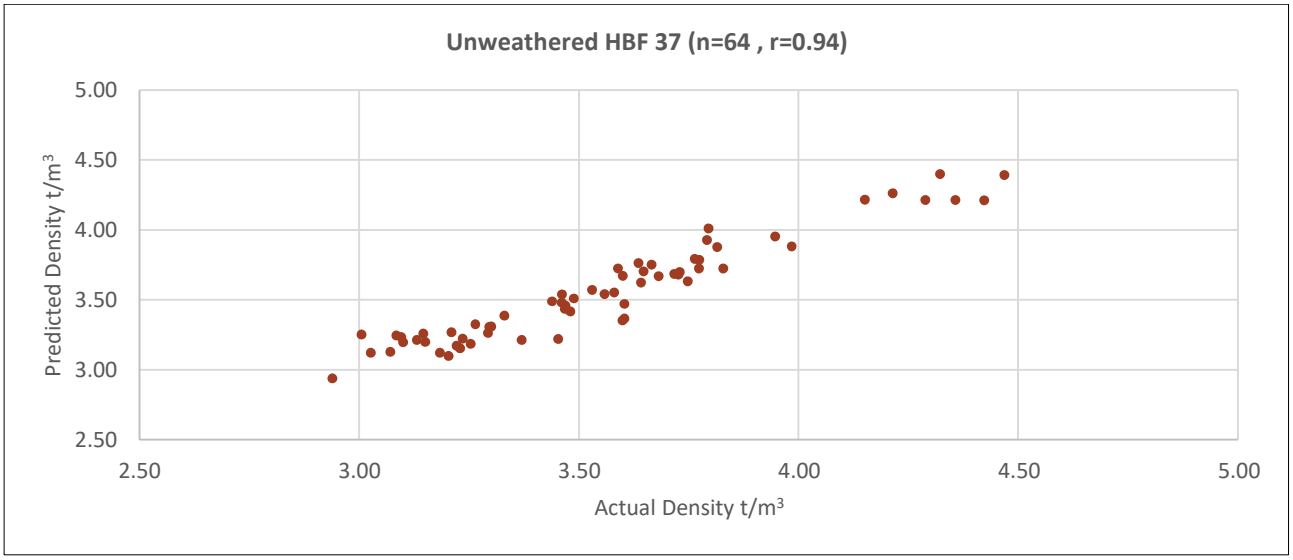


Figure 9.71 – Multiple linear regression model for density in unweathered HBF 37.

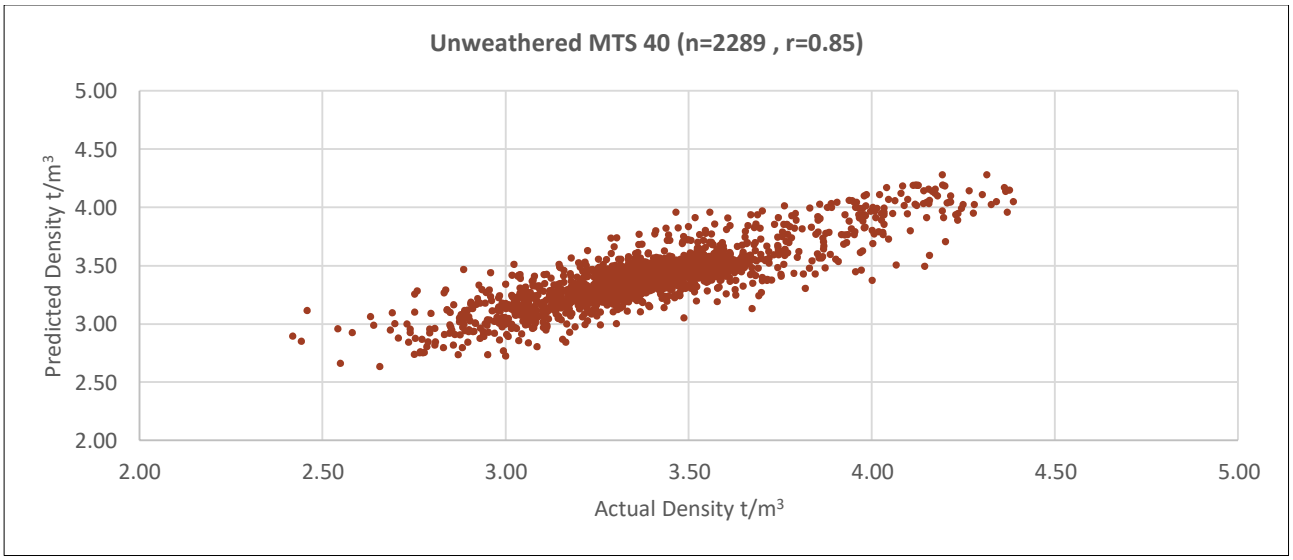


Figure 9.72 – Multiple linear regression model for density in weathered MTS 40.

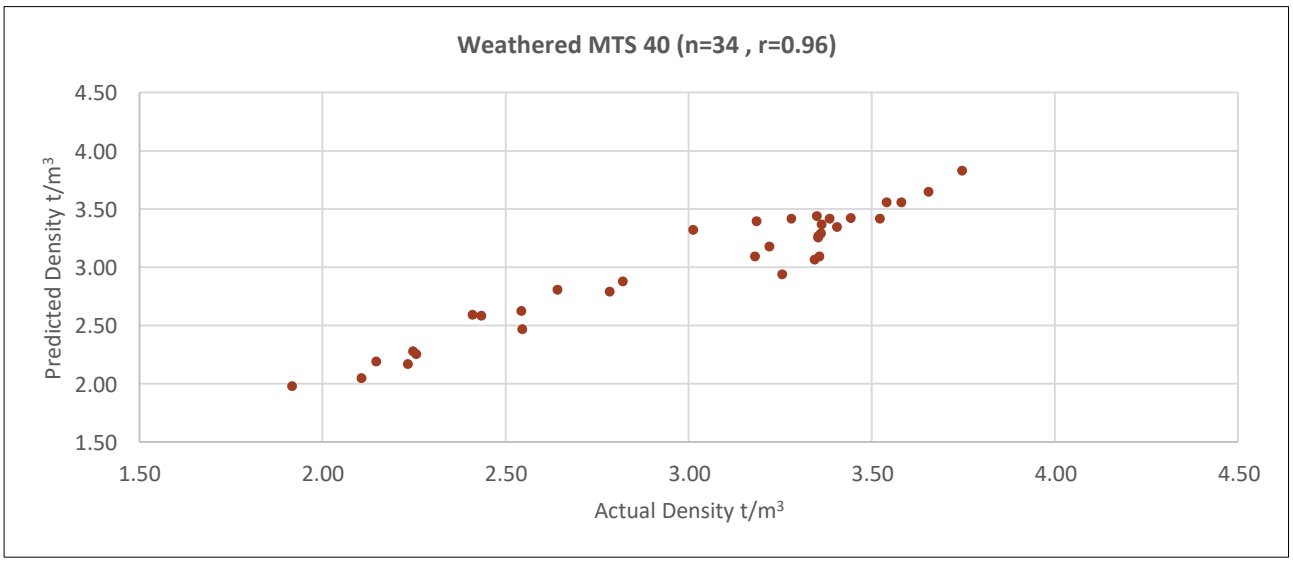


Figure 9.73 – Multiple linear regression model for density in unweathered MTS 40.

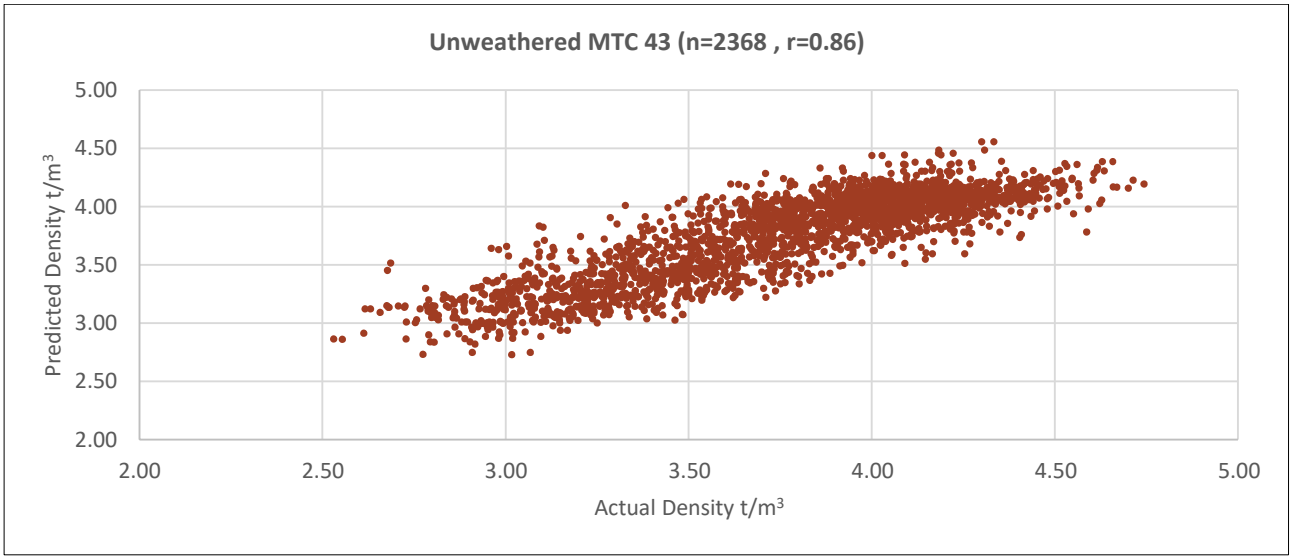


Figure 9.74 – Multiple linear regression model for density in unweathered MTC 43.

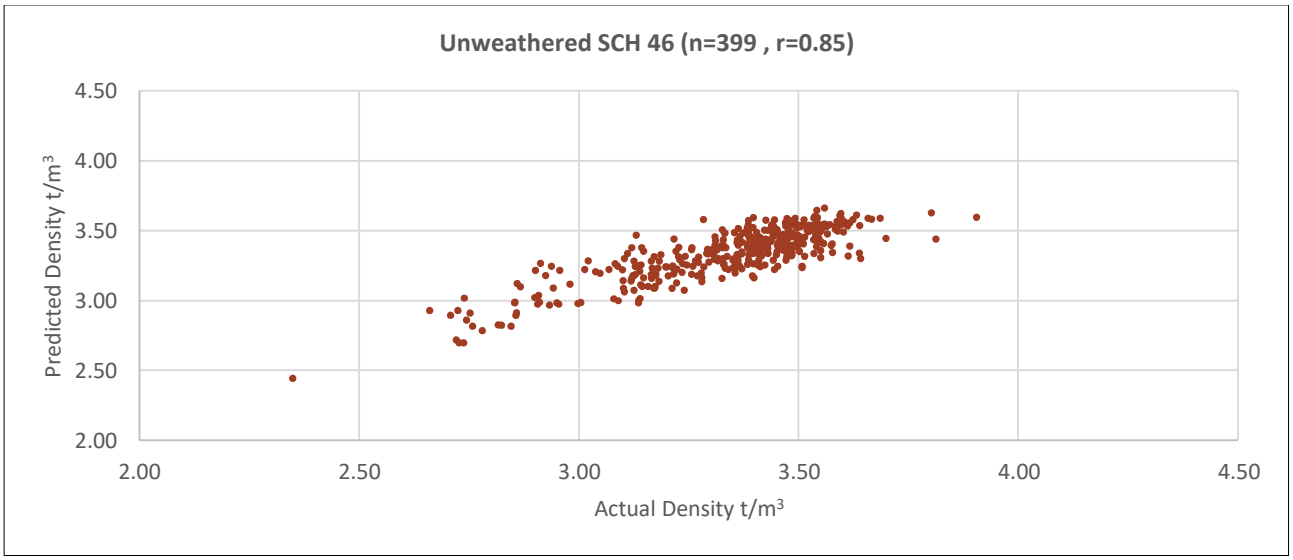


Figure 9.75 – Multiple linear regression model for density in unweathered SCH 46.

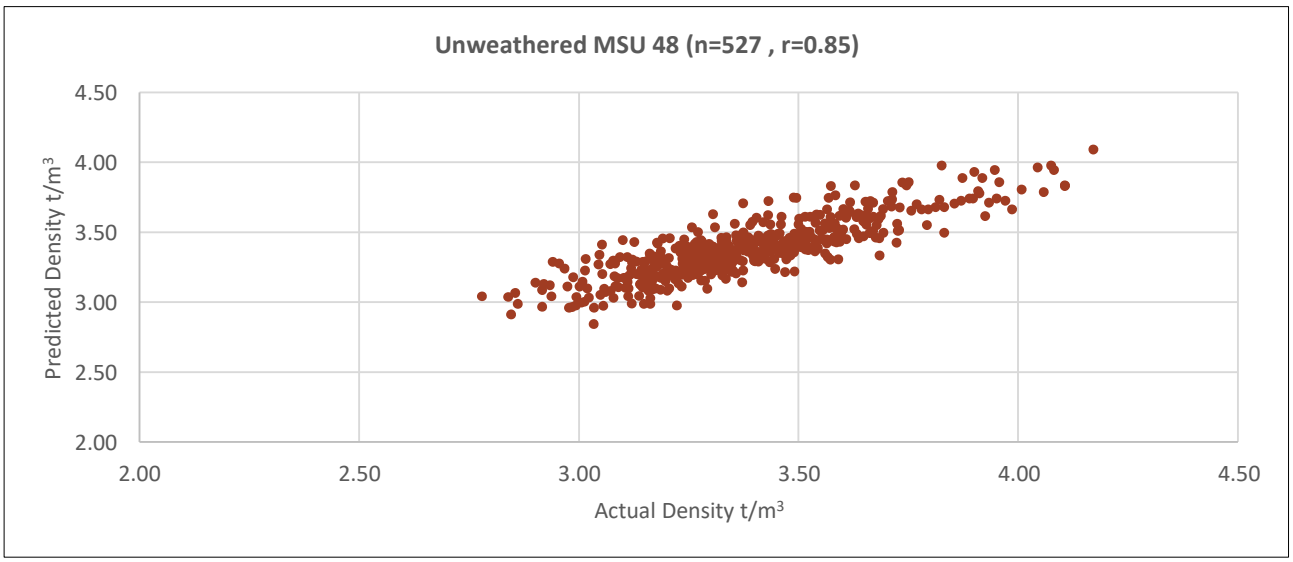


Figure 9.76 – Multiple linear regression model for density in unweathered MSU 48.

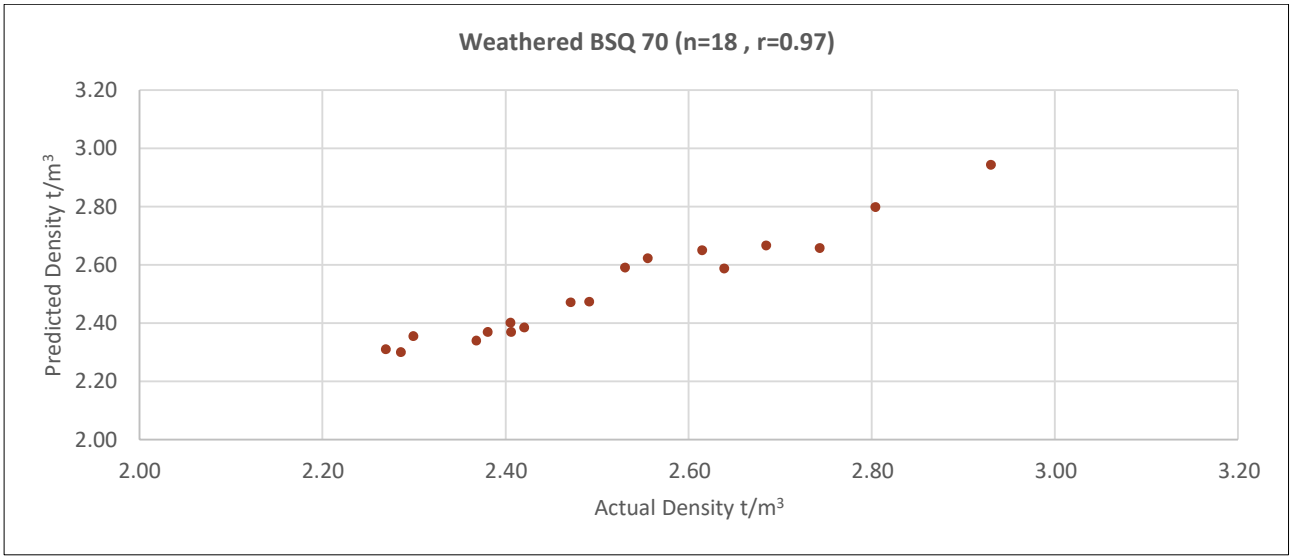


Figure 9.77 – Multiple linear regression model for density in weathered BSQ 70.

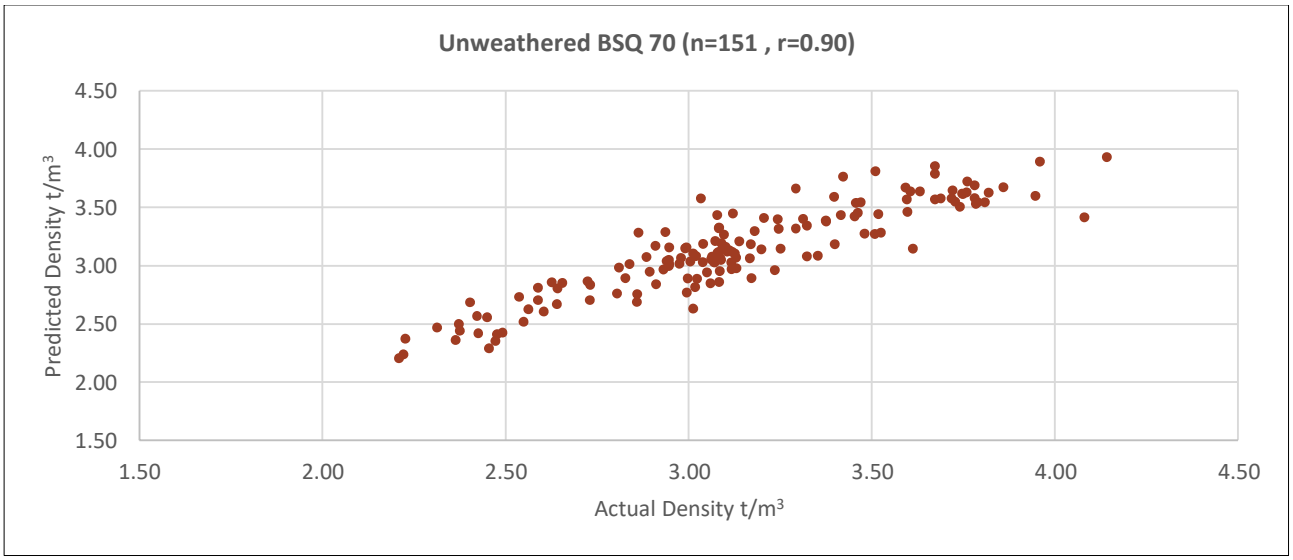


Figure 9.78 – Multiple linear regression model for density in unweathered BSQ 70.

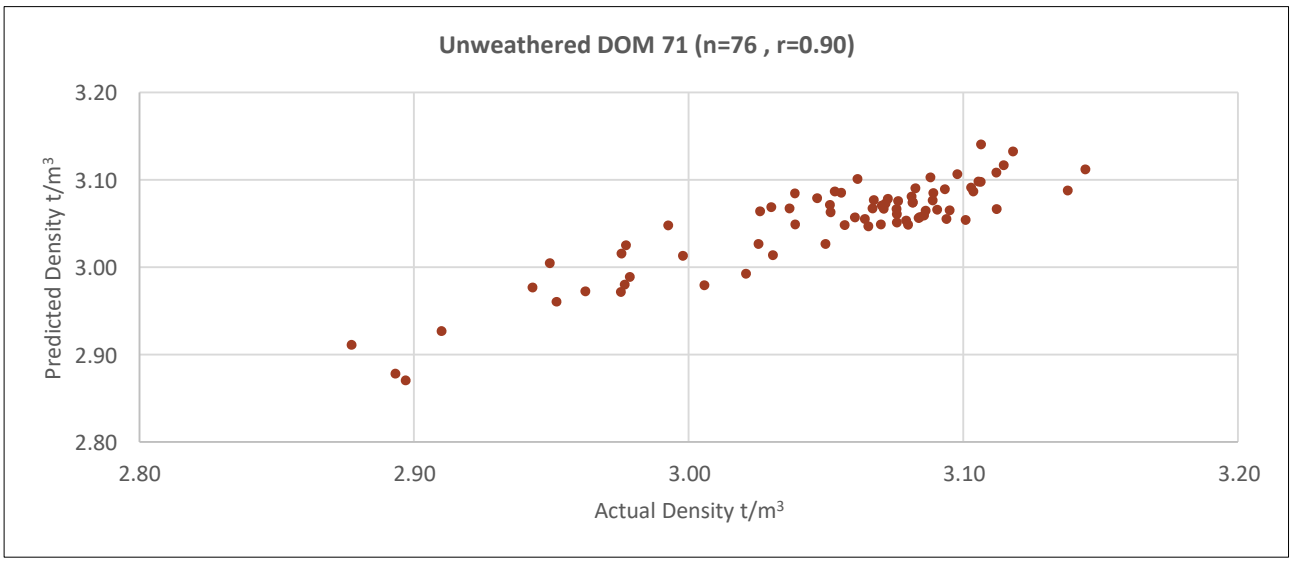


Figure 9.79 – Multiple linear regression model for density in unweathered DOM 71.

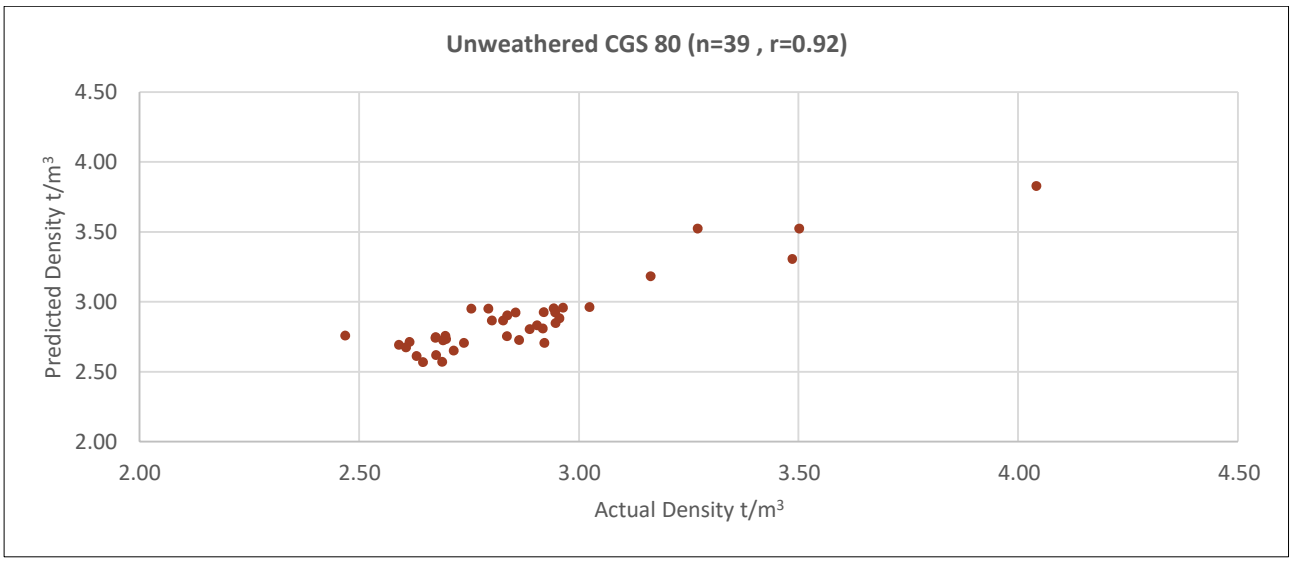


Figure 9.80 – Multiple linear regression model for density in unweathered CGS 80.

During modelling, and prior to estimation to block support, the regression models were validated using several techniques. Plots of residuals (actual minus prediction) versus the leverage (ability to influence the regression model) for each sample were used to gauge the bias in the resulting model. Examples for BIF 20 and MTC 43 are shown in Figure 9.81.

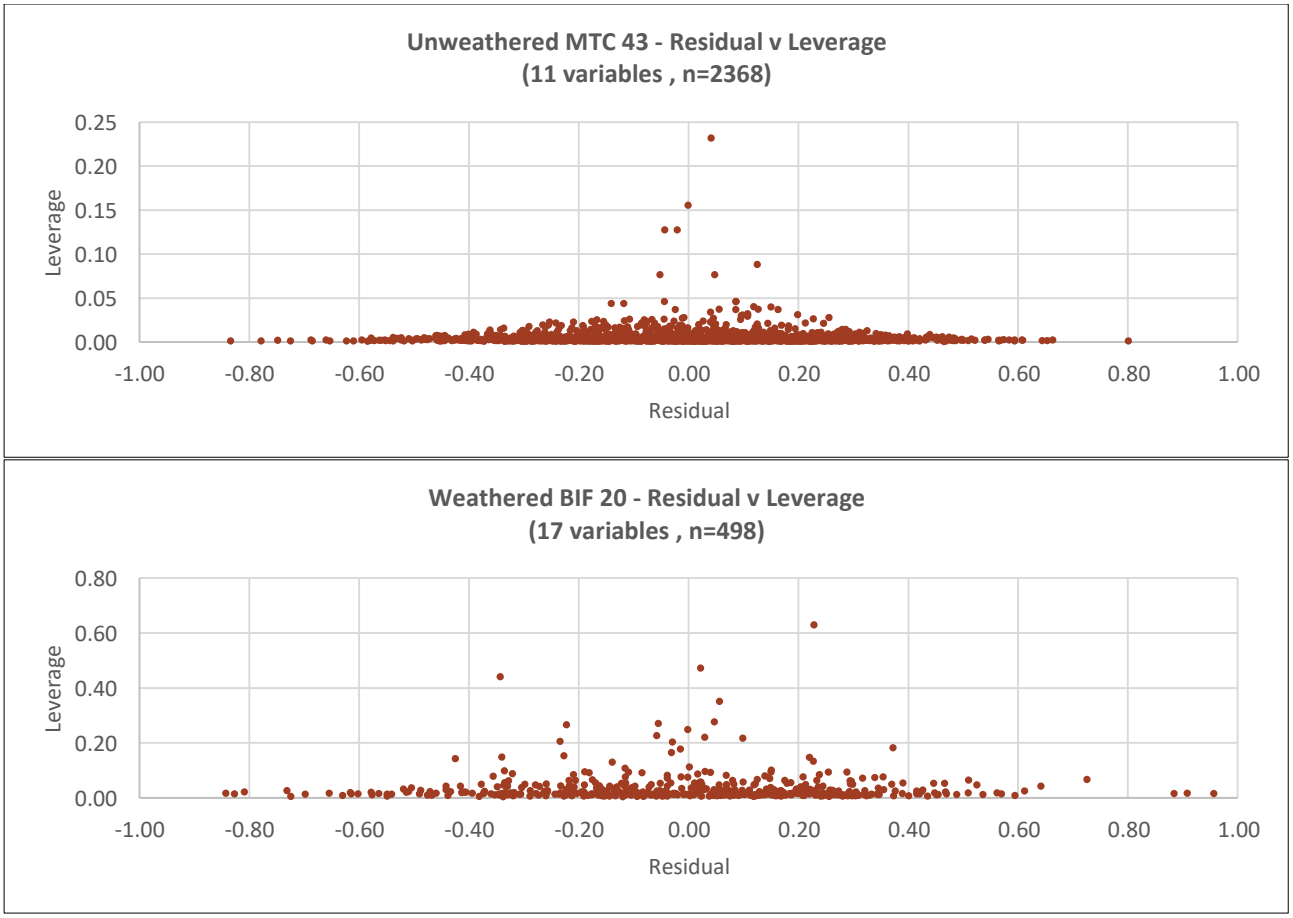


Figure 9.81 – Residual versus leverage for regression models for density in unweathered MTC 43 (TOP) and weathered BIF 20 (BOTTOM). The most influential sample values (highest leverage) also have the lowest residual values indicating that the regression models are unbiased.

Plots of actual and predicted density for each sample in the regression were used to evaluate the appropriateness of the number of analytes and the technique employed to deal with multivariate outliers. Examples for DOM 71, BSQ 70 and SCH46 are shown in Figure 9.82.

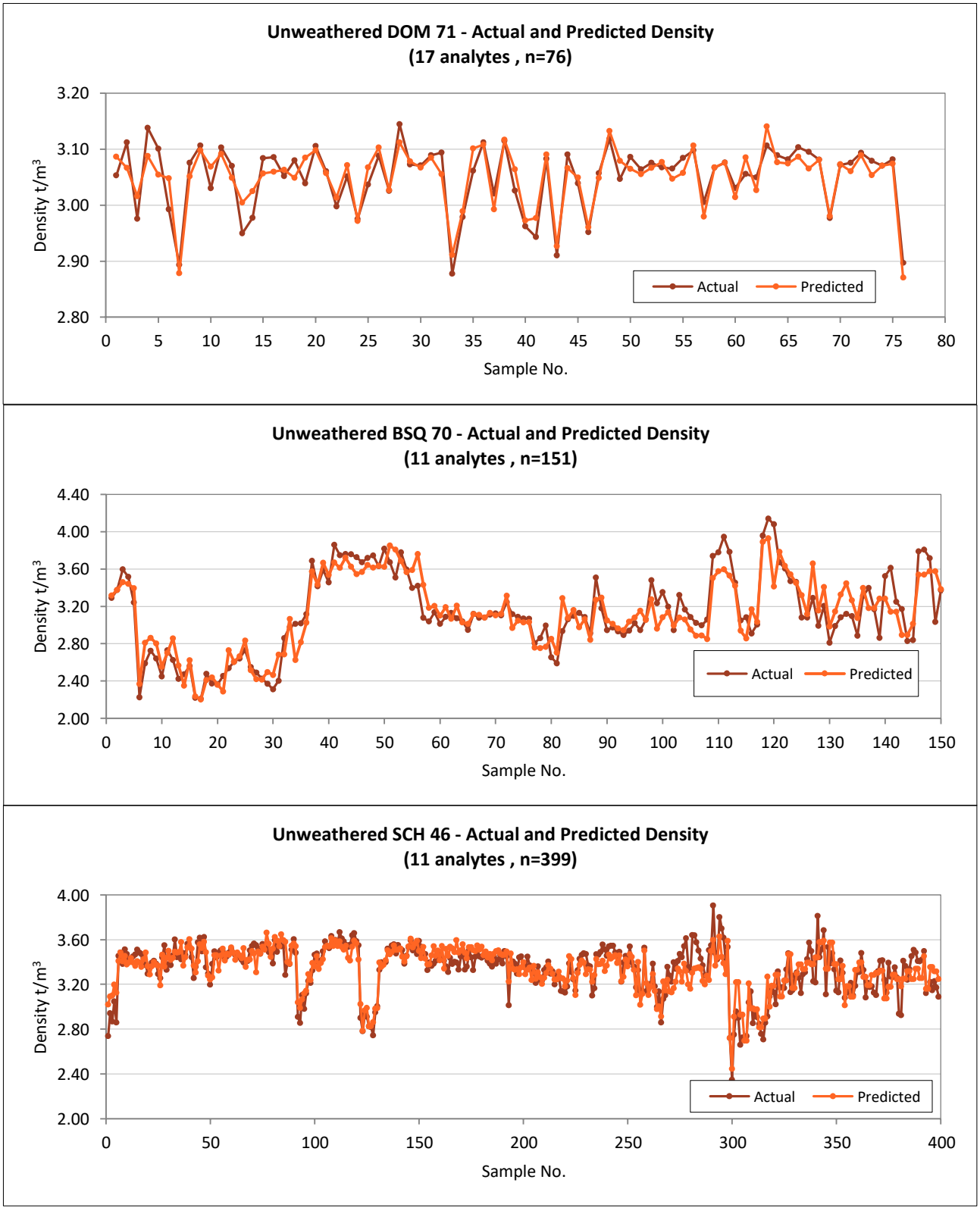


Figure 9.82 – Actual and predicted density for unweathered DOM 71 (TOP), BSQ 70 (MIDDLE) and SCH 46 (BOTTOM) for each sample in the regression model. The closer the lines are to each other, the better the regression model is at predicting density from the analytes used in the regression.

Once the regression models were validated, the final equations (Table 9.7) were used to calculate a density value at those composite sample locations that had no density value in the 2m head assay composite sample file (Figure 9.83). Composite sample locations that had an SSD density as part of the data merging described earlier, retained their original SSD density value, and remained unaffected by the regression equations.




```
if (GEOZONE eq 40) then
  if (weather eq 0) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = -0.076 + 0.004086*al2o3_h + 0.069*cao_h + 0.062*fe_h + 0.061*k2o_h - 0.018*loi_h + 0.039*mgo_h + 0.252*mn_h + 0.054*na2o_h - 0.015*s_h + 0.027*sio2_h + 0.051*tio2_h
      if (e_density lt 1.76) then
        e_density = 1.76
      endif
      if (e_density gt 4.00) then
        e_density = 4.00
      endif
    endif
  endif
  if (weather eq 1) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = 11.379 + 0.18*al2o3_h + 0.134*cao_h - 0.086*fe_h + 0.754*k2o_h - 0.231*loi_h - 0.114*mgo_h + 1.285*mn_h - 0.468*na2o_h - 0.148*s_h - 0.099*sio2_h - 0.773*tio2_h
    endif
  endif
endif
if (GEOZONE eq 43) then
  if (weather eq 0) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = -5.401 + 0.046*al2o3_h + 0.106*cao_h + 0.142*fe_h + 0.418*k2o_h + 0.071*loi_h + 0.089*mgo_h + 0.251*mn_h - 1.26*na2o_h + 0.041*s_h + 0.077*sio2_h + 0.282*tio2_h
      if (e_density lt 2.03) then
        e_density = 2.03
      endif
    endif
  endif
  if (weather eq 1) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = (-5.401 + 0.046*al2o3_h + 0.106*cao_h + 0.142*fe_h + 0.418*k2o_h + 0.071*loi_h + 0.089*mgo_h + 0.251*mn_h - 1.26*na2o_h + 0.041*s_h + 0.077*sio2_h + 0.282*tio2_h) * 0.85
    endif
  endif
endif
if (GEOZONE eq 46) then
  if (weather eq 0) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = 5.386 - 0.096*al2o3_h + 0.014*cao_h - 0.019*fe_h + 0.026*k2o_h - 0.044*loi_h - 0.033*mgo_h - 0.264*mn_h + 0.032*na2o_h + 0.043*s_h - 0.028*sio2_h + 0.21*tio2_h
      if (e_density lt 2.41) then
        e_density = 2.21
      endif
```

```
if (GEOZONE eq 75) then
  if (weather eq 0) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = 8.007 - 0.073*al2o3_h + 0.039*cao_h - 0.049*fe_h - 0.084*k2o_h - 0.107*loi_h - 0.041*mgo_h + 0.519*mn_h - 2.489*na2o_h + 0.027*s_h - 0.055*sio2_h + 0.297*tio2_h
      if (e_density lt 1.98) then
        e_density = 1.98
      endif
    endif
  endif
  if (weather eq 1) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = (8.007 - 0.073*al2o3_h + 0.039*cao_h - 0.049*fe_h - 0.084*k2o_h - 0.107*loi_h - 0.041*mgo_h + 0.519*mn_h - 2.489*na2o_h + 0.027*s_h - 0.055*sio2_h + 0.297*tio2_h) * 0.85
    endif
  endif
endif
if (GEOZONE eq 80) then
  if (weather eq 0) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = 35.634 - 0.27*al2o3_h - 0.32*cao_h - 0.453*fe_h - 0.367*k2o_h - 0.377*loi_h - 0.321*mgo_h - 1.849*mn_h - 1.625*na2o_h + 0.113*s_h - 0.329*sio2_h - 1.017*tio2_h
      if (e_density lt 2.46) then
        e_density = 2.46
      endif
    endif
  endif
  if (weather eq 1) then
    if (al2o3_h ge 0 and cao_h ge 0 and fe_h ge 0 and k2o_h ge 0 and loi_h ge -10 and mgo_h ge 0 and mn_h ge 0 and na2o_h ge 0 and s_h ge 0 and sio2_h ge 0 and tio2_h ge 0) then
      e_density = (35.634 - 0.27*al2o3_h - 0.32*cao_h - 0.453*fe_h - 0.367*k2o_h - 0.377*loi_h - 0.321*mgo_h - 1.849*mn_h - 1.625*na2o_h + 0.113*s_h - 0.329*sio2_h - 1.017*tio2_h) * 0.85
    endif
  endif
endif
* GLOBAL MIN/MAX LIMITS
if (e_density lt 1.5 or e_density gt 5.0) then
  e_density = -999
endif
```

Figure 9.83 – Extract from calculation file used to apply density multiple linear regression equations to sample locations in the 2m head assay composite samples file. Key features of calculations are annotated for clarity.

A final validation step was performed on the two major magnetite domains of MTS 40 and MSU 48 to test how well the statistical properties of the actual density values in the 2m SSD composite samples were replicated by the final regression models applied to the 2m head assay composite samples. This comparison tests the broad trends between the two datasets only, since the smaller SSD density data typically has <10% of the samples that the significantly larger head assay composite sample file has. Results for MTS 40 are presented and discussed below.

Table 9.8 shows a comparison of the density statistics between the two data sets for both unweathered and unweathered MTS 40. Figure 9.84 and Figure 9.85 shows the multivariate correlations for the two datasets, for unweathered and weathered MTS 40, respectively. Figure 9.86 to Figure 9.93 shows the replication of the relationships between density and selected assays for the 2m SSD composites and the 2m head assay composites, for unweathered and unweathered MTS 40.

Table 9.7 – Regression equations for density predictions at the 2m composite sample support.

Domain	Weathering	Regression Equation
AMP10	Unweathered	-6.184 + 0.05*al2o3 + 0.166*cao + 0.145*fe + 0.278*k2o + 0.057*loi + 0.12*mgo + 0.223*mn - 0.264*na2o + 0.08*s + 0.092*sio2 + 0.122*tio2
BIF 20	Unweathered	-4.594 - 0.043*al2o3 + 0.144*cao + 0.128*fe - 1.847*k2o + 0.087*loi + 0.094*mgo + 0.036*mn - 2.618*na2o - 0.334*p - 1.406*s + 0.067*sio2 + 0.181*tio2 + 30.522*zn
BIF 20	Weathered	-2.452 + 0.04*al2o3 - 3.016*ba + 0.018*cao - 1.269*cu + 0.094*fe - 0.194*k2o + 0.021*loi + 0.307*mgo + 0.184*mn - 1.332*na2o - 1.317*p - 17.642*pb - 4.143*s + 0.047*sio2 + 0.395*tio2 - 11.33*v + 4.764*zn
HEO 30	Unweathered	10.813 - 0.047*al2o3 + 0.121*cao - 0.102*fe + 1.197*k2o - 0.15*loi - 0.104*mgo - 0.554*mn - 0.886*na2o + 0.261*s - 0.043*sio2 - 0.588*tio2
HEO 30	Weathered	-23.206 + 0.459*al2o3 - 0.992*cao + 0.386*fe + 0.801*k2o + 0.232*loi + 0.367*mgo + 0.519*mn - 8.393*na2o - 5.057*s + 0.288*sio2 - 0.927*tio2
HEC 32	Unweathered	-2.973 + 0.057*al2o3 + 0.125*cao + 0.101*fe + 4.783*k2o + 0.012*loi + 0.122*mgo - 0.226*mn - 3.03*na2o + 0.079*s + 0.043*sio2 + 0.08*tio2
HBF 37	Unweathered	-5.111 + 0.294*al2o3 - 30.36*ba + 0.172*cao + 5.716*cu + 0.133*fe + 6.037*k2o - 0.002014*loi + 0.088*mgo + 1.124*mn - 2.988*na2o - 0.709*p + 163.667*pb + 0.043*s + 0.091*sio2 - 0.752*tio2 + 1.968*v - 43.62*zn
MTS 40	Unweathered	-0.076 + 0.004086*al2o3 + 0.069*cao + 0.062*fe + 0.061*k2o - 0.018*loi + 0.039*mgo + 0.252*mn + 0.054*na2o - 0.015*s + 0.027*sio2 + 0.051*tio2
MTS 40	Weathered	11.379 + 0.18*al2o3 + 0.134*cao - 0.086*fe + 0.754*k2o - 0.231*loi - 0.114*mgo + 1.285*mn - 0.468*na2o - 0.148*s - 0.099*sio2 - 0.773*tio2
MTC 43	Unweathered	-5.401 + 0.046*al2o3 + 0.106*cao + 0.142*fe + 0.418*k2o + 0.071*loi + 0.089*mgo + 0.251*mn - 1.26*na2o + 0.041*s + 0.077*sio2 + 0.282*tio2
SCH 46	Unweathered	-11.660 + 0.21*al2o3 + 0.213*cao + 0.225*fe + 0.018*k2o + 0.069*loi + 0.162*mgo + 0.281*mn - 0.285*na2o + 0.046*s + 0.144*sio2 + 0.121*tio2
MSU 48	Unweathered	1.992 - 0.005247*al2o3 + 0.028*cao + 0.034*fe - 0.013*k2o_h - 0.006832*loi + 0.018*mgo + 0.058*mn - 0.026*na2o + 0.004886*s + 0.005769*sio2 + 0.114*tio2
BSQ 70	Unweathered	5.386 - 0.096*al2o3 + 0.014*cao - 0.019*fe + 0.026*k2o - 0.044*loi - 0.033*mgo - 0.264*mn + 0.032*na2o + 0.043*s - 0.028*sio2 + 0.21*tio2
BSQ 70	Weathered	9.098 - 0.047*al2o3 - 0.066*cao - 0.099*fe - 0.271*k2o + 0.009634*loi + 0.341*mgo + 0.203*mn - 3.862*na2o - 1.667*s - 0.064*sio2 - 0.035*tio2
DOM 71	Unweathered	2.426 + 0.009401*al2o3 - 0.622*ba + 0.02*cao - 0.629*cu + 0.021*fe + 0.009282*k2o - 0.005377*loi + 0.012*mgo + 0.000605*mn + 0.063*na2o - 1.792*p - 0.657*pb + 0.014*s + 0.002172*sio2 + 0.061*tio2 - 0.907*v - 4.272*zn
ESZ 75	Unweathered	8.007 - 0.073*al2o3 + 0.039*cao - 0.049*fe - 0.084*k2o - 0.107*loi - 0.041*mgo + 0.519*mn - 2.489*na2o + 0.027*s - 0.055*sio2 + 0.297*tio2
CGS 80	Unweathered	35.634 - 0.27*al2o3 - 0.32*cao - 0.453*fe - 0.367*k2o - 0.377*loi - 0.321*mgo - 1.849*mn - 1.625*na2o + 0.113*s - 0.329*sio2 - 1.017*tio2

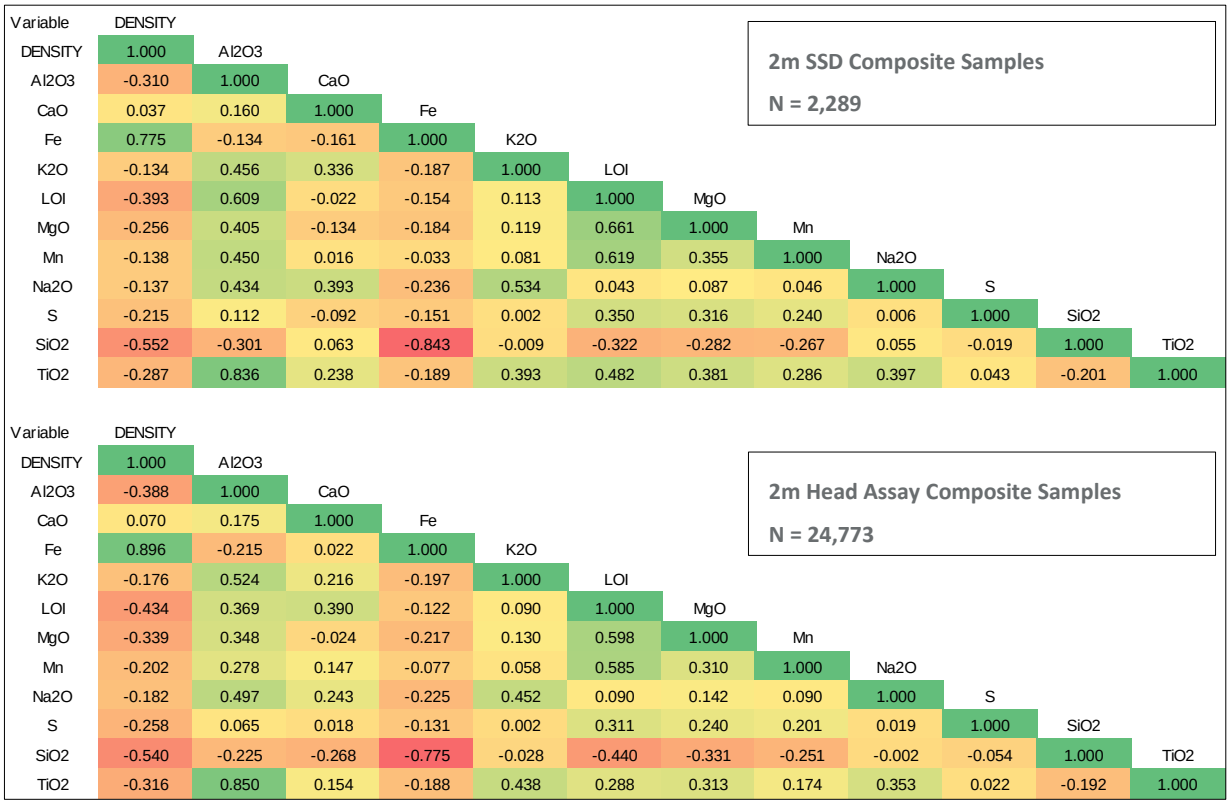
* Where no equation exists for a weathered domain, the unweathered domain equivalent x 0.85 is used.

* MBF 47 and GRT 90 use assigned density values – refer to Table 9.6.

Table 9.8 – Comparison of the statistics for the 2m SSD composites prior to regression, and the 2m head assay composites after the application of the regression equations for MTS 40.

		2m SSD Composites	2m Head Composites (After Regression)
Unweathered	Statistic	DENSITY	DENSITY
	No. Samples	2,289	24,773
	Min	2.417	2.129
	Max	4.386	4.422
	Mean	3.426	3.408
	Median	3.447	3.444
	Std. Dev.	0.256	0.189
Weathered	Statistic	DENSITY	DENSITY
	No. Samples	34*	744
	Min	1.917	1.574
	Max	3.747	7.580
	Mean	2.999	3.251
	Median	3.237	3.271
	Std. Dev.	0.529	0.543

* Statistics for 2m SSD in Weathered MTS 40 should be treated with caution as the 34 samples are clustered



Variable	DENSITY	Al2O3	CaO	Fe	K2O	LOI	MgO	Mn	Na2O	S	SiO2	TiO2
DENSITY	1.000											
Al2O3	-0.310	1.000										
CaO	0.037	0.160	1.000									
Fe	0.775	-0.134	-0.161	1.000								
K2O	-0.134	0.456	0.336	-0.187	1.000							
LOI	-0.393	0.609	-0.022	-0.154	0.113	1.000						
MgO	-0.256	0.405	-0.134	-0.184	0.119	0.661	1.000					
Mn	-0.138	0.450	0.016	-0.033	0.081	0.619	0.355	1.000				
Na2O	-0.137	0.434	0.393	-0.236	0.534	0.043	0.087	0.046	1.000			
S	-0.215	0.112	-0.092	-0.151	0.002	0.350	0.316	0.240	0.006	1.000		
SiO2	-0.552	-0.301	0.063	-0.843	-0.009	-0.322	-0.282	-0.267	0.055	-0.019	1.000	
TiO2	-0.287	0.836	0.238	-0.189	0.393	0.482	0.381	0.286	0.397	0.043	-0.201	1.000

Variable	DENSITY	Al2O3	CaO	Fe	K2O	LOI	MgO	Mn	Na2O	S	SiO2	TiO2
DENSITY	1.000											
Al2O3	-0.388	1.000										
CaO	0.070	0.175	1.000									
Fe	0.896	-0.215	0.022	1.000								
K2O	-0.176	0.524	0.216	-0.197	1.000							
LOI	-0.434	0.369	0.390	-0.122	0.090	1.000						
MgO	-0.339	0.348	-0.024	-0.217	0.130	0.598	1.000					
Mn	-0.202	0.278	0.147	-0.077	0.058	0.585	0.310	1.000				
Na2O	-0.182	0.497	0.243	-0.225	0.452	0.090	0.142	0.090	1.000			
S	-0.258	0.065	0.018	-0.131	0.002	0.311	0.240	0.201	0.019	1.000		
SiO2	-0.540	-0.225	-0.268	-0.775	-0.028	-0.440	-0.331	-0.251	-0.002	-0.054	1.000	
TiO2	-0.316	0.850	0.154	-0.188	0.438	0.288	0.313	0.174	0.353	0.022	-0.192	1.000

Figure 9.84 – Correlation matrix between assay and density for the 2m SSD composites (TOP) and the 2m head composites after application of regression equations (BOTTOM) for unweathered MTS 40. The overall agreement between the two sets of data indicates that observed correlation of density to the other analytes has been well reproduced by the multiple linear regression model, despite a difference of >90% in total samples.

Variable	DENSITY	Al2O3	CaO	Fe	K2O	LOI	MgO	Mn	Na2O	S	SiO2	TiO2
DENSITY	1.000											
Al2O3	0.210	1.000										
CaO	0.275	0.750	1.000									
Fe	0.886	0.027	0.226	1.000								
K2O	0.099	0.698	0.504	-0.019	1.000							
LOI	-0.047	0.593	0.792	0.057	0.471	1.000						
MgO	-0.072	0.635	0.837	-0.071	0.571	0.730	1.000					
Mn	0.298	0.218	0.649	0.297	0.211	0.603	0.357	1.000				
Na2O	-0.204	0.141	0.273	-0.197	0.346	0.155	0.488	0.128	1.000			
S	-0.123	-0.110	0.408	0.066	-0.128	0.541	0.376	0.589	0.018	1.000		
SiO2	-0.727	-0.532	-0.738	-0.793	-0.385	-0.567	-0.508	-0.509	-0.046	-0.243	1.000	
TiO2	0.314	0.987	0.776	0.145	0.684	0.577	0.615	0.264	0.150	-0.095	-0.616	1.000

2m SSD Composite Samples

N = 34

Variable	DENSITY	Al2O3	CaO	Fe	K2O	LOI	MgO	Mn	Na2O	S	SiO2	TiO2
DENSITY	1.000											
Al2O3	0.280	1.000										
CaO	0.278	0.093	1.000									
Fe	0.755	-0.147	0.193	1.000								
K2O	0.379	0.585	0.052	-0.064	1.000							
LOI	0.002	0.533	0.404	-0.041	0.334	1.000						
MgO	-0.140	0.413	0.341	-0.184	0.150	0.542	1.000					
Mn	0.390	0.304	0.132	0.042	0.514	0.456	0.191	1.000				
Na2O	0.030	0.357	0.091	-0.035	0.308	0.444	0.481	0.323	1.000			
S	-0.209	0.024	0.053	-0.141	-0.005	0.202	0.254	0.079	0.071	1.000		
SiO2	-0.721	-0.244	-0.422	-0.847	-0.153	-0.408	-0.295	-0.251	-0.252	0.009	1.000	
TiO2	0.159	0.794	0.144	-0.090	0.460	0.409	0.357	0.249	0.225	0.011	-0.240	1.000

2m Head Assay Composite Samples

N = 744

Figure 9.85 – Correlation matrix between assay and density for the 2m SSD composites (TOP) and the 2m head assay composites after application of regression equations (BOTTOM) for weathered MTS 40. The overall agreement between the two sets of data indicates that observed correlation of density to the other analytes has been well reproduced by the multiple linear regression model, despite a difference of >95% in total samples.

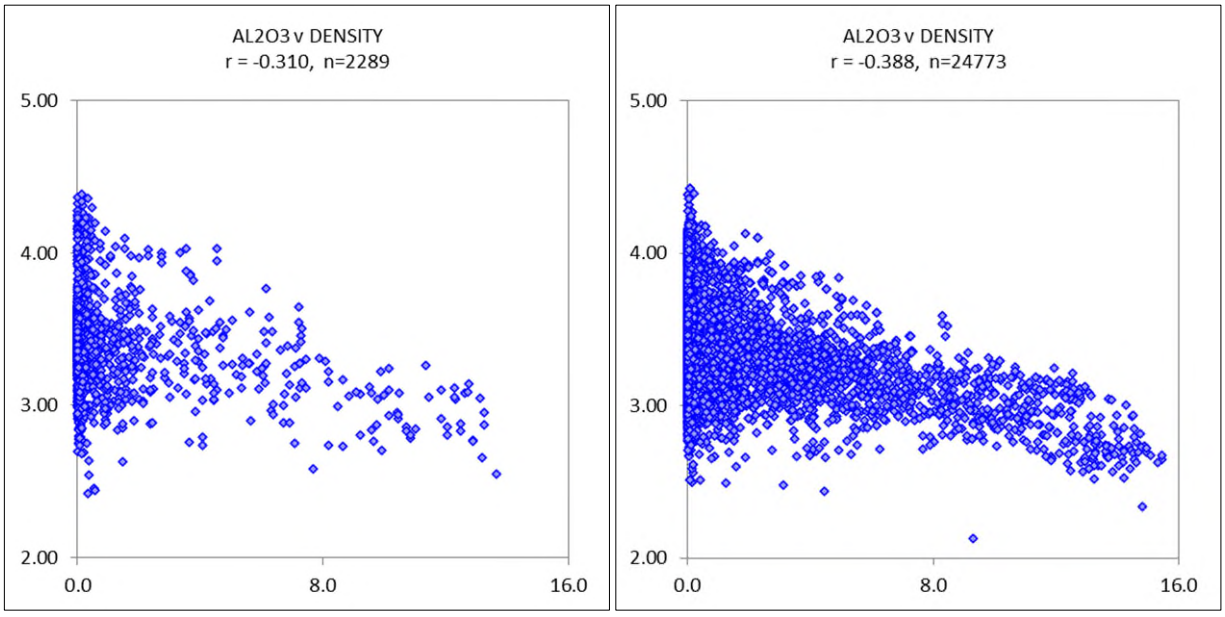


Figure 9.86 – Comparison of the relationship between Al_2O_3 and density in the 2m SSD composites (LEFT) and the 2m head assay composites (RIGHT) for unweathered MTS 40. Note the replication of the relationship despite the 90% difference in samples.

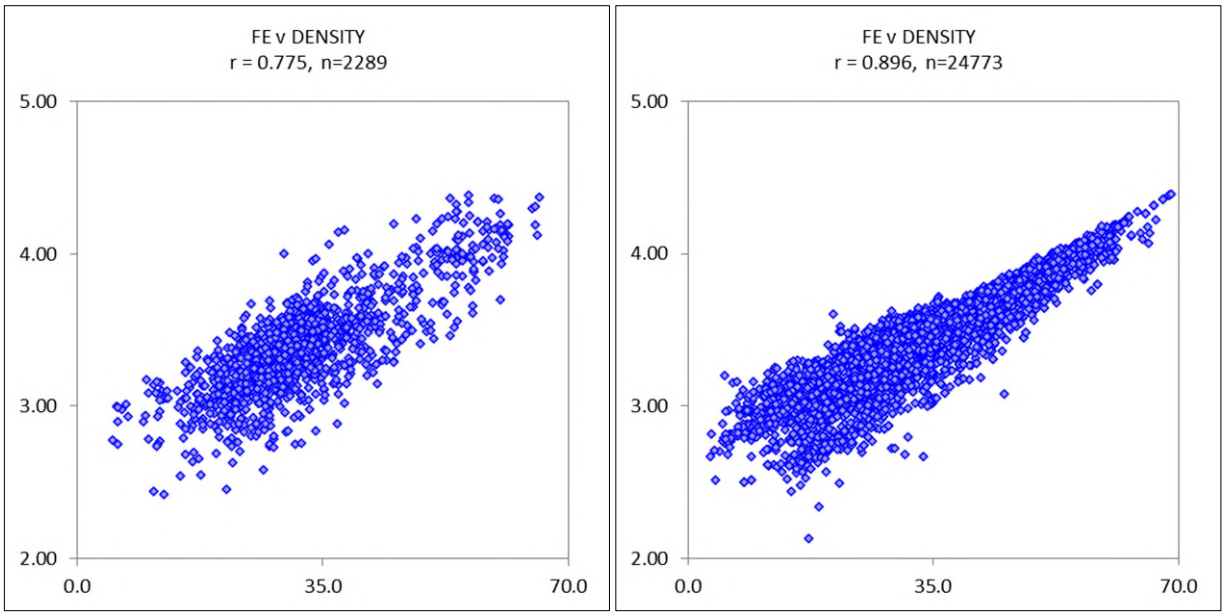


Figure 9.87 – Comparison of the relationship between Fe and density in the 2m SSD composites (LEFT) and the 2m head assay composites (RIGHT) for unweathered MTS 40. Note the replication of the relationship despite the 90% difference in samples.

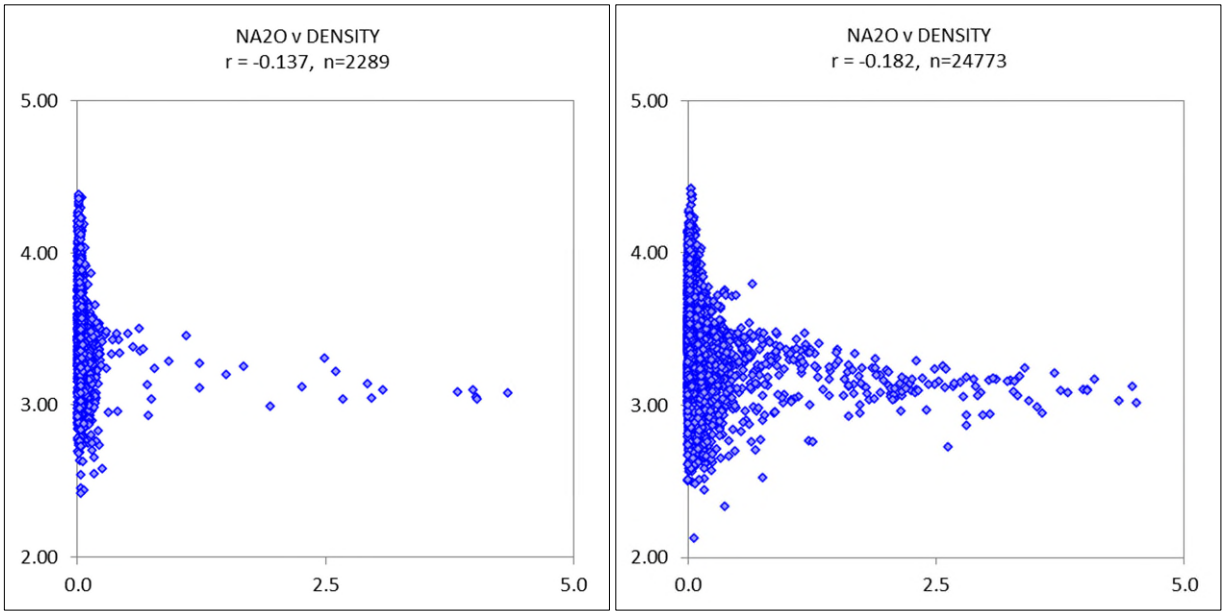


Figure 9.88 – Comparison of the relationship between Na_2O and density in the 2m SSD composites (LEFT) and the 2m head assay composites (RIGHT) for unweathered MTS 40. Note the replication of the relationship despite the 90% difference in samples.

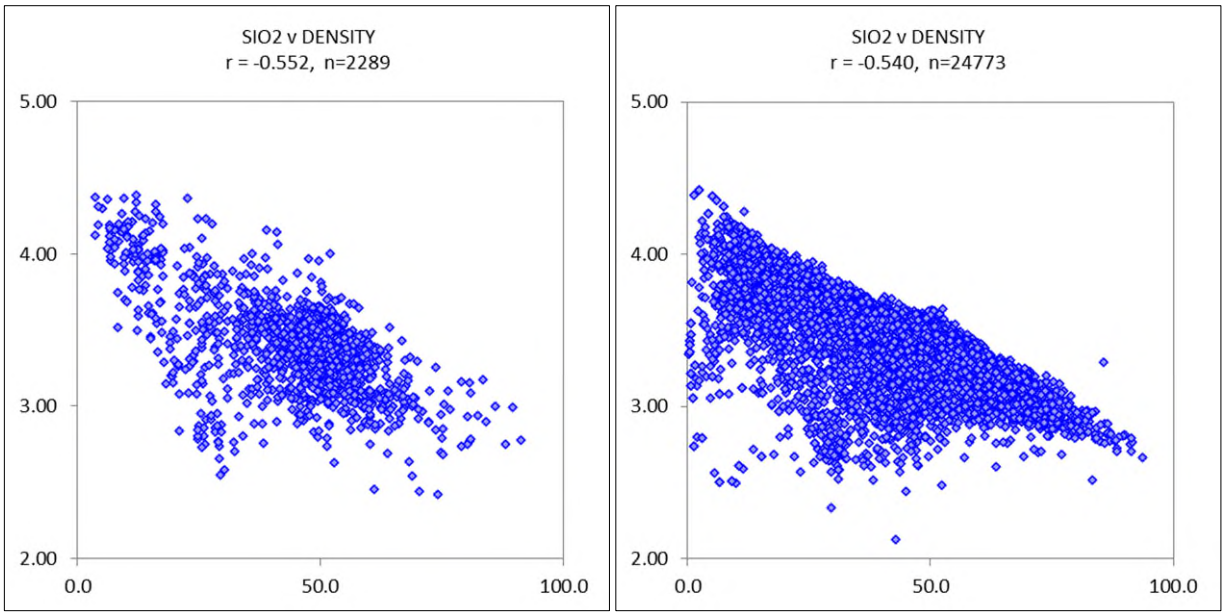


Figure 9.89 – Comparison of the relationship between SiO_2 and density in the 2m SSD composites (LEFT) and the 2m head assay composites (RIGHT) for unweathered MTS 40. Note the replication of the relationship despite the 90% difference in samples.

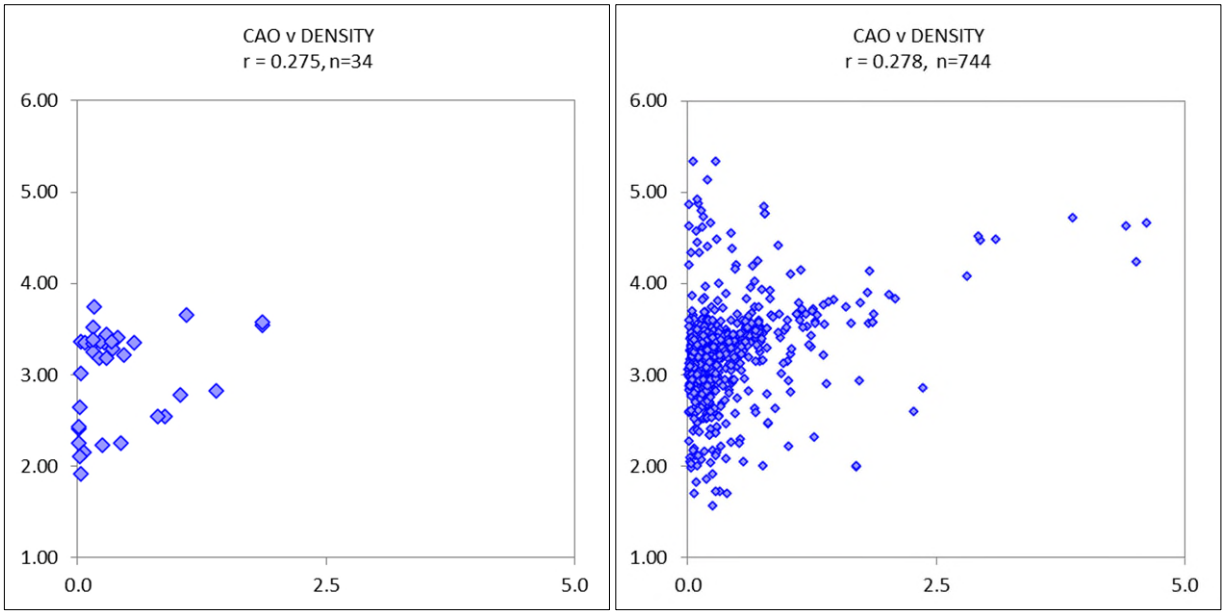


Figure 9.90 – Comparison of the relationship between CaO and density in the 2m SSD composites (LEFT) and the 2m head assay composites (RIGHT) for weathered MTS 40. Note the replication of the relationship despite the 95% difference in samples.

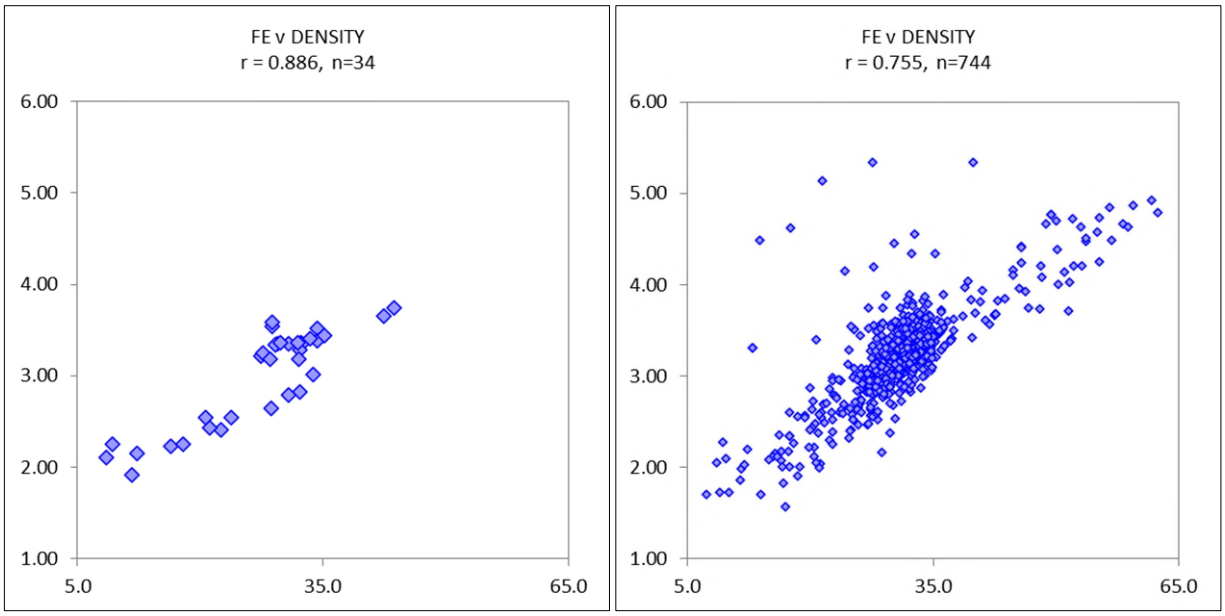


Figure 9.91 – Comparison of the relationship between Fe and density in the 2m SSD composites (LEFT) and the 2m head assay composites (RIGHT) for weathered MTS 40. Note the replication of the relationship despite the 95% difference in samples.

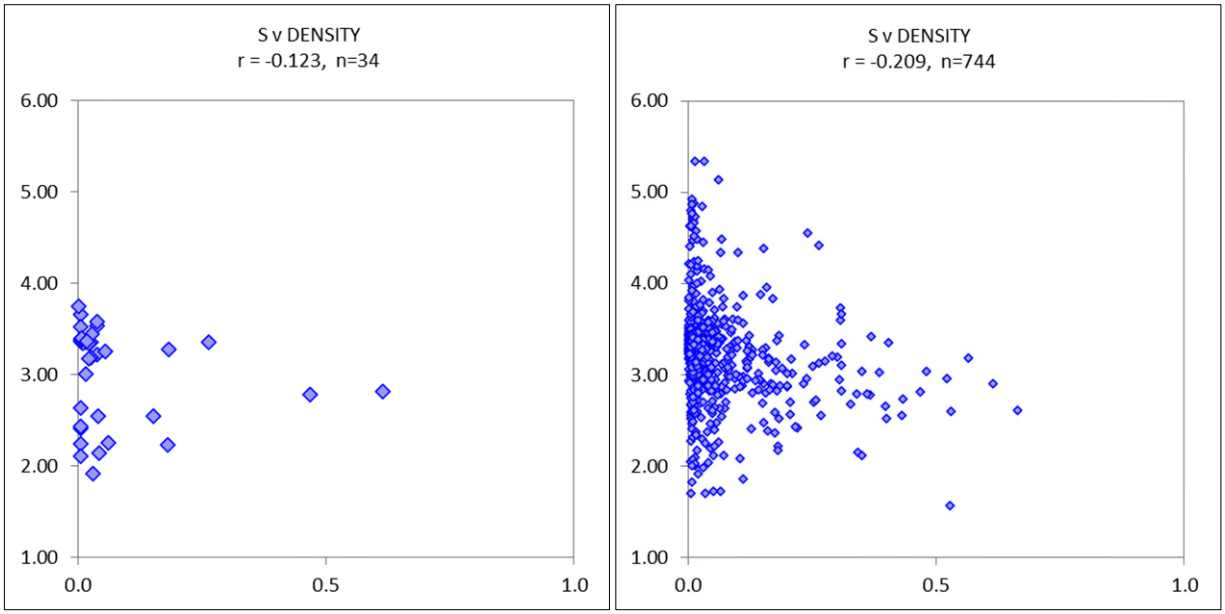


Figure 9.92 – Comparison of the relationship between S and density in the 2m SSD composites (LEFT) and the 2m head assay composites (RIGHT) for weathered MTS 40. Note the replication of the relationship despite the 95% difference in samples.

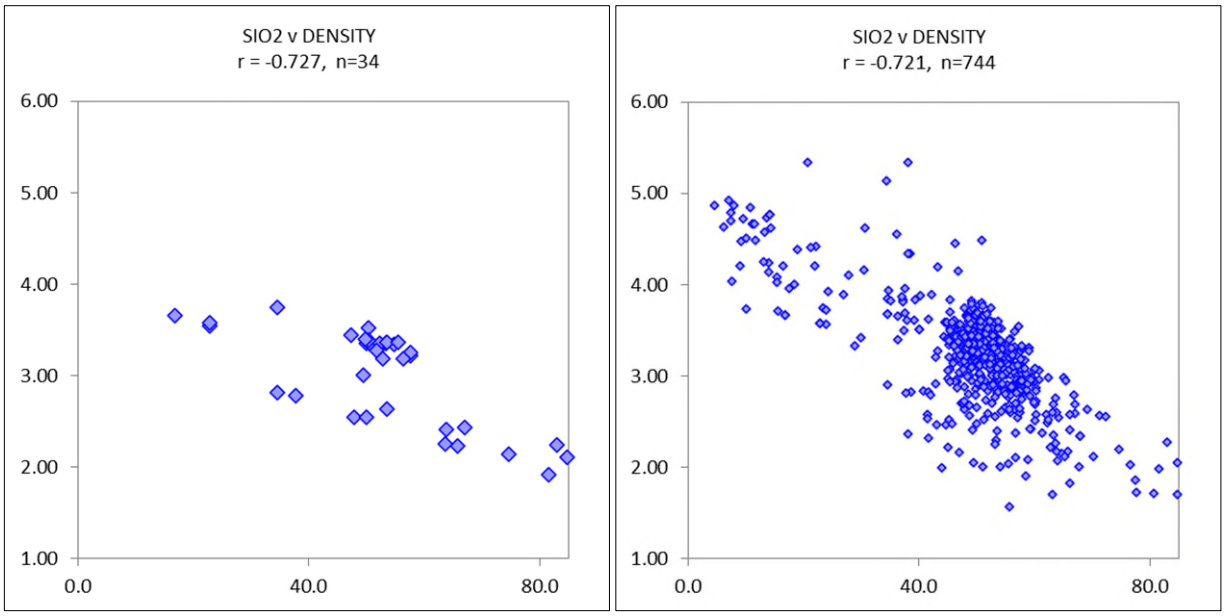


Figure 9.93 – Comparison of the relationship between SiO_2 and density in the 2m SSD composites (LEFT) and the 2m head assay composites (RIGHT) for weathered MTS 40. Note the replication of the relationship despite the 95% difference in samples.

10 Estimation

10.1 Service Variable versus Independent Variable

Prior to May 2023, variography and estimation for concentrate estimates was performed on a service variable (mass recovery multiplied by concentrate grade) to account for an assumed relationship between mass recovery and concentrate grade. During estimation, mass recovery and the service variable were estimated separately, and then the estimated service variable was divided by the mass recovery to back-calculate the estimated concentrate grade. It has been shown that this approach is not best practice, and leads to errors in the final estimate since:

- No relationship exists between mass recovery and concentrate grades (Figure 9.19 and Figure 9.20).
- Imbalance in search neighbourhood and sample selection criteria for mass recovery and the service variable leads to back-calculated grades greater than the theoretical maximum estimate possible (e.g., Fe > 72 % for magnetite).

The errors typically manifest as block grades which do not validate against the sample composites and are especially noticeable on domain boundaries, which is crucial to dilution aspects of mine planning activities based on these estimates. Usually attempts at correcting these errors involved setting grades > 100% to some smaller value, such as the mean of the domain, however, this approach doesn't achieve the desired outcome as it can be shown that at a local scale, the estimates still do not validate well enough against the sample composites.

Figure 10.1 illustrates the problems associated with the use of a service variable for estimation of concentrate grades. Three estimates of concentrate Fe were performed on the MTS domain (Appendix 2):

- Independent estimate (Fe)
- Refined service variable estimate (MassRec x Fe) – same variogram, same search
- Traditional service variable estimate (Massrec x Fe) – different variogram, different search

A comparison between the three types of estimates clearly show that the independent estimate (A) performs the best when validating the block grades against the sample grades. The traditional service variable estimate (C) performs the worst resulting in high grade blocks which are not at all supported by the samples. The refined service variable estimate (B) performs better than the traditional service variable approach but requires using the same variogram and search neighbourhood for both mass recovery and the service variable. This approach is based on the incorrect assumption that the relationships between mass recovery and all concentrate grades (e.g., Fe, SiO_2, Al_2O_3, etc.) are invariable. EDA of the data has shown that this is not the case (Section 9.2).

Thus, all resource estimation from May 2023 onwards, treat concentrate grades as independent variables during variography and later estimation, and the previous service variable methodology has been discontinued.

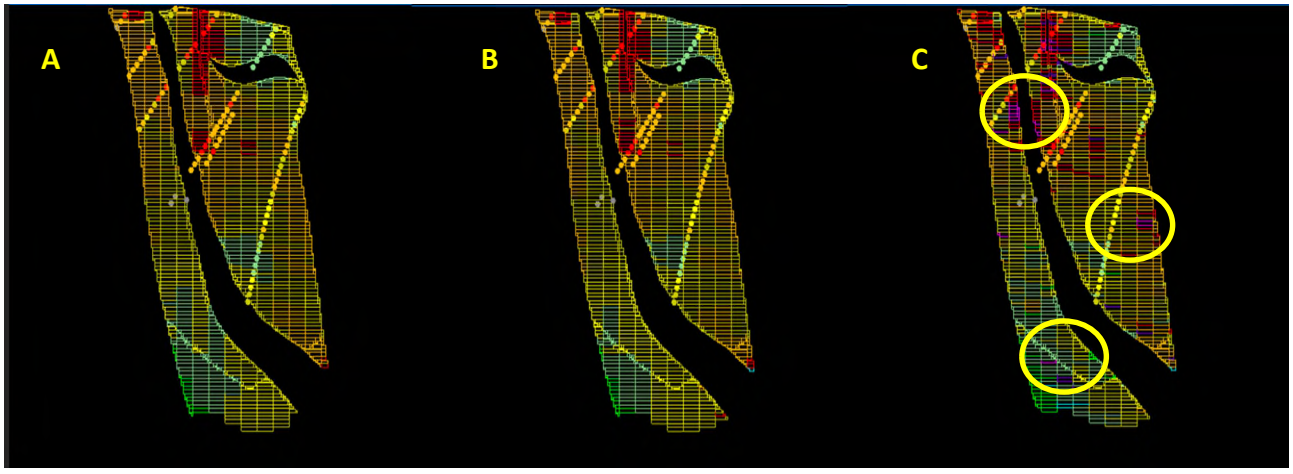


Figure 10.1 – Schematic cross sections, looking north, of an estimate of concentrate Fe in the MTS domain showing (A) independent estimate, (B) refined service variable estimate, and (C) traditional service variable estimate. The yellow rings show the typical errors incurred in the use of a service variable estimation approach.

10.2 Variography

Except for the new DOM 71 domain, variography defined for the May 2023 resource update was used in the October 2023 update as the total size of the data only increased marginally (+5% for head assays and +13% for concentrate assays) across all geological domains.

Variography was completed for the following analytes and domains for the 2M_H head assay composites:

- Domains: 10, 20, 30, 32, 37, 40, 43, 46, 47, 48, 70, 71, 75, 80
- Analytes: Magsus, Fe, SiO_2, Al_2O_3, Mn, TiO_2, CaO, MgO, K_2O, P, S, Na_2O, Ba, Cu, Pb, Zn, V, LOI_10

Variography was initially attempted on the 4M_C and the 8M_C concentrate assay composites separately but there were insufficient pairs to generate robust variograms. The composites were thus combined to undertake variography for the following analytes and domains:

- Domains: 10, 20, 32, 40, 43, 46, 47, 48, 70, 71, 75
- Analytes: Mass Recovery, Fe, SiO_2, Al_2O_3, Mn, TiO_2, CaO, MgO, K_2O, P, S, Na_2O, LOI_10

Individual variograms were modelled in almost all domains, but in a few cases, there were too few samples available to construct robust variograms. In these cases, a variogram from a similar geological domain was used (e.g., MBF 47 _H used BIF 20 _H variogram, ESZ 75 _C used SCH 46 _C variogram, DOM 71 _C used BSQ 75 _C variogram) or data was combined (e.g., ESZ 75 combined with CGS 80 for _H variography). Experimental variography was performed using lag distances appropriate to the data density and spacing on a geological domain basis. Down-the-hole variograms were performed at either 2m, 4m or 8m lag distances, depending on the composite data being used.

The standardised exponential model with practical range and two nested structures was observed to provide the best model fit to the experimental data. In a few cases, too few data were available to model directional anisotropy so omnidirectional variograms were used instead. Variograms modelled with directional anisotropy generally reflected the anisotropy expected from the geological model, but in a few cases geological knowledge was used to enforce a particular anisotropy. The nugget effect was derived exclusively from the down-the-hole variogram.

No distinction between the weathered and unweathered zones was used in variography due to insufficient data in the weathered zone, although the BIF 20 variograms could be considered as being largely in the weathered zone.

10.2.1 2M_H Head Assay

The variograms for the 2M_H composites are highly structured and characterised by low nugget effect of less than 0.20 for most elements, with a some locally higher values in a few domains (Figure 10.2 and Figure 10.3).

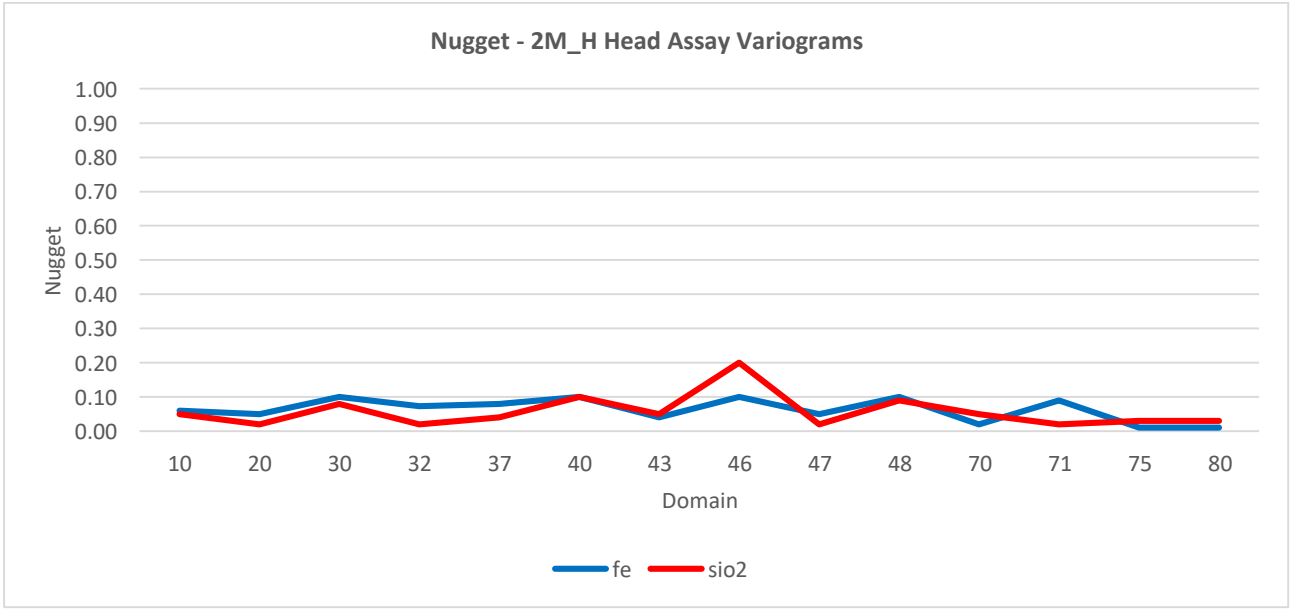


Figure 10.2 – Nugget effect for Fe and SiO_2 for the 2M_H composites across geological domains.

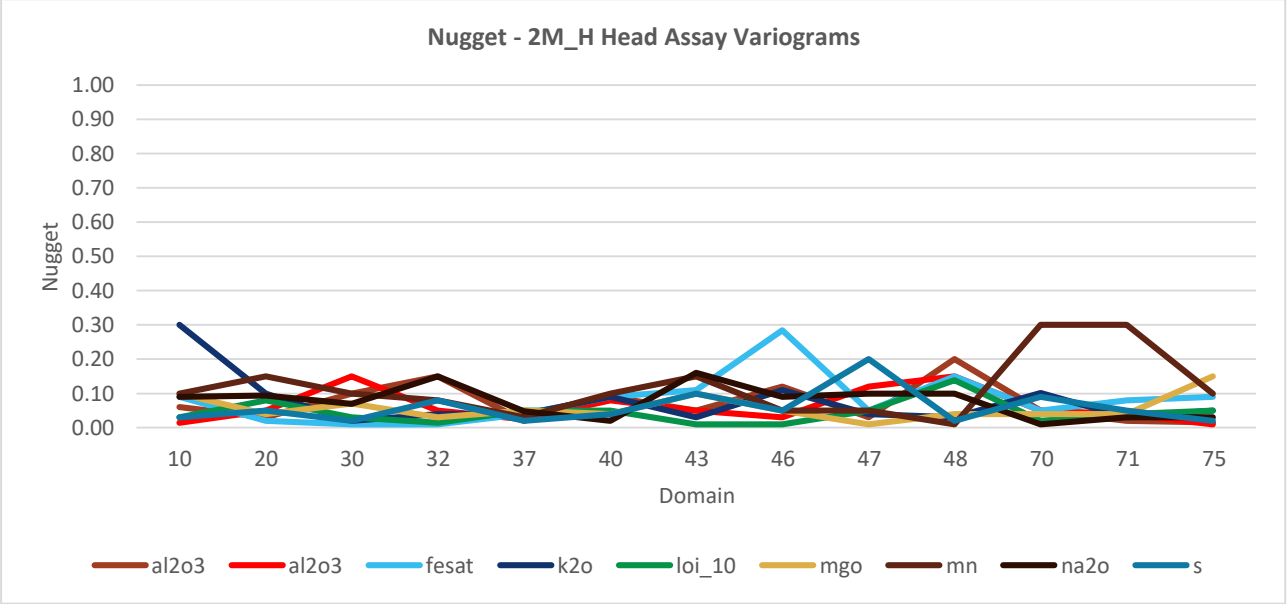


Figure 10.3 – Nugget effect for remaining elements in the 2M_H composites across geological domains.

Examples of down-the-hole variogram, directional variograms, and anisotropy rose diagrams for Fe for domain MTS 40 are shown in Figure 10.4 to Figure 10.6.

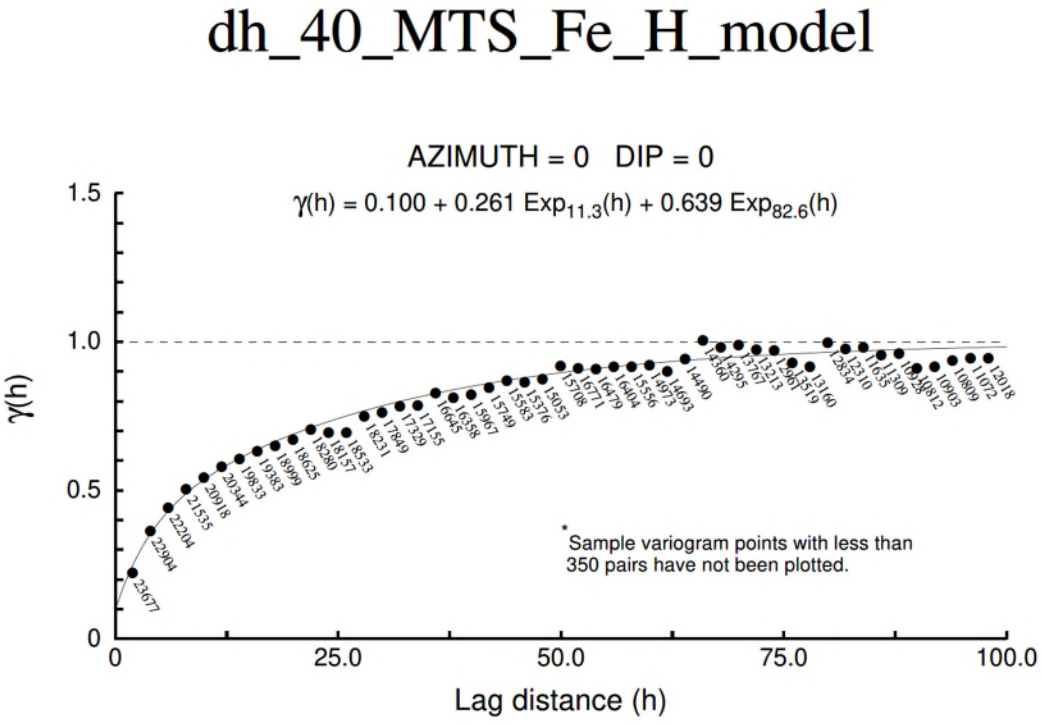


Figure 10.4 – Down-the-hole variogram for head Fe in domain MTS 40.

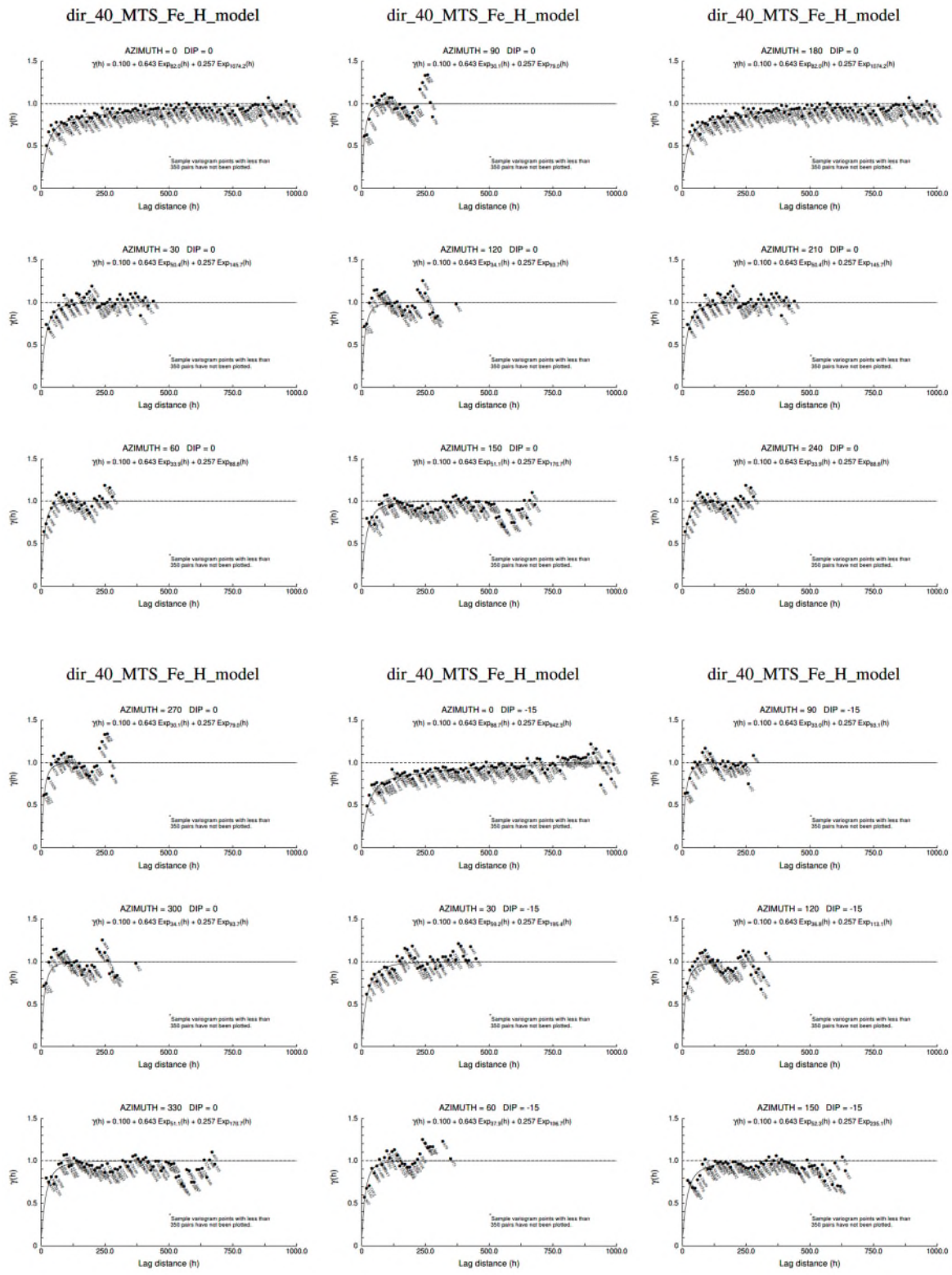


Figure 10.5 – Directional variogram for head Fe in domain MTS 40.

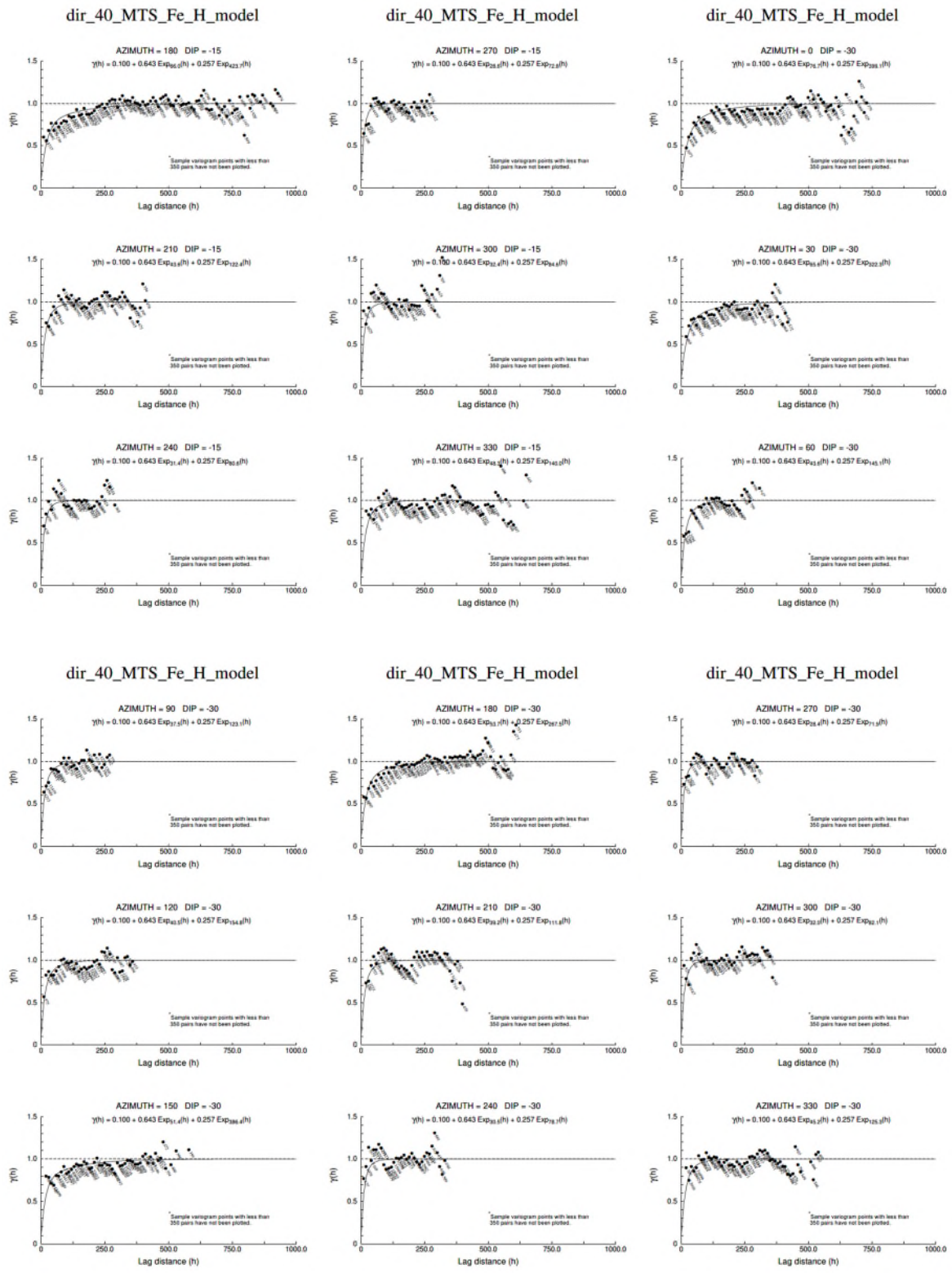


Figure 10.5 (cont.) – Directional variogram for head Fe in domain MTS 40.

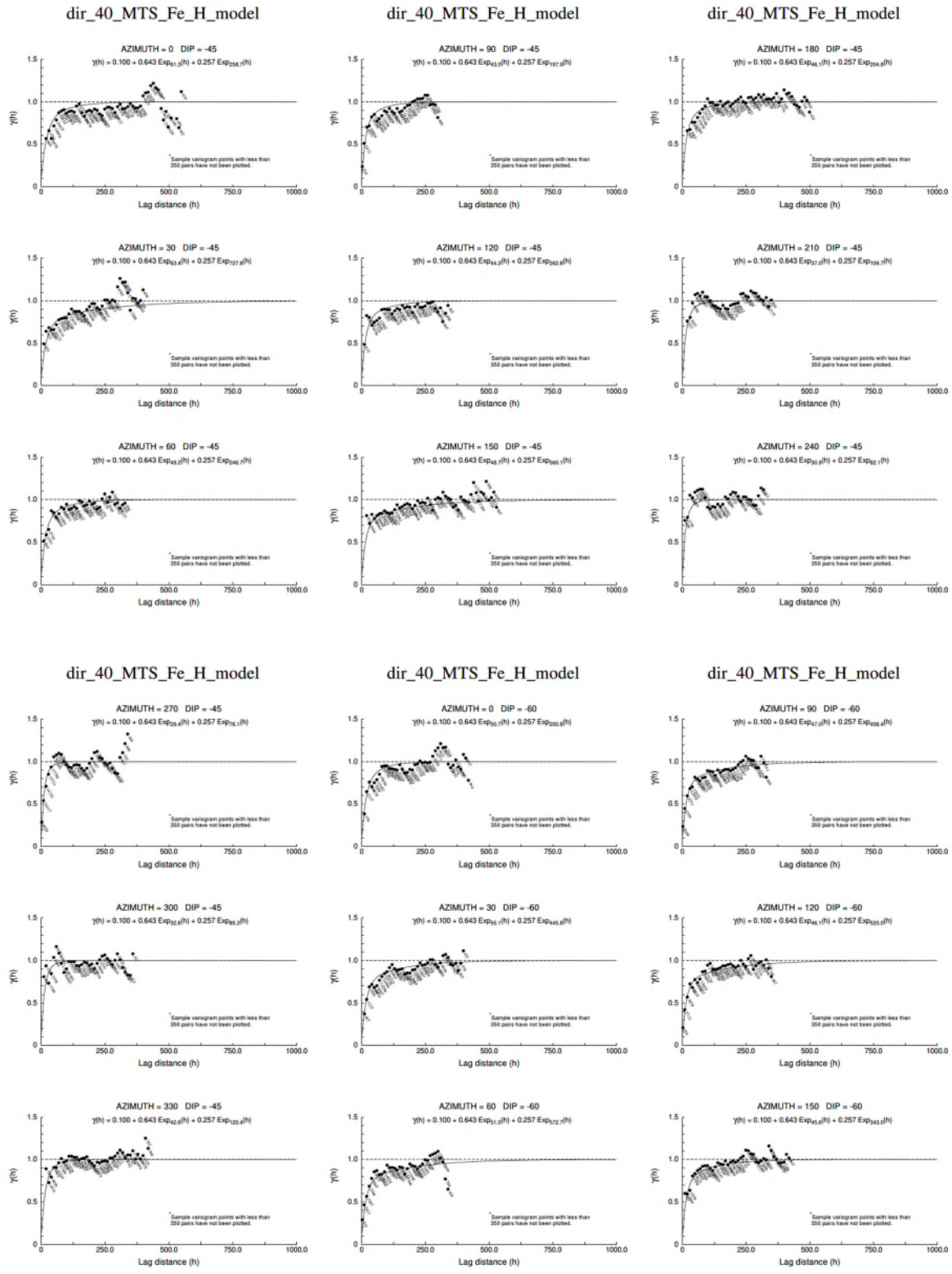


Figure 10.5 (cont.) – Directional variogram for head Fe in domain MTS 40.

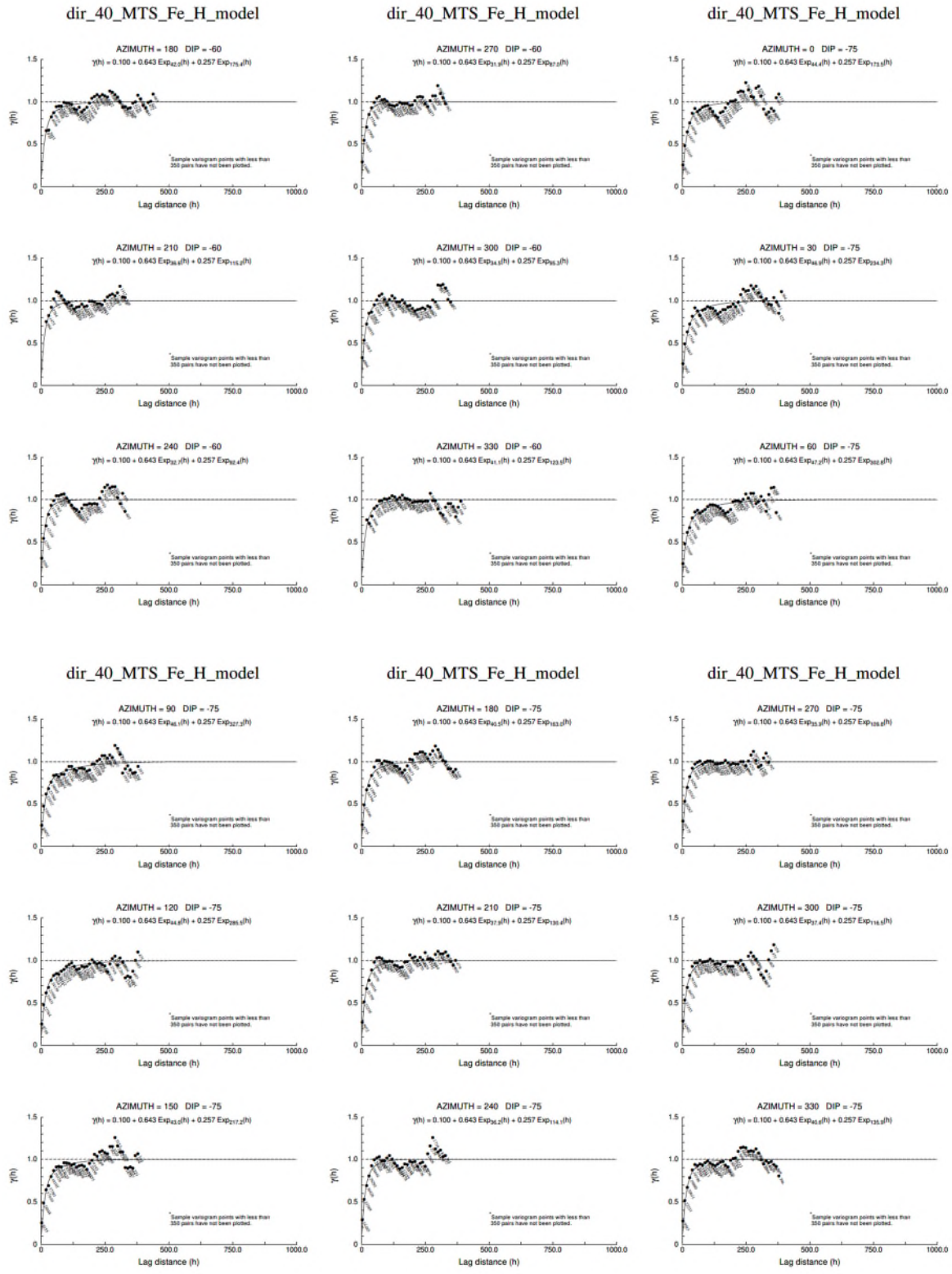


Figure 10.5 (cont.) – Directional variogram for head Fe in domain MTS 40.

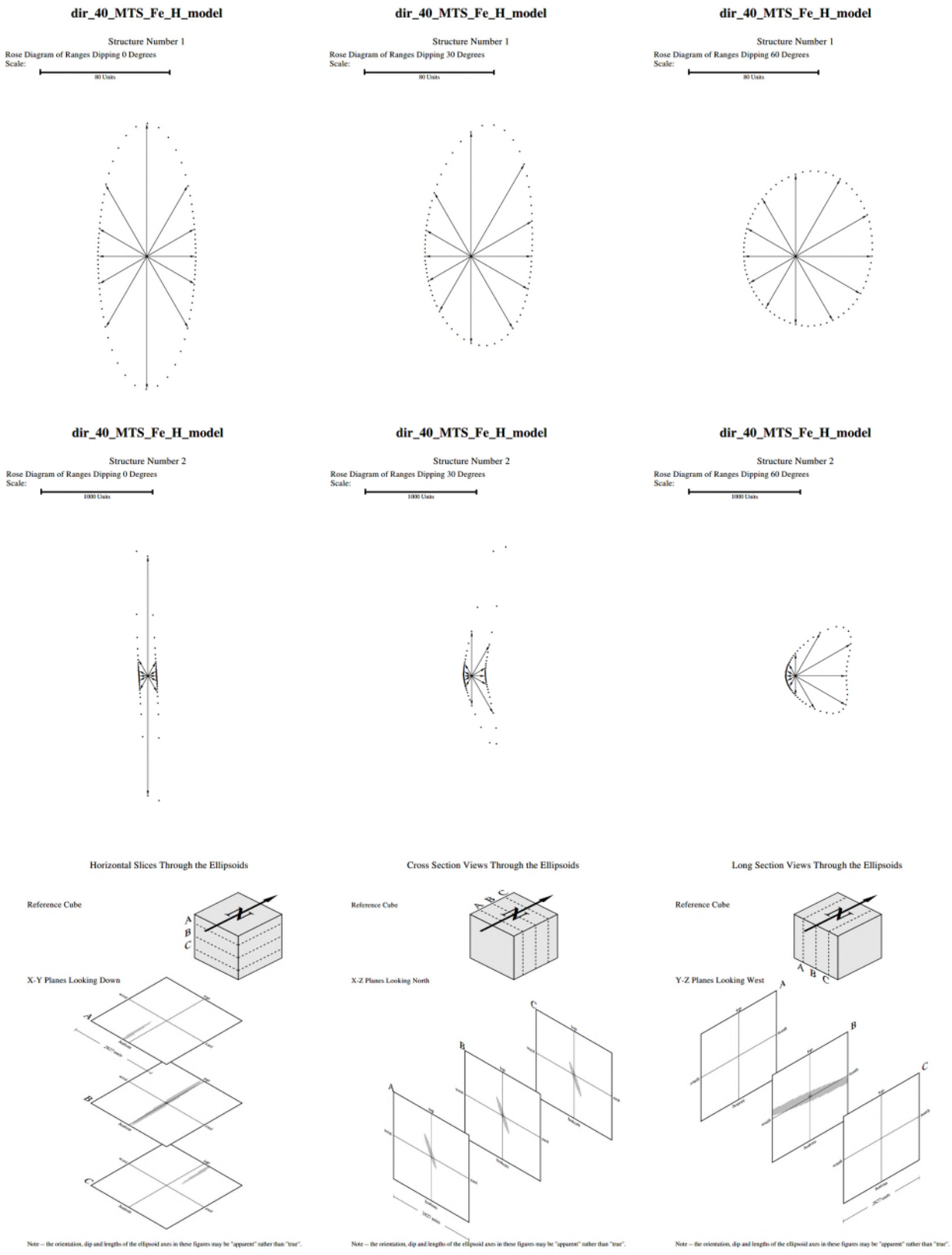


Figure 10.6 – Variogram anisotropy rose diagram for head Fe in domain MTS 40.

For the minor elements, the variogram modelled for P was applied in the estimation of Ba, Cu, P, Pb, V and Zn. Variogram parameters used for major head assay estimates are shown in Table 10.1. Variogram models and anisotropy rose diagrams for all domains and the major head assay elements are in Appendix 3.

Table 10.1 – Variogram model parameters for major head assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
AMP 10	Al_2O_3	0.06	0.345	-17	46	-3	52.3	45.7	15.6	0.595	-17	46	-3	1,182.3	156.6	234.4
	CaO	0.05	0.788	-16	74	-6	48.7	41.4	21.6	0.162	-16	74	-6	1,912.1	172.9	311.8
	Fe	0.06	0.772	-20	11	19	32.5	26.2	43.0	0.168	-20	11	19	1,003.5	152.6	460.3
	K_2O	0.04	0.657	-9	10	7	19.1	20.6	27.4	0.303	-9	10	7	478.5	144.4	384.9
	LOI_10	0.09	0.474	-8	49	-15	34.6	66.1	34.8	0.436	-8	49	-15	609.3	71.0	161.7
	MgO	0.02	0.587	1	25	-1	52.5	57.0	88.6	0.393	1	25	-1	1,932.2	782.0	139.1
	Mn	0.04	0.672	-18	48	-5	32.2	12.7	17.6	0.288	-18	48	-5	863.1	99.8	199.7
	Na_2O	0.10	0.599	9	16	6	58.6	59.8	47.2	0.301	9	16	6	2,011.3	919.6	135.0
	S	0.05	0.290	5	27	-24	51.6	23.0	16.0	0.660	5	27	-24	168.5	74.7	120.5
	SiO_2	0.05	0.290	5	27	-24	51.6	23.0	16.0	0.660	5	27	-24	168.5	74.7	120.5
	TiO_2	0.07	0.290	-18	116	-1	194.1	6.2	88.8	0.640	-18	116	-1	1,200.0	228.0	183.9
BIF 20	Al_2O_3	0.03	0.343	-1	6	-4	94.5	29.8	142.4	0.627	-1	6	-4	908.3	426.7	143.6
	CaO	0.15	0.556	8	89	0	24.0	25.3	11.7	0.294	8	89	0	698.8	41.8	183.3
	Fe	0.05	0.576	-24	81	-2	56.3	54.9	24.0	0.374	-24	81	-2	1,577.3	190.9	468.5
	K_2O	0.09	0.663	-2	7	-1	31.4	16.7	55.5	0.247	-2	7	-1	658.5	178.7	102.7
	LOI_10	0.03	0.425	-11	-2	-27	26.8	34.5	53.5	0.545	-11	-2	-27	1,668.4	252.6	506.1
	MgO	0.04	0.466	-12	81	0	148.2	69.1	62.9	0.494	-12	81	0	1,191.9	80.0	278.4
	Mn	0.15	0.588	-14	92	-3	95.5	21.6	12.2	0.262	-14	92	-3	593.0	95.0	225.9
	Na_2O	0.09	0.679	8	4	0	10.0	19.0	38.5	0.231	8	4	0	391.0	103.1	513.9
	S	0.02	0.492	-20	73	-4	57.6	43.9	35.9	0.488	-20	73	-4	2,230.5	283.9	511.0
	SiO_2	0.02	0.492	-20	73	-4	57.6	43.9	35.9	0.488	-20	73	-4	2,230.5	283.9	511.0
	TiO_2	0.08	0.241	-6	0	-5	60.1	18.5	165.9	0.679	-6	0	-5	835.6	442.2	128.2

Table 10.1 (cont.) – Variogram model parameters for major head assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
HEO 30	Al_2O_3	0.10	0.632	-7	5	-9	27.4	15.3	19.6	0.268	-7	5	-9	1,081.5	74.3	141.9
	CaO	0.05	0.481	-18	11	-2	64.3	46.5	64.4	0.469	-18	11	-2	1,835.1	298.6	133.1
	Fe	0.10	0.494	1	0	-7	21.4	10.8	18.7	0.406	1	0	-7	185.7	55.2	76.9
	K_2O	0.11	0.711	19	86	-2	15.9	43.0	15.1	0.179	19	86	-2	225.9	38.7	43.9
	LOI_10	0.11	0.601	-8	102	0	72.1	56.7	31.7	0.289	-8	102	0	1,133.6	85.7	265.8
	MgO	0.05	0.622	-7	3	-1	83.0	24.6	71.6	0.328	-7	3	-1	1,283.0	2,568.3	242.7
	Mn	0.10	0.754	16	115	-7	23.8	17.4	12.6	0.146	16	115	-7	360.4	106.9	164.9
	Na_2O	0.09	0.729	-6	79	-2	15.5	47.5	10.0	0.177	-6	79	-2	416.0	115.1	114.4
	S	0.08	0.670	9	12	-4	42.3	15.3	18.7	0.250	9	12	-4	204.3	80.3	115.9
	SiO_2	0.08	0.670	9	12	-4	42.3	15.3	18.7	0.250	9	12	-4	204.3	80.3	115.9
	TiO_2	0.10	0.672	-1	6	-18	22.6	13.4	15.4	0.228	-1	6	-18	357.3	49.9	105.5
HEC 32	Al_2O_3	0.15	0.751	1	-1	-17	16.1	8.4	21.7	0.099	1	-1	-17	786.8	134.3	139.6
	CaO	0.03	0.485	-13	24	6	42.9	17.1	58.0	0.490	-13	24	6	1,289.7	180.1	416.9
	Fe	0.07	0.620	-27	30	26	30.6	20.2	24.2	0.306	-27	30	26	1,213.6	173.0	620.8
	K_2O	0.28	0.579	12	81	3	14.7	14.5	11.4	0.137	12	81	3	621.1	175.6	410.3
	LOI_10	0.04	0.509	-16	16	10	40.8	15.0	68.5	0.451	-16	16	10	1,688.1	184.3	393.8
	MgO	0.10	0.473	-25	46	16	29.2	15.9	23.3	0.427	-25	46	16	1,171.3	221.3	427.8
	Mn	0.15	0.484	-57	52	77	31.8	12.9	15.4	0.366	-57	52	77	166.8	67.1	245.2
	Na_2O	0.07	0.780	-8	-7	-2	10.7	13.0	29.5	0.150	-8	-7	-2	844.3	92.4	164.4
	S	0.02	0.633	61	73	-68	25.8	24.5	8.1	0.347	61	73	-68	138.4	31.5	614.6
	SiO_2	0.02	0.633	61	73	-68	25.8	24.5	8.1	0.347	61	73	-68	138.4	31.5	614.6
	TiO_2	0.18	0.677	-99	73	-37	13.2	14.5	9.3	0.143	-99	73	-37	275.2	162.1	1,118.3

Table 10.1 (cont.) – Variogram model parameters for major head assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
HBF 37	Al_2O_3	0.02	0.845	1	48	-4	68.3	33.9	21.1	0.135	1	48	-4	351.9	63.5	377.7
	CaO	0.08	0.592	-22	-4	1	47.2	258.6	45.4	0.328	-22	-4	1	459.3	257.1	131.8
	Fe	0.08	0.691	-7	-2	4	35.1	19.4	21.8	0.229	-7	-2	4	739.4	179.9	380.8
	K_2O	0.05	0.901	-7	84	-6	115.2	18.5	15.4	0.049	-7	84	-6	693.7	247.4	1,158.9
	LOI_10	0.03	0.640	2	65	1	42.5	42.4	99.2	0.330	2	65	1	722.6	184.0	218.3
	MgO	0.04	0.547	13	-15	-18	30.4	34.2	43.8	0.413	13	-15	-18	1,833.4	724.2	255.2
	Mn	0.10	0.615	-3	-3	-28	48.7	77.1	41.3	0.285	-3	-3	-28	948.4	49.9	199.6
	Na_2O	0.15	0.421	4	-25	-3	38.7	18.6	19.1	0.429	4	-25	-3	116.0	61.0	623.9
	S	0.04	0.586	-5	-34	-4	27.8	80.1	31.3	0.374	-5	-34	-4	878.5	280.5	358.8
	SiO_2	0.04	0.586	-5	-34	-4	27.8	80.1	31.3	0.374	-5	-34	-4	878.5	280.5	358.8
	TiO_2	0.02	0.966	-10	11	-2	69.6	17.3	27.0	0.014	-10	11	-2	246.2	23.8	448.2
MTS 40	Al_2O_3	0.09	0.677	3	3	2	27.3	17.7	16.6	0.233	3	3	2	594.8	120.0	283.2
	CaO	0.05	0.816	24	84	2	25.4	82.5	26.8	0.134	24	84	2	3,009.5	1,361.4	599.9
	Fe	0.10	0.643	4	26	-15	91.7	29.9	48.9	0.257	4	26	-15	1,958.5	70.4	514.3
	K_2O	0.15	0.826	2	142	-2	3.1	10.0	165.4	0.024	2	142	-2	736.3	317.3	641.8
	LOI_10	0.10	0.572	14	-13	21	34.6	23.7	103.0	0.327	14	-13	21	2,613.2	324.7	548.0
	MgO	0.07	0.409	0	71	-8	268.9	40.3	24.7	0.520	33	-10	-38	727.0	467.5	1,191.2
	Mn	0.08	0.892	-7	-2	1	43.2	28.6	247.2	0.028	-7	-2	1	90.2	47.7	267.5
	Na_2O	0.05	0.819	-69	118	9	19.7	11.3	17.9	0.133	-69	118	9	56.7	994.5	158.8
	S	0.10	0.366	-15	34	13	62.5	25.0	40.2	0.534	-15	34	13	620.1	116.2	497.5
	SiO_2	0.10	0.366	-15	34	13	62.5	25.0	40.2	0.534	-15	34	13	620.1	116.2	497.5
	TiO_2	0.15	0.731	6	6	-5	18.7	9.5	15.0	0.119	6	6	-5	670.5	87.1	221.1

Table 10.1 (cont.) – Variogram model parameters for major head assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
MTC 43	Al_2O_3	0.05	0.646	-9	57	-5	46.4	15.3	10.5	0.304	-9	57	-5	1,010.3	292.0	136.4
	CaO	0.03	0.464	1	47	-8	97.6	85.1	34.4	0.506	1	47	-8	1,449.1	163.7	486.0
	Fe	0.04	0.684	1	30	-8	47.9	30.4	43.4	0.276	1	30	-8	1,518.4	40.0	200.9
	K_2O	0.05	0.803	-13	-12	35	19.5	15.6	17.6	0.147	-13	-12	35	128.3	77.7	418.8
	LOI_10	0.03	0.389	-1	43	2	45.5	25.0	21.6	0.581	-1	43	2	470.3	109.6	216.3
	MgO	0.03	0.833	0	111	-2	59.1	44.4	28.5	0.137	0	111	-2	1,140.8	91.5	342.1
	Mn	0.03	0.713	-4	50	-3	91.9	39.1	54.2	0.257	-4	50	-3	1,980.6	577.7	312.9
	Na_2O	0.02	0.839	77	-1	6	14.4	19.7	94.8	0.141	77	-1	6	209.8	30.9	397.9
	S	0.05	0.437	-3	35	4	114.4	55.2	70.6	0.513	-3	35	4	1,009.8	90.8	358.1
	SiO_2	0.05	0.437	-3	35	4	114.4	55.2	70.6	0.513	-3	35	4	1,009.8	90.8	358.1
	TiO_2	0.03	0.660	-9	30	-4	24.2	10.0	9.8	0.310	-9	30	-4	998.1	230.1	132.1
SCH 46	Al_2O_3	0.12	0.582	-58	67	76	33.4	58.9	5.8	0.298	-58	67	76	608.3	66.2	574.8
	CaO	0.12	0.760	13	4	-32	61.3	14.7	39.4	0.120	13	4	-32	965.5	143.3	310.3
	Fe	0.10	0.782	-1	-1	-2	86.2	16.1	34.5	0.118	-1	-1	-2	4,901.0	151.6	617.4
	K_2O	0.08	0.684	17	25	-32	119.6	27.4	9.3	0.236	17	25	-32	402.2	93.4	454.9
	LOI_10	0.05	0.367	-29	76	-6	21.9	72.5	11.9	0.583	-29	76	-6	343.2	370.1	486.2
	MgO	0.05	0.096	-103	17	41	79.3	181.8	14.4	0.854	-103	17	41	741.6	355.0	165.9
	Mn	0.10	0.759	-73	4	-57	81.4	86.2	3.2	0.141	-73	4	-57	339.9	1,218.8	428.2
	Na_2O	0.16	0.519	14	17	-2	91.6	7.9	20.1	0.321	14	17	-2	272.4	95.9	1,193.6
	S	0.20	0.478	11	60	0	192.3	49.2	37.7	0.322	11	60	0	367.6	99.0	750.7
	SiO_2	0.20	0.478	11	60	0	192.3	49.2	37.7	0.322	11	60	0	367.6	99.0	750.7
	TiO_2	0.15	0.599	15	17	-29	85.0	18.0	11.7	0.251	15	17	-29	597.8	82.8	801.0

Table 10.1 (cont.) – Variogram model parameters for major head assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
MBF 47	Al_2O_3	0.03	0.343	-1	6	-4	94.5	29.8	142.4	0.627	-1	6	-4	908.3	426.7	143.6
	CaO	0.15	0.556	8	89	0	24.0	25.3	11.7	0.294	8	89	0	698.8	41.8	183.3
	Fe	0.05	0.576	-24	81	-2	56.3	54.9	24.0	0.374	-24	81	-2	1,577.3	190.9	468.5
	K_2O	0.09	0.663	-2	7	-1	31.4	16.7	55.5	0.247	-2	7	-1	658.5	178.7	102.7
	LOI_10	0.03	0.425	-11	-2	-27	26.8	34.5	53.5	0.545	-11	-2	-27	1,668.4	252.6	506.1
	MgO	0.04	0.466	-12	81	0	148.2	69.1	62.9	0.494	-12	81	0	1,191.9	80.0	278.4
	Mn	0.15	0.588	-14	92	-3	95.5	21.6	12.2	0.262	-14	92	-3	593.0	95.0	225.9
	Na_2O	0.09	0.679	8	4	0	10.0	19.0	38.5	0.231	8	4	0	391.0	103.1	513.9
	S	0.02	0.492	-20	73	-4	57.6	43.9	35.9	0.488	-20	73	-4	2,230.5	283.9	511.0
	SiO_2	0.02	0.492	-20	73	-4	57.6	43.9	35.9	0.488	-20	73	-4	2,230.5	283.9	511.0
	TiO_2	0.08	0.241	-6	0	-5	60.1	18.5	165.9	0.679	-6	0	-5	835.6	442.2	128.2
MSU 48	Al_2O_3	0.20	0.744	7	53	-15	89.4	12.7	33.0	0.056	7	53	-15	728.7	560.5	380.0
	CaO	0.05	0.443	-4	57	-14	90.9	22.8	6.4	0.507	-4	57	-14	480.3	190.7	128.2
	Fe	0.10	0.631	-7	10	-8	37.6	16.4	20.7	0.269	-7	10	-8	1,213.7	98.6	919.5
	K_2O	0.30	0.637	-4	10	4	96.8	8.9	10.7	0.063	-4	10	4	195.8	72.0	1,879.0
	LOI_10	0.08	0.549	-4	-8	-15	67.6	18.1	28.0	0.371	-4	-8	-15	1,062.7	150.3	845.8
	MgO	0.10	0.333	5	-22	5	94.3	53.3	18.7	0.567	5	-22	5	741.3	248.6	1,728.1
	Mn	0.05	0.352	-7	69	-9	154.7	10.4	20.6	0.598	-7	69	-9	478.7	195.6	69.3
	Na_2O	0.10	0.639	-82	89	-45	131.3	2.1	23.5	0.261	-82	89	-45	503.6	200.6	96.3
	S	0.09	0.258	-7	7	1	128.9	47.0	18.0	0.652	-7	7	1	1,241.0	191.1	1,806.9
	SiO_2	0.09	0.258	-7	7	1	128.9	47.0	18.0	0.652	-7	7	1	1,241.0	191.1	1,806.9
	TiO_2	0.15	0.803	8	18	-20	77.0	12.9	14.8	0.047	8	18	-20	587.4	61.9	415.6

Table 10.1 (cont.) – Variogram model parameters for major head assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
BSQ 70	Al_2O_3	0.05	0.496	0	86	-9	34.8	36.5	20.3	0.454	0	86	-9	506.2	201.2	218.4
	CaO	0.04	0.277	-6	0	-16	92.7	52.5	70.3	0.683	-6	0	-16	612.4	70.6	192.6
	Fe	0.09	0.395	-14	18	8	65.2	39.6	56.0	0.515	-14	18	8	467.2	68.9	110.1
	K_2O	0.10	0.760	-11	4	-2	29.6	24.3	119.4	0.140	-11	4	-2	560.1	149.7	236.1
	LOI_10	0.03	0.310	-7	4	-16	93.6	46.2	40.7	0.660	-7	4	-16	1,899.7	116.5	441.9
	MgO	0.05	0.241	-1	-5	11	86.8	240.1	36.7	0.709	-1	-5	11	1,247.0	270.9	408.1
	Mn	0.05	0.768	-6	9	-19	64.3	23.5	10.6	0.182	-6	9	-19	3,441.3	209.2	2,180.2
	Na_2O	0.10	0.733	19	29	5	17.5	35.6	31.4	0.167	19	29	5	117.0	120.4	964.4
	S	0.05	0.594	-3	-7	-3	49.2	51.8	333.8	0.356	-3	-7	-3	1,278.6	126.8	815.5
	SiO_2	0.05	0.594	-3	-7	-3	49.2	51.8	333.8	0.356	-3	-7	-3	1,278.6	126.8	815.5
	TiO_2	0.08	0.546	9	6	-8	30.2	20.6	23.9	0.374	9	6	-8	424.2	153.5	238.9
DOM71	Al_2O_3	0.02	0.375	0	86	-9	240.1	125.1	40.9	0.605	0	86	-9	189.0	80.0	151.6
	CaO	0.01	0.376	-6	0	-16	226.7	207.9	79.2	0.614	-6	0	-16	695.0	35.1	135.9
	Fe	0.02	0.000	-14	18	8	108.5	93.9	58.2	0.980	-14	18	8	306.4	45.2	55.9
	K_2O	0.02	0.000	-14	18	8	108.5	93.9	58.2	0.980	-14	18	8	306.4	45.2	55.9
	LOI_10	0.02	0.598	-11	4	-2	23.7	44.9	27.1	0.382	-11	4	-2	714.0	126.2	188.1
	MgO	0.015	0.430	-7	4	-16	244.7	71.2	176.1	0.555	-7	4	-16	348.0	193.0	37.2
	Mn	0.01	0.473	-1	-5	11	124.5	61.0	606.8	0.517	-1	-5	11	3,928.9	366.3	122.8
	Na_2O	0.01	0.910	-6	9	-19	26.9	34.2	12.1	0.080	-6	9	-19	3,198.2	79.6	94.5
	S	0.01	0.855	19	29	5	148.1	582.7	27.1	0.135	19	29	5	1,699.6	176.3	779.6
	SiO_2	0.10	0.820	-3	-7	-3	80.1	29.7	26.2	0.080	-3	-7	-3	3472.1	3,472.1	502.8
	TiO_2	0.02	0.672	-3	-7	-3	188.0	324.1	71.9	0.308	-3	-7	-3	992.8	70.0	1,372.0

Table 10.1 (cont.) – Variogram model parameters for major head assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
ESZ 75	Al_2O_3	0.02	0.474	-3	22	-1	40.1	43.5	83.6	0.511	-3	22	-1	3,570.8	180.5	780.9
	CaO	0.03	0.875	-3	2	2	36.2	12.4	408.2	0.095	-3	2	2	1,332.9	244.2	229.0
	Fe	0.01	0.473	-8	29	4	25.9	105.5	115.7	0.517	-8	29	4	4,461.4	149.6	765.2
	K_2O	0.04	0.351	-6	32	-3	84.3	35.6	39.9	0.609	-6	32	-3	1,774.5	111.1	446.5
	LOI_10	0.05	0.437	-1	-2	-10	36.2	49.0	75.3	0.513	-1	-2	-10	3,520.4	177.3	477.6
	MgO	0.04	0.483	2	65	12	31.3	67.2	33.7	0.477	2	65	12	2,774.2	823.2	390.0
	Mn	0.30	0.275	-6	-48	7	54.5	378.6	561.1	0.425	-6	-48	7	2,227.1	206.3	129.6
	Na_2O	0.03	0.552	-65	2	11	149.5	8.9	450.2	0.418	-65	2	11	184.3	188.8	1,568.5
	S	0.03	0.390	-1	-16	6	34.0	31.1	49.8	0.580	-1	-16	6	966.4	100.4	398.9
	SiO_2	0.03	0.390	-1	-16	6	34.0	31.1	49.8	0.580	-1	-16	6	966.4	100.4	398.9
	TiO_2	0.05	0.761	2	79	1	27.9	97.3	19.9	0.189	2	79	1	5,289.5	731.4	228.8
CGS 80	Al_2O_3	0.02	0.474	-3	22	-1	40.1	43.5	83.6	0.511	-3	22	-1	3,570.8	180.5	780.9
	CaO	0.03	0.875	-3	2	2	36.2	12.4	408.2	0.095	-3	2	2	1,332.9	244.2	229.0
	Fe	0.01	0.473	-8	29	4	25.9	105.5	115.7	0.517	-8	29	4	4,461.4	149.6	765.2
	K_2O	0.04	0.351	-6	32	-3	84.3	35.6	39.9	0.609	-6	32	-3	1,774.5	111.1	446.5
	LOI_10	0.05	0.437	-1	-2	-10	36.2	49.0	75.3	0.513	-1	-2	-10	3,520.4	177.3	477.6
	MgO	0.04	0.483	2	65	12	31.3	67.2	33.7	0.477	2	65	12	2,774.2	823.2	390.0
	Mn	0.30	0.275	-6	-48	7	54.5	378.6	561.1	0.425	-6	-48	7	2,227.1	206.3	129.6
	Na_2O	0.03	0.552	-65	2	11	149.5	8.9	450.2	0.418	-65	2	11	184.3	188.8	1,568.5
	S	0.03	0.390	-1	-16	6	34.0	31.1	49.8	0.580	-1	-16	6	966.4	100.4	398.9
	SiO_2	0.03	0.390	-1	-16	6	34.0	31.1	49.8	0.580	-1	-16	6	966.4	100.4	398.9
	TiO_2	0.05	0.761	2	79	1	27.9	97.3	19.9	0.189	2	79	1	5,289.5	731.4	228.8

10.2.2 2M_SSD Density

The variogram models for density were initially derived from the 2M_SSD composites from May 2023. The appropriateness of these models for the current resource estimate was tested on the MTS 40 and MTC 43 domains by fitting the same models to the density predictions derived from the multiple linear regression modelling as described in Section 9.2.3. The goal here was to determine how well the existing variogram models fitted the regression data, and whether it would be similar enough to not warrant a complete update in the interests of delivering the update earlier than expected for further mine planning work. Experimental variography was performed on the regression-derived density using the same lag spacings, lag tolerance distance tolerance, and angular tolerance used for the May 2023 SSD data.

Figure 10.7. Figure 10.8, Figure 10.9, and Figure 10.10 show comparisons between the model fitted to the May 2023 SSD data, and the same model fitted to the latest regression derived data, for 12 of the 37 modelled directions.

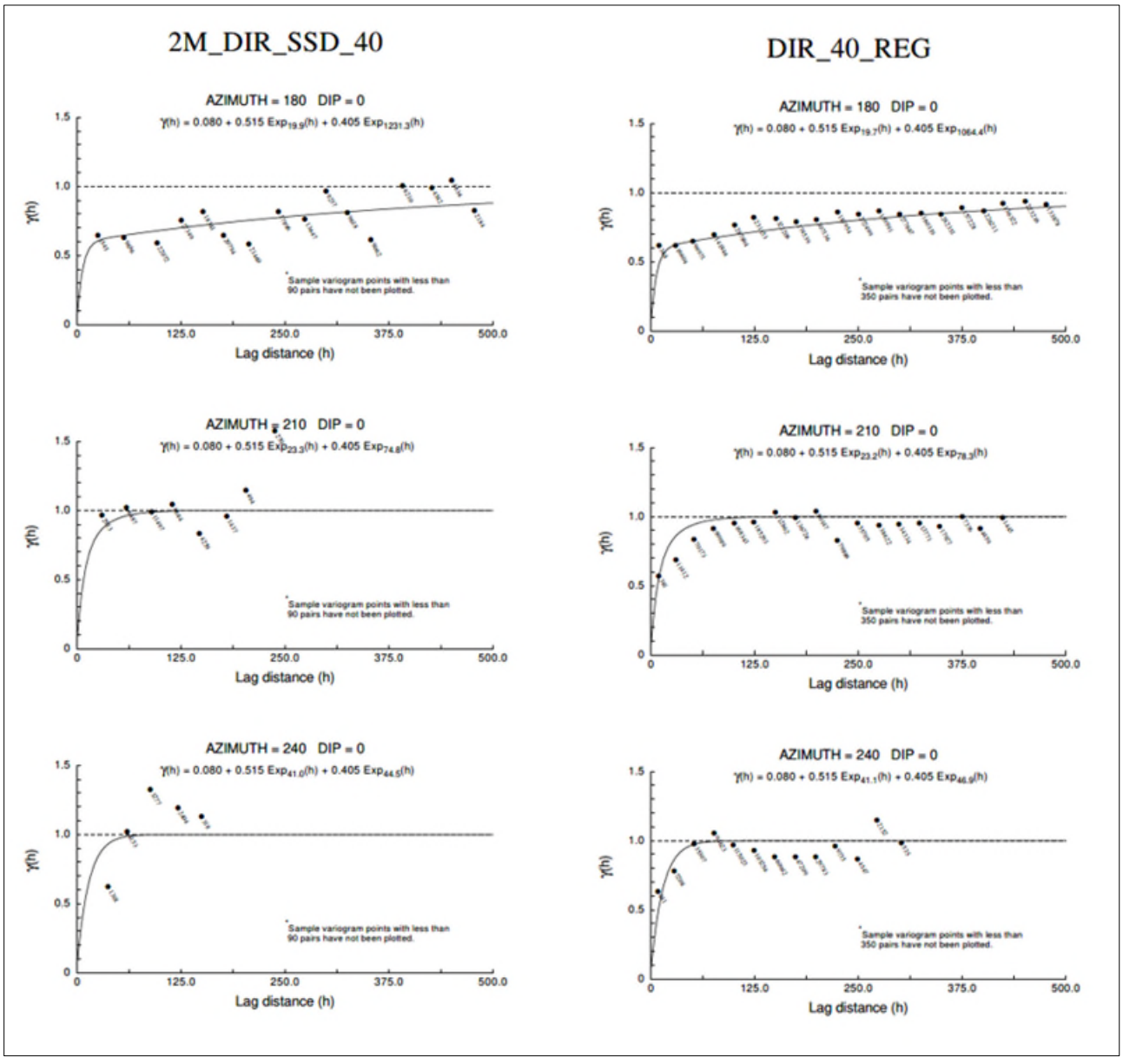


Figure 10.7 – Variogram model for MTS 40 based on May 2023 SSD data (left) fitted to experimental variograms derived from regression data (right) for azimuths 180° to 240° dipping 0°.

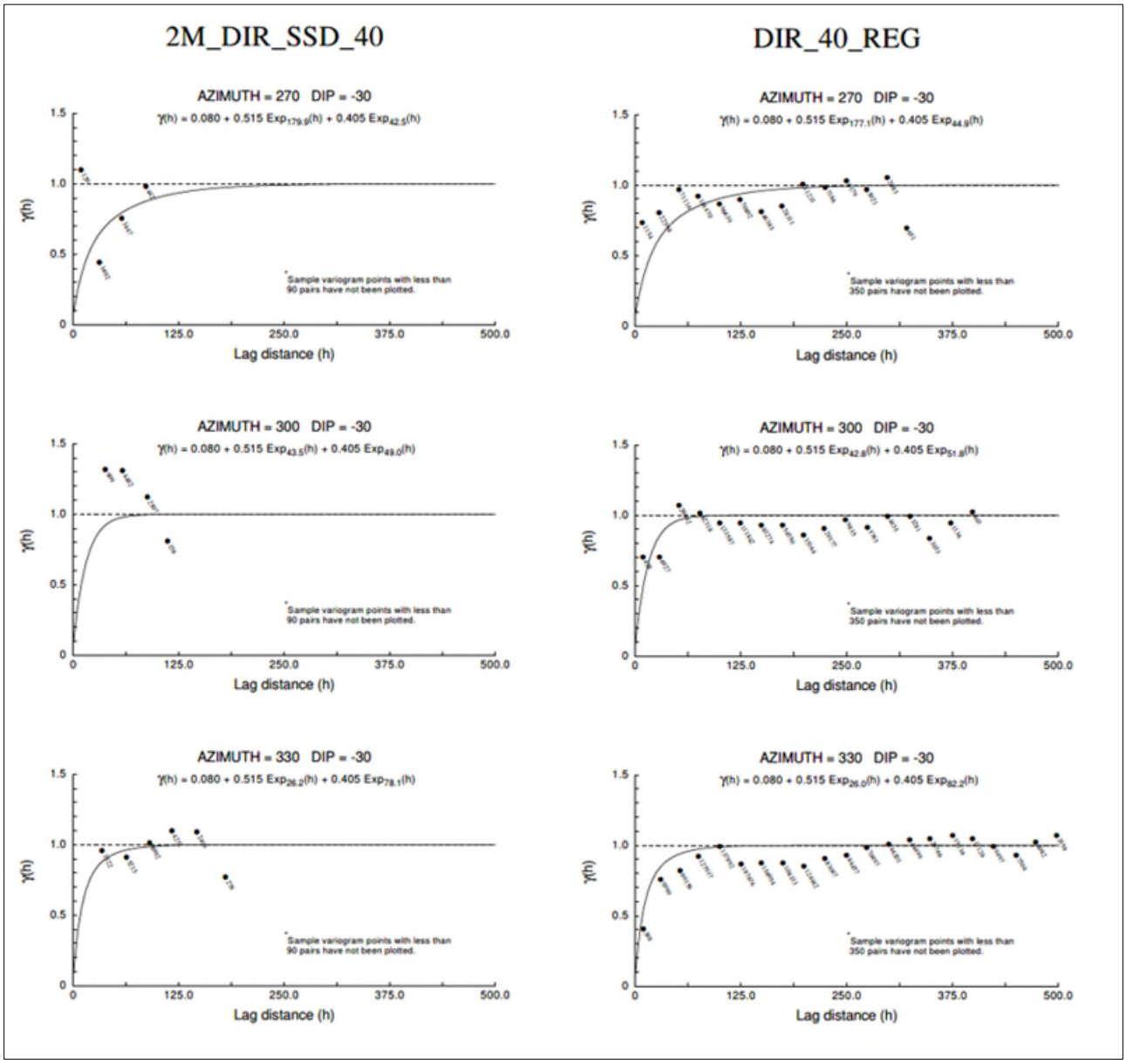


Figure 10.8 – Variogram model for MTS 40 based on May 2023 SSD data (left) fitted to experimental variograms derived from regression data (right) for azimuths 270° to 330° dipping -30°.

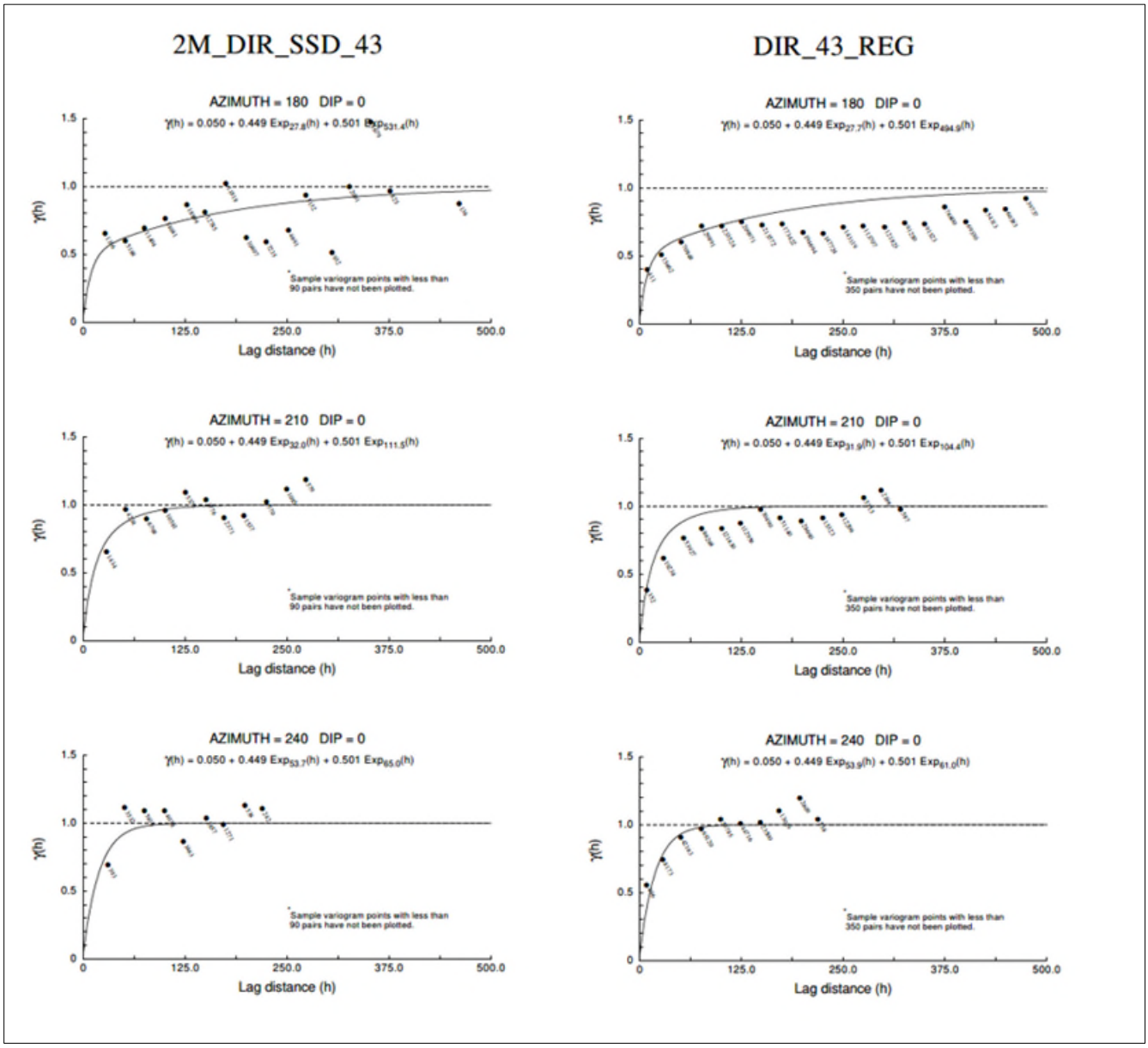


Figure 10.9 – Variogram model for MTC 43 based on May 2023 SSD data (left) fitted to experimental variograms derived from regression data (right) for azimuths 180° to 240° dipping 0°.

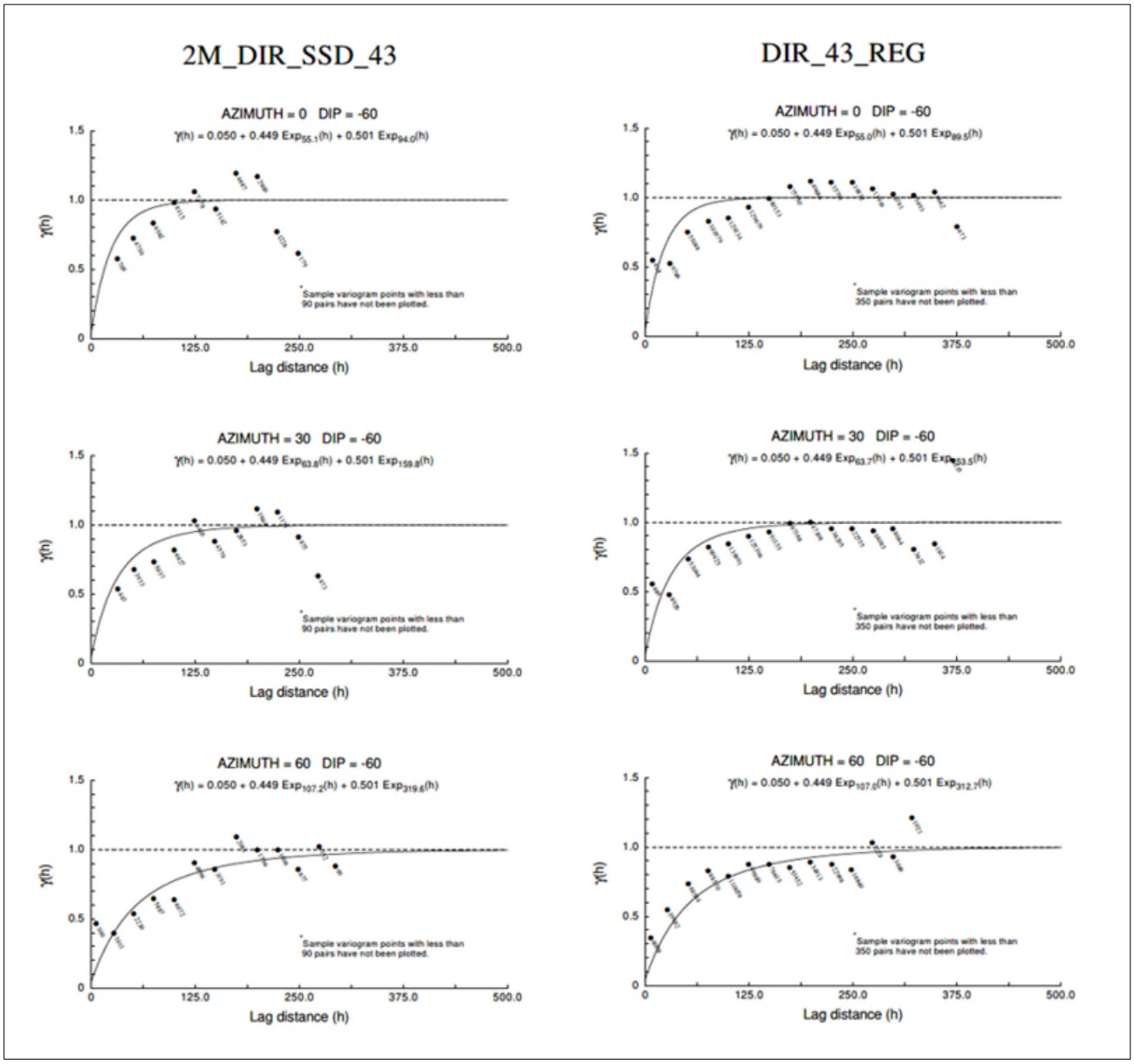


Figure 10.10 – Variogram model for MTC 43 based on May 2023 SSD data (left) fitted to experimental variograms derived from regression data (right) for azimuths 0° to 60° dipping -60°.

Based on the comparisons across all the modelled directions, it was observed that the existing variogram models matched the new regression experimental variograms well enough, especially close to the origin of the variogram. Based on the above observations and given that the bulk of the density estimates are made using samples gathered with search neighbourhoods of less than the range of the second structure, it was judged that estimation of density could proceed with the current variogram models. For completeness' sake, the variography will be updated based on regression data at the next model update.

The modelled density variograms are characterised by very low nugget effect of less than 0.3 (Figure 10.11).

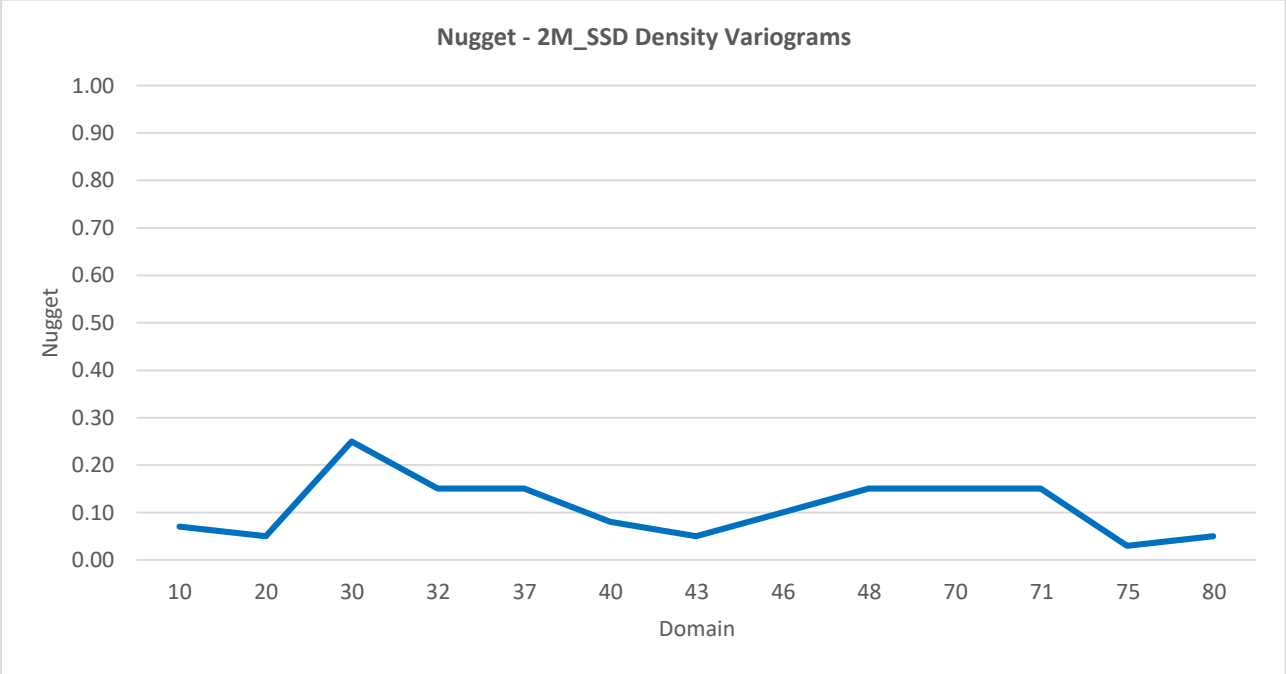


Figure 10.11 – Nugget effect for density in the 2M_SSD composites across geological domains.

Examples of down-the-hole variogram, directional variograms, and anisotropy rose diagrams for density for domain MTC 43 are shown in Figure 10.12 to Figure 10.14.

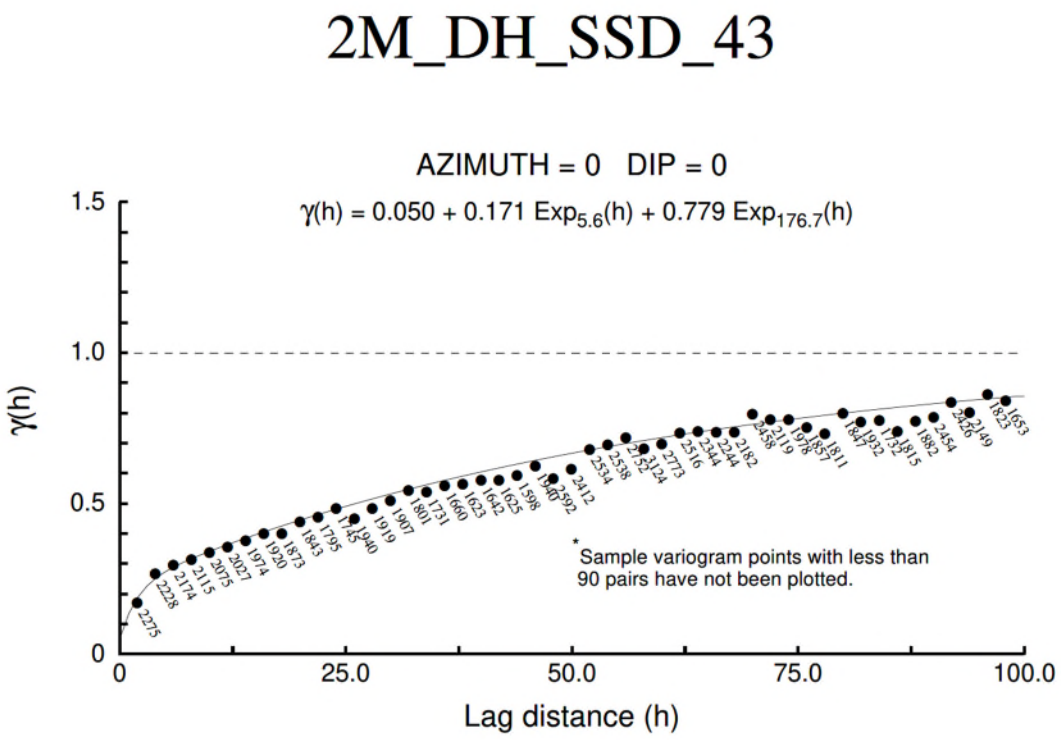


Figure 10.12 – Down-the-hole variogram for density in domain MTC 43.

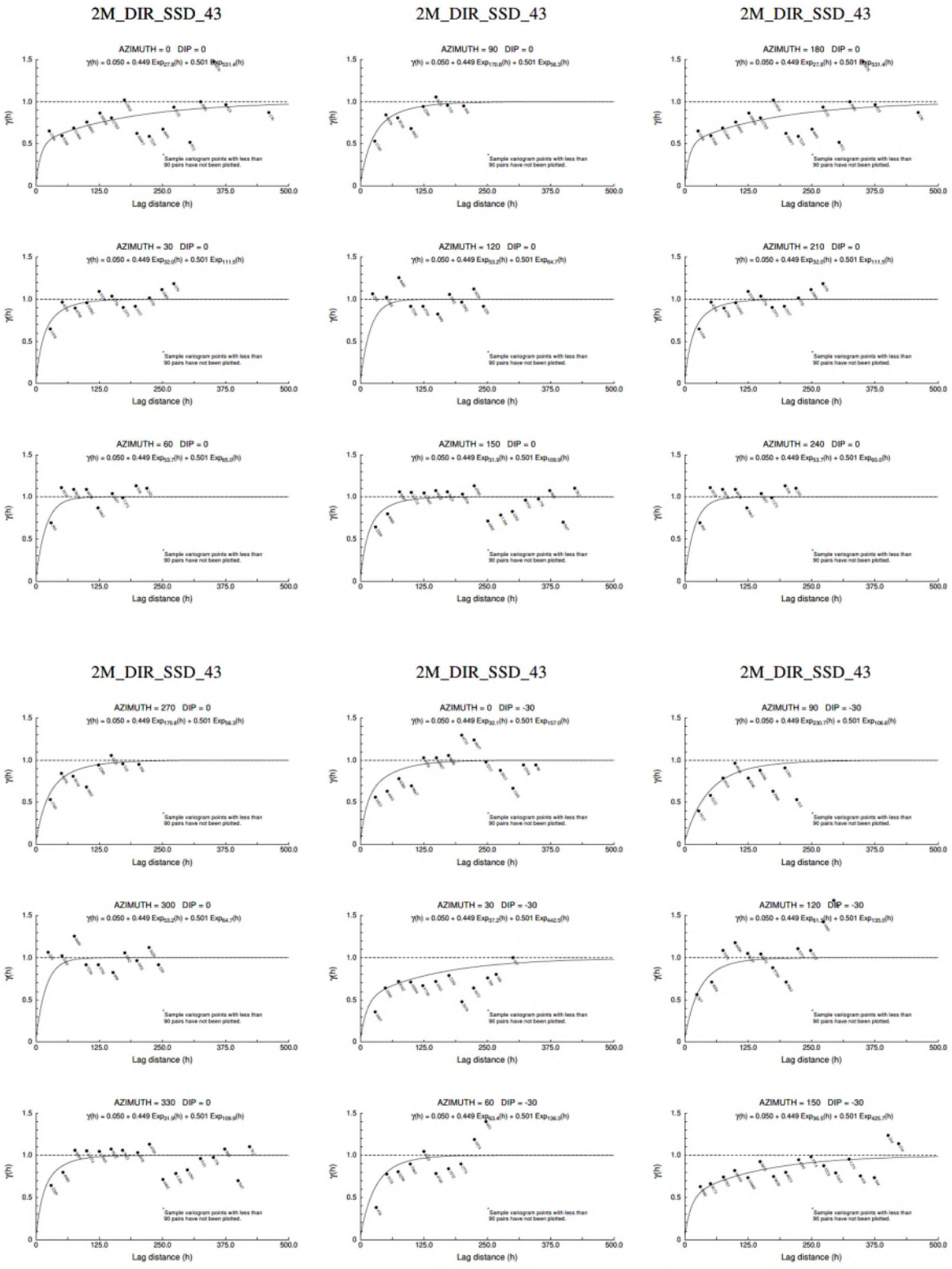


Figure 10.13 – Directional variogram for density in domain MTC 43.

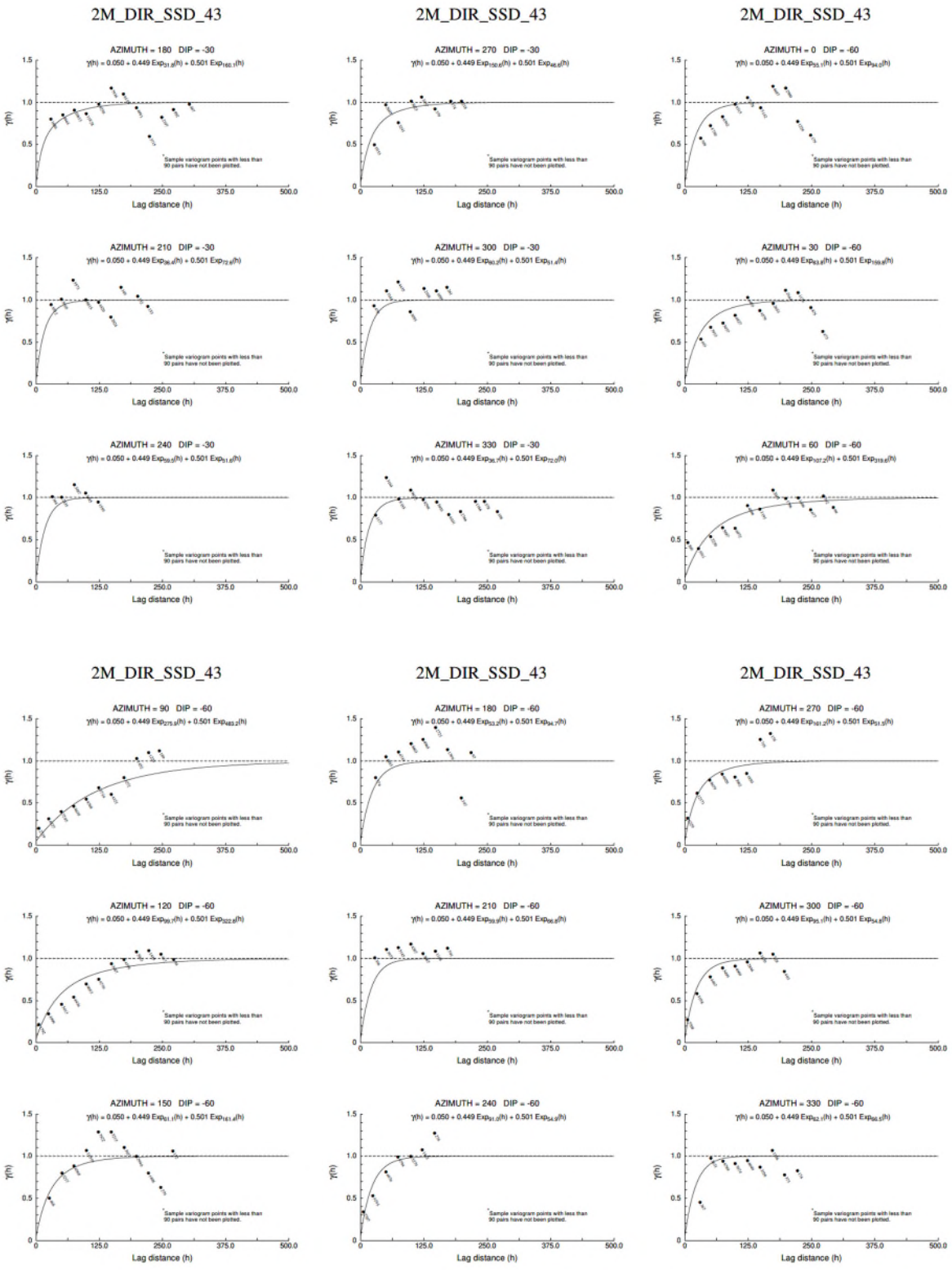


Figure 10.13 (cont.) – Directional variogram for density in domain MTC 43.

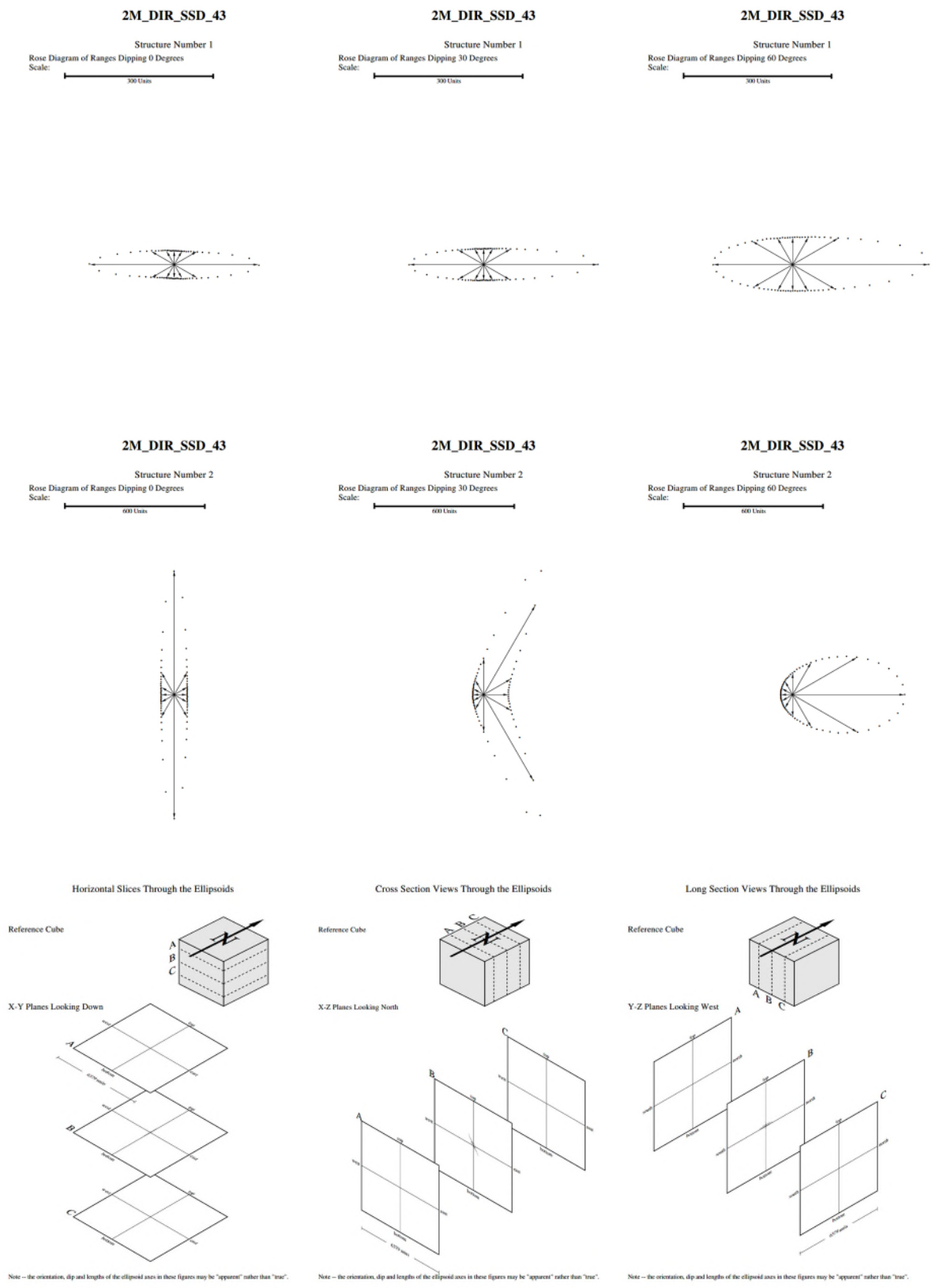


Figure 10.14 – Variogram anisotropy rose diagram for density in domain MTC 43.

Variogram parameters used for density estimates are shown in Table 10.2. Variogram models and anisotropy rose diagrams for density in all domains are in Appendix 4.

Table 10.2 - Variogram model parameters for density estimates. All models are exponential with practical range.

Element	Domain	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
Density	AMP 10	0.07	0.137	-15	-9	-10	24.9	72.9	193.2	0.793	-15	-9	-10	1,672.8	132.0	355.7
	BIF 20	0.05	0.103	2	-2	-39	290.8	82.6	35.6	0.847	2	-2	-39	615.8	39.2	95.6
	HEO 30	0.25	0.632	10	11	27	250.0	24.9	31.9	0.118	10	11	27	120.5	62.7	999.7
	HEC 32	0.15	0.418	98	-50	58	27.1	152.8	214.8	0.432	98	-50	58	2,128.2	432.6	52.2
	HBF 37	0.15	0.418	98	-50	58	27.1	152.8	214.8	0.432	98	-50	58	2,128.2	432.6	52.2
	MTS 40	0.08	0.515	-2	1	3	19.7	178.3	189.6	0.405	-2	1	3	2,567.7	41.4	79.1
	MTC 43	0.05	0.449	89	-56	89	283.3	163.8	27.7	0.501	89	-56	89	732.7	43.8	495.2
	SCH 46	0.10	0.537	0	0	0	86.2	86.2	86.2	0.363	0	0	0	86.1	86.1	86.1
	MSU 48	0.15	0.688	27	-4	145	55.2	1.8	21.0	0.162	27	-4	145	37.0	29.9	462.3
	BSQ 70	0.15	0.688	27	-4	145	55.2	1.8	21.0	0.162	27	-4	145	37.0	29.9	462.3
	DOM 71	0.15	0.688	27	-4	145	55.2	1.8	21.0	0.162	27	-4	145	37.0	29.9	462.3
	ESZ 75	0.03	0.647	30	-19	8	16.7	352.9	797.0	0.323	30	-19	8	203.3	181.6	1,378.9
	CGS 80	0.05	0.400	0	0	0	30.6	30.6	30.6	0.550	0	0	0	200.0	200.0	200.0

* BSQ 70 and DOM 71 share the variogram model parameters of geologically similar MSU 48 as these domains have too few samples for robust variography,

* MBF 47 and GRT 90 – too few samples for robust variography.

10.2.3 4M_C and 8M_C Concentrate Assay

Variography for concentrate assays was performed using a combination of the 4M_C and 8M_C composites using data from the May 2023 resource update. The concentrate grade variograms are not a true reflection of the geological character of the deposit domains as these samples represent the magnetic fraction of the domains in which there is concentration of some elements, for example Fe in magnetite, or diffusion of others, for example SiO_2 in silicate minerals. As such these variograms can be considered pseudo-spatial geological/metallurgical variograms. The variograms tend to be poorer quality variograms compared to those for head assays, due to less pairs, and the reasons described above.

The variograms for these composites are characterised by low to moderate nugget effect ranging between 0.01 and 0.50 depending on which element and domain is considered (Figure 10.15 and Figure 10.16).

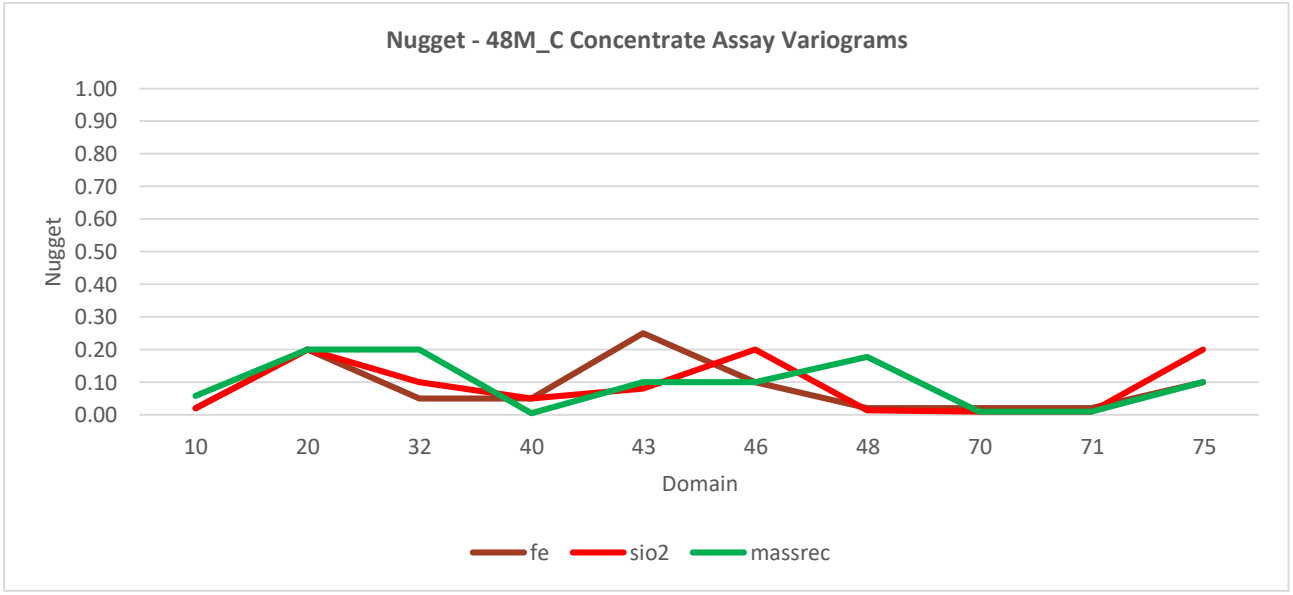


Figure 10.15 – Nugget effect for mass recovery and concentrate Fe and SiO_2 grades in combined 48M_C composites.

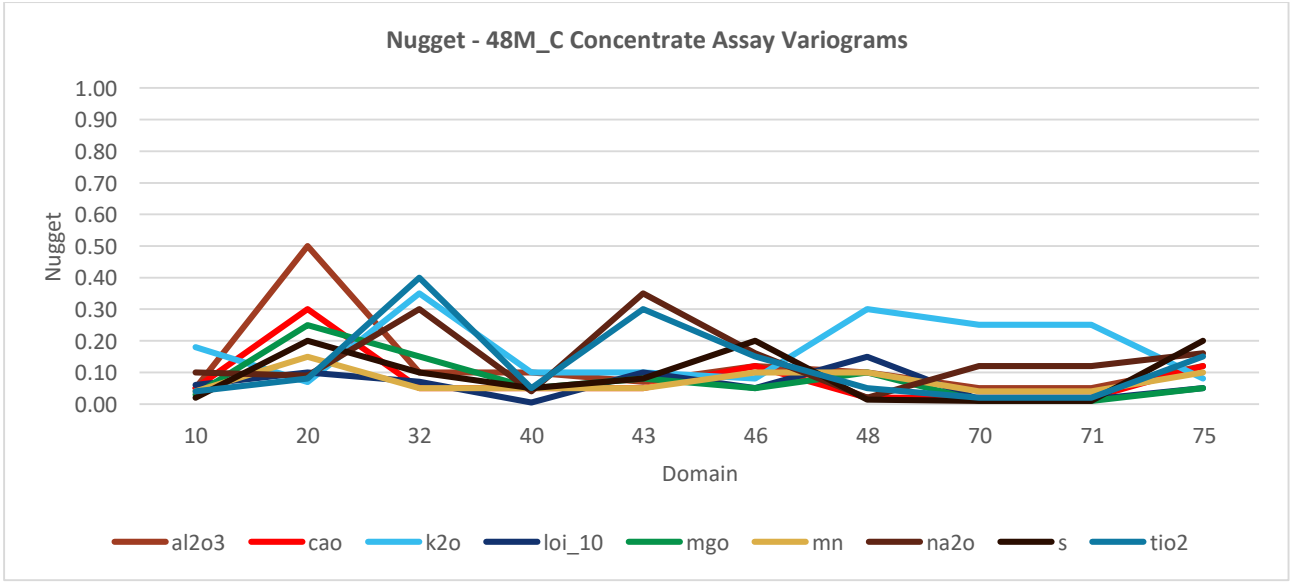


Figure 10.16 – Nugget effect for remaining concentrate grades in combined 48M_C composites.

Examples of down-the-hole variograms for mass recovery and Fe and SiO_2 concentrate grades in domain MTS 40 are shown in Figure 10.17. Directional variograms, and anisotropy rose diagrams for mass recovery for domain MTS 40 are shown in Figure 10.18 and Figure 10.19.

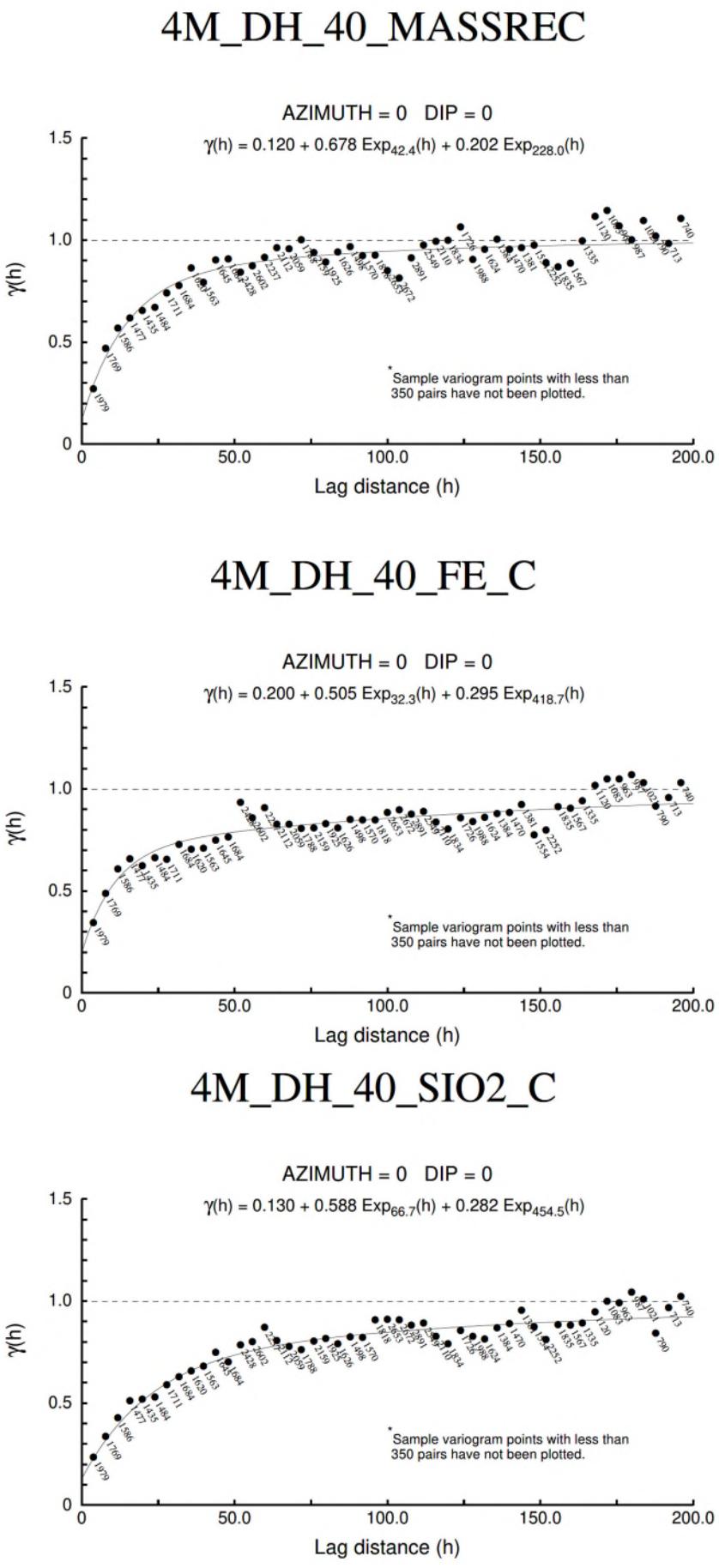


Figure 10.17 – Down-the-hole variograms for mass recovery and concentrate Fe and SiO_2 in domain MTS 40.

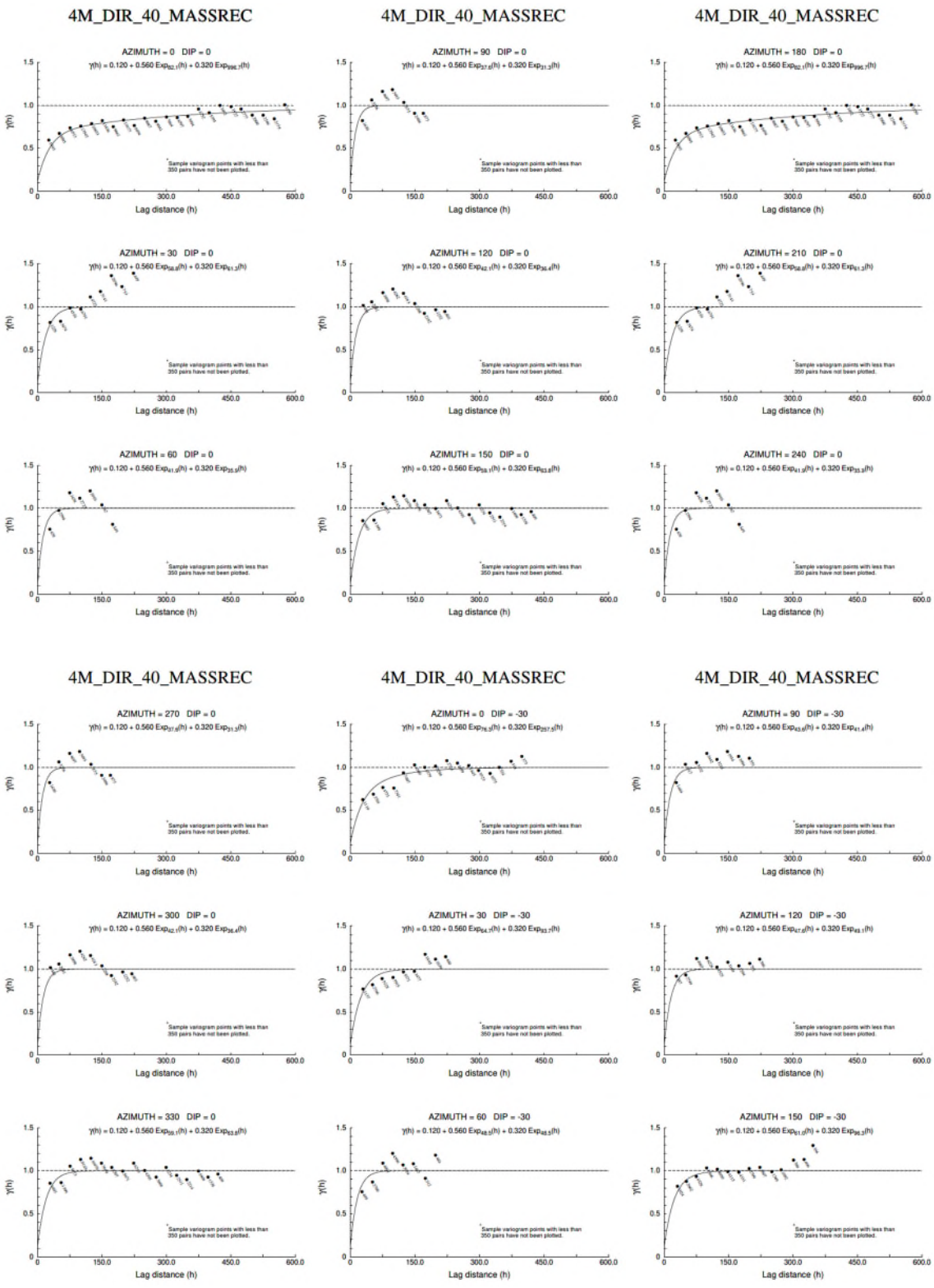


Figure 10.18 – Directional variograms for mass recovery in domain MTS 40.

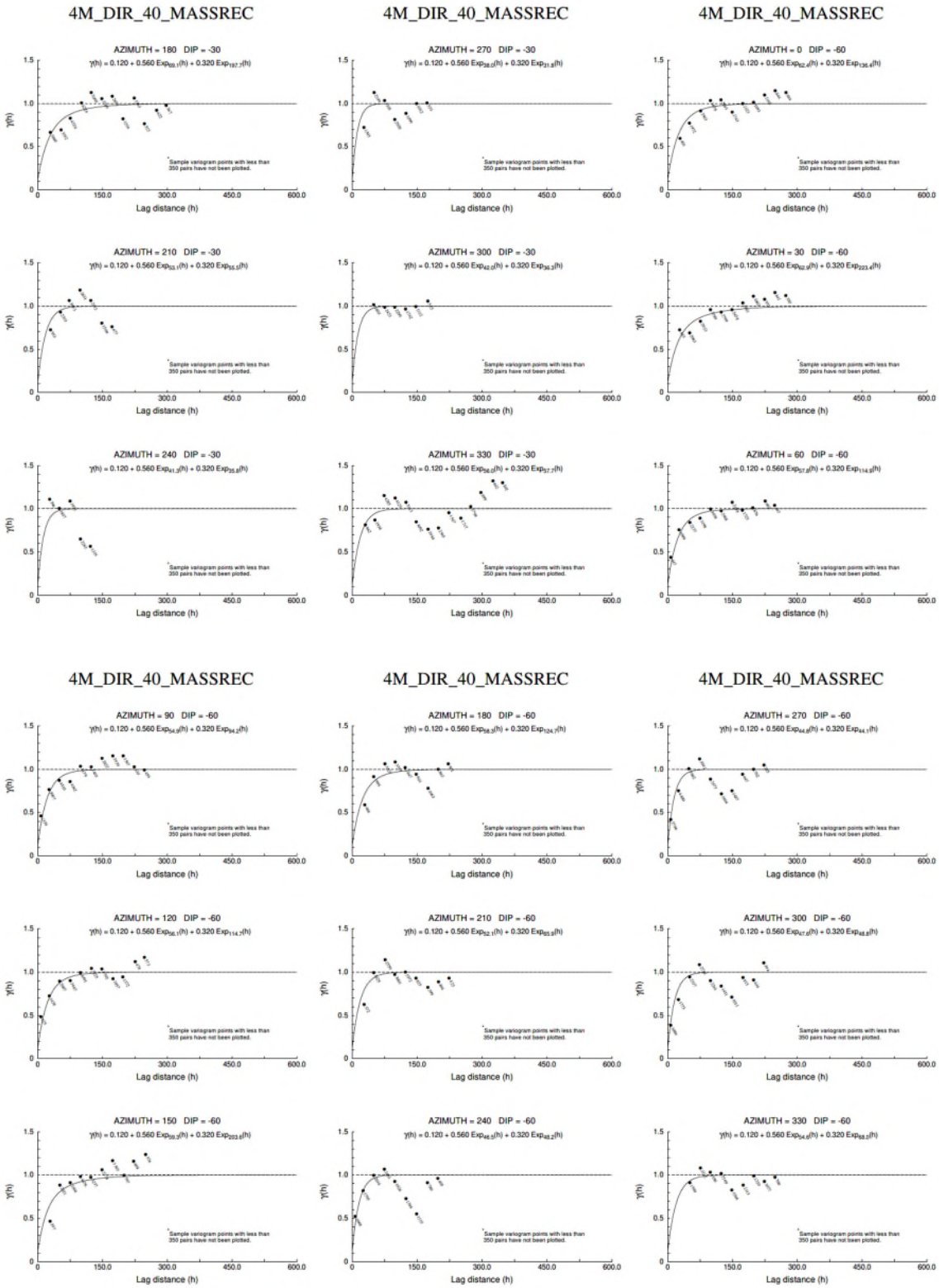


Figure 10.18 (cont.) – Directional variograms for mass recovery in domain MTS 40.

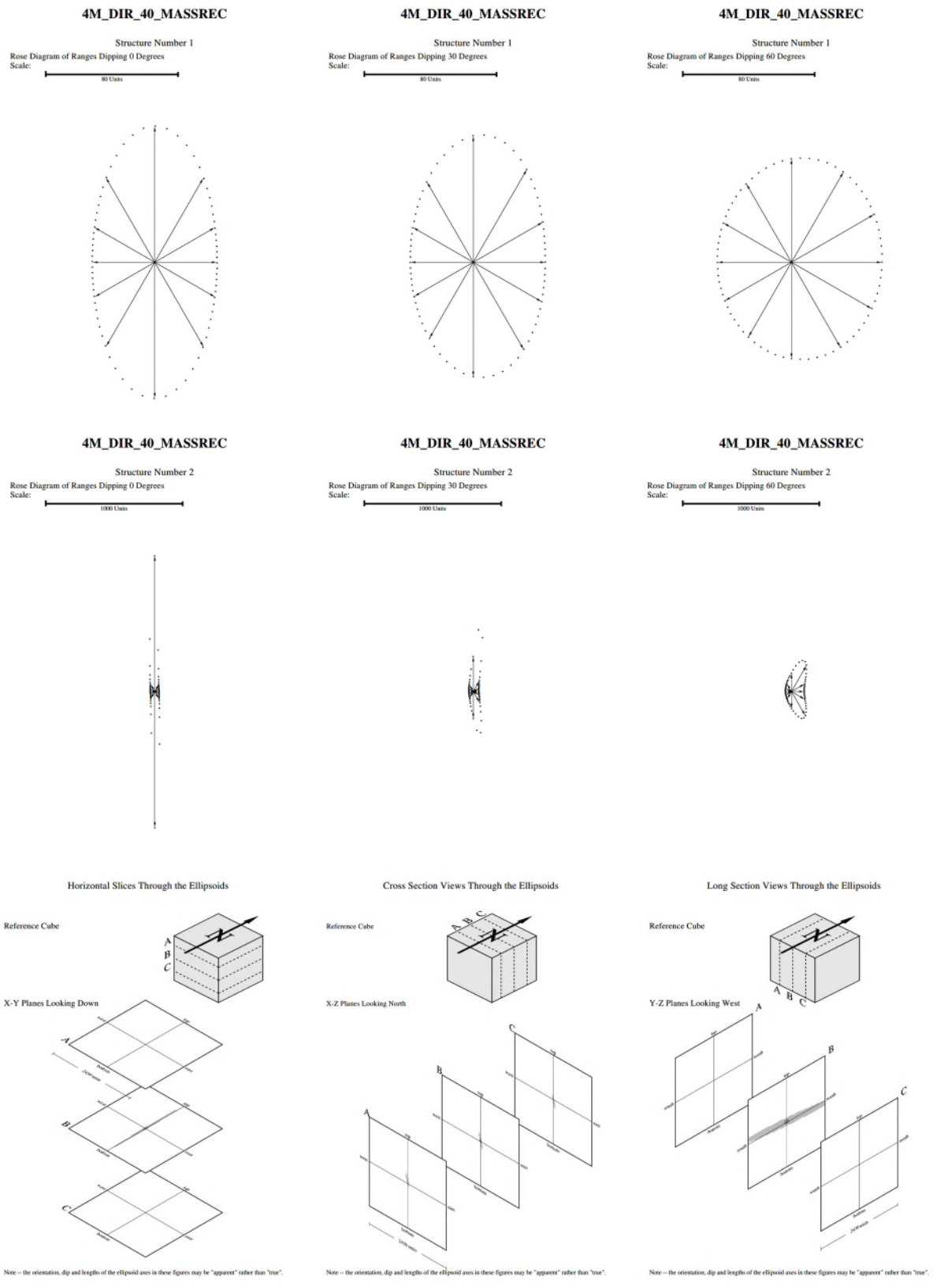


Figure 10.19 – Variogram anisotropy rose diagram for mass recovery in domain MTS 40.

Variogram parameters used for mass recovery and concentrate estimates are shown in Table 10.3. Variogram models and anisotropy rose diagrams for mass recovery and concentrate grades in all domains are in Appendix 5.

Table 10.3 – Variogram model parameters for major concentrate assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
AMP 10	Al_2O_3	0.05	0.455	9	57	-2	48.2	60.8	6.2	0.495	-22	13	58	219.2	129.6	505.1
	CaO	0.05	0.493	5	-11	-19	19.6	245.5	45.3	0.457	5	-11	-19	234.9	364.7	77.9
	Fe	0.02	0.457	51	-1	-1	65.6	38.9	35.2	0.523	51	-1	-1	63.1	53.4	692.7
	K_2O	0.18	0.129	9	31	-43	27.3	16.3	43.1	0.691	9	31	-43	198.6	24.6	35.2
	LOI_10	0.06	0.512	-6	0	22	17.9	276.7	36.8	0.428	-6	0	22	184.1	123.4	900.0
	MASSREC	0.06	0.575	-28	2	1	21.4	32.8	116.4	0.368	-28	2	1	392.1	17.8	172.8
	MgO	0.03	0.813	19	25	3	23.9	41.7	111.8	0.157	19	25	3	899.4	233.4	103.8
	Mn	0.04	0.294	-72	1	-42	88.3	92.1	15.7	0.666	-72	1	-42	182.4	65.7	518.6
	Na_2O	0.10	0.483	38	30	39	109.9	42.5	4.4	0.417	38	30	39	172.4	20.2	586.0
	S	0.02	0.329	-8	-7	-4	58.7	48.9	89.7	0.651	-8	-7	-4	144.5	68.6	335.8
	SiO_2	0.02	0.329	-8	-7	-4	58.7	48.9	89.7	0.651	-8	-7	-4	144.5	68.6	335.8
	TiO_2	0.04	0.657	4	58	-4	18.6	33.7	29.5	0.303	4	58	-4	900.0	158.3	408.6
BIF 20	Al_2O_3	0.50	0.450	0	0	0	22.3	22.3	22.3	0.050	0	0	0	900.0	900.0	900.0
	CaO	0.30	0.000	0	0	0	50.0	50.0	50.0	0.700	0	0	0	29.7	29.7	29.7
	Fe	0.20	0.508	0	0	0	26.9	26.9	26.9	0.292	0	0	0	900.0	900.0	900.0
	K_2O	0.07	0.761	0	0	0	19.1	19.1	19.1	0.169	0	0	0	349.5	349.5	349.5
	LOI_10	0.10	0.000	0	0	0	40.0	40.0	40.0	0.900	0	0	0	32.3	32.3	32.3
	MASSREC	0.20	0.623	0	0	0	17.1	17.1	17.1	0.177	0	0	0	900.0	900.0	900.0
	MgO	0.25	0.241	0	0	0	25.0	25.0	25.0	0.509	0	0	0	465.5	465.5	465.5
	Mn	0.15	0.502	0	0	0	33.3	33.3	33.3	0.348	0	0	0	900.0	900.0	900.0
	Na_2O	0.09	0.679	8	4	0	10.0	19.0	38.5	0.231	8	4	0	391.0	103.1	513.9
	S	0.20	0.553	0	0	0	35.0	35.0	35.0	0.247	0	0	0	900.0	900.0	900.0
	SiO_2	0.20	0.553	0	0	0	35.0	35.0	35.0	0.247	0	0	0	900.0	900.0	900.0
	TiO_2	0.08	0.241	-6	0	-5	60.1	18.5	165.9	0.679	-6	0	-5	835.6	442.2	128.2

Table 10.3 (cont.) – Variogram model parameters for major concentrate assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
HEC 32	Al_2O_3	0.10	0.509	0	0	0	15.3	15.3	15.3	0.391	0	0	0	140.6	140.6	140.6
	CaO	0.05	0.494	0	0	0	16.8	16.8	16.8	0.456	0	0	0	110.6	110.6	110.6
	Fe	0.05	0.651	0	0	0	47.0	47.0	47.0	0.299	0	0	0	47.2	47.2	47.2
	K_2O	0.35	0.611	0	0	0	70.0	70.0	70.0	0.039	0	0	0	900.0	900.0	900.0
	LOI_10	0.07	0.136	0	0	0	7.4	7.4	7.4	0.794	0	0	0	124.6	124.6	124.6
	MASSREC	0.20	0.436	0	0	0	19.3	19.3	19.3	0.364	0	0	0	324.3	324.3	324.3
	MgO	0.15	0.577	0	0	0	28.1	28.1	28.1	0.273	0	0	0	113.2	113.2	113.2
	Mn	0.05	0.876	0	0	0	35.1	35.1	35.1	0.074	0	0	0	264.6	264.6	264.6
	Na_2O	0.30	0.391	0	0	0	26.8	26.8	26.8	0.309	0	0	0	102.7	102.7	102.7
	S	0.10	0.611	0	0	0	9.7	9.7	9.7	0.289	0	0	0	101.1	101.1	101.1
	SiO_2	0.10	0.611	0	0	0	9.7	9.7	9.7	0.289	0	0	0	101.1	101.1	101.1
	TiO_2	0.40	0.566	0	0	0	23.1	23.1	23.1	0.034	0	0	0	467.7	467.7	467.7
MTS 40	Al_2O_3	0.10	0.757	-54	37	-32	38.5	21.6	14.4	0.143	-54	37	-32	900.0	900.0	258.3
	CaO	0.05	0.617	-15	91	1	117.7	70.2	128.7	0.333	-15	91	1	900.0	275.0	132.8
	Fe	0.05	0.160	-21	16	-6	107.5	36.0	100.6	0.790	-21	16	-6	900.0	452.2	370.1
	K_2O	0.10	0.836	1	21	-60	37.7	61.0	12.8	0.064	1	21	-60	569.1	44.3	224.5
	LOI_10	0.01	0.107	-21	-30	1	104.1	170.9	65.0	0.888	-21	-30	1	900.0	423.1	518.0
	MASSREC	0.01	0.787	-9	-5	-8	108.1	35.4	54.6	0.208	-9	-5	-8	900.0	144.6	191.2
	MgO	0.05	0.053	-19	-13	-1	423.4	245.7	228.3	0.897	-19	-13	-1	900.0	449.6	642.7
	Mn	0.05	0.183	-18	22	11	188.9	120.8	149.3	0.767	-18	22	11	900.0	194.4	385.9
	Na_2O	0.04	0.846	-16	-24	6	41.5	25.9	139.8	0.114	-16	-24	6	486.8	165.2	648.8
	S	0.05	0.412	-14	75	-9	135.9	155.6	39.0	0.538	-14	75	-9	900.0	282.7	583.6
	SiO_2	0.05	0.412	-14	75	-9	135.9	155.6	39.0	0.538	-14	75	-9	900.0	282.7	583.6
	TiO_2	0.05	0.864	-2	-1	-26	14.2	9.5	24.7	0.086	-2	-1	-26	344.1	57.6	118.1

Table 10.3 (cont.) – Variogram model parameters for major concentrate assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
HEC 32	Al_2O_3	0.07	0.764	1	35	5	19.5	28.3	19.3	0.166	1	35	5	900.0	437.4	223.4
	CaO	0.05	0.599	-8	47	2	117.8	62.0	24.8	0.351	-8	47	2	900.0	137.4	395.8
	Fe	0.25	0.496	10	74	-11	33.4	104.0	23.4	0.254	10	74	-11	900.0	123.9	147.3
	K_2O	0.10	0.717	105	180	-26	9.3	27.1	25.8	0.183	105	180	-26	116.7	22.7	776.7
	LOI_10	0.10	0.881	-80	84	15	16.4	46.0	14.7	0.019	-80	84	15	621.3	75.8	900.0
	MASSREC	0.10	0.669	20	41	-33	107.5	48.2	48.4	0.231	20	41	-33	900.0	49.0	837.7
	MgO	0.08	0.870	-18	79	1	16.9	73.4	27.2	0.050	-18	79	1	412.6	94.2	454.3
	Mn	0.05	0.632	-3	33	9	60.1	44.8	38.0	0.318	-3	33	9	859.7	119.6	231.0
	Na_2O	0.35	0.504	6	4	2	27.2	26.7	154.3	0.146	6	4	2	87.3	789.8	723.0
	S	0.08	0.521	4	36	-6	131.9	71.4	76.3	0.399	4	36	-6	900.0	104.1	148.9
	SiO_2	0.08	0.521	4	36	-6	131.9	71.4	76.3	0.399	4	36	-6	900.0	104.1	148.9
	TiO_2	0.30	0.475	-13	110	-3	117.0	7.8	7.2	0.225	-13	110	-3	461.5	92.0	178.1
MTS 40	Al_2O_3	0.12	0.582	-58	67	76	33.4	58.9	5.8	0.298	-58	67	76	608.3	66.2	574.8
	CaO	0.12	0.760	13	4	-32	61.3	14.7	39.4	0.120	13	4	-32	965.5	143.3	310.3
	Fe	0.10	0.782	-1	-1	-2	86.2	16.1	34.5	0.118	-1	-1	-2	4,901.0	151.6	617.4
	K_2O	0.08	0.684	17	25	-32	119.6	27.4	9.3	0.236	17	25	-32	402.2	93.4	454.9
	LOI_10	0.05	0.367	-29	76	-6	21.9	72.5	11.9	0.583	-29	76	-6	343.2	370.1	486.2
	MASSREC	0.10	0.782	-1	-1	-2	86.2	16.1	34.5	0.118	-1	-1	-2	4,901.0	151.6	617.4
	MgO	0.05	0.096	-103	17	41	79.3	181.8	14.4	0.854	-103	17	41	741.6	355.0	165.9
	Mn	0.10	0.759	-73	4	-57	81.4	86.2	3.2	0.141	-73	4	-57	339.9	1,218.8	428.2
	Na_2O	0.16	0.519	14	17	-2	91.6	7.9	20.1	0.321	14	17	-2	272.4	95.9	1,193.6
	S	0.20	0.478	11	60	0	192.3	49.2	37.7	0.322	11	60	0	367.6	99.0	750.7
	SiO_2	0.20	0.478	11	60	0	192.3	49.2	37.7	0.322	11	60	0	367.6	99.0	750.7
	TiO_2	0.15	0.599	15	17	-29	85.0	18.0	11.7	0.251	15	17	-29	597.8	82.8	801.0

Table 10.3 (cont.) – Variogram model parameters for major concentrate assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
SCH 46	Al_2O_3	0.10	0.663	-27	4	14	31.1	20.2	13.1	0.237	-27	4	14	365.7	50.6	148.6
	CaO	0.02	0.674	25	46	-14	38.8	52.2	31.1	0.306	25	46	-14	564.2	93.6	216.0
	Fe	0.02	0.408	-1	0	19	128.9	8.5	28.1	0.572	-1	0	19	171.3	147.3	900.0
	K_2O	0.30	0.654	102	-1	-1	49.7	42.1	157.8	0.046	102	-1	-1	174.1	36.4	247.8
	LOI_10	0.15	0.441	-25	-17	-16	26.6	46.9	38.4	0.409	-25	-17	-16	550.2	49.2	185.8
	MASSREC	0.18	0.667	-49	49	73	40.1	24.0	44.9	0.155	-49	49	73	399.9	25.5	136.3
	MgO	0.10	0.385	-89	33	-69	13.5	47.2	11.9	0.515	-89	33	-69	489.0	46.0	28.4
	Mn	0.10	0.384	2	-22	24	38.7	76.6	79.4	0.516	2	-22	24	295.4	82.2	152.4
	Na_2O	0.02	0.749	60	-9	-13	31.3	33.1	326.3	0.231	60	-9	-13	208.3	23.5	288.8
	S	0.01	0.382	-14	11	23	28.8	19.7	7.0	0.604	-14	11	23	470.7	177.9	900.0
	SiO_2	0.01	0.382	-14	11	23	28.8	19.7	7.0	0.604	-14	11	23	470.7	177.9	900.0
	TiO_2	0.05	0.759	-39	24	46	34.9	11.2	11.0	0.191	-39	24	46	147.2	20.2	223.1
MSU 48	Al_2O_3	0.05	0.355	8	-6	1	45.7	19.9	2.6	0.595	8	-6	1	105.5	82.0	900.0
	CaO	0.02	0.388	-54	9	-8	37.6	219.3	18.6	0.592	-54	9	-8	60.3	179.4	900.0
	Fe	0.02	0.589	2	66	4	180.3	28.7	3.6	0.391	2	66	4	128.1	900.0	900.0
	K_2O	0.25	0.557	18	-40	-68	265.5	436.4	4.9	0.193	18	-40	-68	900.0	580.6	87.6
	LOI_10	0.02	0.596	3	-11	0	17.3	14.6	162.8	0.389	3	-11	0	900.0	295.0	900.0
	MASSREC	0.01	0.155	3	-6	6	25.8	29.0	70.4	0.835	3	-6	6	599.7	18.1	314.0
	MgO	0.01	0.747	-73	2	-65	41.9	229.1	4.1	0.243	-73	2	-65	600.1	44.4	900.0
	Mn	0.04	0.258	11	69	-3	133.3	12.0	32.0	0.702	11	69	-3	438.9	440.8	35.6
	Na_2O	0.12	0.275	-86	1	27	13.2	68.2	472.4	0.605	-86	1	27	900.0	49.5	900.0
	S	0.01	0.576	24	-8	1	143.4	43.1	12.9	0.414	24	-8	1	900.0	187.6	900.0
	SiO_2	0.01	0.576	24	-8	1	143.4	43.1	12.9	0.414	24	-8	1	900.0	187.6	900.0
	TiO_2	0.02	0.581	8	-63	-7	16.4	113.3	3.3	0.399	8	-63	-7	56.6	814.0	780.9

Table 10.3 (cont.) – Variogram model parameters for major concentrate assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
BSQ 70	Al_2O_3	0.05	0.355	8	-6	1	45.7	19.9	2.6	0.595	8	-6	1	105.5	82.0	900.0
	CaO	0.02	0.388	-54	9	-8	37.6	219.3	18.6	0.592	-54	9	-8	60.3	179.4	900.0
	Fe	0.02	0.589	2	66	4	180.3	28.7	3.6	0.391	2	66	4	128.1	900.0	900.0
	K_2O	0.25	0.557	18	-40	-68	265.5	436.4	4.9	0.193	18	-40	-68	900.0	580.6	87.6
	LOI_10	0.02	0.596	3	-11	0	17.3	14.6	162.8	0.389	3	-11	0	900.0	295.0	900.0
	MASSREC	0.01	0.155	3	-6	6	25.8	29.0	70.4	0.835	3	-6	6	599.7	18.1	314.0
	MgO	0.01	0.747	-73	2	-65	41.9	229.1	4.1	0.243	-73	2	-65	600.1	44.4	900.0
	Mn	0.04	0.258	11	69	-3	133.3	12.0	32.0	0.702	11	69	-3	438.9	440.8	35.6
	Na_2O	0.12	0.275	-86	1	27	13.2	68.2	472.4	0.605	-86	1	27	900.0	49.5	900.0
	S	0.01	0.576	24	-8	1	143.4	43.1	12.9	0.414	24	-8	1	900.0	187.6	900.0
	SiO_2	0.01	0.576	24	-8	1	143.4	43.1	12.9	0.414	24	-8	1	900.0	187.6	900.0
	TiO_2	0.02	0.581	8	-63	-7	16.4	113.3	3.3	0.399	8	-63	-7	56.6	814.0	780.9
DOM 71	Al_2O_3	0.05	0.355	8	-6	1	45.7	19.9	2.6	0.595	8	-6	1	105.5	82.0	900.0
	CaO	0.02	0.388	-54	9	-8	37.6	219.3	18.6	0.592	-54	9	-8	60.3	179.4	900.0
	Fe	0.02	0.589	2	66	4	180.3	28.7	3.6	0.391	2	66	4	128.1	900.0	900.0
	K_2O	0.25	0.557	18	-40	-68	265.5	436.4	4.9	0.193	18	-40	-68	900.0	580.6	87.6
	LOI_10	0.02	0.596	3	-11	0	17.3	14.6	162.8	0.389	3	-11	0	900.0	295.0	900.0
	MASSREC	0.01	0.155	3	-6	6	25.8	29.0	70.4	0.835	3	-6	6	599.7	18.1	314.0
	MgO	0.01	0.747	-73	2	-65	41.9	229.1	4.1	0.243	-73	2	-65	600.1	44.4	900.0
	Mn	0.04	0.258	11	69	-3	133.3	12.0	32.0	0.702	11	69	-3	438.9	440.8	35.6
	Na_2O	0.12	0.275	-86	1	27	13.2	68.2	472.4	0.605	-86	1	27	900.0	49.5	900.0
	S	0.01	0.576	24	-8	1	143.4	43.1	12.9	0.414	24	-8	1	900.0	187.6	900.0
	SiO_2	0.01	0.576	24	-8	1	143.4	43.1	12.9	0.414	24	-8	1	900.0	187.6	900.0
	TiO_2	0.02	0.581	8	-63	-7	16.4	113.3	3.3	0.399	8	-63	-7	56.6	814.0	780.9

Table 10.3 (cont.) – Variogram model parameters for major concentrate assay estimates. All models are exponential with practical range.

Domain	Element	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
ESZ 75	Al_2O_3	0.12	0.582	-58	67	76	33.4	58.9	5.8	0.298	-58	67	76	608.3	66.2	574.8
	CaO	0.12	0.760	13	4	-32	61.3	14.7	39.4	0.120	13	4	-32	965.5	143.3	310.3
	Fe	0.10	0.782	-1	-1	-2	86.2	16.1	34.5	0.118	-1	-1	-2	4,901.0	151.6	617.4
	K_2O	0.08	0.684	17	25	-32	119.6	27.4	9.3	0.236	17	25	-32	402.2	93.4	454.9
	LOI_10	0.05	0.367	-29	76	-6	21.9	72.5	11.9	0.583	-29	76	-6	343.2	370.1	486.2
	MASSREC	0.10	0.782	-1	-1	-2	86.2	16.1	34.5	0.118	-1	-1	-2	4,901.0	151.6	617.4
	MgO	0.05	0.096	-103	17	41	79.3	181.8	14.4	0.854	-103	17	41	741.6	355.0	165.9
	Mn	0.10	0.759	-73	4	-57	81.4	86.2	3.2	0.141	-73	4	-57	339.9	1,218.8	428.2
	Na_2O	0.16	0.519	14	17	-2	91.6	7.9	20.1	0.321	14	17	-2	272.4	95.9	1,193.6
	S	0.20	0.478	11	60	0	192.3	49.2	37.7	0.322	11	60	0	367.6	99.0	750.7
	SiO_2	0.20	0.478	11	60	0	192.3	49.2	37.7	0.322	11	60	0	367.6	99.0	750.7
	TiO_2	0.15	0.599	15	17	-29	85.0	18.0	11.7	0.251	15	17	-29	597.8	82.8	801.0

* BSQ 70 and DOM 71 share the variogram model parameters of geologically similar MSU 48 as these domains have too few samples for robust variography,

10.3 Block Model

The block model was created as per the parameters in Table 10.4, the extents of which were chosen to accommodate the area drilled, the resulting geological interpretation, and a Whittle pit shell for eventual use in reporting the estimates. A parent block size of 20 x 25 x 4m was chosen based on the drill spacing, and a sub-block size of 2.5 x 2.5 x 1m was chosen to provide sufficient resolution at the domain boundaries.

Table 10.4 – Block model dimensions and block sizes.

	Starting Coordinate	Ending Coordinate	Model Dimensions	Parent Block Size	Sub-Block Size	No. Parent Blocks	No. Sub-Blocks
X	95,810mE	97,610mE	1,800m	20m	2.5m	90	720
Y	15,600mN	21,500mN	5,900m	25m	2.5m	236	2,360
Z	-200mRL	388mRL	588m	4m	1.0m	147	588

* Number of parent and sub-blocks is the maximum possible

Blocks were coded against geological wireframes developed as part of the geological modelling process (Section 7), in addition to wireframes representing several topographic and other related surfaces (Table 10.5).

Table 10.5 – Major wireframes used in the block model creation.

Wireframe	Description
dcs_natural_topo_2022.00t	Natural topographic wireframe (pre-mining)
dcs_23_weather.00t	Weathering profile wireframe
AMP_dm.00t	Geological domain wireframe – refer to Table 7.1
BIF_dm.00t	
BSQ_dm.00t	
CGS_dm.00t	
ESZ_dm.00t	
GRT_dm.00t	
HBF_dm.00t	
HEC_dm.00t	
HEO_dm.00t	
MBF_dm.00t	
DOM_dm.00t	
MSU_dm.00t	
MTC_dm.00t	
MTS_dm.00t	
SCH1_dm.00t	
SCH2_dm.00t	
mining_surface_20230101.00t	Topographic wireframe (post-mining) as of 1 January 2023
topo_smr_mag_all_20230701.00t	Topographic wireframe (post-mining) as of 1 July 2023
n17220.00t	Spatial northern area wireframe
s17220.00t	Spatial southern area wireframe
ID_2015_START_FILL.00t	Pre-backfill mining surface wireframe
Run016b_Shell_57_162.00t	May 2023 Whittle pit shell wireframe
dm_Run017b_Shell_57_162_RPEEE_sft	October 2023 Whittle pit shell wireframe

10.4 Grade Estimation

10.4.1 Overview

Except for the granite (GRT 90) and Cook Gap Schist (CGS 80) domains, which had too few samples to define a robust variogram, all estimates were performed using Ordinary Kriging (OK). Inverse Distance Weighting to the Power 3 (IDW3) was used for those domains in which too few data were present to define variograms. Blocks left un-estimated after OK or IDW3, typically on the periphery of the estimation search neighbourhood, were assigned a default value based on statistical analysis of earlier estimates and/or composite sample data.

All estimates considered domain boundaries to be hard boundaries, and no sample sharing across boundaries was permitted. An exception to this was for one domain (MBF 47) which is poorly defined by the sampling therein. In this case limited sample sharing is employed with the surrounding and geologically similar BIF 20 domain.

The use of service variables to estimate concentrate grades was not used for the reasons described in Section 10.1, and thus mass recovery and all concentrate grades were estimated independently. The technical memorandum describing the work in arriving at this decision is in Appendix 2.

All estimation was carried out using Vulcan software.

10.4.2 Estimation Support

Grade estimation into the block model comprised of four major estimation groups:

- Head assays (_h)
- Density
- Concentrate assays (_c)
- Net Acid Production Potential (NAPP)

The support at which these estimates are made, vary for the groups due to differences in drill spacing, drill hole sample location, and sample composite length, and is summarised in Table 10.6.

Table 10.6 – Estimation support for major estimation groups.

Estimation Group	Composite Length	Estimation Support	Location of Blocks Considered for Estimation
Head Assay (_h)	2m	20 x 25 x 4m	All blocks in the model
Density	2m	20 x 25 x 4m	All blocks in the model
NAPP	2m	20 x 25 x 4m	All blocks in the model
Concentrate Assay (_c)	4m	20 x 25 x 4m	Blocks south of 17,225mN
	8m	20 x 25 x 8m	Blocks north of 17,225mN and south of 19,325mN

10.4.3 Kriging Neighbourhood Analysis (KNA)

Kriging Neighbourhood Analysis (KNA) is based on the data used in the May 2023 resource update. KNA was performed prior to establishing final estimation parameters to optimise the maximum number of samples for any estimate. The technique determines the Kriging Efficiency (KE) and Slope of Regression (ZZ) for an estimate, which can be used to judge whether the Kriging neighbourhood is optimal.

Notional drilling grids of 20x20m, 50x50m, and 50x100m drillholes with 2m sample intervals were used to setup and run OK estimates for head Fe and SiO_2, for each domain, using the variograms defined in Table 10.1 and the estimation parameters summarised in Table 10.7.

Each KNA run comprised 40 iterations, with the first iteration starting with 3 samples, and the last iteration ending with 42 samples (Table 10.8).

Table 10.7 – KNA run parameters using 50x100m drill spacing and 25x50m estimation support.

Variable	Drilling Data	Discretisation Array	Search Orientation	Search Dimension	Min Samples	Max Samples	Max Samples per Drillhole
Fe	50x100m	5x8x3	Fe Variogram	Fe Variogram	3	3	3
SiO_2	50x100m	5x8x3	SiO_2 Variogram	SiO_2 Variogram	3	3	3

*3 Min/Max samples iterated by 1 for total of 40 runs; search orientation and dimensions set to variograms to optimise the Kriging neighbourhood

Table 10.8 – Summary of completed KNA runs for Fe and SiO_2 across major domains and drill spacing.

Domain	50x100m Drill Spacing	50x50m Drill Spacing	20x20m Drill Spacing	No. Runs Fe	KNA Runs SiO_2	Sample Iteration
AMP 10	Completed	Completed	-	40	40	3……42
BIF 20 + MBF 47	Completed	Completed	-	40	40	3……42
HEO 30	Completed	Completed	Completed	40	40	3……42
HEC32	Completed	Completed	-	40	40	3……42
HBF 37	Completed	Completed	-	40	40	3……42
MTS 40	Completed	Completed	-	40	40	3……42
MTC 43	Completed	Completed	-	40	40	3……42
SCH 46	Completed	Completed	-	40	40	3……42
MSU 48	Completed	Completed	-	40	40	3……42
BSQ 70	Completed	Completed	-	40	40	3……42
ESZ 75 + CGS 80	Completed	Completed	-	40	40	3……42

The KNA runs allows the metrics for evaluating the Kriging neighbourhood (KE and ZZ) for a particular domain and drill spacing to be plotted against the maximum number of samples used in each estimate (Figure 10.20 to Figure 10.25). Charts for Fe and SiO_2 across all the domains analysed show that on average most of the benefit (>90%) in the estimate is achieved using a maximum of 10 samples.

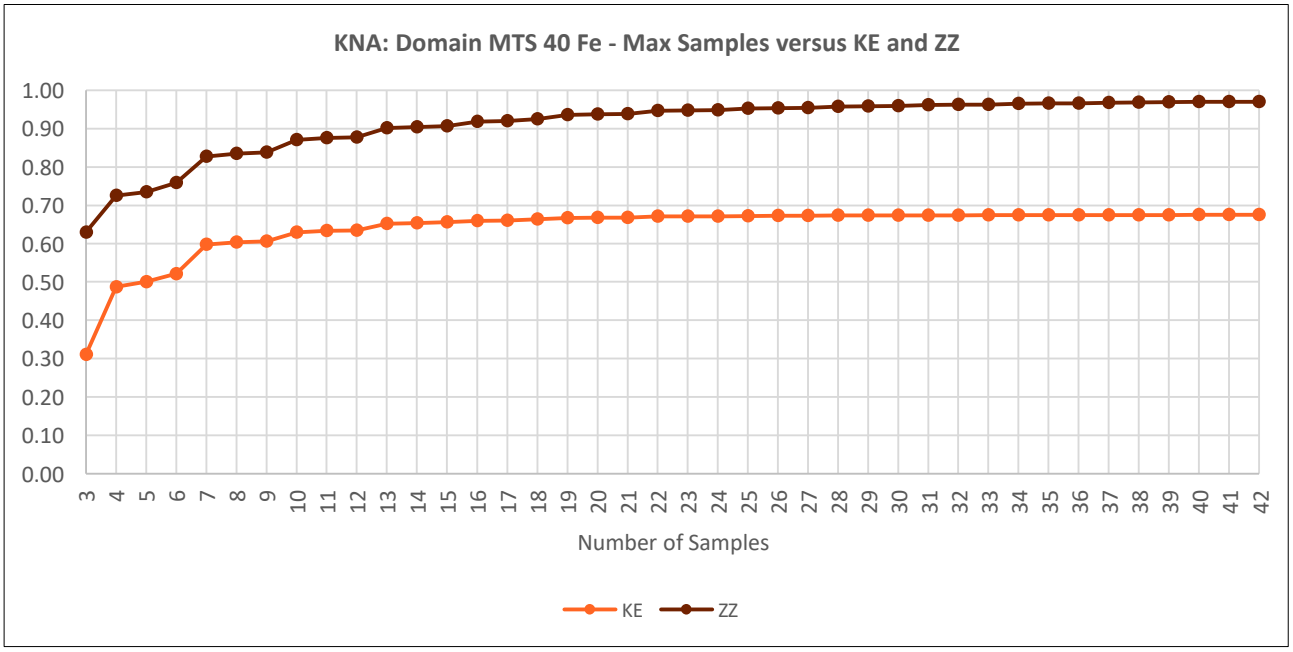


Figure 10.20 – KNA for Fe in domain MTS 40 using a 50x100m drill spacing, showing that the Kriging Efficiency (KE) and Slope of Regression (ZZ) achieves most of its effectiveness at a maximum of 10 samples per estimate.

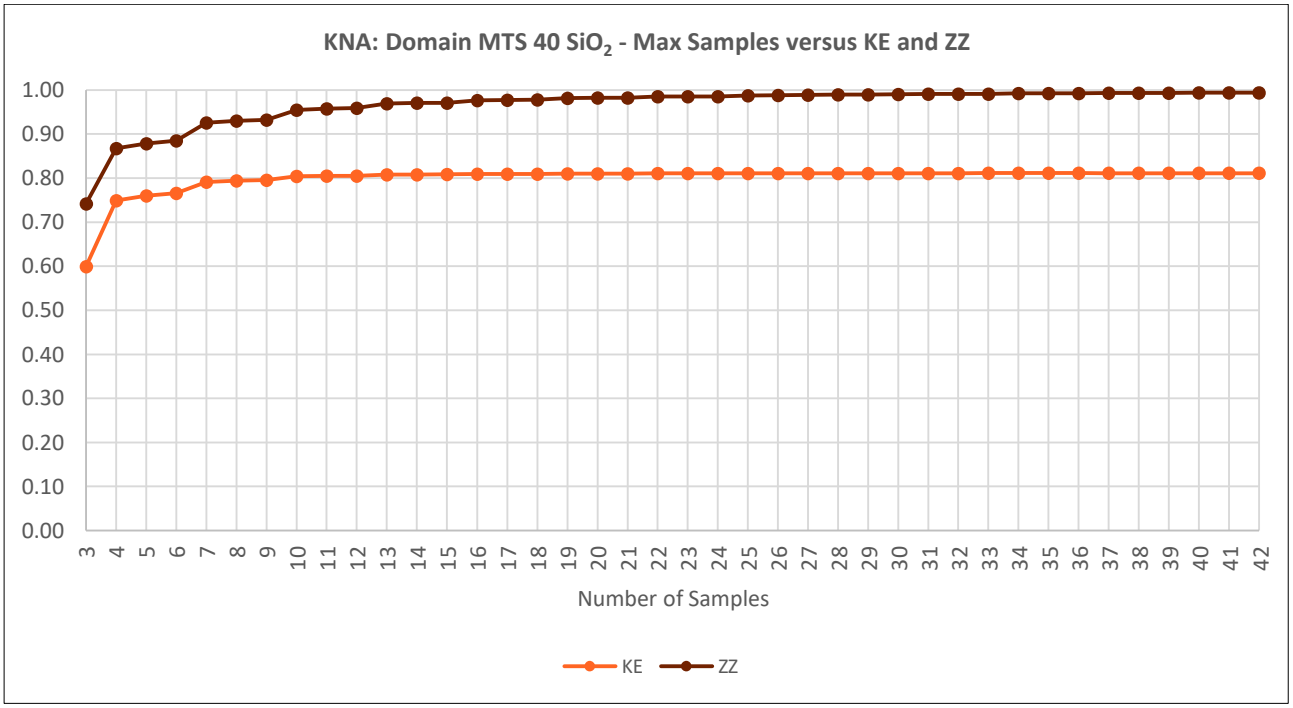


Figure 10.21 – KNA for SiO_2 in domain MTS 40 using a 50x100m drill spacing, showing that the Kriging Efficiency (KE) and Slope of Regression (ZZ) achieves most of its effectiveness at a maximum of 10 samples per estimate.

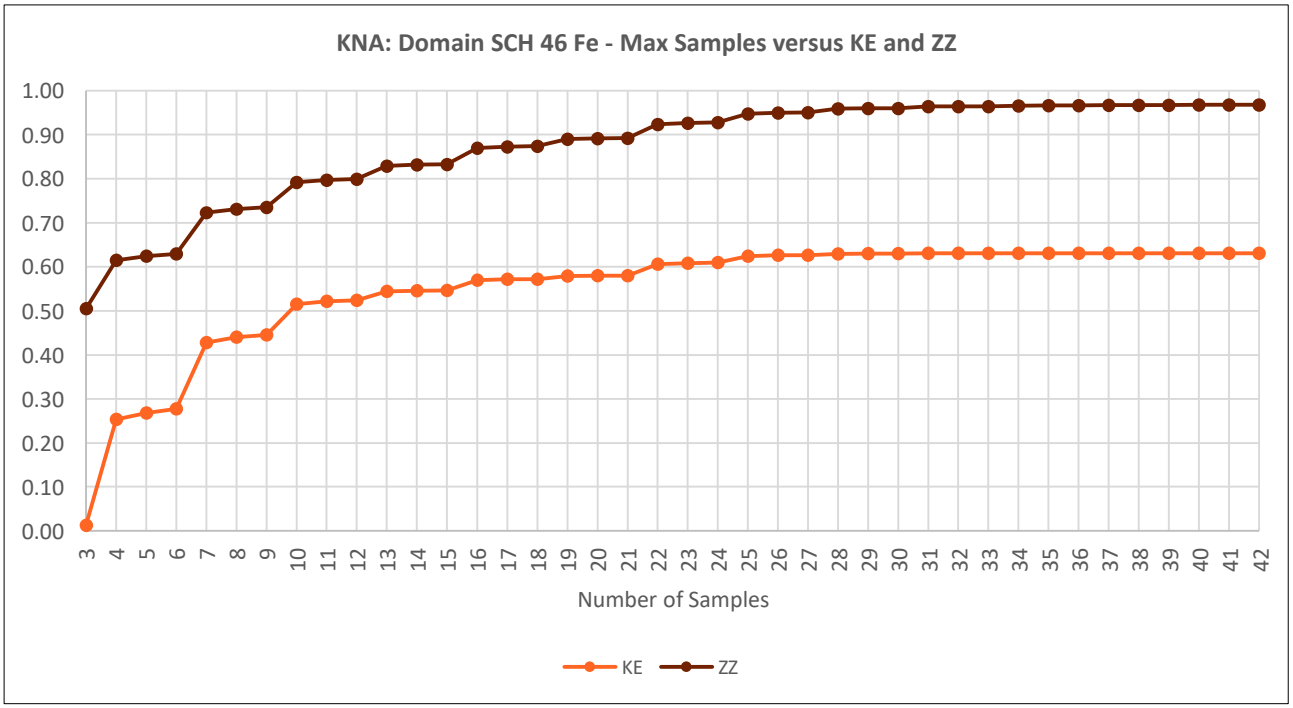


Figure 10.22 – KNA for Fe in domain SCH 46 using a 50x100m drill spacing, showing that the Kriging Efficiency (KE) and Slope of Regression (ZZ) achieves most of its effectiveness at a maximum of 10 samples per estimate.

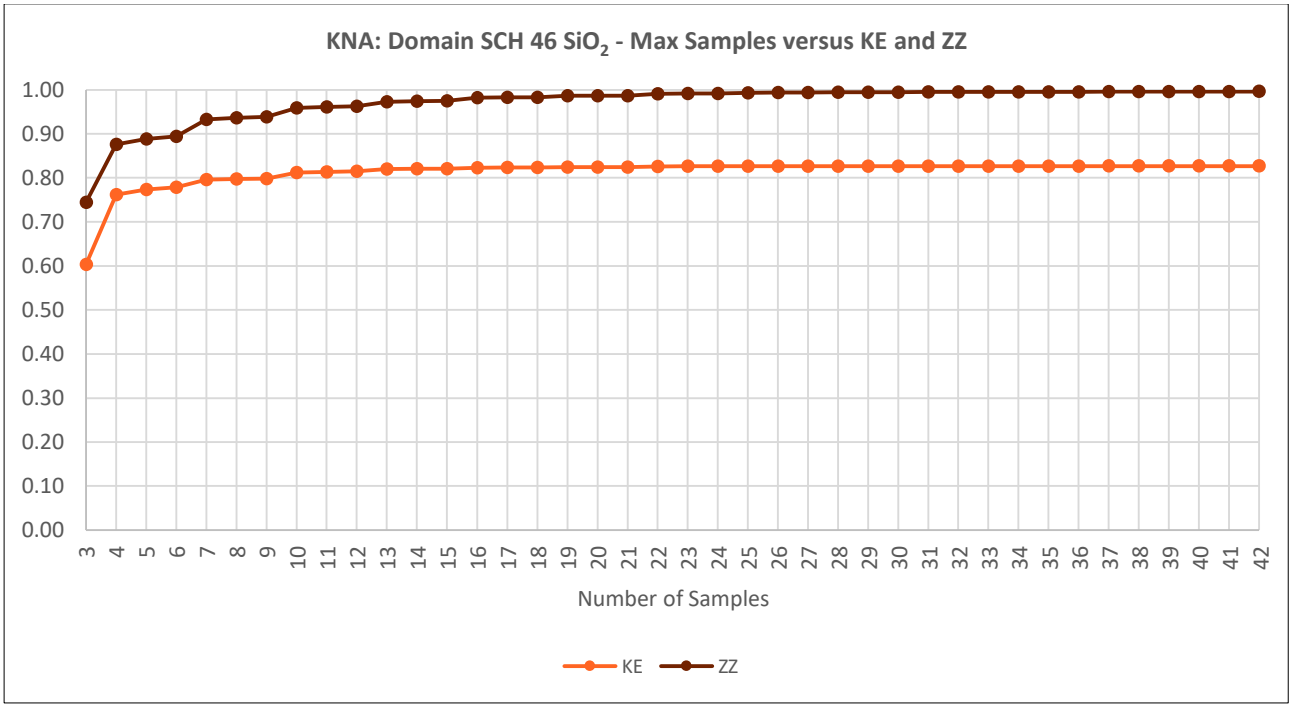


Figure 10.23 – KNA for SiO_2 in domain SCH 46 using a 50x100m drill spacing, showing that the Kriging Efficiency (KE) and Slope of Regression (ZZ) achieves most of its effectiveness at a maximum of 10 samples per estimate.

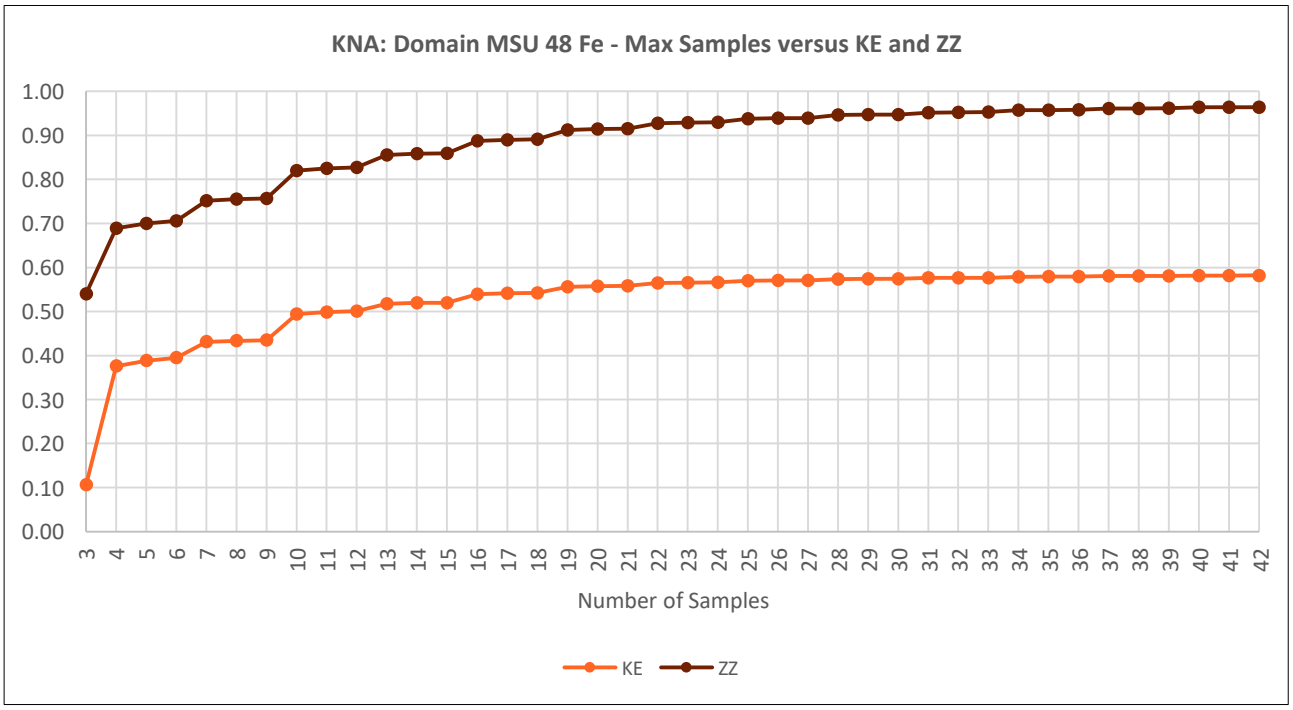


Figure 10.24 – KNA for Fe in domain MSU 48 using a 50x100m drill spacing, showing that the Kriging Efficiency (KE) and Slope of Regression (ZZ) achieves most of its effectiveness at a maximum of 10 samples per estimate.

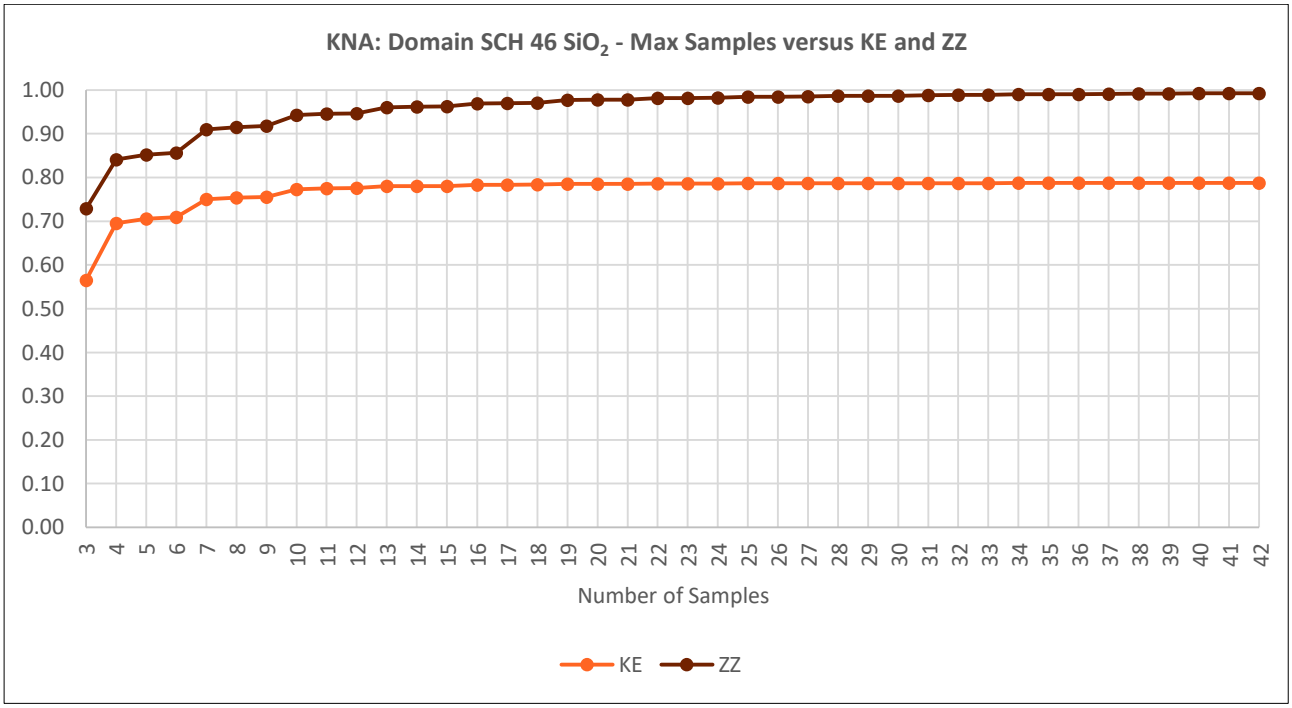


Figure 10.25 – KNA for SiO_2 in domain MSU 48 using a 50x100m drill spacing, showing that the Kriging Efficiency (KE) and Slope of Regression (ZZ) achieves most of its effectiveness at a maximum of 10 samples per estimate.

The effect of using more than 10 maximum samples per estimate was determined by performing an estimate with the same drill hole samples, same variogram and same search neighbourhood, and comparing it to an estimate made with 9 maximum samples. The comparison was made for Fe and SiO_2 in domain MTS 40 using two cases, the criteria of which are shown in Table 10.9.

Table 10.9 – Summary of criteria for comparing the effect of different number of samples in estimation.

Case	Estimation Variable	Drilling Data	Discretisation Array	Search Orientation Dimensions	Min Samples	Max Samples	Max Samples per Drillhole
A	Fe	50x100m	5 x 8 x 3	Fe Variogram	5	9	3
B	Fe	50x100m	5 x 8 x 3	Fe Variogram	12	24	8
A	SiO_2	50x100m	5 x 8 x 3	SiO_2 Variogram	5	9	3
B	SiO_2	50x100m	5 x 8 x 3	SiO_2 Variogram	12	24	8

The results were analysed by comparing the grade/volume curves of the two cases against each other (Figure 10.26 to Figure 10.29).

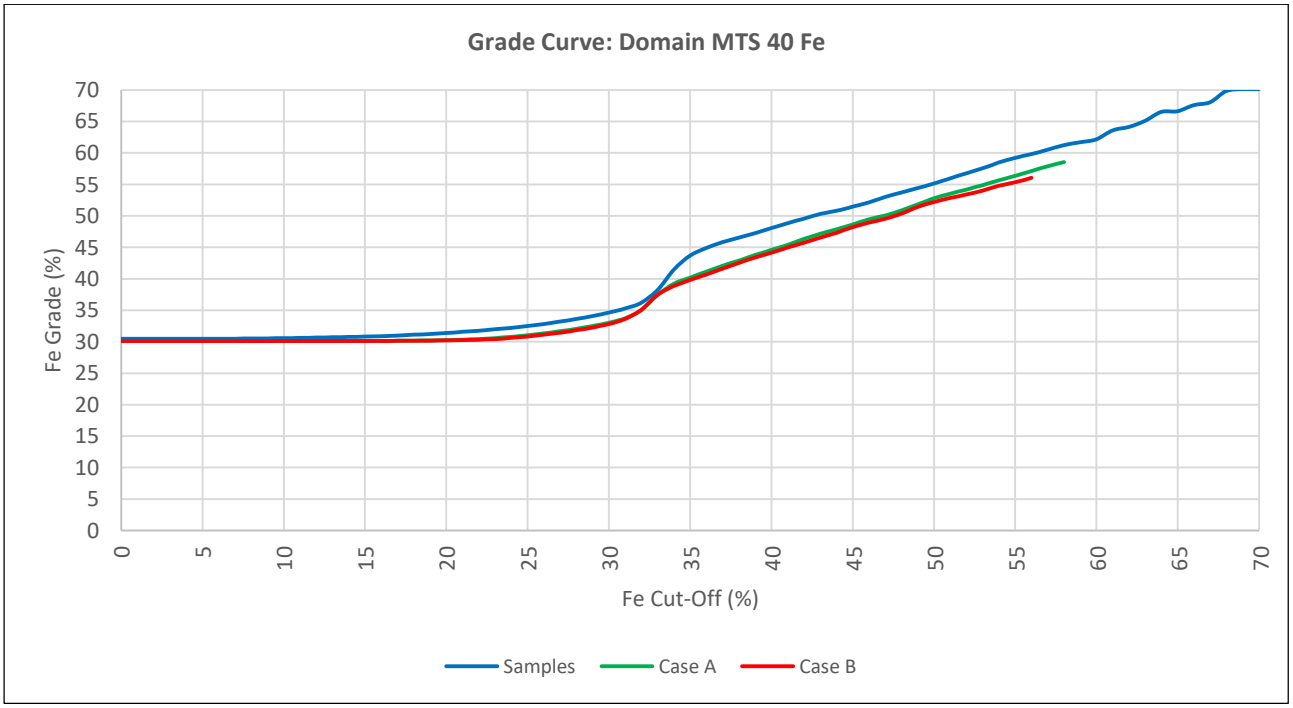


Figure 10.26 – Comparison of grade curves for Case A and Case B estimates, for Fe in domains MTS 40.

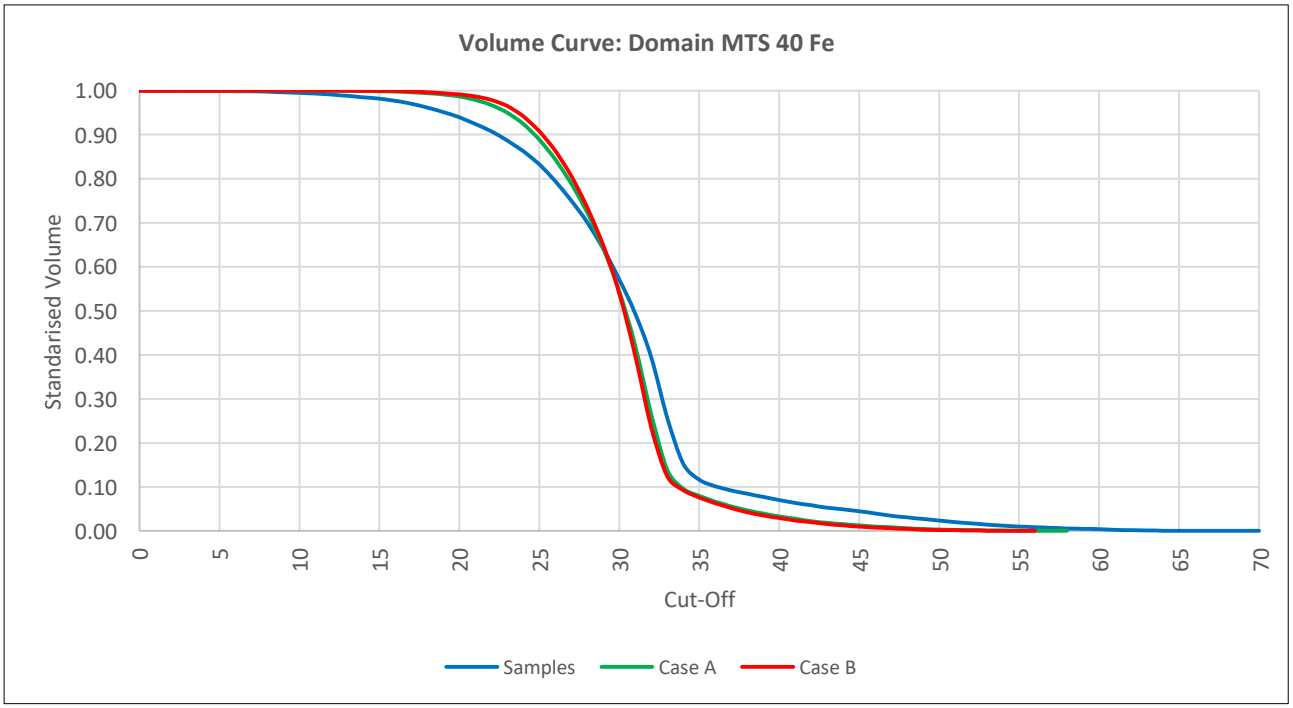


Figure 10.27 – Comparison of standarised volume curves for Case A and Case B estimates, for Fe in domains MTS 40.

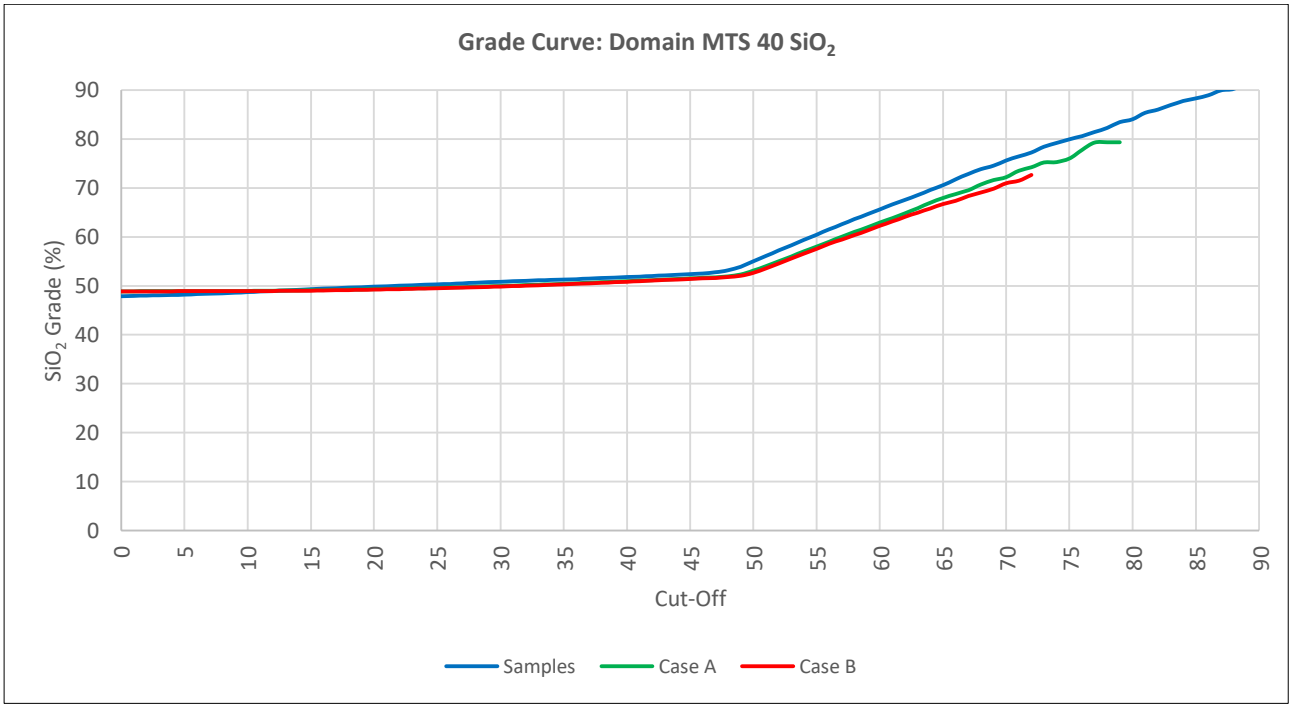


Figure 10.27 – Comparison of grade curves for Case A and Case B estimates, for SiO_2 in domains MTS 40.

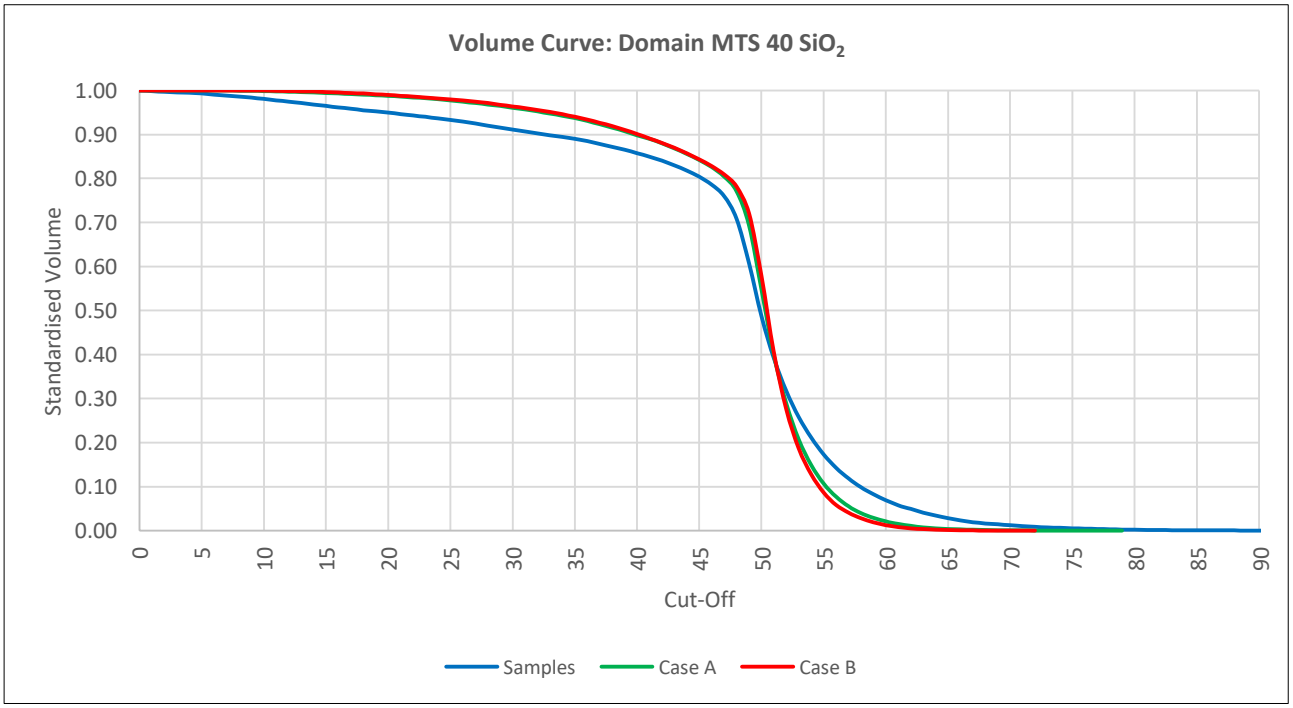


Figure 10.29 – Comparison of volume curves for Case A and Case B estimates, for SiO_2 in domains MTS 40.

In the case of the Fe estimate, Case B (min=12; max=24 samples) under-estimates the grade and the volume of material above the average Fe grade for domain MTS 40, relative to Case A (min=5; max=9 samples).

Similarly, for the SiO_2 estimate, Case B under-estimates the grade and the volume of material above the average SiO_2 grade for domain MTS 40, relative to Case A.

In summary, using more samples in an estimate, results in more volume at lower grades.

Case A and Case B were also compared to the theoretical grade/volume curve determined by means of a change of support of the drill hole sample data using the Discrete Gaussian Change of Support Model (DGCOS), applying an information effect (average Kriging Variance) of approximately 40% for Fe and 20% for SiO_2 to account for the data spacing and support used in the resource estimate. Figure 10.30 to Figure 10.33 shows the relative difference for Case A and Case B from the DGCOS model.

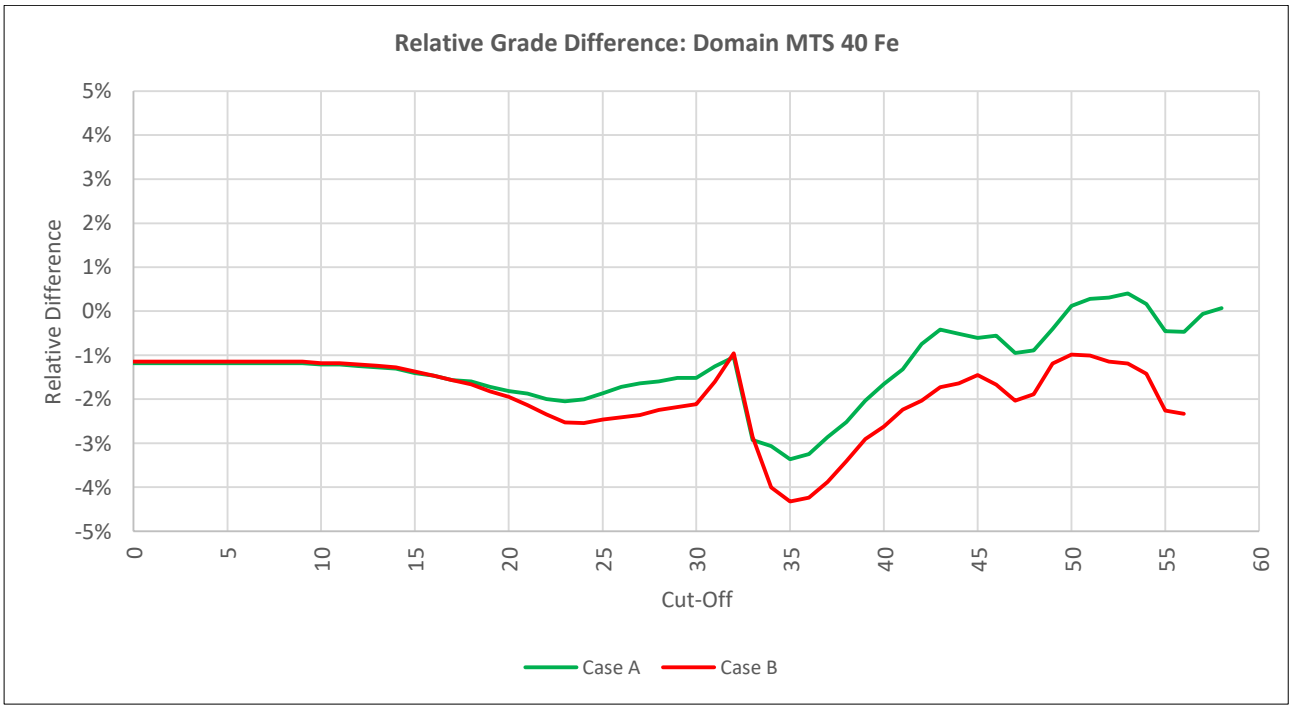


Figure 10.30 – Fe grade difference for Case A and B, relative to the Discrete Gaussian Change of Support model.

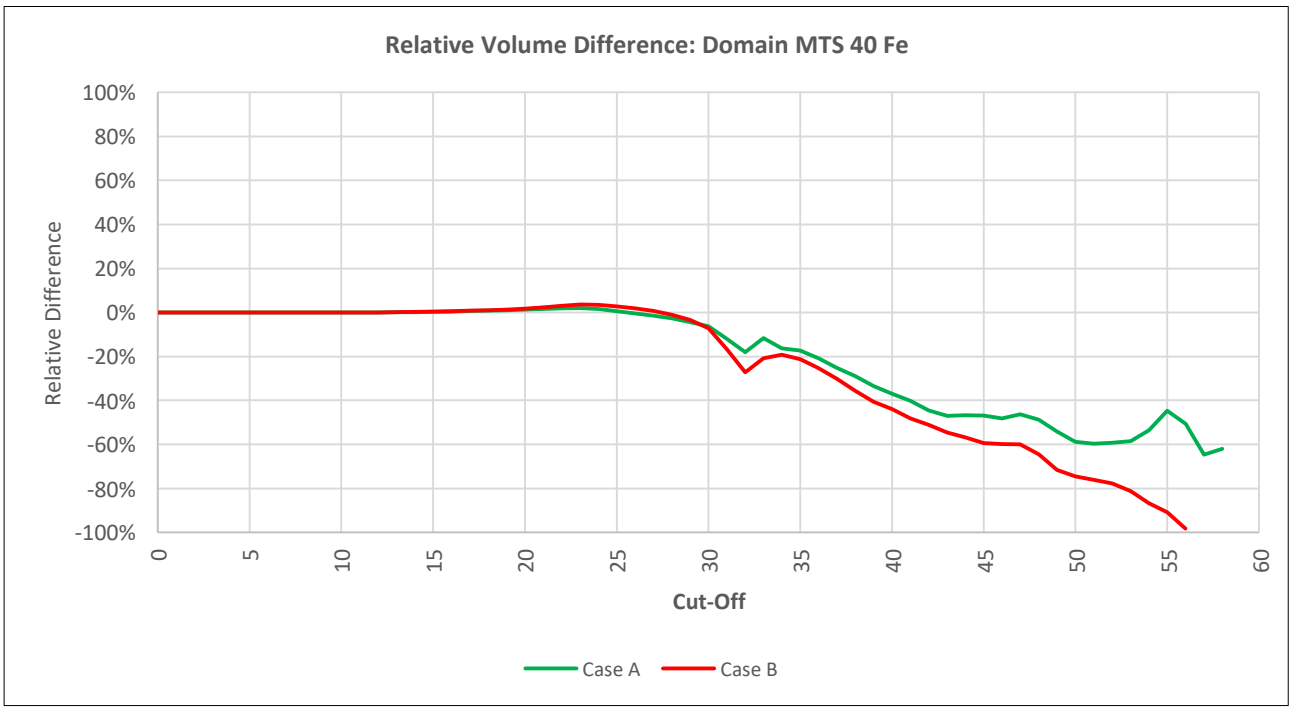


Figure 10.31 – Fe volume difference for Case A and B, relative to the Discrete Gaussian Change of Support model.

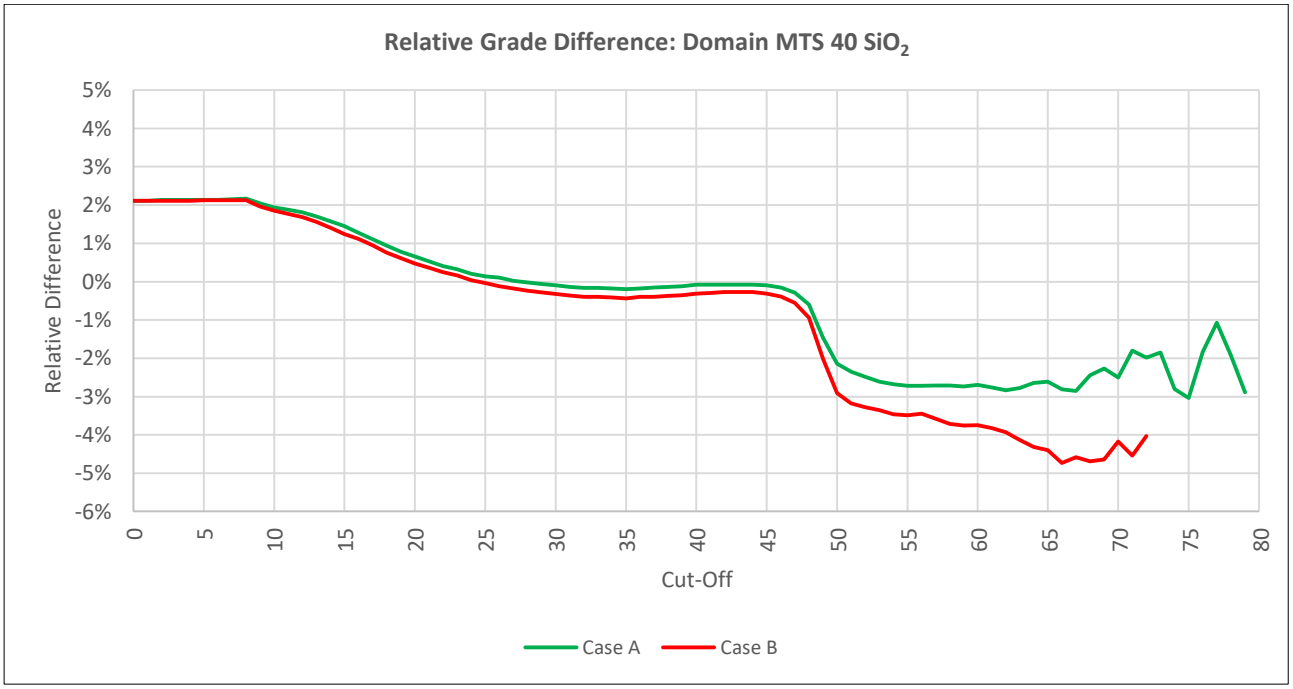


Figure 10.32 – SiO_2 grade difference for Case A and B, relative to the Discrete Gaussian Change of Support model.

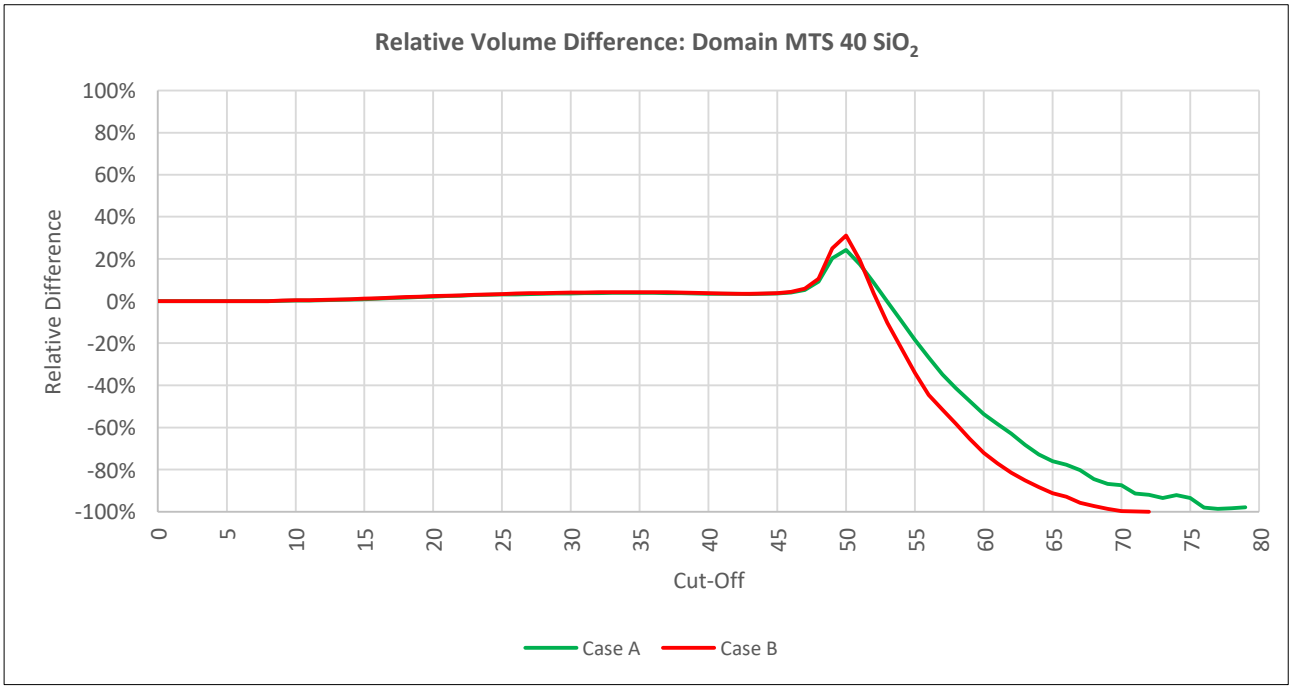


Figure 10.33 – SiO_2 volume difference for Case A and B, relative to the Discrete Gaussian Change of Support model.

In both the case of the Fe and SiO_2 estimate, Case B lies further from the zero relative difference line than does Case A. Thus, estimates using a maximum of 24 samples smooths much more than estimates using a maximum of 9 samples. This technique for checking smoothing during estimation is discussed in Section 11.1. The conclusion reached from the KNA work was that using more than 9 to 10 samples per estimate is not best practice because:

- Estimates would take significantly longer to complete.
- Conditional bias leading to inaccurate local (mine scale) estimates is introduced through over-smoothing/smearing.

10.4.4 Head Grade Estimation

All head grade estimation (_h estimates) was performed using 2m composites in the Vulcan database ***dsmdcs_0823_h.2m.isis*** and grouped by relative abundance into:

- Major elements: FeSAT, Fe, SiO_2, Al_2O_3, Mn, TiO_2, CaO, MgO, K_2O, S, Na_2O and LOI_10.
- Minor elements: Ba, Cu, P, Pb, V and Zn.

Each element group was estimated on a domain basis, and multi-threading utilised to gain efficiencies in the process by executing several runs in parallel. The strategy behind the resource update was to produce locally accurate estimates, so an empirical process was undertaken such that four (4) search passes were usually employed, with each search pass becoming less restrictive in terms of size and number of samples. A summary of the head grade estimates undertaken is found in Table 10.9.

Table 10.9 – Summary of head grade (_h) estimates undertaken.

Method	Domains	No. of Domains	No. of Elements	No. of Passes	No. of Estimates
OK	10,20,30,32,40,43,46,47,48,70,71,75	13	18	4	936
IDW3	80,90	2	18	1	36
				Total	**972**

OK = Ordinary Kriging; IDW3 = Inverse Distance Weighting to the Power 3

Each search pass comprised of a search ellipsoid with orientations mimicking the variograms modelled for each element and domain, but in some instances were adjusted to match observed geological orientations where it was judged to be more appropriate. Ellipsoid dimensions were based on data spacing, and number of samples based on the KNA discussed earlier. Local declustering was achieved by limiting the maximum number of samples per drill hole such that a minimum of 2 drillholes was always used for an estimate. An example of the typical search neighbourhood strategy employed is shown for a few elements in Table 10.10. A unique "pass" variable is used to control which search pass estimate is run. Once a particular pass has been executed, its pass variable value is set thus avoiding it being overwritten by subsequent passes. All blocks were estimated with a 4 x 5 x 3 discretisation array.

Table 10.10 – Search neighbourhood parameters for CaO, Fe, and SiO_2 _h estimates in domain MTS 40.

		Search Orientation			Search Dimensions			Sample Numbers		
Element	Pass	Bearing	Plunge	Dip	Major	Semi	Minor	Min	Max	DDH
CaO	1	24	2	84	25	15	25	5	9	2
	2	24	2	84	50	25	50	5	9	2
	3	24	2	84	75	38	75	5	9	2
	4	24	2	84	150	100	150	3	9	2
Fe	1	4	-15	26	25	15	25	5	9	2
	2	4	-15	26	50	25	50	5	9	2
	3	4	-15	26	75	38	75	5	9	2
	4	4	-15	26	150	100	150	3	9	2
SiO_2	1	-15	13	34	25	15	25	5	9	2
	2	-15	13	34	50	25	50	5	9	2
	3	-15	13	34	75	38	75	5	9	2
	4	-15	13	34	150	100	150	3	9	2

Some domains have a stronger obvious structural influence than others resulting in more localised anisotropy (e.g., SCH 46 and ESZ 75). In these cases, a localised dynamic anisotropy was modelled using the structural/contact surface wireframes and a dynamic bearing, dip and plunge stored for each block in the model (Figure 10.34). This dynamic anisotropy was then used in preference to the global search orientation bearing, dip and plunge values during the estimation of all the elements for that domain (Figure 10.35).

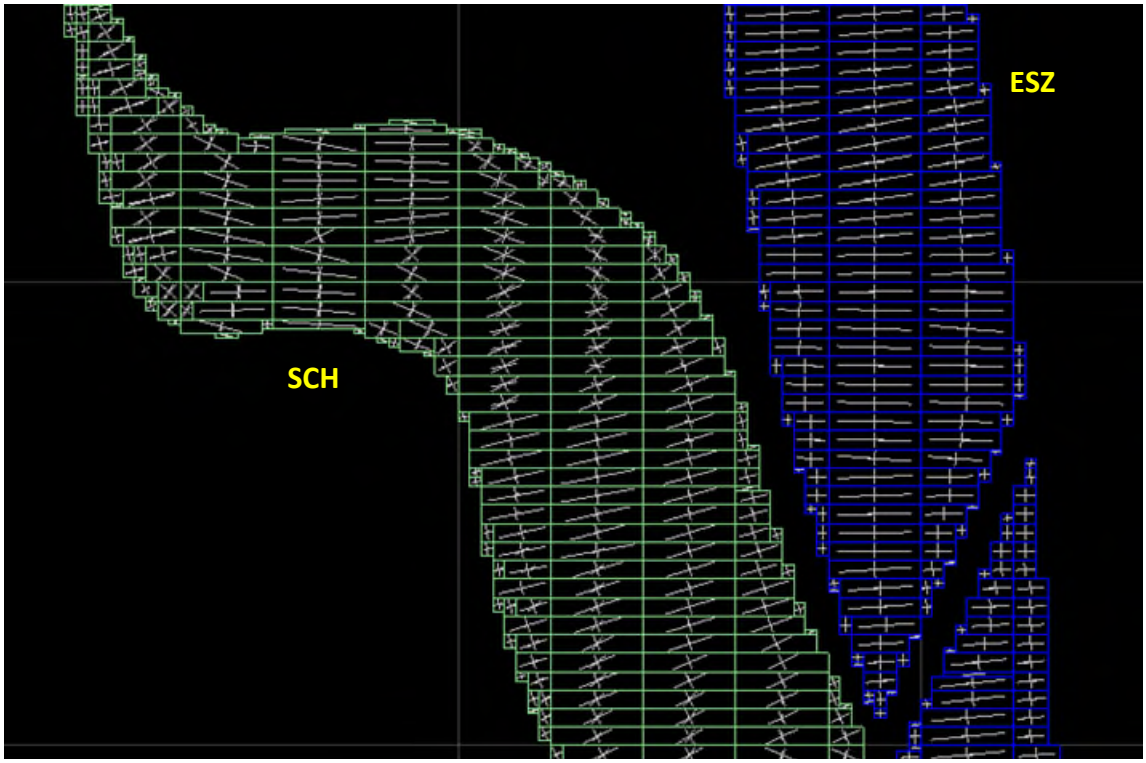


Figure 10.34 – Cross section at 17,481mN looking north through the Duchess South block model, showing the SCH 46 (green) and ESZ 75 (blue) blocks and the modelled local anisotropic orientations stored for each block (grey).

	Estimation ID	Standard Bearing	Bearing (Z)	Standard Plunge	Plunge (Y)	Standard Dip	Dip (X)	Alternative Bearing	Alternative Bearing Variable	Alternative Plunge	Alternative Plunge Variable	Alternative Dip	Alternative Dip Variable	Standard Major Axis	Major Axis	Standard Semi-Major Axis	Semi-Major Axis	Standard Minor Axis	Minor Axis
al2o3_h_1	al2o3_h_1	☐	-58.0	☐	76.0	☐	67.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	25.0	☑	15.0	☑	25.0
al2o3_h_2	al2o3_h_2	☐	-58.0	☐	76.0	☐	67.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	50.0	☑	25.0	☑	50.0
al2o3_h_3	al2o3_h_3	☐	-58.0	☐	76.0	☐	67.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	75.0	☑	38.0	☑	75.0
al2o3_h_4	al2o3_h_4	☐	-58.0	☐	76.0	☐	67.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	150.0	☑	100.0	☑	150.0
cao_h_1	cao_h_1	☐	13.0	☐	-32.0	☐	4.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	25.0	☑	15.0	☑	25.0
cao_h_2	cao_h_2	☐	13.0	☐	-32.0	☐	4.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	50.0	☑	25.0	☑	50.0
cao_h_3	cao_h_3	☐	13.0	☐	-32.0	☐	4.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	75.0	☑	38.0	☑	75.0
cao_h_4	cao_h_4	☐	13.0	☐	-32.0	☐	4.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	150.0	☑	100.0	☑	150.0
fe_h_1	fe_h_1	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	25.0	☑	15.0	☑	25.0
fe_h_2	fe_h_2	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	50.0	☑	25.0	☑	50.0
fe_h_3	fe_h_3	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	75.0	☑	38.0	☑	75.0
fe_h_4	fe_h_4	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	150.0	☑	100.0	☑	150.0
fesat_h_1	fesat_h_1	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	25.0	☑	15.0	☑	25.0
fesat_h_2	fesat_h_2	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	50.0	☑	25.0	☑	50.0
fesat_h_3	fesat_h_3	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	75.0	☑	38.0	☑	75.0
fesat_h_4	fesat_h_4	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	150.0	☑	100.0	☑	150.0
k2o_h_1	k2o_h_1	☐	17.0	☐	-32.0	☐	25.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	25.0	☑	15.0	☑	25.0
k2o_h_2	k2o_h_2	☐	17.0	☐	-32.0	☐	25.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	50.0	☑	25.0	☑	50.0
k2o_h_3	k2o_h_3	☐	17.0	☐	-32.0	☐	25.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	75.0	☑	38.0	☑	75.0
k2o_h_4	k2o_h_4	☐	17.0	☐	-32.0	☐	25.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	150.0	☑	100.0	☑	150.0
loi_10_h_1	loi_10_h_1	☐	-29.0	☐	-6.0	☐	76.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	25.0	☑	15.0	☑	25.0
loi_10_h_2	loi_10_h_2	☐	-29.0	☐	-6.0	☐	76.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	50.0	☑	25.0	☑	50.0
loi_10_h_3	loi_10_h_3	☐	-29.0	☐	-6.0	☐	76.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	75.0	☑	38.0	☑	75.0
loi_10_h_4	loi_10_h_4	☐	-29.0	☐	-6.0	☐	76.0	☑	d_bearing	☑	d_plunge	☑	d_dip	☑	150.0	☑	100.0	☑	150.0

Figure 10.35 – Extract from the _h estimation parameter file for domain SCH 46 showing the use of local (dynamic) anisotropy (blue) in preference to global anisotropy (brown) for the search orientations used in estimation.

Empirical observations, especially during validation of estimates, are that for thinner units (usually with obvious strong structural control), the dynamic anisotropy approach produces an estimate that validates better than one that uses a global anisotropy approach. For thicker more continuous units such as MTS 40, very little difference in estimate quality can be discerned. In these cases, a global anisotropy approach was used to maximise the estimation run times.

Most estimates used a hard boundary approach where only samples of the same domain code as the blocks was used for selection during estimation (Table 10.11). In some cases, there were insufficient samples in a domain to generate a reliable estimate necessitating the sharing of samples from geologically similar and spatially connected domains, for example blocks in domain MBF 47 required samples from both MBF 47 and BIF 20 to produce a reliable estimate (Table 10.12).The SCH 46 domain is split into an upper and lower lens (Figure 10.36), and in the interests of localising the estimates as much as possible, especially in light of the use of dynamic anisotropic searches, only samples from the respective lenses was used to estimate the blocks in those lenses (Table 10.13).

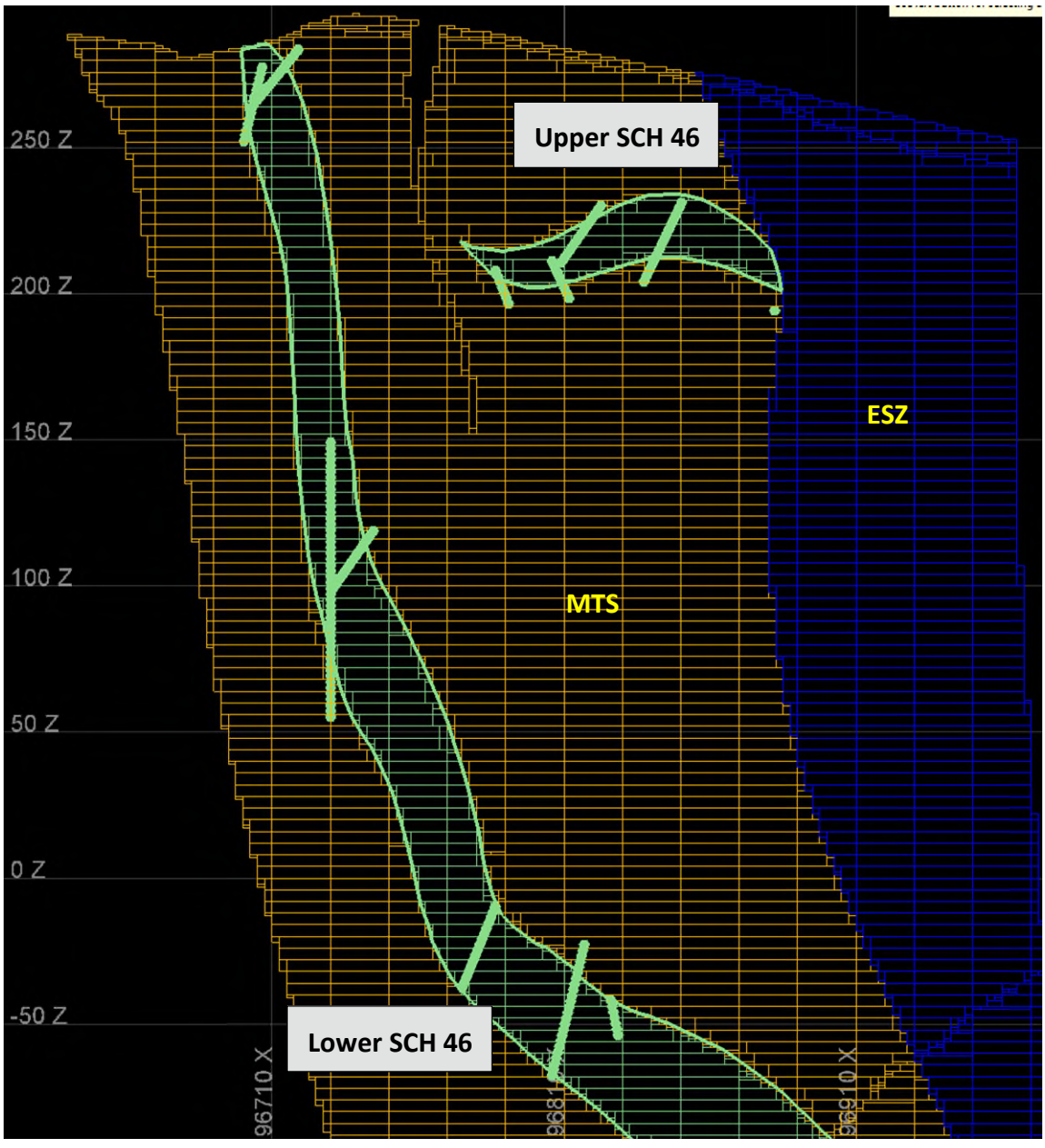


Figure 10.36 – Cross section at 18,180mN looking north through the Duchess South block model, showing the lower and upper SCH 46 lenses (green) and the respective composite SCH 46 sample intersections.

As part of the sample selection criteria, the allowable limits for the sample values were also specified, which avoids the use of non-sampled or non-composited intervals denoted by a value of -999 in the samples databases used in estimation.

Table 10.11 – Sample selection and block selection criteria for Fe in domain MTS 40, showing sample selection by condition only.

Estimate	Pass Number	Assay Field	Sample Selection Criteria By Wireframe	Sample Selection Criteria By Condition	Block Selection Criteria By Wireframe	Block Selection Criteria By Condition
Fe	1	FE	-	GEOZONE 40, FE_H 0&100	-	geozone eq 40 and pass_fe eq 0 and yworld le 19325
	2	FE	-	GEOZONE 40, FE_H 0&100	-	geozone eq 40 and pass_fe eq 0 and yworld le 19325
	3	FE	-	GEOZONE 40, FE_H 0&100	-	geozone eq 40 and pass_fe eq 0 and yworld le 19325
	4	FE	-	GEOZONE 40, FE_H 0&100	-	geozone eq 40 and pass_fe eq 0 and yworld le 19325

Table 10.12 – Sample selection and block selection criteria for Fe in domain MBF 47, showing sample sharing using sample selection by condition.

Estimate	Pass Number	Assay Field	Sample Selection Criteria By Wireframe	Sample Selection Criteria By Condition	Block Selection Criteria By Wireframe	Block Selection Criteria By Condition
Fe	1	FE	-	GEOZONE 47,20, FE_H 0&100	-	geozone eq 47 and pass_fe eq 0 and yworld le 19325
	2	FE	-	GEOZONE 47,20, FE_H 0&100	-	geozone eq 47 and pass_fe eq 0 and yworld le 19325
	3	FE	-	GEOZONE 47,20, FE_H 0&100	-	geozone eq 47 and pass_fe eq 0 and yworld le 19325
	4	FE	-	GEOZONE 47,20, FE_H 0&100	-	geozone eq 47 and pass_fe eq 0 and yworld le 19325

Table 10.13 – Sample selection and block selection criteria for Fe in the lower and upper SCH 46 domain, showing sample selection by wireframe and condition.

Estimate	Pass Number	Assay Field	Sample Selection Criteria By Wireframe	Sample Selection Criteria By Condition	Block Selection Criteria By Wireframe	Block Selection Criteria By Condition
Fe	1	FE	SCH1_dm.00t	GEOZONE 46, FE_H 0&100	-	geozone eq 46 and sch_trend eq 1 and pass_fe eq 0
	2	FE	SCH1_dm.00t	GEOZONE 46, FE_H 0&100	-	geozone eq 46 and sch_trend eq 1 and pass_fe eq 0
	3	FE	SCH1_dm.00t	GEOZONE 46, FE_H 0&100	-	geozone eq 46 and sch_trend eq 1 and pass_fe eq 0
	4	FE	SCH1_dm.00t	GEOZONE 46, FE_H 0&100	-	geozone eq 46 and sch_trend eq 1 and pass_fe eq 0
Fe	1	FE	SCH2_dm.00t	GEOZONE 46, FE_H 0&100	-	geozone eq 46 and sch_trend eq 2 and pass_fe eq 0
	2	FE	SCH2_dm.00t	GEOZONE 46, FE_H 0&100	-	geozone eq 46 and sch_trend eq 2 and pass_fe eq 0
	3	FE	SCH2_dm.00t	GEOZONE 46, FE_H 0&100	-	geozone eq 46 and sch_trend eq 2 and pass_fe eq 0
	4	FE	SCH2_dm.00t	GEOZONE 46, FE_H 0&100	-	geozone eq 46 and sch_trend eq 2 and pass_fe eq 0

FE_H 0&100 means select Fe values greater than 0 but less than 100

All estimates were subject to local grade capping to avoid smearing extreme values into blocks during estimation, especially for highly skewed distributions and estimates in the final passes. Rather than using traditional capping or cutting techniques which are outdated and have no spatial relevance, Vulcan's spatial high yielding was used. This technique is a sophisticated approach to limiting the influence of sample grades above a nominated threshold to within a user-defined search neighbourhood. Typically, the initial threshold value chosen is the 99th percentile of the sample distribution, but estimates were individually examined and empirically customised during the initial validation stages of every element and domain. An example of the empirical development of a typical high yielding approach for S% in MTS 40 is shown in Figure 10.37.

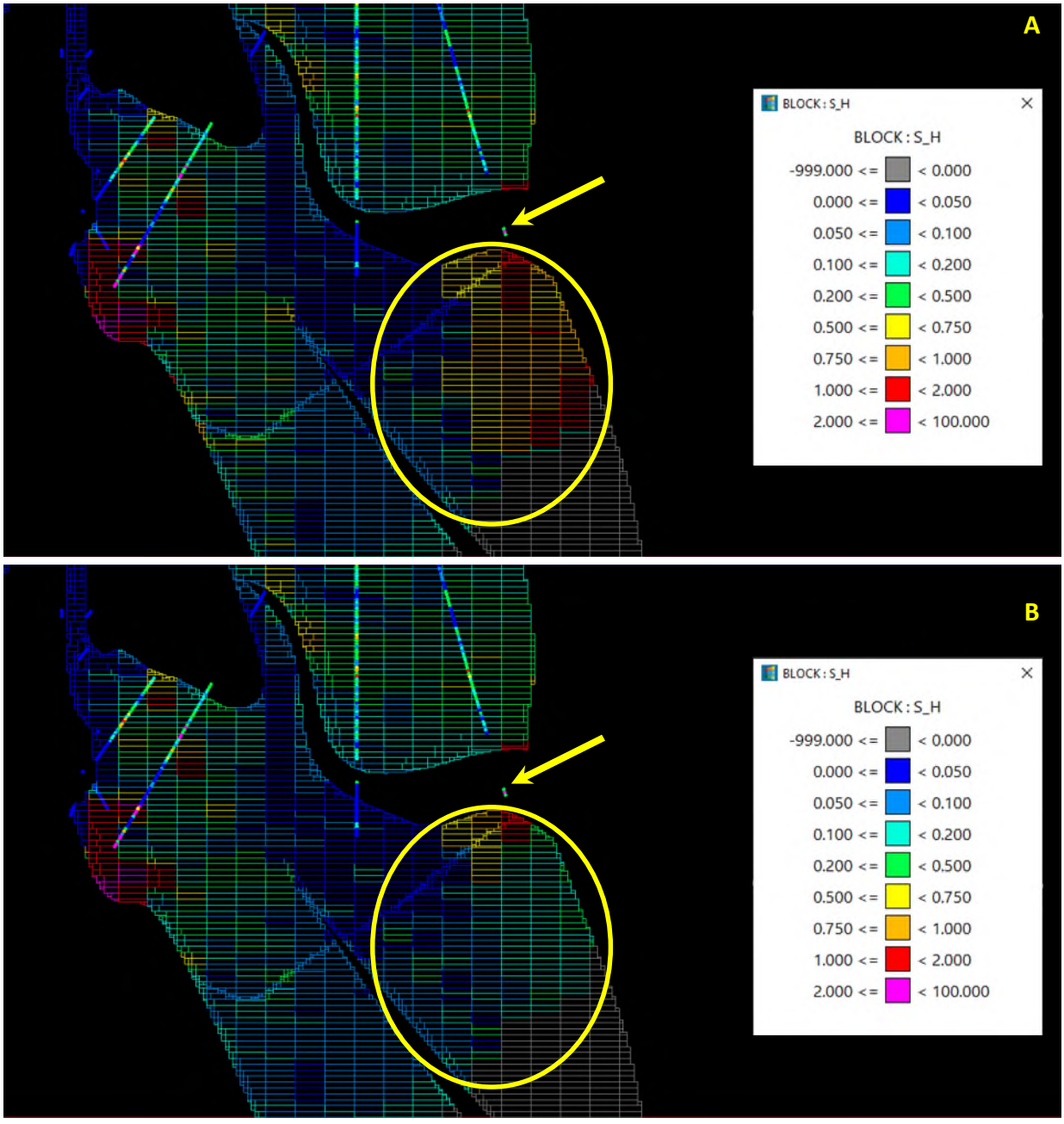


Figure 10.37 – Cross section at 18,665mN looking north through the Duchess South block model, showing the typical empirical development of a high yielding approach for S% in MTS 40. Top (A) shows an initial estimate without a high yield restriction implementation. Bottom (B) shows an updated estimate with a high yield restriction of 1.2% S inside a 20x25x4m search ellipsoid in the 4th estimation pass. Note how the influence (yellow ring) of the extreme sample value is reduced in the block estimates.

The high yield ellipsoid orientations can be customised separately, but in this instance because the dimensions of the ellipsoids are typically much smaller than a 1st pass estimation ellipsoid, and often not much large than a single parent block, they were set to the same orientations of the estimation search ellipsoid across all the passes. In those cases where the high yield restriction required implementation across more than one estimation pass, the threshold value was usually the same, but on rare occasions different threshold values were used for each pass, depending on the outcomes of visual validation.

The decision about which threshold value and ellipsoid dimensions to use is subjective and based on experience. Typically, a high yield strategy is only finalised after several tens of iterations of estimation, validation, and re-estimation, and so it becomes an exercise in trading off between achieving 80% of the outcome with 20% of the effort because of the time-consuming nature of the process.

Table 10.14 to Table 10.17 shows examples of some high yield restrictions for several domains and elements as implemented in this resource estimate.

Table 10.14 – High yield restriction policy for minor estimates in MTC 43.

			Ellipsoid Dimension			Ellipsoid Orientation		
Estimate	Pass	Value	Major	Semi	Minor	Bearing	Plunge	Dip
P	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.24	20.0	25.0	4.0	-5.0	-7.0	-41.0
	4	0.24	20.0	25.0	4.0	-5.0	-7.0	-41.0
Cu	1	-	-	-	-	-	-	-
	2	0.10	20.0	25.0	4.0	-5.0	-7.0	-41.0
	3	0.09	20.0	25.0	4.0	-5.0	-7.0	-41.0
	4	0.09	20.0	25.0	4.0	-5.0	-7.0	-41.0
Zn	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.026	20.0	25.0	4.0	-5.0	-7.0	-41.0
	4	0.026	20.0	25.0	4.0	-5.0	-7.0	-41.0
Ba	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.04	20.0	25.0	4.0	-5.0	-7.0	-41.0
	4	0.04	20.0	25.0	4.0	-5.0	-7.0	-41.0
Pb	1	-	-	-	-	-	-	-
	2	0.05	20.0	25.0	4.0	-5.0	-7.0	-41.0
	3	0.05	20.0	25.0	4.0	-5.0	-7.0	-41.0
	4	0.05	20.0	25.0	4.0	-5.0	-7.0	-41.0
V	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.04	20.0	25.0	4.0	-5.0	-7.0	-41.0
	4	0.04	20.0	25.0	4.0	-5.0	-7.0	-41.0

Table 10.15 – High yield restriction policy for major estimates in MTS 40.

			Ellipsoid Dimension			Ellipsoid Orientation		
Estimate	Pass	Value	Major	Semi	Minor	Bearing	Plunge	Dip
Al_2O_3	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	11.758	20.0	25.0	4.0	3.0	2.0	3.0
	4	11.758	20.0	25.0	4.0	3.0	2.0	3.0
CaO	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	7.115	20.0	25.0	4.0	24.0	2.0	84.0
	4	7.115	20.0	25.0	4.0	24.0	2.0	84.0
Fe	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	55.9	20.0	25.0	4.0	4.0	-15.0	26.0
	4	55.9	20.0	25.0	4.0	4.0	-15.0	26.0
K_2O	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.666	20.0	25.0	4.0	2.0	-2.0	142.0
	4	0.666	20.0	25.0	4.0	2.0	-2.0	142.0
LOI_10	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	22.9	20.0	25.0	4.0	14.0	21.0	-13.0
	4	20.0	20.0	25.0	4.0	14.0	21.0	-13.0
MgO	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	16.685	20.0	25.0	4.0	33.0	-38.0	-10.0
	4	16.685	20.0	25.0	4.0	33.0	-38.0	-10.0
Mn	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.72	20.0	25.0	4.0	-7.0	1.0	-2.0
	4	0.72	20.0	25.0	4.0	-7.0	1.0	-2.0
Na_2O	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.515	20.0	25.0	4.0	-69.0	9.0	118.0
	4	0.515	20.0	25.0	4.0	-69.0	9.0	118.0
SiO_2	1	-	-	-	-	-	-	-
	2	75.0	20.0	25.0	4.0	-15.0	34.0	13.0
	3	72.0	20.0	25.0	4.0	-15.0	34.0	13.0
	4	72.0	20.0	25.0	4.0	-15.0	34.0	13.0
S	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	1.2	20.0	25.0	4.0	-40.0	34.0	83.0
	4	1.2	20.0	25.0	4.0	-40.0	34.0	83.0
TiO_2	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	1.327	20.0	25.0	4.0	6.0	-5.0	6.0
	4	1.327	20.0	25.0	4.0	6.0	-5.0	6.0

Table 10.16 – High yield restriction policy for major estimates in MSU 48.

			Ellipsoid Dimension			Ellipsoid Orientation		
Estimate	Pass	Value	Major	Semi	Minor	Bearing	Plunge	Dip
Al_2O_3	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	10.81	20.0	25.0	4.0	7.0	-15.0	53.0
	4	10.81	20.0	25.0	4.0	7.0	-15.0	53.0
CaO	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	20.676	20.0	25.0	4.0	-4.0	-14.0	57.0
	4	20.676	20.0	25.0	4.0	-4.0	-14.0	57.0
Fe	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	54.1	20.0	25.0	4.0	-7.0	-8.0	10.0
	4	54.1	20.0	25.0	4.0	-7.0	-8.0	10.0
K_2O	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.703	20.0	25.0	4.0	-4.0	4.0	10.0
	4	0.703	20.0	25.0	4.0	-4.0	4.0	10.0
LOI_10	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	33.73	20.0	25.0	4.0	-4.0	-15.0	-8.0
	4	33.73	20.0	25.0	4.0	-4.0	-15.0	-8.0
MgO	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	16.923	20.0	25.0	4.0	5.0	5.0	-22.0
	4	16.923	20.0	25.0	4.0	5.0	5.0	-22.0
Mn	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	1.452	20.0	25.0	4.0	-7.0	-9.0	69.0
	4	1.452	20.0	25.0	4.0	-7.0	-9.0	69.0
Na_2O	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.207	20.0	25.0	4.0	-82.0	-45.0	89.0
	4	0.207	20.0	25.0	4.0	-82.0	-45.0	89.0
SiO_2	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	70.0	20.0	25.0	4.0	-7.0	7.0	1.0
	4	70.0	20.0	25.0	4.0	-7.0	7.0	1.0
S	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	9.0	20.0	25.0	4.0	-10.0	10.0	3.0
	4	9.0	20.0	25.0	4.0	-10.0	10.0	3.0
TiO_2	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	1.621	20.0	25.0	4.0	8.0	-20.0	18.0
	4	1.621	20.0	25.0	4.0	8.0	-20.0	18.0

Table 10.17 – High yield restriction policy for major estimates in SCH 46 lower lens.

			Ellipsoid Dimension			Ellipsoid Orientation		
Estimate	Pass	Value	Major	Semi	Minor	Bearing	Plunge	Dip
Al_2O_3	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	13.31	20.0	25.0	4.0	-58.0	76.0	67.0
	4	13.31	20.0	25.0	4.0	-58.0	76.0	67.0
CaO	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	6.517	20.0	25.0	4.0	13.0	-32.0	4.0
	4	6.517	20.0	25.0	4.0	13.0	-32.0	4.0
Fe	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	43.82	20.0	25.0	4.0	-1.0	-2.0	-1.0
	4	43.82	20.0	25.0	4.0	-1.0	-2.0	-1.0
K_2O	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.694	20.0	25.0	4.0	17.0	-32.0	25.0
	4	0.694	20.0	25.0	4.0	17.0	-32.0	25.0
LOI_10	1	-	-	-	-	-	-	-
	2	20.288	20.0	25.0	4.0	-29.0	-6.0	76.0
	3	18.288	20.0	25.0	4.0	-29.0	-6.0	76.0
	4	18.288	20.0	25.0	4.0	-29.0	-6.0	76.0
MgO	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	19.6	20.0	25.0	4.0	-103.0	41.0	17.0
	4	19.6	20.0	25.0	4.0	-103.0	41.0	17.0
Mn	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.758	20.0	25.0	4.0	-73.0	-57.0	4.0
	4	0.758	20.0	25.0	4.0	-73.0	-57.0	4.0
Na_2O	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	1.519	20.0	25.0	4.0	-82.0	-45.0	89.0
	4	1.519	20.0	25.0	4.0	-82.0	-45.0	89.0
SiO_2	1	-	-	-	-	-	-	-
	2	74.0	20.0	25.0	4.0	11.0	60.0	0.0
	3	74.0	20.0	25.0	4.0	11.0	60.0	0.0
	4	74.0	20.0	25.0	4.0	11.0	60.0	0.0
S	1	2.0	40.0	50.0	8.0	-50.0	35.0	-67.0
	2	2.0	40.0	50.0	8.0	-50.0	35.0	-67.0
	3	1.0	20.0	25.0	4.0	-50.0	35.0	-67.0
	4	1.0	20.0	25.0	4.0	-50.0	35.0	-67.0
TiO_2	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	1.383	20.0	25.0	4.0	15.0	-29.0	17.0
	4	1.383	20.0	25.0	4.0	15.0	-29.0	17.0

Blocks not estimated by the final estimation pass and lying within a notional pit shell determined from previous estimation updates for the area, were assigned the median value of the blocks estimated in the 1st to 4th pass, as calculated from EDA on the block estimates, on a domain basis. Figure 10.38. shows examples on how un-estimated blocks were assigned for three domains.

```
if (geozone eq 40) then
   if (al2o3_h eq -999) then
     al2o3_h = 0.191
     pass_al2o3 = 9
   endif
   if (cao_h eq -999) then
     cao_h = 0.734
     pass_cao = 9
   endif
   if (fe_h eq -999) then
     fe_h = 29.674
     pass_fe = 9
   endif
   if (fesat_h eq -999) then
     fesat_h = 24.813
     pass_fesat = 9
   endif
   if (k2o_h eq -999) then
     k2o_h = 0.010
     pass_k2o = 9
   endif
   if (loi_10_h eq -999) then
     loi_10_h = 10.693
     pass_loi_10 = 9
   endif
   if (mgo_h eq -999) then
     mgo_h = 4.141
     pass_mgo = 9
   endif
   if (mn_h eq -999) then
     mn_h = 0.100
     pass_mn = 9
   endif
   if (na2o_h eq -999) then
     na2o_h = 0.050
     pass_na2o = 9
   endif
   if (sio2_h eq -999) then
     sio2_h = 50.906
     pass_sio2 = 9
   endif
   if (s_h eq -999) then
     s_h = 0.092
     pass_s = 9
   endif
   if (tio2_h eq -999) then
     tio2_h = 0.022
     pass_tio2 = 9
   endif
endif
```

```
if (geozone eq 46) then
   if (al2o3_h eq -999) then
     al2o3_h = 0.232
     pass_al2o3 = 9
   endif
   if (cao_h eq -999) then
     cao_h = 0.669
     pass_cao = 9
   endif
   if (fe_h eq -999) then
     fe_h = 26.374
     pass_fe = 9
   endif
   if (fesat_h eq -999) then
     fesat_h = 12.455
     pass_fesat = 9
   endif
   if (k2o_h eq -999) then
     k2o_h = 0.015
     pass_k2o = 9
   endif
   if (loi_10_h eq -999) then
     loi_10_h = 10.478
     pass_loi_10 = 9
   endif
   if (mgo_h eq -999) then
     mgo_h = 5.920
     pass_mgo = 9
   endif
   if (mn_h eq -999) then
     mn_h = 0.237
     pass_mn = 9
   endif
   if (na2o_h eq -999) then
     na2o_h = 0.058
     pass_na2o = 9
   endif
   if (sio2_h eq -999) then
     sio2_h = 52.744
     pass_sio2 = 9
   endif
   if (s_h eq -999) then
     s_h = 0.186
     pass_s = 9
   endif
   if (tio2_h eq -999) then
     tio2_h = 0.021
     pass_tio2 = 9
   endif
endif
```

```
if (geozone eq 48) then
   if (al2o3_h eq -999) then
     al2o3_h = 0.458
     pass_al2o3 = 9
   endif
   if (cao_h eq -999) then
     cao_h = 2.687
     pass_cao = 9
   endif
   if (fe_h eq -999) then
     fe_h = 25.968
     pass_fe = 9
   endif
   if (fesat_h eq -999) then
     fesat_h = 18.282
     pass_fesat = 9
   endif
   if (k2o_h eq -999) then
     k2o_h = 0.020
     pass_k2o = 9
   endif
   if (loi_10_h eq -999) then
     loi_10_h = 13.699
     pass_loi_10 = 9
   endif
   if (mgo_h eq -999) then
     mgo_h = 6.360
     pass_mgo = 9
   endif
   if (mn_h eq -999) then
     mn_h = 0.244
     pass_mn = 9
   endif
   if (na2o_h eq -999) then
     na2o_h = 0.054
     pass_na2o = 9
   endif
   if (sio2_h eq -999) then
     sio2_h = 46.538
     pass_sio2 = 9
   endif
   if (s_h eq -999) then
     s_h = 1.223
     pass_s = 9
   endif
   if (tio2_h eq -999) then
     tio2_h = 0.063
     pass_tio2 = 9
   endif
endif
```

Figure 10.38 – Extract from a script showing how an un-estimated block is assigned a head grade estimate for various elements in domain MTS 40, SCH 46 and MSU 48. The actual values are derived by analysing the statistics of the initial estimates on a domain basis.

10.4.5 Density Estimation

All density estimation was performed using 2m regression derived density composites in the Vulcan database ***dsmdcs_0823_hssd.d2m.isis*** (Section 9.2.3). Estimation was performed on a domain and weathering zone basis using Ordinary Kriging (OK),

Table 10. 18 summarises the approach taken in the estimation of density and Table 10.19 provides details of the assumed density in domains without sufficient samples for a representative estimate.

Table 10.18 – Summary of density estimation approach.

Method	Domains	No. of Domains	Weathering Zones	No. of Passes	No. of Estimates
OK	10,20,30,32,37,40,43,46,48,70,71,75,80	13	2	4	104
Assigned	47,90	2	2	-	-
				Total	**104**

* MBF 47 and GRT 90 – assigned density only due to insufficient samples

Table 10.19 – Assumed density in domains without any representative samples.

Domain	Unweathered Density	Weathering Factor	Weathered Density
MBF 47	3.19	-	2.59
GRT 90	2.70	0.85	2.30

* MBF 47 – weathered density assumed to be same as default weathered density for BIF 20

Four (4) estimation passes were used for each domain with ellipsoid orientations mirroring the average orientations of the domains and variogram models, and similar ellipsoid dimensions to those used in head assay estimation. The minimum and maximum number of samples for an estimate, and the maximum samples per drill hole used in the head assay estimation was also used for density (Table 10.20). A hard-domain boundary approach was used for sample selection for all domains.

Table 10.20 – Example of the density search neighbourhood using unweathered domains MTS 40 and MSU 48.

		Search Orientation			Search Dimensions			Sample Numbers		
Domain	Pass	Bearing	Plunge	Dip	Major	Semi	Minor	Min	Max	DDH
40	1	-2	1	3	25	15	25	5	9	2
	2	-2	1	3	50	30	50	5	9	2
	3	-2	1	3	100	60	100	5	9	2
	4	-2	1	3	150	120	150	3	9	2
48	1	27	-4	145	25	15	25	5	9	2
	2	27	-4	145	50	30	50	5	9	2
	3	27	-4	145	100	60	100	5	9	2
	4	27	-4	145	150	120	150	3	9	2

Composite samples with density values below 1.5 tm^3 and greater than 5.0 tm^3 were ignored during sample selection as these values have historically been shown to be unrepresentative of the in-situ material. A local high yielding approach like that for head assay estimation and described in Section 10.4.4, was also applied at a weathering, domain, and estimation pass level. Yield values were empirically derived over several estimation runs, and typically resulted in limiting the spatial influence of the top 1st percentile of the distribution whilst estimating Pass 2, 3 and 4 of each domain. Table 10.21 shows some examples of the high yield application in weathered domains.

All blocks were estimated with a 4 x 5 x 3 discretisation array. In the case of un-estimated blocks, mean values from composite samples were applied on a domain basis.

Examples of sample selection criteria, block selection criteria, and sample value limits are shown in Table 10.22 and Table 10.23.

Table 10.21 – High yield restriction policy for density estimates in some weathered domains.

			Ellipsoid Dimension			Ellipsoid Orientation		
Domain	Pass	Value	Major	Semi	Minor	Bearing	Plunge	Dip
10	1	-	-	-	-	-	-	-
	2	3.35	20.0	25.0	4.0	-15	-9	-10
	3	3.35	20.0	25.0	4.0	15	-9	-10
	4	3.35	20.0	25.0	4.0	-15	-9	-10
20	1	-	-	-	-	-	-	-
	2	4.13	20.0	25.0	4.0	2	-2	-39
	3	4.13	20.0	25.0	4.0	2	-2	-39
	4	4.13	20.0	25.0	4.0	2	-2	-39
30	1	-	-	-	-	-	-	-
	2	4.34	20.0	25.0	4.0	10	11	27
	3	4.34	20.0	25.0	4.0	10	11	27
	4	4.34	20.0	25.0	4.0	10	11	27
32	1	-	-	-	-	-	-	-
	2	3.57	20.0	25.0	4.0	98	-50	58
	3	3.57	20.0	25.0	4.0	98	-50	58
	4	3.57	20.0	25.0	4.0	98	-50	58
37	1	-	-	-	-	-	-	-
	2	4.49	20.0	25.0	4.0	98	-50	58
	3	4.49	20.0	25.0	4.0	98	-50	58
	4	4.49	20.0	25.0	4.0	98	-50	58
40	1	-	-	-	-	-	-	-
	2	4.72	20.0	25.0	4.0	-2	1	3
	3	4.72	20.0	25.0	4.0	-2	1	3
	4	4.72	20.0	25.0	4.0	-2	1	3
43	1	-	-	-	-	-	-	-
	2	4.05	20.0	25.0	4.0	89	-56	89
	3	4.05	20.0	25.0	4.0	89	-56	89
	4	4.05	20.0	25.0	4.0	89	-56	89
46	1	-	-	-	-	-	-	-
	2	3.12	20.0	25.0	4.0	0	0	0
	3	3.12	20.0	25.0	4.0	0	0	0
	4	3.12	20.0	25.0	4.0	0	0	0
48	1	-	-	-	-	-	-	-
	2	3.45	20.0	25.0	4.0	27	-4	145
	3	3.45	20.0	25.0	4.0	27	-4	145
	4	3.45	20.0	25.0	4.0	27	-4	145
70	1	-	-	-	-	-	-	-
	2	3.00	20.0	25.0	4.0	27	-4	145
	3	3.00	20.0	25.0	4.0	27	-4	145
	4	3.00	20.0	25.0	4.0	27	-4	145
75	1	-	-	-	-	-	-	-
	2	3.20	20.0	25.0	4.0	30	-19	8
	3	3.20	20.0	25.0	4.0	30	-19	8
	4	3.20	20.0	25.0	4.0	30	-19	8

Table 10.22 – Sample selection and block selection criteria for density in the weathered portions of domain MTS 40, MSU 48 AND ESZ 75.

Domain	Pass Number	Sample Selection Criteria By Wireframe	Sample Selection Criteria By Condition	Block Selection Criteria By Wireframe	Block Selection Criteria By Condition
40	1	-	WEATHER 1, GEOZONE 40, DENSITY 1.5&5	-	geozone eq 40 and pass_density eq 0 and weather eq 1
	2	-	WEATHER 1, GEOZONE 40, DENSITY 1.5&5	-	geozone eq 40 and pass_density eq 0 and weather eq 1
	3	-	WEATHER 1, GEOZONE 40, DENSITY 1.5&5	-	geozone eq 40 and pass_density eq 0 and weather eq 1
48	1	-	WEATHER 1, GEOZONE 48, DENSITY 1.5&5	-	geozone eq 48 and pass_density eq 0 and weather eq 1
	2	-	WEATHER 1, GEOZONE 48, DENSITY 1.5&5	-	geozone eq 48 and pass_density eq 0 and weather eq 1
	3	-	WEATHER 1, GEOZONE 48, DENSITY 1.5&5	-	geozone eq 48 and pass_density eq 0 and weather eq 1
75	1	-	WEATHER 1, GEOZONE 75,46 DENSITY 1.5&5	-	geozone eq 75 and pass_density eq 0 and weather eq 1
	2	-	WEATHER 1, GEOZONE 75,46 DENSITY 1.5&5	-	geozone eq 75 and pass_density eq 0 and weather eq 1
	3	-	WEATHER 1, GEOZONE 75,46 DENSITY 1.5&5	-	geozone eq 75 and pass_density eq 0 and weather eq 1

Table 10.23 – Sample selection and block selection criteria for density in the unweathered portions of domain MTS 40, MSU 48 AND ESZ 75.

Domain	Pass Number	Sample Selection Criteria By Wireframe	Sample Selection Criteria By Condition	Block Selection Criteria By Wireframe	Block Selection Criteria By Condition
40	1	-	WEATHER 0, GEOZONE 40, DENSITY 1.5&5	-	geozone eq 40 and pass_density eq 0 and weather eq 0
	2	-	WEATHER 0, GEOZONE 40, DENSITY 1.5&5	-	geozone eq 40 and pass_density eq 0 and weather eq 0
	3	-	WEATHER 0, GEOZONE 40, DENSITY 1.5&5	-	geozone eq 40 and pass_density eq 0 and weather eq 0
48	1	-	WEATHER 0, GEOZONE 48, DENSITY 1.5&5	-	geozone eq 48 and pass_density eq 0 and weather eq 0
	2	-	WEATHER 0, GEOZONE 48, DENSITY 1.5&5	-	geozone eq 48 and pass_density eq 0 and weather eq 0
	3	-	WEATHER 0, GEOZONE 48, DENSITY 1.5&5	-	geozone eq 48 and pass_density eq 0 and weather eq 0
75	1	-	WEATHER 0, GEOZONE 75,46 DENSITY 1.5&5	-	geozone eq 75 and pass_density eq 0 and weather eq 0
	2	-	WEATHER 0, GEOZONE 75,46 DENSITY 1.5&5	-	geozone eq 75 and pass_density eq 0 and weather eq 0
	3	-	WEATHER 0, GEOZONE 75,46 DENSITY 1.5&5	-	geozone eq 75 and pass_density eq 0 and weather eq 0

Weather 1 = weathered; Weather 0 = unweathered

10.4.6 Concentrate Grade Estimation

All concentrate grade estimation (_c estimates) was performed using either 4m or 8m composites, in the Vulcan database ***dsmdcs_0823_h.48c.isis*** and comprising of:

- MASSREC, Fe, SiO_2, Al_2O_3, Mn, TiO_2, CaO, MgO, K_2O, S, Na_2O, P and LOI_10.

Estimation to the 20x25x4m support south of 17,225mN using 4m composites, and estimation to the 20x25x8m support north of 17,225mN using the 8m composites, was executed separately on a domain basis (Figure 10.39) and previously discussed in Section 10.4.2.

	Parent Block X	Parent Block Y	Parent Block Z	Samples Database or Map file	Sample Group	Location X Field	Location Y Field	Location Z Field	Assay Field	Condition
al2o3_c_1	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	AL2O3_C	space eq 0 and geozone eq 43 and pass_al2o3_c eq 0 and yworld le 19325
al2o3_c_2	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	AL2O3_C	space eq 0 and geozone eq 43 and pass_al2o3_c eq 0 and yworld le 19325
al2o3_c_3	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	AL2O3_C	space eq 0 and geozone eq 43 and pass_al2o3_c eq 0 and yworld le 19325
cao_c_1	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	CAO_C	space eq 0 and geozone eq 43 and pass_cao_c eq 0 and yworld le 19325
cao_c_2	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	CAO_C	space eq 0 and geozone eq 43 and pass_cao_c eq 0 and yworld le 19325
cao_c_3	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	CAO_C	space eq 0 and geozone eq 43 and pass_cao_c eq 0 and yworld le 19325
fe_c_1	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	FE_C	space eq 0 and geozone eq 43 and pass_fe_c eq 0 and yworld le 19325
fe_c_2	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	FE_C	space eq 0 and geozone eq 43 and pass_fe_c eq 0 and yworld le 19325
fe_c_3	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	FE_C	space eq 0 and geozone eq 43 and pass_fe_c eq 0 and yworld le 19325
massrec_1	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	MASSREC	space eq 0 and geozone eq 43 and pass_massrec eq 0 and yworld le 19325
massrec_2	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	MASSREC	space eq 0 and geozone eq 43 and pass_massrec eq 0 and yworld le 19325
massrec_3	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	MASSREC	space eq 0 and geozone eq 43 and pass_massrec eq 0 and yworld le 19325
k2o_c_1	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	K2O_C	space eq 0 and geozone eq 43 and pass_k2o_c eq 0 and yworld le 19325
k2o_c_2	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	K2O_C	space eq 0 and geozone eq 43 and pass_k2o_c eq 0 and yworld le 19325
k2o_c_3	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	K2O_C	space eq 0 and geozone eq 43 and pass_k2o_c eq 0 and yworld le 19325
loi_10_c_1	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	LOI_10_C	space eq 0 and geozone eq 43 and pass_loi_10_c eq 0 and yworld le 19325
loi_10_c_2	20.0	25.0	4.0	dsmdcs_1122_c.48m.isis	4M_C	MIDX	MIDY	MIDZ	LOI_10_C	space eq 0 and geozone eq 43 and pass_loi_10_c eq 0 and yworld le 19325

	Parent Block X	Parent Block Y	Parent Block Z	Samples Database or Map file	Sample Group	Location X Field	Location Y Field	Location Z Field	Assay Field	Condition
al2o3_c_1	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	AL2O3_C	space eq 1 and geozone eq 43 and pass_al2o3_c eq 0 and yworld le 19325
al2o3_c_2	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	AL2O3_C	space eq 1 and geozone eq 43 and pass_al2o3_c eq 0 and yworld le 19325
al2o3_c_3	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	AL2O3_C	space eq 1 and geozone eq 43 and pass_al2o3_c eq 0 and yworld le 19325
cao_c_1	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	CAO_C	space eq 1 and geozone eq 43 and pass_cao_c eq 0 and yworld le 19325
cao_c_2	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	CAO_C	space eq 1 and geozone eq 43 and pass_cao_c eq 0 and yworld le 19325
cao_c_3	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	CAO_C	space eq 1 and geozone eq 43 and pass_cao_c eq 0 and yworld le 19325
fe_c_1	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	FE_C	space eq 1 and geozone eq 43 and pass_fe_c eq 0 and yworld le 19325
fe_c_2	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	FE_C	space eq 1 and geozone eq 43 and pass_fe_c eq 0 and yworld le 19325
fe_c_3	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	FE_C	space eq 1 and geozone eq 43 and pass_fe_c eq 0 and yworld le 19325
massrec_1	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	MASSREC	space eq 1 and geozone eq 43 and pass_massrec eq 0 and yworld le 19325
massrec_2	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	MASSREC	space eq 1 and geozone eq 43 and pass_massrec eq 0 and yworld le 19325
massrec_3	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	MASSREC	space eq 1 and geozone eq 43 and pass_massrec eq 0 and yworld le 19325
k2o_c_1	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	K2O_C	space eq 1 and geozone eq 43 and pass_k2o_c eq 0 and yworld le 19325
k2o_c_2	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	K2O_C	space eq 1 and geozone eq 43 and pass_k2o_c eq 0 and yworld le 19325
k2o_c_3	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	K2O_C	space eq 1 and geozone eq 43 and pass_k2o_c eq 0 and yworld le 19325
loi_10_c_1	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	LOI_10_C	space eq 1 and geozone eq 43 and pass_loi_10_c eq 0 and yworld le 19325
loi_10_c_2	20.0	25.0	8.0	dsmdcs_1122_c.48m.isis	8M_C	MIDX	MIDY	MIDZ	LOI_10_C	space eq 1 and geozone eq 43 and pass_loi_10_c eq 0 and yworld le 19325

Figure 10.39 – Extract from two separate _c estimation parameter files for MTC 43 for blocks estimated at a 20x25x4m support (top) and blocks estimated at a 20x25x8m support (bottom) showing the use of the sample group ID and block condition to control estimation. Space=0 identifies blocks required to be estimated at a 20x25x4m support and Space=1 identifies blocks required to be estimated at a 20x25x8m support.

The strategy behind the _c estimation was also to produce locally accurate estimates like that for the head assay estimation. Three (3) search passes were employed, with each search pass becoming less restrictive in terms of size and number of samples. A summary of the concentrate grade estimates undertaken is found in Table 10.24.

Table 10.24 – Summary of concentrate grade (_c) estimates undertaken.

Composite Group	Domains	No. of Domains	No. of Elements	No. of Passes	No. of Estimates
4M_C	10,20,32,40,43,46,48,70,71,75	10	13	3	390
8M_C	10,20,32,40,43,46,48,70,71,75	10	13	3	390
				Total	**780**

4M_C = 4m composites; 8M_C = 8m composites

Search neighbourhood ellipsoid orientations were based on the modelled variogram anisotropy, but in some cases the orientations were adjusted to match observed geological orientations where it was judged to be more appropriate. Search ellipsoid dimensions were empirically derived considering the data spacing in each domain. The minimum and maximum number of samples, maximum samples per drillhole, and discretisation array used was the same as that used for head assay estimates. As was the case with the estimation of the head assays, a unique pass variable was used to control which search passes were being executed. An example of the search neighbourhoods used in the _C estimation is shown in Table 10.25.

Table 10.25 – Search neighbourhood parameters for MASSREC, Fe, SiO_2 and S _c estimates in domain MTS 40.

		Search Orientation			Search Dimensions			Sample Numbers		
Element	Pass	Bearing	Plunge	Dip	Major	Semi	Minor	Min	Max	DDH
MASSREC	1	4	-15	26	50	30	50	5	9	2
	2	4	-15	26	100	60	100	5	9	2
	3	4	-15	26	150	120	150	5	9	2
Fe	1	4	-15	26	50	30	50	5	9	2
	2	4	-15	26	100	60	100	5	9	2
	3	4	-15	26	150	120	150	5	9	2
SiO_2	1	-15	13	34	50	30	50	5	9	2
	2	-15	13	34	100	60	100	5	9	2
	3	-15	13	34	150	120	150	5	9	2
S	1	-40	83	34	50	30	50	5	9	2
	2	-40	83	34	100	60	100	5	9	2
	3	-40	83	34	150	120	150	5	9	2

The _c estimation used the same local (dynamic) anisotropy approach (Figure 10.40) for the same domains, as described for head grade estimation. Sample selection criteria, block selection criteria, and sample limits were similarly structured to those for the head assay estimates (Table 10.26 to Table 10.28).

	Estimation ID	Standard Bearing	Bearing (Z)	Standard Plunge	Plunge (Y)	Standard Dip	Dip (X)	Alternative Bearing	Alternative Bearing Variable	Alternative Plunge	Alternative Plunge Variable	Alternative Dip	Alternative Dip Variable	Standard Major Axis	Major Axis	Standard Semi-Major Axis	Semi-Major Axis	Standard Minor Axis	Minor Axis
al2o3_c_1	al2o3_c_1	☐	-58.0	☐	76.0	☐	67.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	50.0	☑	30.0	☑	50.0
al2o3_c_2	al2o3_c_2	☐	-58.0	☐	76.0	☐	67.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	100.0	☑	60.0	☑	100.0
al2o3_c_3	al2o3_c_3	☐	-58.0	☐	76.0	☐	67.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	150.0	☑	120.0	☑	150.0
cao_c_1	cao_c_1	☐	13.0	☐	-32.0	☐	4.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	50.0	☑	30.0	☑	50.0
cao_c_2	cao_c_2	☐	13.0	☐	-32.0	☐	4.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	100.0	☑	60.0	☑	100.0
cao_c_3	cao_c_3	☐	13.0	☐	-32.0	☐	4.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	150.0	☑	120.0	☑	150.0
fe_c_1	fe_c_1	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	50.0	☑	30.0	☑	50.0
fe_c_2	fe_c_2	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	100.0	☑	60.0	☑	100.0
fe_c_3	fe_c_3	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	150.0	☑	120.0	☑	150.0
massrec_1	massrec_1	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	50.0	☑	30.0	☑	50.0
massrec_2	massrec_2	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	100.0	☑	60.0	☑	100.0
massrec_3	massrec_3	☐	-1.0	☐	-2.0	☐	-1.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	150.0	☑	120.0	☑	150.0
k2o_c_1	k2o_c_1	☐	17.0	☐	-32.0	☐	25.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	50.0	☑	30.0	☑	50.0
k2o_c_2	k2o_c_2	☐	17.0	☐	-32.0	☐	25.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	100.0	☑	60.0	☑	100.0
k2o_c_3	k2o_c_3	☐	17.0	☐	-32.0	☐	25.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	150.0	☑	120.0	☑	150.0
loi_10_c_1	loi_10_c_1	☐	-29.0	☐	-6.0	☐	76.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	50.0	☑	30.0	☑	50.0
loi_10_c_2	loi_10_c_2	☐	-29.0	☐	-6.0	☐	76.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	100.0	☑	60.0	☑	100.0
loi_10_c_3	loi_10_c_3	☐	-29.0	☐	-6.0	☐	76.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	150.0	☑	120.0	☑	150.0
mgo_c_1	mgo_c_1	☐	-103.0	☐	41.0	☐	17.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	50.0	☑	30.0	☑	50.0
mgo_c_2	mgo_c_2	☐	-103.0	☐	41.0	☐	17.0	☑	d_bearin	☑	d_plunge	☑	d_dip	☑	100.0	☑	60.0	☑	100.0

Figure 10.40 – Extract from the _c estimation parameter file for domain ESZ 75 showing the use of local (dynamic) anisotropy (blue) in preference to global anisotropy (brown) for the search orientations used in estimation.

Table 10.26 – Sample selection and block selection criteria for MASSREC and Fe concentrate grade in domain MTS 40 for blocks estimated at a 20 x 25 x 8m support.

Estimate	Pass Number	Assay Field	Sample Group	Sample Selection Criteria By Condition	Block Selection Criteria By Wireframe	Block Selection Criteria By Condition
Fe	1	FE_C	8M_C	GEOZONE 40, FE_C 0&100	-	space eq 1 and geozone eq 40 and pass_fe_c eq 0 and yworld le 19325
	2	FE_C	8M_C	GEOZONE 40, FE_C 0&100	-	space eq 1 and geozone eq 40 and pass_fe_c eq 0 and yworld le 19325
	3	FE_C	8M_C	GEOZONE 40, FE_C 0&100	-	space eq 1 and geozone eq 40 and pass_Fe_c eq 0 and yworld le 19325
MASSREC	1	MASSREC	8M_C	GEOZONE 40, MASSREC 0&100	-	space eq 1 and geozone eq 40 and pass_massrec eq 0 and yworld le 19325
	2	MASSREC	8M_C	GEOZONE 40, MASSREC 0&100	-	space eq 1 and geozone eq 40 and pass_massrec eq 0 and yworld le 19325
	3	MASSREC	8M_C	GEOZONE 40, MASSREC 0&100	-	space eq 1 and geozone eq 40 and pass_massrec eq 0 and yworld le 19325

Table 10.27 – Sample selection and block selection criteria for SiO_2 and S concentrate grade in domain MSU 48 for blocks estimated at a 20 x 25 x 4m support.

Estimate	Pass Number	Assay Field	Sample Group	Sample Selection Criteria By Condition	Block Selection Criteria By Wireframe	Block Selection Criteria By Condition
SiO_2	1	SIO2_C	4M_C	GEOZONE 48, SIO2_C 0&100	-	space eq 0 and geozone eq 48 and pass_sio2_c eq 0 and yworld le 19325
	2	SIO2_C	4M_C	GEOZONE 48, SIO2_C 0&100	-	space eq 0 and geozone eq 48 and pass_sio2_c eq 0 and yworld le 19325
	3	SIO2_C	4M_C	GEOZONE 48, SIO2_C 0&100	-	space eq 0 and geozone eq 48 and pass_sio2_c eq 0 and yworld le 19325
S	1	S_C	4M_C	GEOZONE 48, S_C 0&100	-	space eq 0 and geozone eq 48 and pass_s_c eq 0 and yworld le 19325
	2	S_C	4M_C	GEOZONE 48, S_C 0&100	-	space eq 0 and geozone eq 48 and pass_s_c eq 0 and yworld le 19325
	3	S_C	4M_C	GEOZONE 48, S_C 0&100	-	space eq 0 and geozone eq 48 and pass_s_c eq 0 and yworld le 19325

Table 10.28 – Sample selection and block selection criteria for MASSREC and K_2O concentrate grade in domain ESZ 75 for blocks estimated at a 20 x 25 x 4m support.

Estimate	Pass Number	Assay Field	Sample Group	Sample Selection Criteria By Condition	Block Selection Criteria By Wireframe	Block Selection Criteria By Condition
MASSREC	1	MASSREC	4M_C	GEOZONE 75,46 MASSREC 0&100	-	space eq 0 and geozone eq 75 and pass_massrec eq 0
	2	MASSREC	4M_C	GEOZONE 75,46 MASSREC 0&100	-	space eq 0 and geozone eq 75 and pass_massrec eq 0
	3	MASSREC	4M_C	GEOZONE 75,46 MASSREC 0&100	-	space eq 0 and geozone eq 75 and pass_massrec eq 0
K_2O	1	K2O_C	4M_C	GEOZONE 75,46 K2O_C 0&100	-	space eq 0 and geozone eq 75 and pass_k2o_c eq 0
	2	K2O_C	4M_C	GEOZONE 75,46 K2O_C 0&100	-	space eq 0 and geozone eq 75 and pass_k2o_c eq 0
	3	K2O_C	4M_C	GEOZONE 75,46 K20_C 0&100	-	space eq 0 and geozone eq 75 and pass_k2o_c eq 0

As was the case with the head grade estimates, concentrate grade estimates were also subject to spatial high yield policies so that the smearing of extreme assay values to blocks was avoided. The same empirical approach of estimation, initial high yield application, validation, and re-estimation with revised high yield was performed for all elements in all domains. Due to the nature of the concentrate assays (magnetic proportion of sample only) most elements showed very low variability, and in many cases the high yield threshold was set between the 95th and 99th percentile of the population. Some exceptions were noted, such as for S% and P% concentrate grades, but thresholds were always determined from visual validation of estimates, regardless of the element being reviewed. Examples of some high yield thresholds for the concentrate estimation are shown in Table 10.29 and Table 10.30.

Table 10.29 – Examples of high yield thresholds in domain MTS 40 for blocks estimated at a 20 x 25 x 8m support.

			Ellipsoid Dimension			Ellipsoid Orientation		
Estimate	Pass	Value	Major	Semi	Minor	Bearing	Plunge	Dip
Al_2O_3	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.87	20.0	25.0	8.0	3	2	3
CaO	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.86	20.0	25.0	8.0	24	2	84
Fe	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	71.627	20.0	25.0	8.0	4	-15	26
MASSREC	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	70.154	20.0	25.0	8.0	4	-15	26
MgO	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	5.788	20.0	25.0	8.0	33	-38	-10
Mn	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.339	20.0	25.0	8.0	-7	1	-2
Na_2O	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.19	20.0	25.0	8.0	-69	9	118
SiO_2	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	24.935	20.0	25.0	8.0	-15	34	13
S	1	-	-	-	-	-	-	-
	2	0.695	20.0	25.0	8.0	-40	34	83
	3	0.695	20.0	25.0	8.0	-40	34	83
P	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.047	20.0	25.0	8.0	8	-22	18

Table 10.30 – Examples of high yield thresholds in domain BSQ 70 for blocks estimated at a 20 x 25 x 4m support.

			Ellipsoid Dimension			Ellipsoid Orientation		
Estimate	Pass	Value	Major	Semi	Minor	Bearing	Plunge	Dip
Al_2O_3	1	-	-	-	-	-	-	-
	2	1.0	20.0	25.0	4.0	0	-9	86
	3	0.85	20.0	25.0	4.0	0	-9	86
CaO	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	2.858	20.0	25.0	4.0	-6	-16	0
Fe	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	72.992	20.0	25.0	4.0	-14	8	18
MASSREC	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	43.678	20.0	25.0	4.0	-14	8	18
MgO	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	4.891	20.0	25.0	4.0	-1	11	-5
Mn	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.696	20.0	25.0	4.0	-6	-19	9
Na_2O	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.324	20.0	25.0	4.0	19	5	29
SiO_2	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	20.762	20.0	25.0	4.0	-3	-7	-3
S	1	10.0	20.0	25.0	4.0	-1	16	-36
	2	7.0	20.0	25.0	4.0	-1	16	-36
	3	3.0	20.0	25.0	4.0	-1	16	-36
P	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	0.037	20.0	25.0	4.0	-3	11	61

Blocks not estimated by the final estimation pass were assigned the median value of the blocks estimated in the 1st to 4th pass, calculated from EDA on the blocks, on a domain basis. Figure 10.41 shows examples on how un-estimated blocks were assigned for three domains.

```
if (geozone eq 10) then
   if (al2o3_c eq -999) then
      al2o3_c = 0.2513
      pass_al2o3_c = 9
   endif
   if (cao_c eq -999) then
      cao_c = 0.2918
      pass_cao_c = 9
   endif
   if (fe_c eq -999) then
      fe_c = 67.8348
      pass_fe_c = 9
   endif
   if (k2o_c eq -999) then
      k2o_c = 0.0041
      pass_k2o_c = 9
   endif
   if (loi_10_c eq -999) then
      loi_10_c = 8.8028
      pass_loi_10_c = 9
   endif
   if (massrec eq -999) then
      massrec = 21.5375
      pass_massrec = 9
   endif
   if (mgo_c eq -999) then
      mgo_c = 0.6253
      pass_mgo_c = 9
   endif
   if (mn_c eq -999) then
      mn_c = 0.0757
      pass_mn_c = 9
   endif
   if (na2o_c eq -999) then
      na2o_c = 0.0177
      pass_na2o_c = 9
   endif
   if (p_c eq -999) then
      p_c = 0.0126
      pass_p_c = 9
   endif
   if (s_c eq -999) then
      s_c = 0.036
      pass_s_c = 9
   endif
   if (sio2_c eq -999) then
      sio2_c = 2.3977
      pass_sio2_c = 9
   endif
   if (tio2_c eq -999) then
      tio2_c = 0.0693
      pass_tio2_c = 9
   endif
endif
```

```
if (geozone eq 40) then
   if (al2o3_c eq -999) then
      al2o3_c = 0.0432
      pass_al2o3_c = 9
   endif
   if (cao_c eq -999) then
      cao_c = 0.1002
      pass_cao_c = 9
   endif
   if (fe_c eq -999) then
      fe_c = 64.8414
      pass_fe_c = 9
   endif
   if (k2o_c eq -999) then
      k2o_c = 0.0022
      pass_k2o_c = 9
   endif
   if (loi_10_c eq -999) then
      loi_10_c = 7.3028
      pass_loi_10_c = 9
   endif
   if (massrec eq -999) then
      massrec = 32.4848
      pass_massrec = 9
   endif
   if (mgo_c eq -999) then
      mgo_c = 0.3889
      pass_mgo_c = 9
   endif
   if (mn_c eq -999) then
      mn_c = 0.0491
      pass_mn_c = 9
   endif
   if (na2o_c eq -999) then
      na2o_c = 0.0102
      pass_na2o_c = 9
   endif
   if (p_c eq -999) then
      p_c = 0.0092
      pass_p_c = 9
   endif
   if (s_c eq -999) then
      s_c = 0.0275
      pass_s_c = 9
   endif
   if (sio2_c eq -999) then
      sio2_c = 9.1879
      pass_sio2_c = 9
   endif
   if (tio2_c eq -999) then
      tio2_c = 0.0163
      pass_tio2_c = 9
   endif
endif
```

```
if (geozone eq 48) then
   if (al2o3_c eq -999) then
      al2o3_c = 0.0634
      pass_al2o3_c = 9
   endif
   if (cao_c eq -999) then
      cao_c = 0.1966
      pass_cao_c = 9
   endif
   if (fe_c eq -999) then
      fe_c = 66.9497
      pass_fe_c = 9
   endif
   if (k2o_c eq -999) then
      k2o_c = 0.0031
      pass_k2o_c = 9
   endif
   if (loi_10_c eq -999) then
      loi_10_c = 7.4827
      pass_loi_10_c = 9
   endif
   if (massrec eq -999) then
      massrec = 23.4071
      pass_massrec = 9
   endif
   if (mgo_c eq -999) then
      mgo_c = 0.5159
      pass_mgo_c = 9
   endif
   if (mn_c eq -999) then
      mn_c = 0.0692
      pass_mn_c = 9
   endif
   if (na2o_c eq -999) then
      na2o_c = 0.0122
      pass_na2o_c = 9
   endif
   if (p_c eq -999) then
      p_c = 0.0047
      pass_p_c = 9
   endif
   if (s_c eq -999) then
      s_c = 0.3101
      pass_s_c = 9
   endif
   if (sio2_c eq -999) then
      sio2_c = 4.5632
      pass_sio2_c = 9
   endif
   if (tio2_c eq -999) then
      tio2_c = 0.0245
      pass_tio2_c = 9
   endif
endif
```

Figure 10.41 – Extract from a script showing how an un-estimated block is assigned a value for a concentrate grade estimate in domain AMP 10, MTS 40 and MSU 48. The actual values are derived by analysing the statistics of the estimated blocks on a domain basis.

10.4.7 Net Acid Production Potential (NAPP) Estimation

The potential for acid forming waste rock occurs primarily within the MSU 48 and BSQ 70 domains, in which visible pyrite, pyrrhotite and elevated S% assays are regularly observed and assayed (Figure 10.42) and have the potential to generate acid rock drainage when stored on surface waste rock dumps. Reliable estimates of the net acid production potential (NAPP), acid neutralising capacity (ANC), and maximum potential acidity (MPA) of the rock to be mined, are thus required for integrated waste landform design. Since all mine planning and scheduling activities are performed on a block basis, a change of support is required between the analysed samples and blocks, achieved using traditional estimation with enough samples.

Based on experiences modelling density using multiple linear regression techniques, a comprehensive revision of the May 2023 NAPP regression modelling technique was undertaken. Based strictly on the underlying geology, updated multiple linear regression modelling was used to provide predictions of NAPP from head assay sample locations with sufficient analytes. The dependant variable was the NAPP analysis from the original 978 naïve samples, and the independent variables several head assay analytes, all composited to 2m lengths.

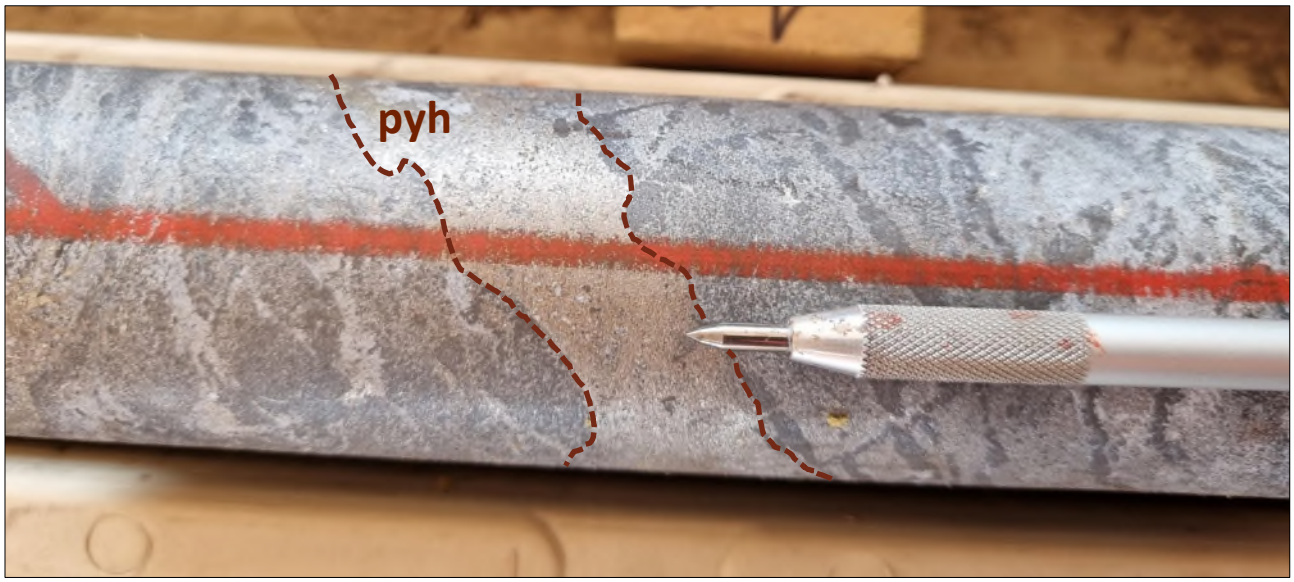


Figure 10.42 – Core sample photograph of typical MSU 48 showing thick 2-3cm band of pyrrhotite sulphide.

Initial experimental multiple linear regression was performed using all available analytes, which can be broadly grouped as:

- Primary: Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, P, S, SiO_2, TiO_2
- Secondary: Ba, Cu, Pb, Zn, V
- Tertiary: As, Co, Cr, Ni, Sn

Whilst validating the resulting models, a key consideration was the availability of the secondary and tertiary analytes at the head assay locations in all domains across the deposit since these head assay locations are critical for the robust generation of NAPP estimates at the block support. Whilst some regression models with a combination of the primary + secondary analytes, or the primary + tertiary analytes, or all three, often provided the best theoretical prediction of NAPP at the sample support, from a practical point of view the models would be unusable as many sample locations were not assayed for these secondary and/or tertiary analytes.

It was found through empirical observation that there was no material difference between models based on whether they were constructed from primary analytes only, or combinations of primary, secondary, and tertiary analytes (Figure 10.43).

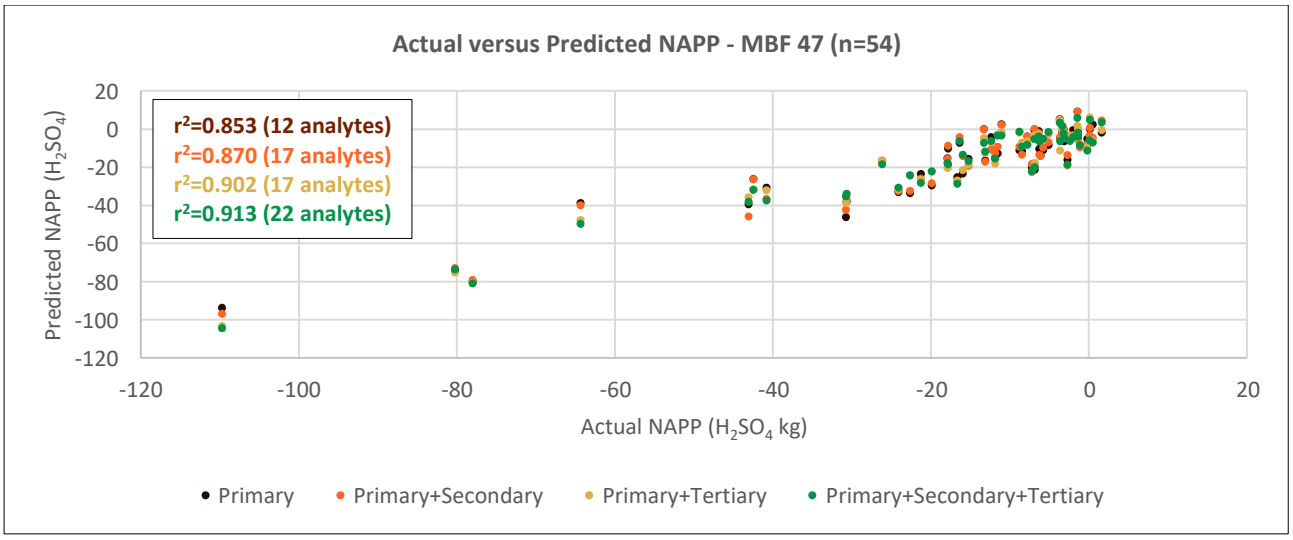


Figure 10.43 – Plot of actual versus predicted NAPP for domain MBF 47 based on 4 variants of a regression model.

In fact, predictions based on the 12 primary analytes performed no worse than models based on combinations of other analyte groups as demonstrated in Figure 10.44 and was the basis for final models across all the domains.

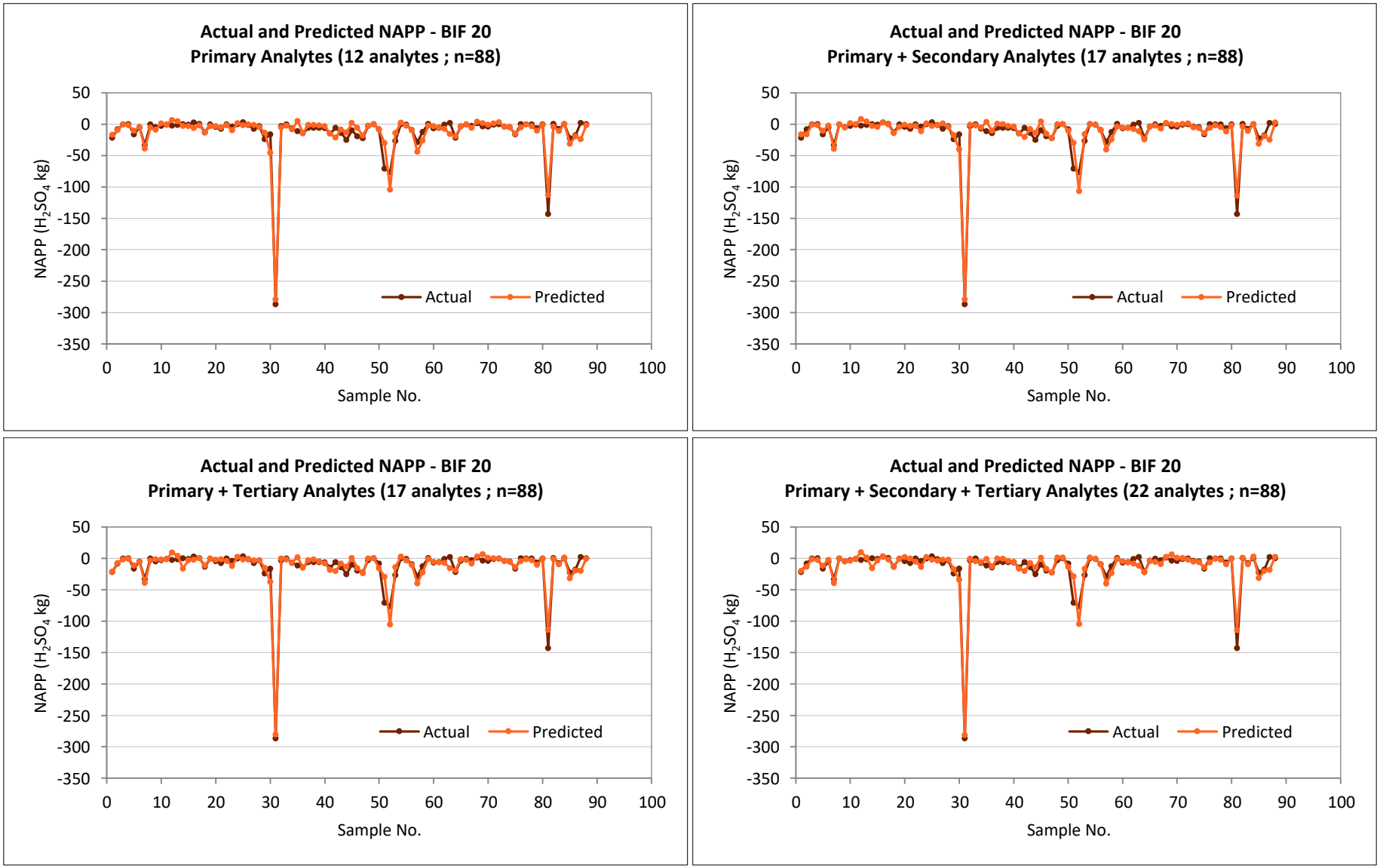


Figure 10.44 – Plot of actual and predicted NAPP for four variants of a regression model for BIF 20. A prediction for NAPP using the 12 primary analytes (TOP LEFT) is just as good as a prediction using 17 or 22 analytes, but infinitely more useful once NAPP is estimated to blocks for practical mine planning activities.

The final regression models are shown in Figure 10.45 to Figure 10.56 and summarised in Table 10.31. Outliers in the regression models were dealt with in the same manner as that used for density regression modelling.

Several domains had an insufficient number of NAPP analysis samples to generate reliable regression models, and were modelled as:

- MTC 43 - combined with MTS 40
- HEC 32 - combined with HEO 30
- BSQ 70 - based on 9 analytes
- DOM 71 - based on MTS, MTC and MSU NAPP samples with similar values of CaO, MgO and SiO_2 for head assays in this domain.

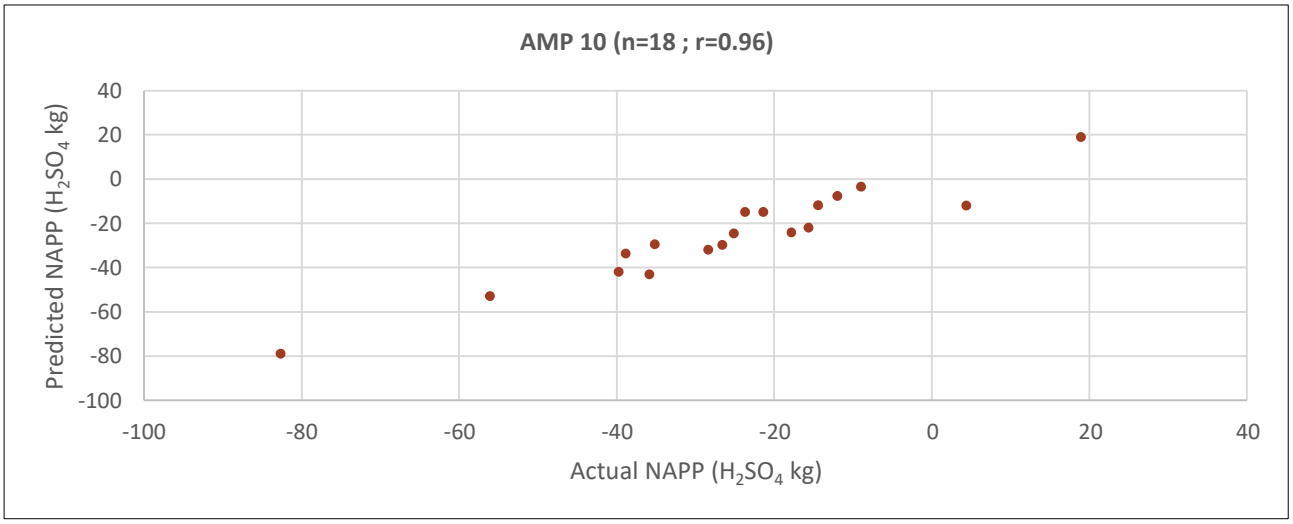


Figure 10.45 – Multiple linear regression model for NAPP in AMP 10.

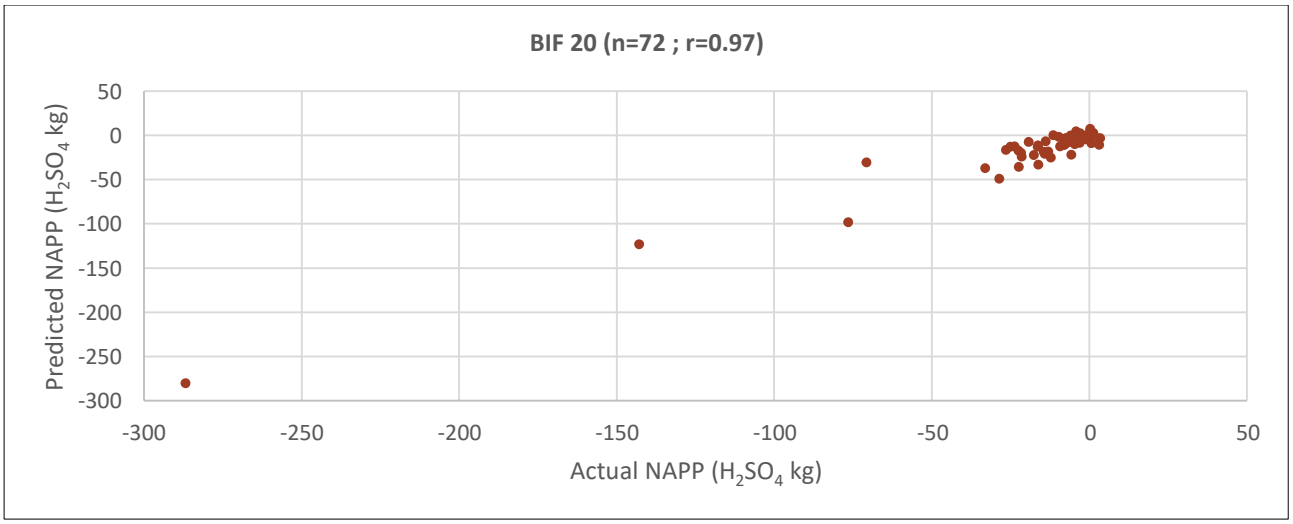


Figure 10.46 – Multiple linear regression model for NAPP in BIF 20.

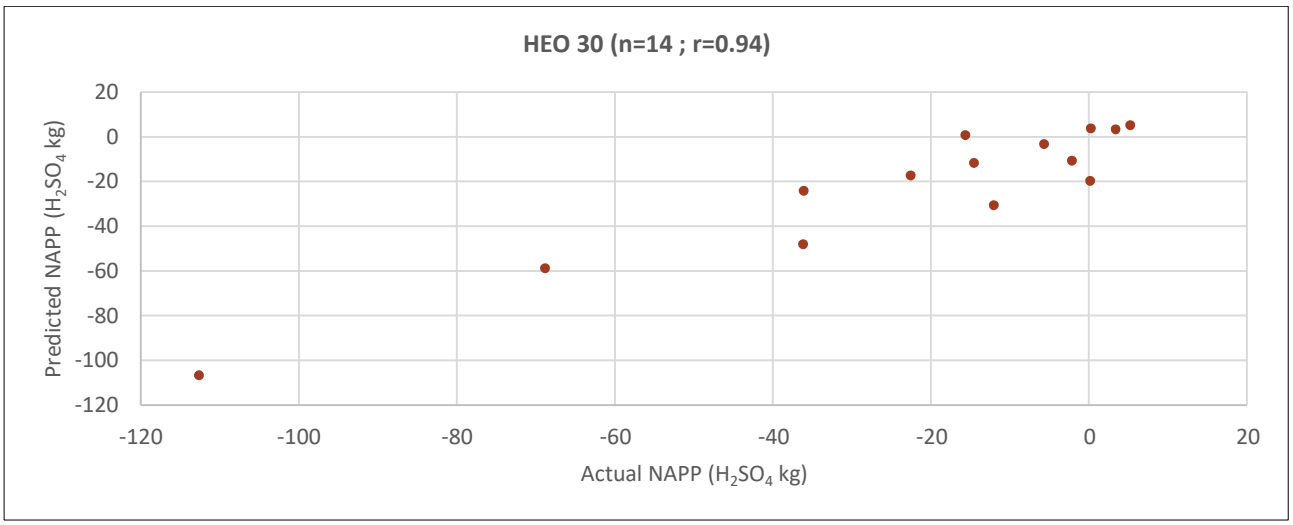


Figure 10.47 – Multiple linear regression model for NAPP in HEO 30.

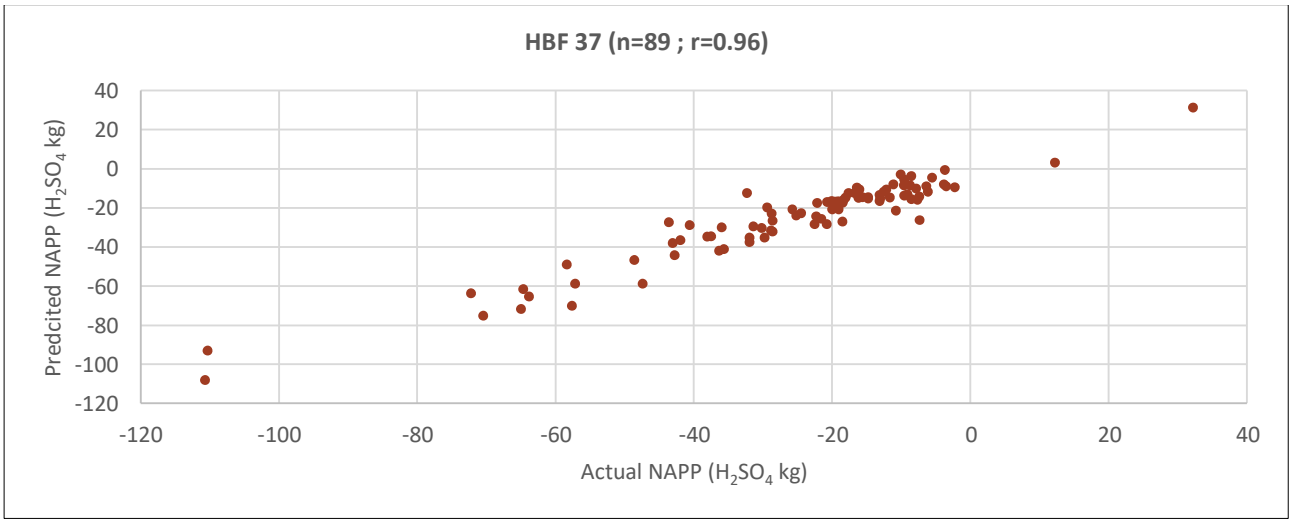


Figure 10.48 – Multiple linear regression model for NAPP in HBF 37.

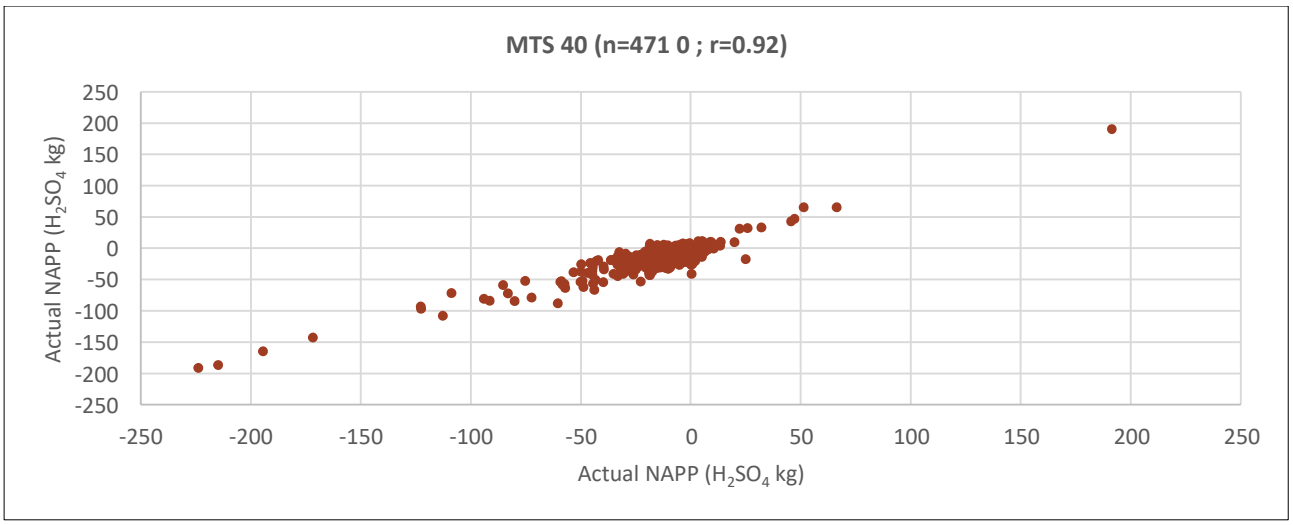


Figure 10.49 – Multiple linear regression model for NAPP in MTS 40.

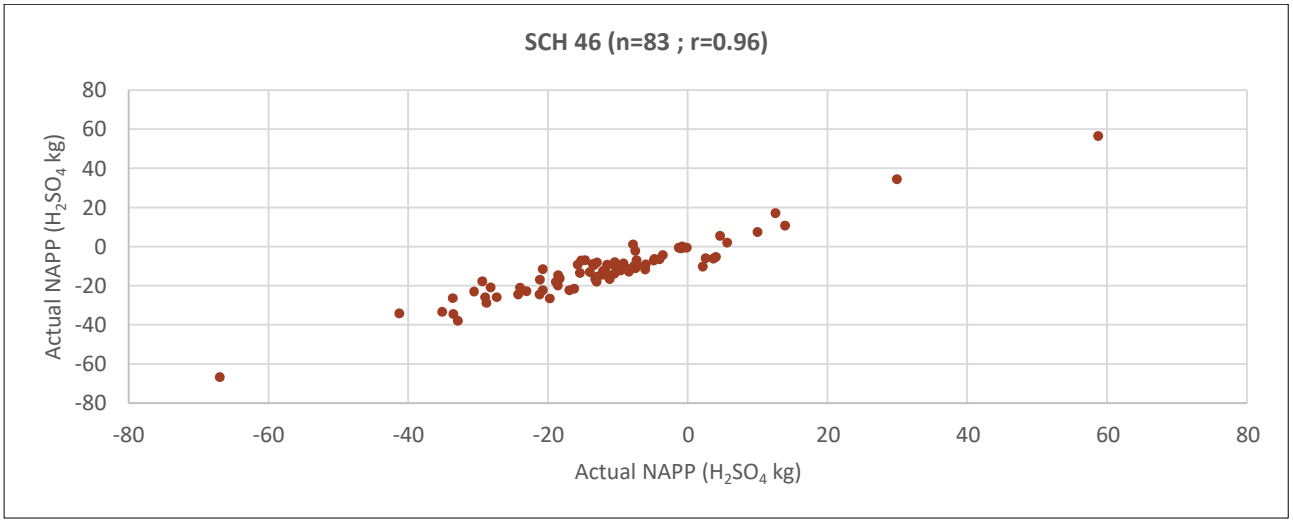


Figure 10.50 – Multiple linear regression model for NAPP in SCH 46.

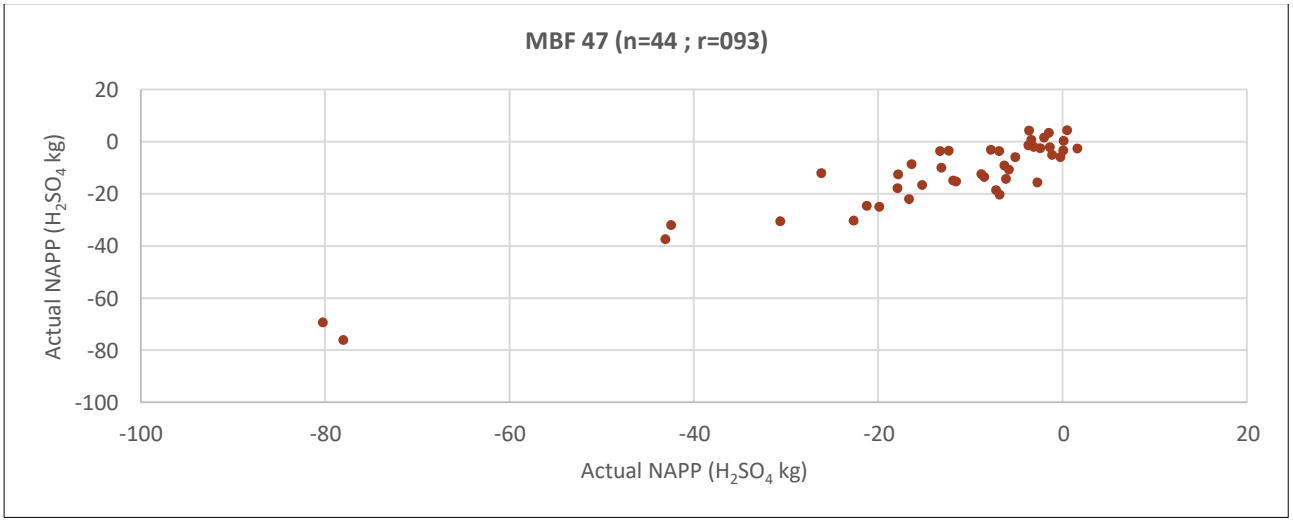


Figure 10.51 – Multiple linear regression model for NAPP in MBF 47.

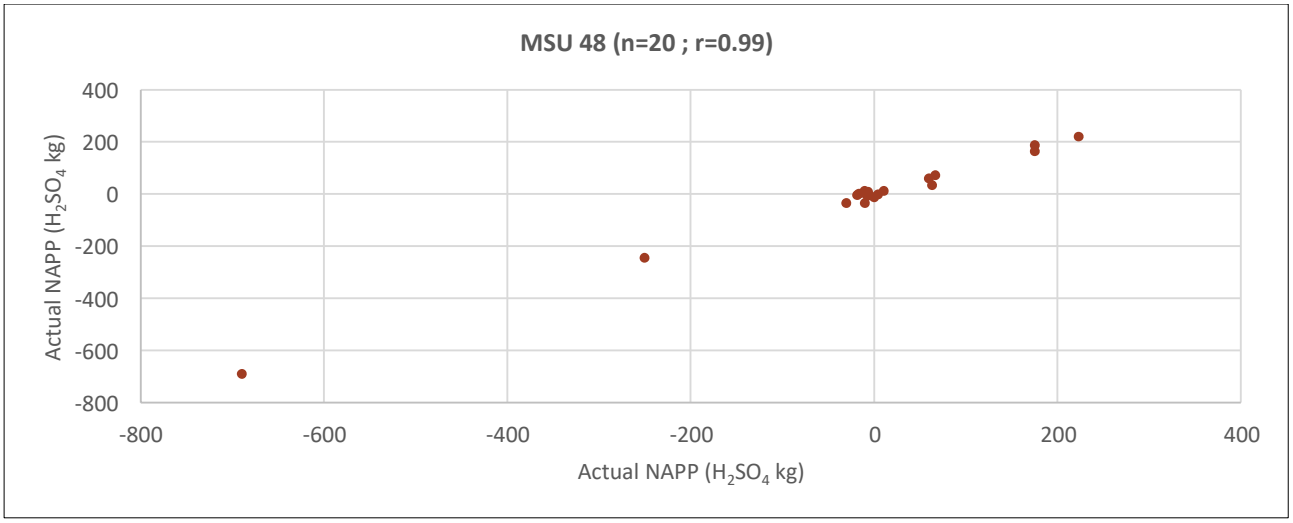


Figure 10.52 – Multiple linear regression model for NAPP in MSU 48.

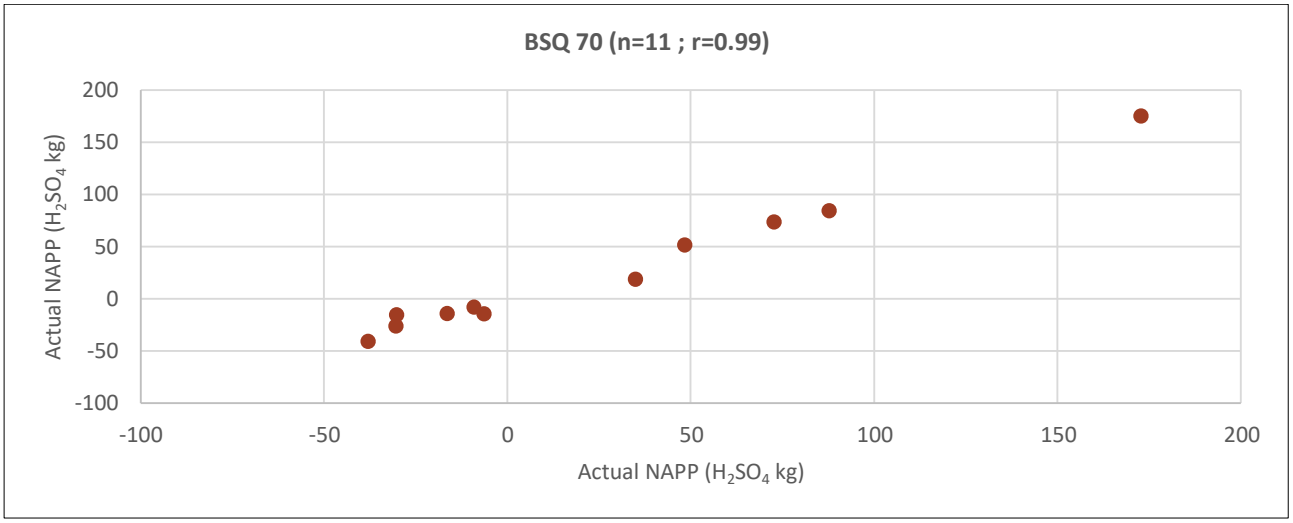


Figure 10.53 – Multiple linear regression model for NAPP in BSQ 70.

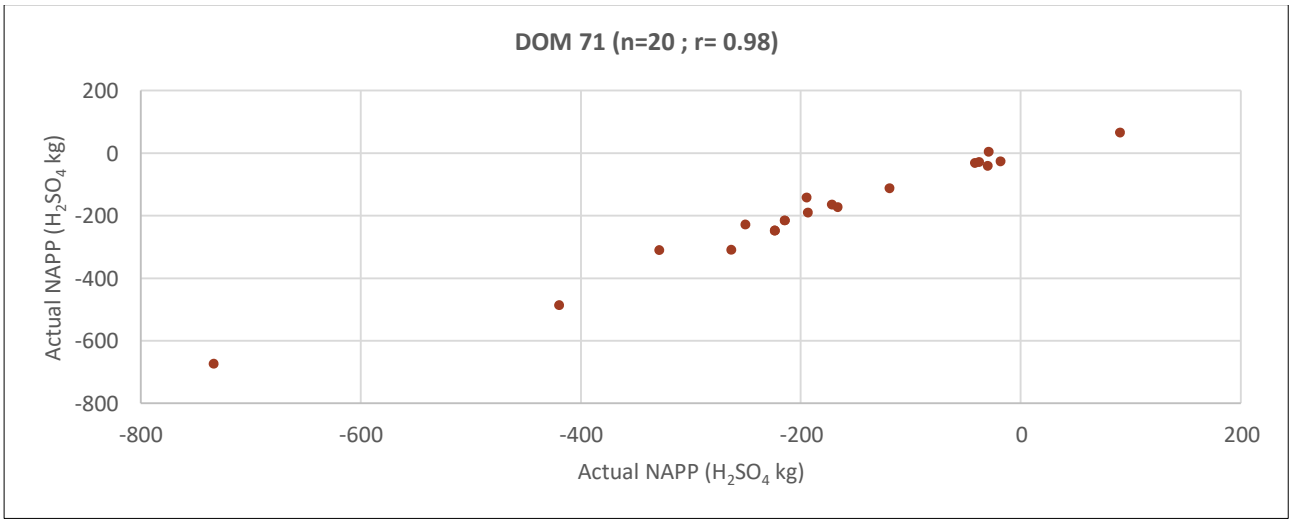


Figure 10.54 – Multiple linear regression model for NAPP in DOM 71.

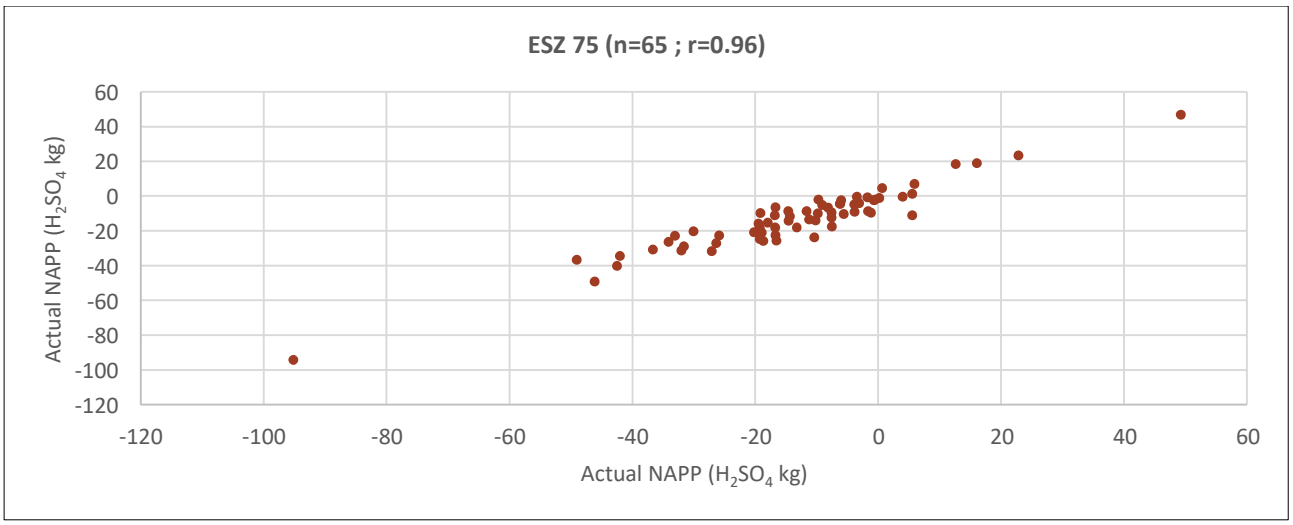


Figure 10.55 – Multiple linear regression model for NAPP in ESZ 75.

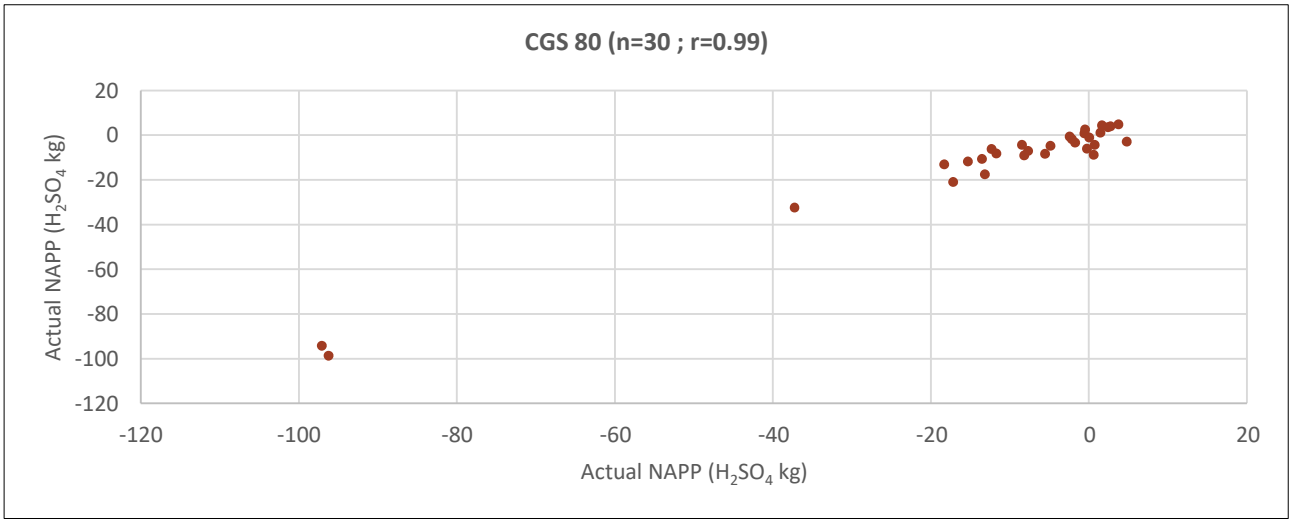


Figure 10.56 – Multiple linear regression model for NAPP in CGS 80.

Table 10.31 – Regression equations for NAPP predictions at the 2m composite sample support.

Domain	Analytes	Regression Equation
AMP10	12	-1053 + 14.035*al2o3 + 3.258*cao + 15.328*fe + 102.378*k2o - 0.745*loi + 11.907*mgo - 36.683*mn - 17.98*na2o - 448.413*p + 46.583*s + 10.514*sio2 + 30.583*tio2
BIF 20	12	-1282 + 14.434*al2o3 - 5.041*cao + 19.039*fe + 16.811*k2o + 7.093*loi + 11.042*mgo + 11.505*mn + 28.035*na2o + 57.625*p + 32.587*s + 12.799*sio2 + 14.859*tio2
HEO 30	12	-8028 + 83.819*al2o3 + 75.373*cao + 115.054*fe - 447.494*k2o + 113.637*loi + 69.899*mgo - 983.683*mn - 165.782*na2o + 70.491*p - 22.251*s + 86.953*sio2 + 529.324*tio2
* HEC 32	-	-8028 + 83.819*al2o3 + 75.373*cao + 115.054*fe - 447.494*k2o + 113.637*loi + 69.899*mgo - 983.683*mn - 165.782*na2o + 70.491*p - 22.251*s + 86.953*sio2 + 529.324*tio2
HBF 37	12	340.852 - 3.474*al2o3 - 29.125*cao - 5.043*fe - 148.455*k2o - 5.104*loi - 3.255*mgo - 20.169*mn - 29.786*na2o + 38.979*p + 28.621*s - 3.413*sio2 - 26.972*tio2
MTS 40	12	-182.467 + 8.852*al2o3 - 13.722*cao + 2.181*fe + 4.893*k2o - 4.122*loi + 1.674*mgo - 3.165*mn + 24.505*na2o + 32.438*p + 35.003*s + 1.978*sio2 - 29.751*tio2
* MTC 43	-	-182.467 + 8.852*al2o3 - 13.722*cao + 2.181*fe + 4.893*k2o - 4.122*loi + 1.674*mgo - 3.165*mn + 24.505*na2o + 32.438*p + 35.003*s + 1.978*sio2 - 29.751*tio2
SCH 46	12	-543.256 + 9.669*al2o3 - 10.118*cao + 7.759*fe + 2.347*k2o + 1.727*loi + 5.813*mgo - 16.02*mn + 11.911*na2o + 22.086*p + 37.698*s + 5.326*sio2 - 4.657*tio2
MBF 47	12	1234 - 1.581*al2o3 - 37.218*cao - 17.796*fe + 39.633*k2o - 16.28*loi - 14.113*mgo - 23.246*mn - 30.405*na2o + 106.667*p + 44.003*s - 12.273*sio2 - 10.977*tio2
MSU 48	12	-1062 + 9.837*al2o3 - 6.699*cao + 16.777*fe + 400.23*k2o + 9.577*loi + 12.371*mgo + 40.072*mn - 255.215*na2o - 1659*p + 28.67*s + 10.577*sio2 + 90.532*tio2
BSQ 70	9	3796 - 68.473*al2o3 - 18.373*cao - 56.553*fe - 41.353*loi - 31.541*mgo - 136.852*mn + 29.185*s - 39.046*sio2 + 100.015*tio2
DOM 71	12	8173 - 42.461*al2o3 - 97.882*cao - 112.51*fe - 4120*k2o - 100.268*loi - 87.043*mgo + 35.174*mn - 251.19*na2o - 1575*p + 174.829*s - 82.373*sio2 - 191.95*tio2
ESZ 75	12	-991.522 + 8.515*al2o3 - 3.539*cao + 14.194*fe + 35.645*k2o + 6.042*loi + 9.148*mgo - 9.248*mn + 30.877*na2o - 66.389*p + 31.735*s + 9.945*sio2 + 34.105*tio2
CGS 80	12	1931 - 20.826*al2o3 - 38.566*cao - 27.581*fe - 16.169*k2o - 18.629*loi - 20.211*mgo - 68.816*mn - 11.383*na2o - 129.965*p + 13.463*s - 19.355*sio2 + 7.751*tio2

* HEC 32 uses the HEO 30 regression equation

* MTC 43 uses the MTS 40 regression equation

Models were validated prior to estimation using similar techniques to that adopted for density modelling, with plots of actual and predicted NAPP being the primary means of judging the appropriateness of the models (Figure 10.57 and Figure 10.58).

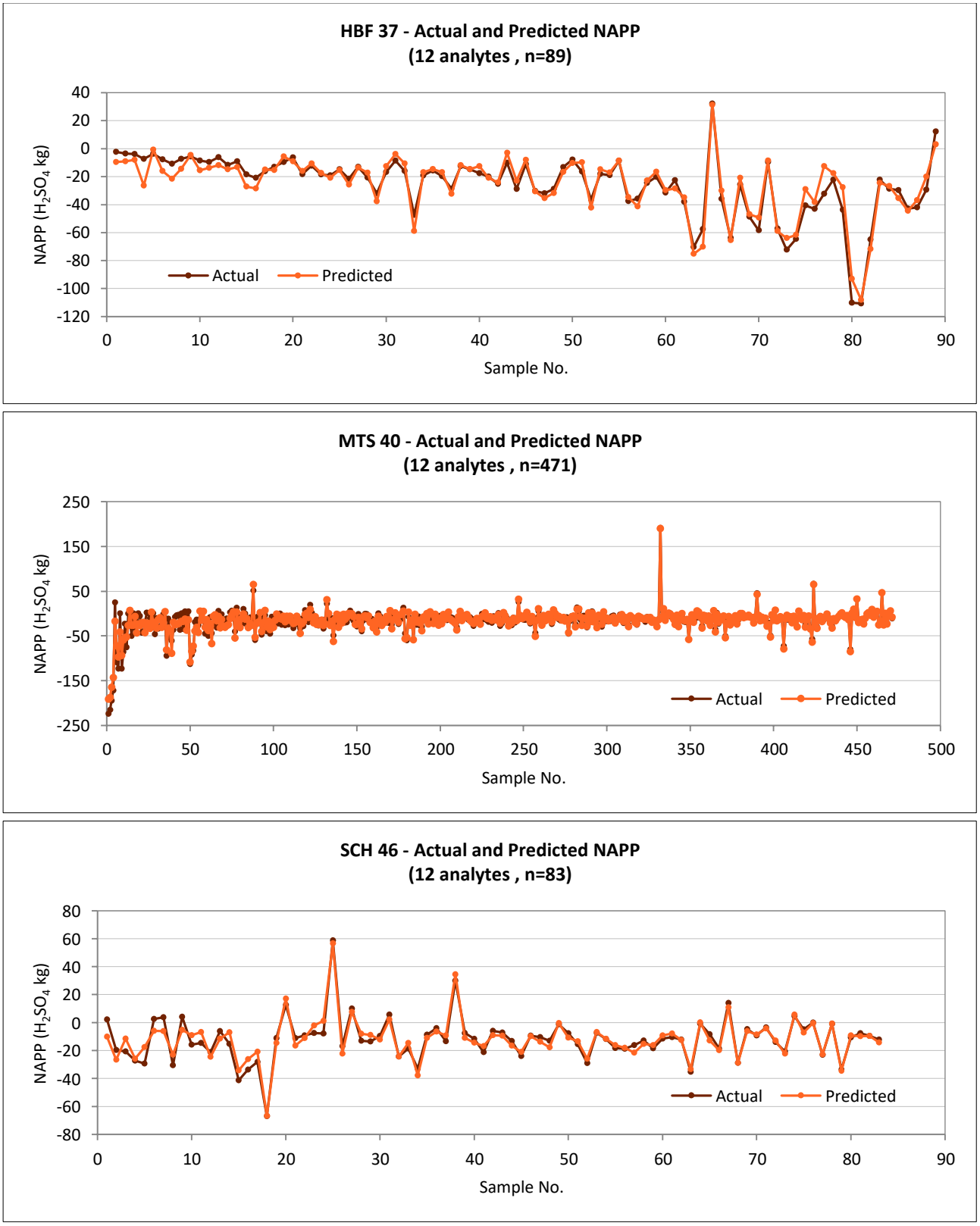


Figure 10.57 – Actual and predicted NAPP for HBF 37 (TOP), MTS 40 (MIDDLE) and SCH 46 (BOTTOM) for each sample in the regression model. The closer the lines are to each other, the better the regression model is at predicting density from the analytes used in the regression.

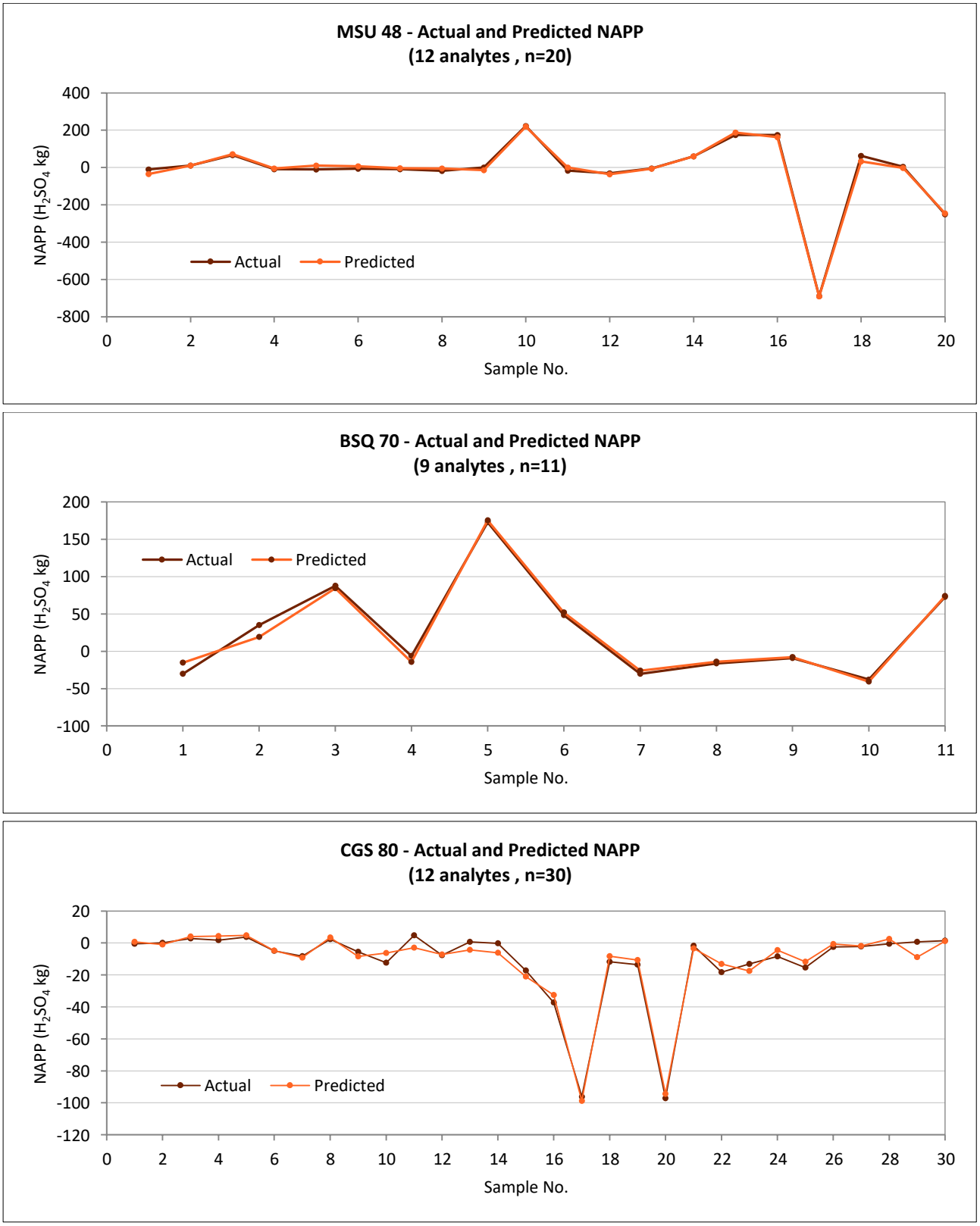


Figure 10.58 – Actual and predicted NAPP for MSU 48 (TOP), BSQ 70 (MIDDLE) and CGS 80 (BOTTOM) for each sample in the regression model. The closer the lines are to each other, the better the regression model is at predicting density from the analytes used in the regression.

Once the regression models were validated, the final equations (Table 10.31) were used to calculate a NAPP value at the 2m head assay composite locations (Figure 10.59).

```
25    if (GEOZONE eq 30 or GEOZONE eq 32) then
26      napp = -8028 + 83.819*AL2O3_H + 75.373*CAO_H + 115.054*FE_H - 447.494*K2O_H + 113.637*LOI_H + 69.899*MGO_H - 983.683*MN_H - 165.782*NA2O_H + 70.491*P_H - 22.251*S_H + 86.953*SIO2_H + 529.324*TIO2_H
27      if (napp lt -112) then
28        napp = -112
29      endif
30      if (napp gt 6) then
31        napp = 6
32      endif
33    endif
34    if (GEOZONE eq 37) then
35      napp = 340.852 - 3.474*AL2O3_H - 29.125*CAO_H - 5.043*FE_H - 148.455*K2O_H - 5.104*LOI_H - 3.255*MGO_H - 20.169*MN_H - 29.786*NA2O_H + 38.979*P_H + 28.621*S_H - 3.413*SIO2_H - 26.972*TIO2_H
36      if (napp lt -111) then
37        napp = -111
38      endif
39      if (napp gt 35) then
40        napp = 35
41      endif
42    endif
43    if (GEOZONE eq 40 or geozone eq 43) then
44      napp = -182.467 + 8.852*AL2O3_H - 13.722*CAO_H + 2.181*FE_H + 4.893*K2O_H - 4.122*LOI_H + 1.674*MGO_H - 3.165*MN_H + 24.505*NA2O_H + 32.438*P_H + 35.003*S_H + 1.978*SIO2_H - 29.751*TIO2_H
45      if (geozone eq 40 and napp gt 192) then
46        napp = 192
47      endif
48      if (geozone eq 43 and napp lt -735) then
49        napp = -735
50      endif
51      if (geozone eq 43 and napp gt 91) then
52        napp = 91
53      endif
54    endif
55    if (GEOZONE eq 46) then
56      napp = -543.256 + 9.669*AL2O3_H - 10.118*CAO_H + 7.759*FE_H + 2.347*K2O_H + 1.727*LOI_H + 5.813*MGO_H - 16.02*MN_H + 11.911*NA2O_H + 22.086*P_H + 37.698*S_H + 5.326*SIO2_H - 4.657*TIO2_H
57    endif
58    if (GEOZONE eq 47) then
59      napp = 1234 - 1.581*AL2O3_H - 37.218*CAO_H - 17.796*FE_H + 39.633*K2O_H - 16.28*LOI_H - 14.113*MGO_H - 23.246*MN_H - 30.405*NA2O_H + 106.667*P_H + 44.003*S_H - 12.273*SIO2_H - 10.977*TIO2_H
60      if (napp lt -81) then
61        napp = -81
62      endif
63      if (napp gt 2) then
64        napp = 2
65      endif
66    endif
67    if (GEOZONE eq 48) then
68      napp = -1062 + 9.837*AL2O3_H - 6.699*CAO_H + 16.777*FE_H + 400.23*K2O_H + 9.577*LOI_H + 12.371*MGO_H + 40.072*MN_H - 255.215*NA2O_H - 1659*P_H + 28.67*S_H + 10.577*SIO2_H + 90.532*TIO2_H
69      if (napp lt -690) then
70        napp = -690
71      endif
72      if (napp gt 224) then
73        napp = 224
74      endif
75    endif
76    if (GEOZONE eq 70) then
77      napp = 3796 - 68.473*AL2O3_H - 18.373*CAO_H - 56.553*FE_H - 41.353*LOI_H - 31.541*MGO_H - 136.852*MN_H + 29.185*S_H - 39.046*SIO2_H + 100.015*TIO2_H
78      if (napp gt 173) then
79        napp = 173
80      endif
81    endif
```

MTS 40 or MTC 43 domain

Local upper limit for MTS 40

Local lower limit for MTC 43

Local upper limit for MTC 43

Figure 10.59 – Extract from calculation file used to apply NAPP multiple linear regression equations to sample locations in the 2m head assay composite samples file. Key features of calculations are annotated for clarity.

After several iterations of modelling and validation, local lower and upper values were enforced on a domain basis using statistics of the regression where it was judged that the model predictions resulted in a few cases of unrealistically low or high estimates. Maximum potential acidity (MPA) was calculated assuming all S% is associated with pyrite (MPA = S% x 30.6), and acid neutralising capacity (ANC) was calculated for the same samples by subtraction of NAPP from MPA (Figure 10.60).

```
91      if (GEOZONE eq 75) then
92        napp = -991.522 + 8.515*AL2O3_H - 3.539*CAO_H + 14.194*FE_H + 35.645
93      endif
94      if (GEOZONE eq 80) then
95        napp = 1931 - 20.826*AL2O3_H - 38.566*CAO_H - 27.581*FE_H - 16.169*K
96        if (napp gt 10) then
97          napp = 10
98        endif
99      endif
100     if (GEOZONE gt 0) then
101       mpa = s_h * 30.6
102       if (napp gt -999) then
103         anc = mpa - napp
104       endif
105       if (napp eq -999) then
106         mpa = -999
107         anc = -999
108       endif
109     endif
110   endif
111 endif
112
```

Figure 10.60 – Extract from calculation file used to apply NAPP multiple linear regression equations showing the calculation of MPA and ANC.

Experimental variography was performed on NAPP regression predictions for 2m composites as there were too few samples of the original NAPP analysis (n=978) to generate robust variograms at a geological domain level. Variography was performed using similar lag spacings, lag tolerance, distance tolerance, and angular tolerance used for the 2m head assays (Section 10.2.1). The resulting variogram models (two structure nested exponential with practical range) are characterised by low to moderate nugget effect (Figure 10.61) with most of the variance accounted for by the first structure over reasonable short ranges (Table 10.32).

Examples of down-the-hole variograms are shown in Figure 10.62, examples of directional variograms in Figure 10.63, Figure 10.64 and Figure 10.65, and anisotropy rose diagrams in Figure 10.66. Appendix 6 contains all the NAPP variogram models.

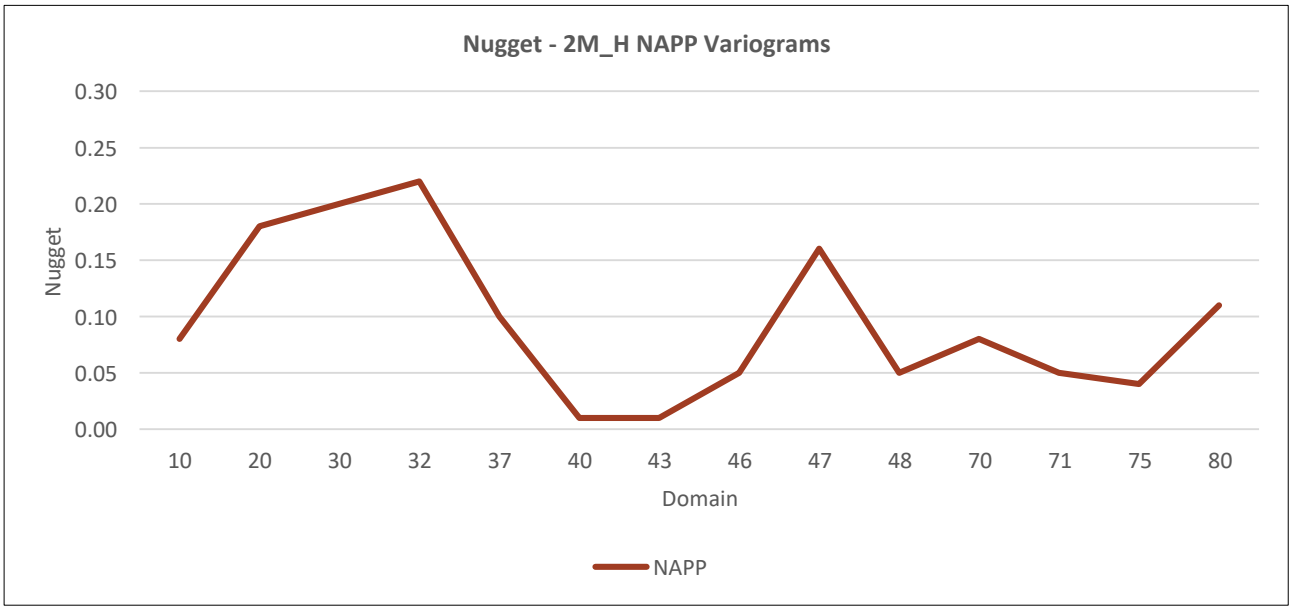


Figure 10.61 – Nugget effect for NAPP for the 2M_H composites across geological domains.

Table 10.32 - Variogram model parameters for NAPP estimates. All models are exponential with practical range.

Element	Domain	Nugget	Exponential Structure 1							Exponential Structure 2						
			Sill	RotZ	RotY	RotX	Major	Semi	Minor	Sill	RotZ	RotY	RotX	Major	Semi	Minor
NAPP	AMP 10	0.08	0.540	-6	-15	72	23.6	56.6	32.8	0.380	-6	-15	72	1040.6	92.1	124.3
	BIF 20	0.18	0.586	-13	-1	79	9.5	26.9	11.6	0.234	-13	-1	79	451.9	49.4	93.9
	HEO 30	0.20	0.447	-89	-6	0	23.5	58.7	49.4	0.353	89	-6	0	1003.9	355.3	110.9
	HEC 32	0.22	0.351	-1	-6	-14	42.6	30.8	12.1	0.429	-1	-6	-14	148.7	52.8	82.1
	HBF 37	0.10	0.791	-27	-1	100	72.9	84.3	34.8	0.109	-27	-1	100	1084.3	55.0	299.7
	MTS 40	0.01	0.921	-77	19	64	21.3	33.9	84.6	0.068	-77	19	64	439.2	114.5	852.6
	MTC 43	0.01	0.921	-77	19	64	21.3	33.9	84.6	0.068	-77	19	64	439.2	114.5	852.6
	SCH 46	0.05	0.936	-88	13	82	15.3	43.0	42.8	0.363	-88	13	82	568.4	221.9	1014.6
	MBF 47	0.16	0.740	-22	2	82	41.2	22.1	14.0	0.100	-22	2	82	982.2	45.5	750.3
	MSU 48	0.05	0.616	0	-16	43	272.1	35.8	9.5	0.162	0	-16	43	1687.1	70.6	173.5
	BSQ 70	0.08	0.357	13	-16	37	48.9	65.9	33.5	0.162	13	-16	37	551.6	133.0	1770.2
	DOM 71	0.05	0.469	-6	-4	-15	19.5	7.0	49.7	0.162	-6	-4	-15	242.8	38.4	136.3
	ESZ 75	0.04	0.752	-3	1	28	49.4	18.2	44.2	0.323	-3	1	28	1682.2	169.5	245.6
	CGS 80	0.11	0.733	-92	73	91	150.2	8.7	14.9	0.550	-92	73	91	268.6	439.6	4673.2

* MTC 43 uses the same variogram as MTS 40

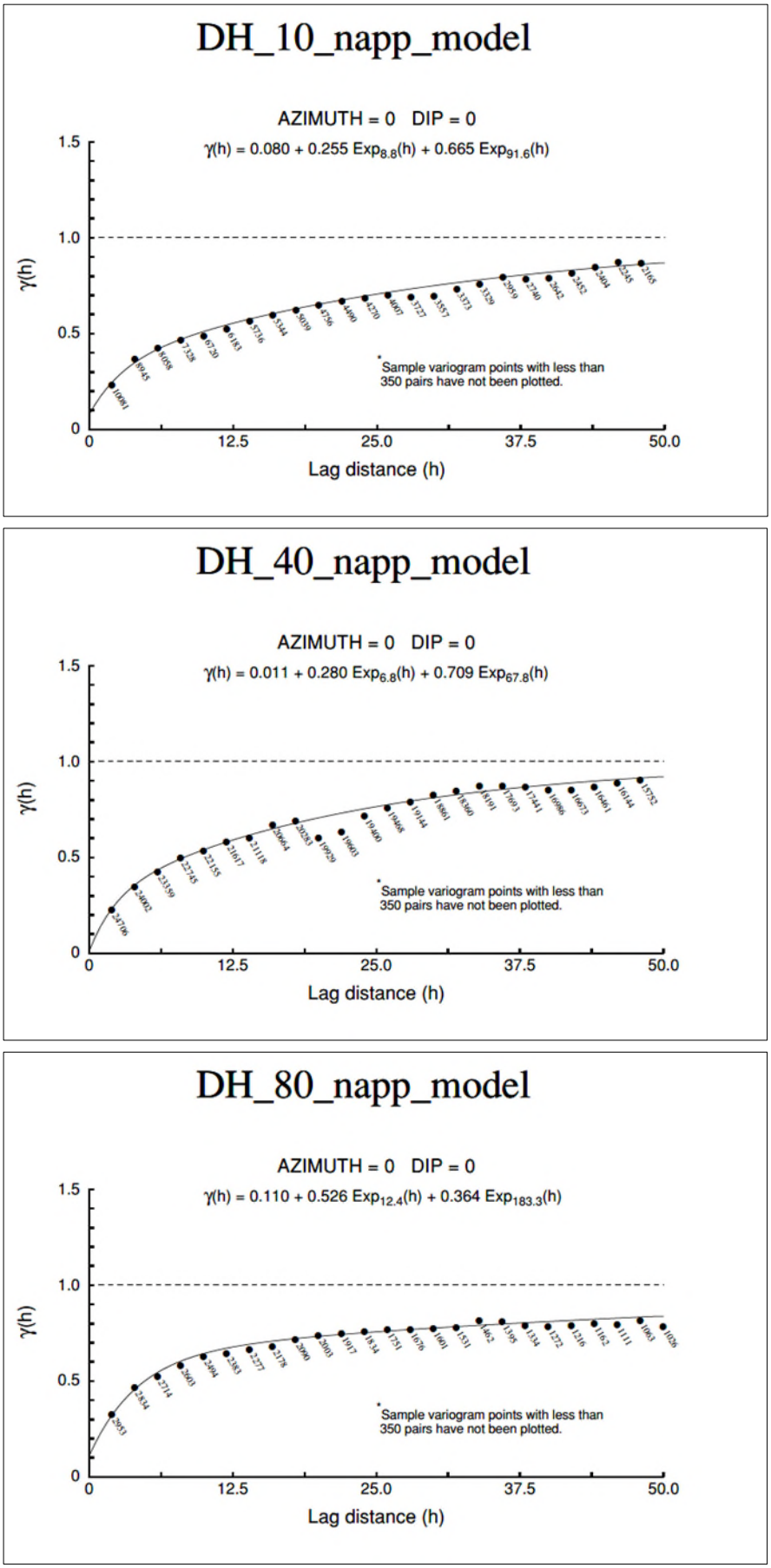


Figure 10.62 – Down-the-hole variograms for NAPP in domain AMP 10 (TOP), MTS 40 (MIDDLE) and CGS 80 (BOTTOM).

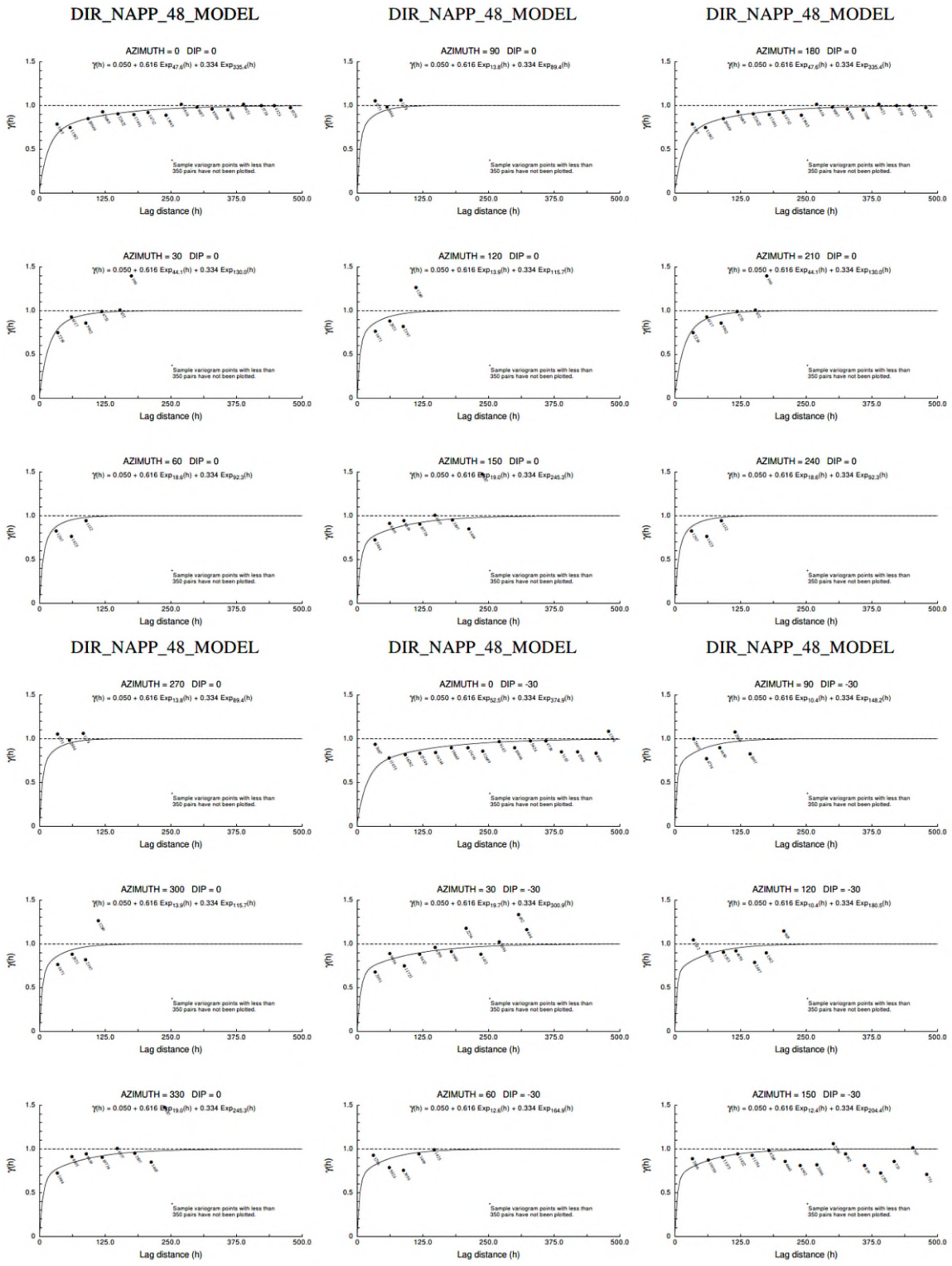


Figure 10.63 – Directional variograms for NAPP in domain MSU 48.

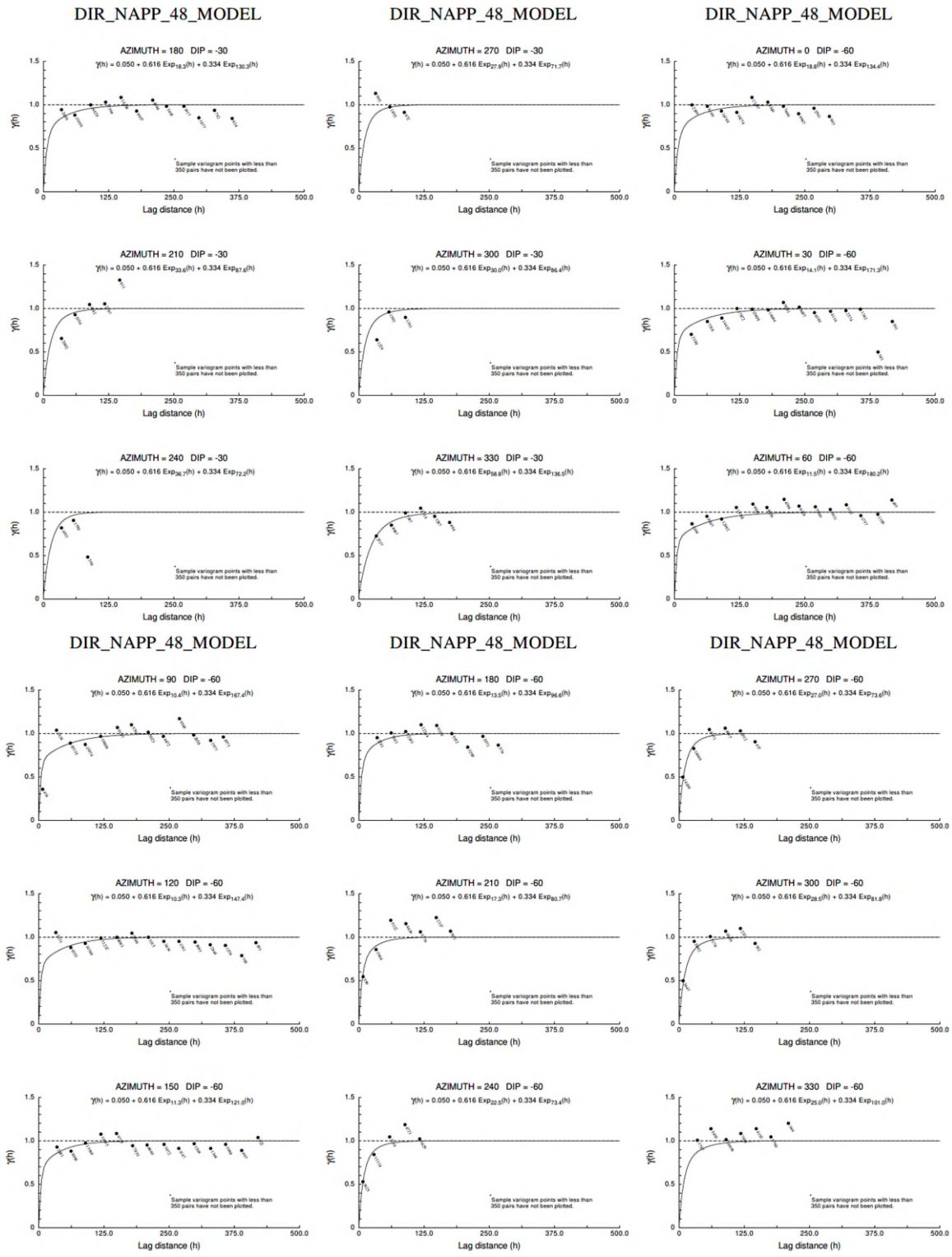


Figure 10.63 (cont.) – Directional variograms for NAPP in domain MSU 48.

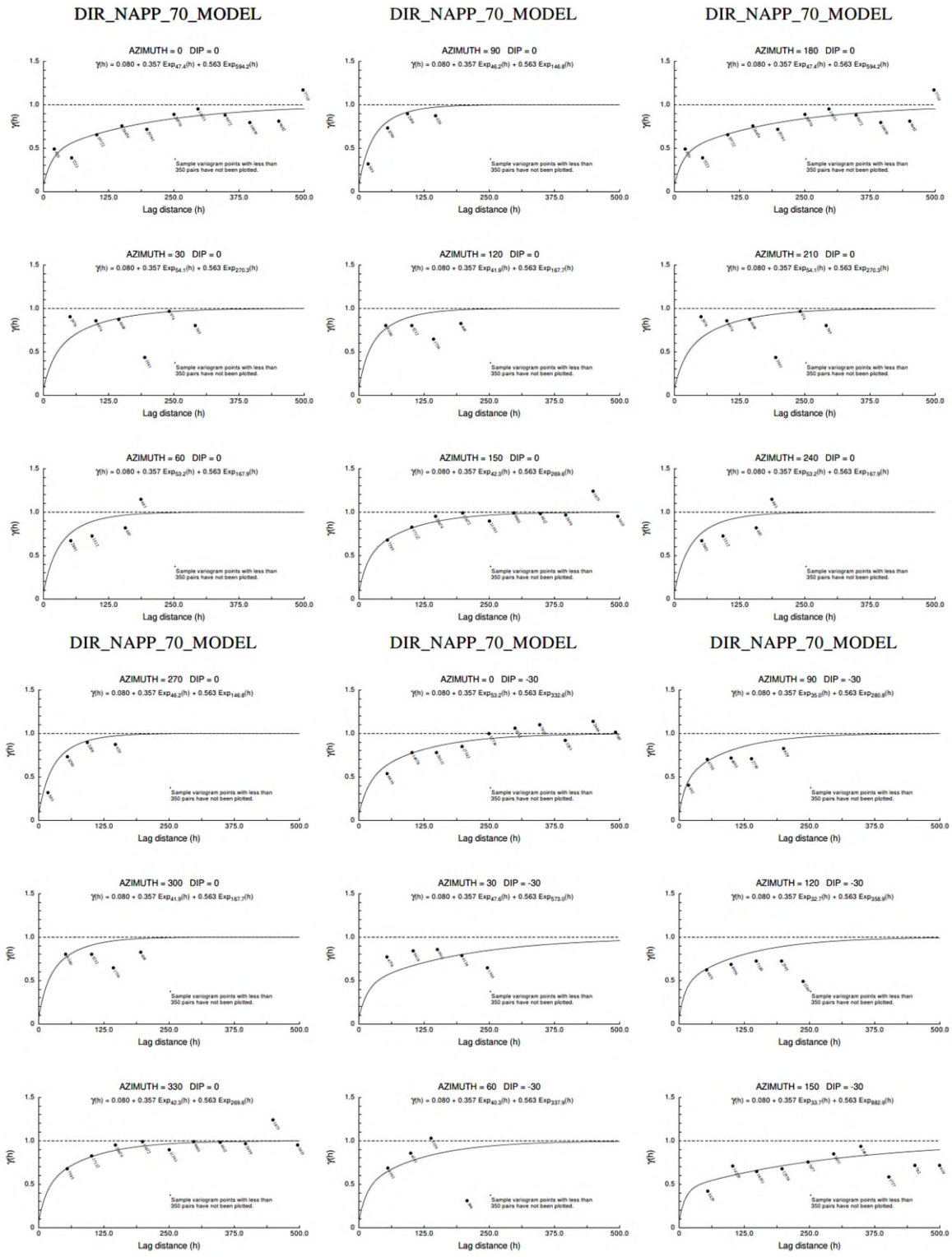


Figure 10.64 – Directional variograms for NAPP in domain BSQ 70.

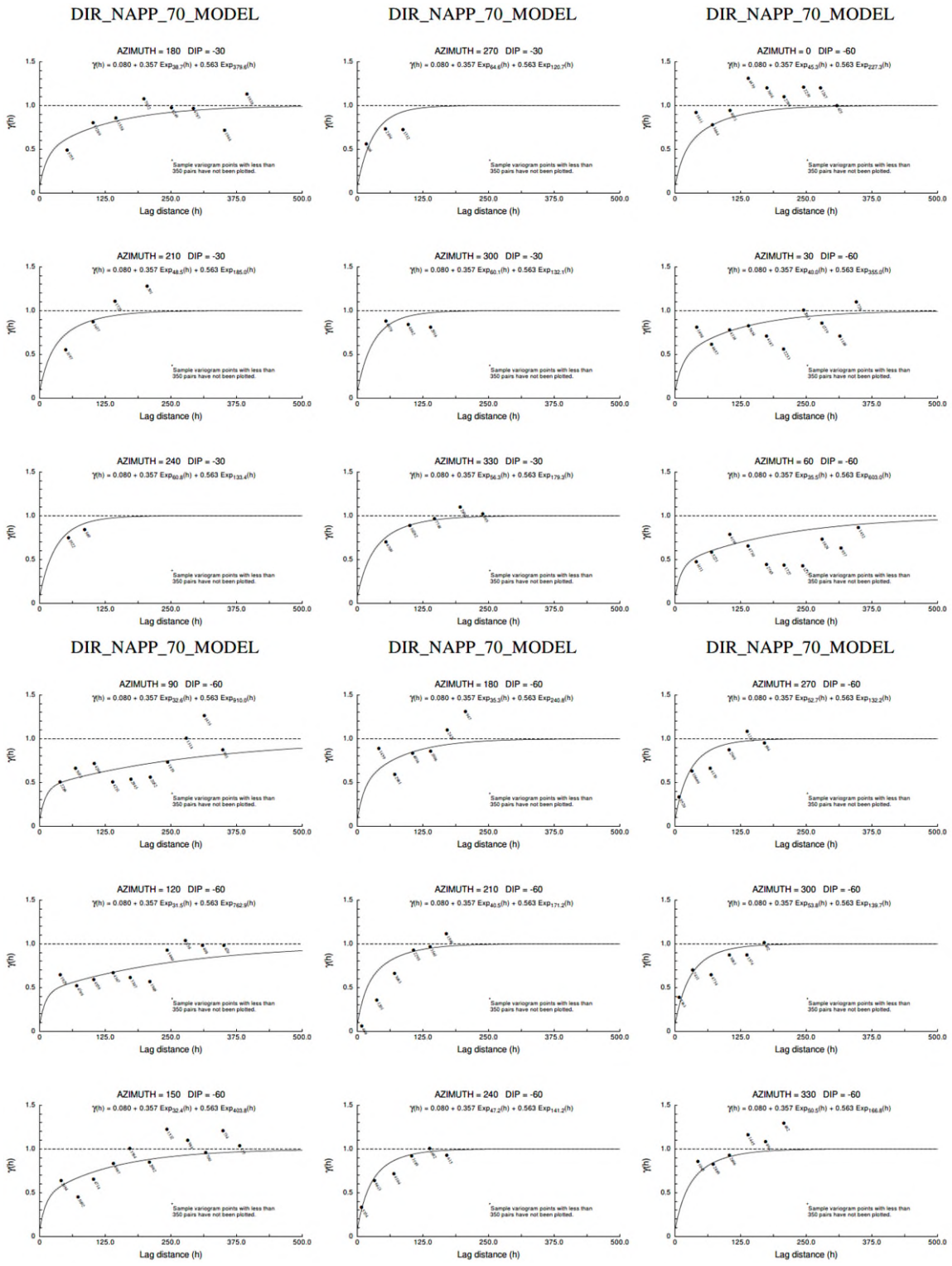


Figure 10.64 (cont.) – Directional variograms for NAPP in domain BSQ 70.

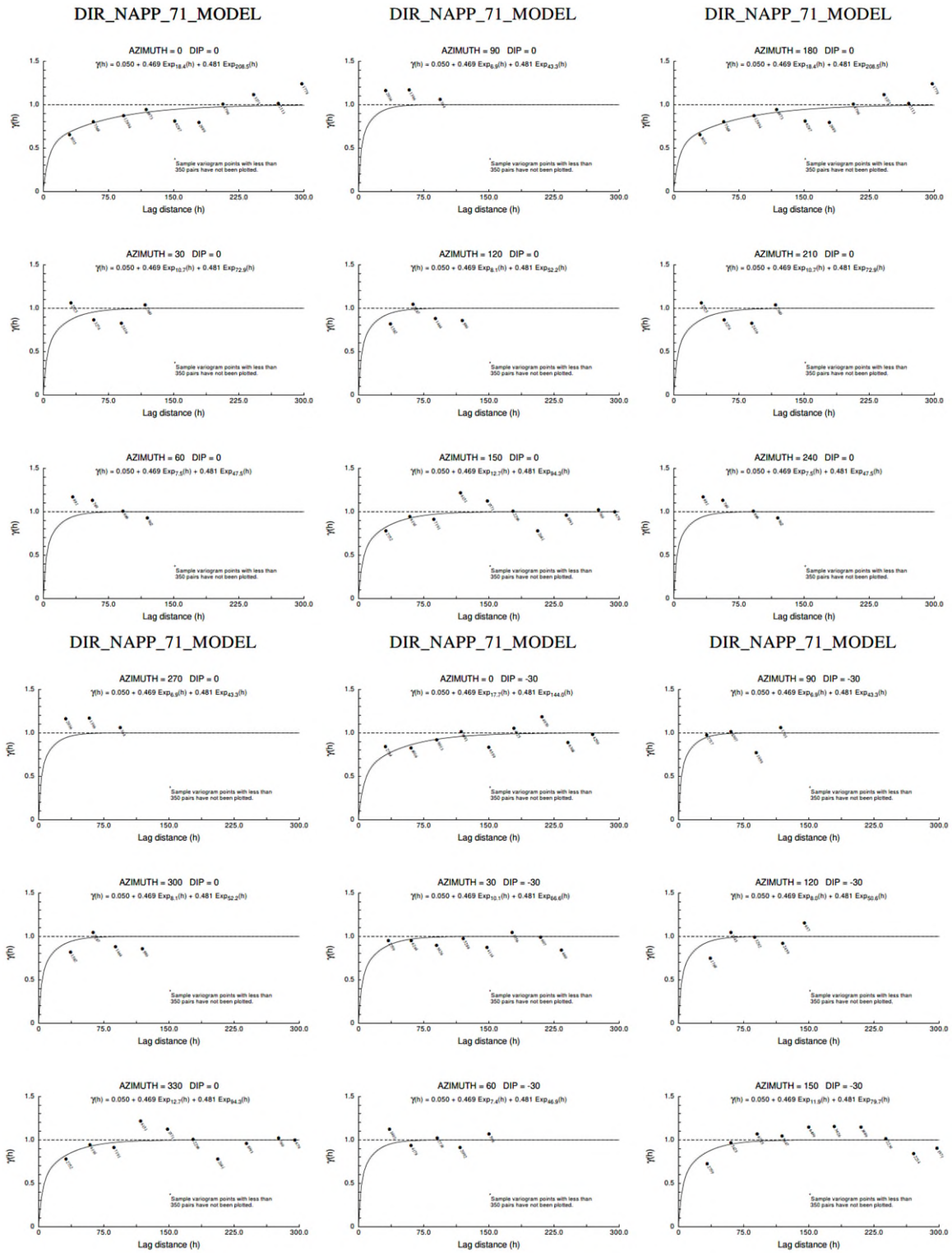


Figure 10.65 – Directional variograms for NAPP in domain DOM 71.

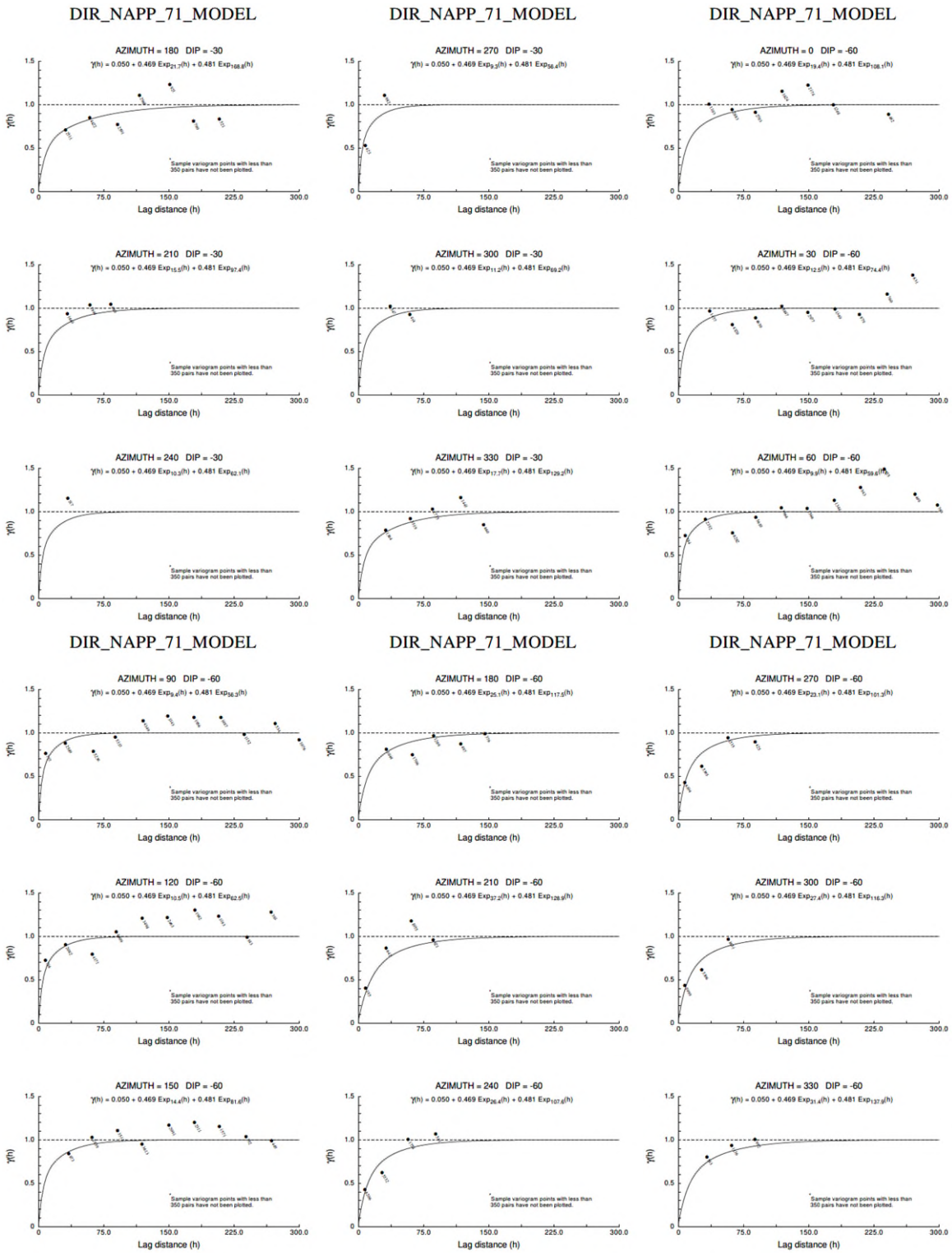


Figure 10.65 (cont.) – Directional variograms for NAPP in domain DOM 71.

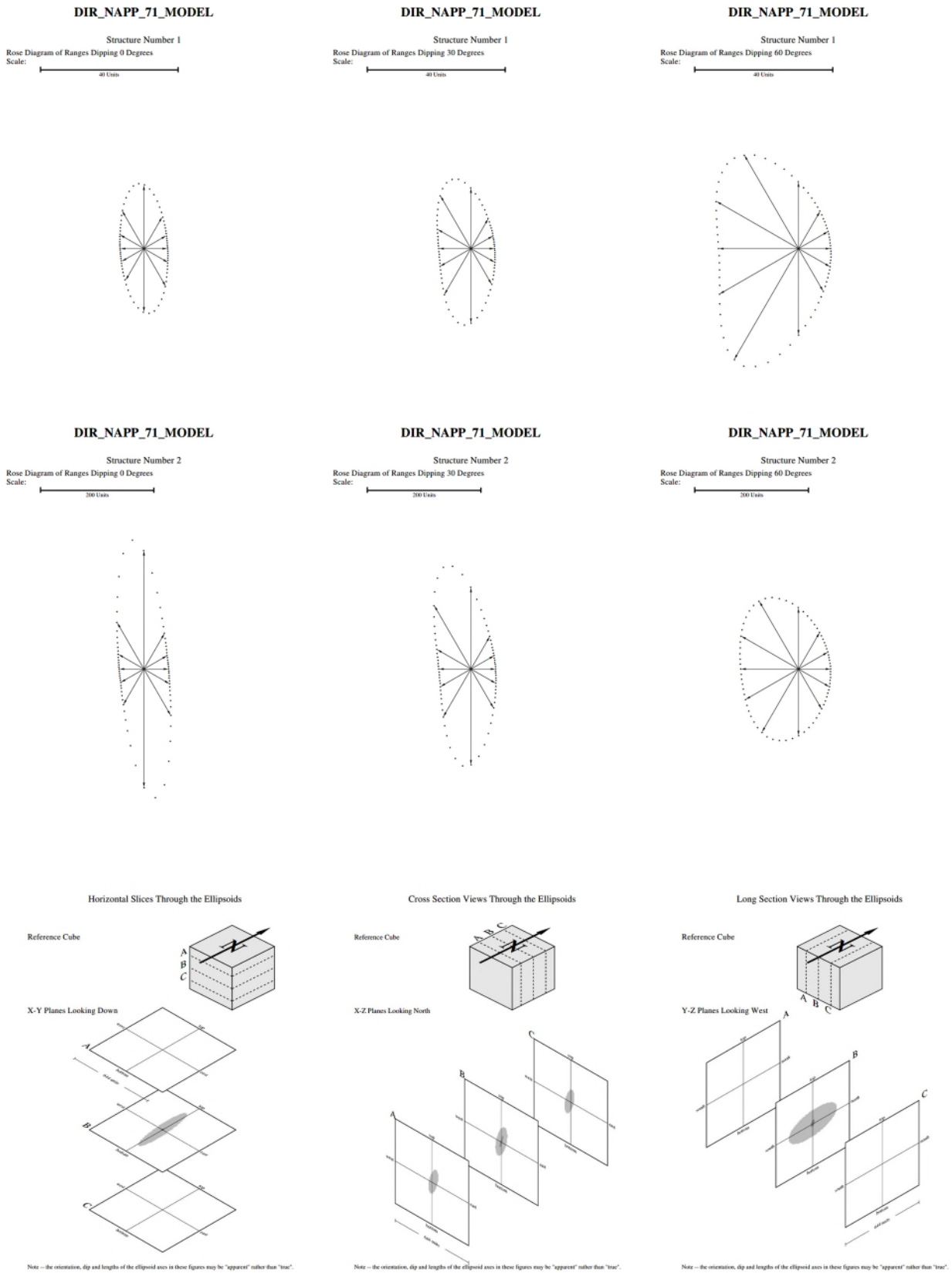


Figure 10.66 – Variogram anisotropy rose diagram for NAPP in domain DOM 71.

All NAPP estimates were performed using regression derived NAPP 2m composites merged with head assays composites in the Vulcan database ***dsmdcs_0823_hssd.d2m.isis*** (Section 9.2.3). Estimation was performed on a domain basis to parent block support using Ordinary Kriging (Table 10.33) with a discretisation array of 4 x 5 x 3.

Table 10.33 – Summary of NAPP estimation approach.

Method	Domains	No. of Domains	Estimation Passes	No. of Estimates
OK	10,20,30,32,37,40,43,46,48,70,71,75,80	14	4	56

* GRT 90 – assigned default NAPP due to insufficient samples for an estimate

Four (4) estimation passes were used for each domain with ellipsoid orientations mirroring the average orientations of the domains and variogram models, and similar ellipsoid dimensions to those used in head assay estimation. The minimum and maximum number of samples for an estimate, and the maximum samples per drill hole used in the head assay estimation was also used for NAPP (Table 10.34). A hard-domain boundary approach was used for sample selection for all domains.

Table 10.34 – Example of the search neighbourhood for NAPP in domains MTS 40, MSU 48, BSQ 70 and CGS 80.

Domain	Search Orientation				Search Dimensions			Sample Numbers		
	Pass	Bearing	Plunge	Dip	Major	Semi	Minor	Min	Max	DDH
40	1	-77	19	64	25	15	25	5	9	2
	2	-77	19	64	50	30	50	5	9	2
	3	-77	19	64	100	60	100	5	9	2
	4	-77	19	64	150	120	150	3	9	2
48	1	0	-16	43	25	15	25	5	9	2
	2	0	-16	43	50	30	50	5	9	2
	3	0	-16	43	100	60	100	5	9	2
	4	0	-16	43	150	120	150	3	9	2
70	1	13	-16	37	25	15	25	5	9	2
	2	13	-16	37	50	30	50	5	9	2
	3	13	-16	37	100	60	100	5	9	2
	4	13	-16	37	150	120	150	3	9	2
80	1	-92	73	91	25	15	25	5	9	2
	2	-92	73	91	50	30	50	5	9	2
	3	-92	73	91	100	60	100	5	9	2
	4	-92	73	91	150	120	150	3	9	2

A local high yielding approach similar to that used for head assay and density estimation, was also applied to NAPP on a domain basis. Yield values were empirically derived and typically resulted in limiting the spatial influence of the top 1st percentile of the distribution. Table 10.35 shows some examples of the high yield approach used for NAPP, and Table 10.36 shows examples of the sample and block selection criteria for the estimates.

Table 10.35 – High yield restriction policy for NAPP estimates in some domains.

			Ellipsoid Dimension			Ellipsoid Orientation		
Domain	Pass	Value	Major	Semi	Minor	Bearing	Plunge	Dip
10	1	-	-	-	-	-	-	-
	2	3.18	20.0	25.0	4.0	-6	-15	72
	3	3.18	20.0	25.0	4.0	-6	-15	72
	4	3.18	20.0	25.0	4.0	-6	-15	72
20	1	-	-	-	-	-	-	-
	2	2.86	20.0	25.0	4.0	-13	-1	79
	3	2.86	20.0	25.0	4.0	-13	-1	79
	4	2.86	20.0	25.0	4.0	-13	-1	79
30	1	-	-	-	-	-	-	-
	2	0.99	20.0	25.0	4.0	-89	-6	0
	3	0.99	20.0	25.0	4.0	-89	-6	0
	4	0.99	20.0	25.0	4.0	-89	-6	0
37	1	-	-	-	-	-	-	-
	2	-4.4	20.0	25.0	4.0	-27	-1	100
	3	-4.4	20.0	25.0	4.0	-27	-1	100
	4	-4.4	20.0	25.0	4.0	-27	-1	100
40	1	-	-	-	-	-	-	-
	2	2.57	20.0	25.0	4.0	-77	19	64
	3	2.57	20.0	25.0	4.0	-77	19	64
	4	2.57	20.0	25.0	4.0	-77	19	64
43	1	-	-	-	-	-	-	-
	2	77.56	20.0	25.0	4.0	-77	19	64
	3	77.56	20.0	25.0	4.0	-77	19	64
	4	77.56	20.0	25.0	4.0	-77	19	64
46	1	-	-	-	-	-	-	-
	2	6.09	20.0	25.0	4.0	-88	13	82
	3	6.09	20.0	25.0	4.0	-88	13	82
	4	6.09	20.0	25.0	4.0	-88	13	82
48	1	-	-	-	-	-	-	-
	2	152.7	20.0	25.0	4.0	0	-16	43
	3	152.7	20.0	25.0	4.0	0	-16	43
	4	152.7	20.0	25.0	4.0	0	-16	43
70	1	152.3	-	-	-	-	-	-
	2	152.3	20.0	25.0	4.0	13	-16	37
	3	152.3	20.0	25.0	4.0	13	-16	37
	4	152.3	20.0	25.0	4.0	13	-16	37
71	1	-	-	-	-	-	-	-
	2	57.19	20.0	25.0	4.0	-6	-4	-15
	3	57.19	20.0	25.0	4.0	-6	-4	-15
	4	57.19	20.0	25.0	4.0	-6	-4	-15
75	1	-	-	-	-	-	-	-
	2	12.39	20.0	25.0	4.0	-3	-1	28
	3	12.39	20.0	25.0	4.0	-3	-1	28
	4	12.39	20.0	25.0	4.0	-3	-1	28
80	1	-	-	-	-	-	-	-
	2	2.37	20.0	25.0	4.0	-92	73	91
	3	2.37	20.0	25.0	4.0	-92	73	91
	4	2.37	20.0	25.0	4.0	-92	73	91

Table 10.36 – Examples of sample and block selection criteria for NAPP estimation.

Domain	Pass Number	Assay Field	Assay Value to Ignore	Sample Selection Criteria	Block Selection Criteria
10	1	NAPP	-999	GEOZONE 10	geozone eq 10and pass_napp eq 0
	2	NAPP	-999	GEOZONE 10	geozone eq 10and pass_napp eq 0
	3	NAPP	-999	GEOZONE 10	geozone eq 10and pass_napp eq 0
	4	NAPP	-999	GEOZONE 10	geozone eq 10and pass_napp eq 0
20	1	NAPP	-999	GEOZONE 20	geozone eq 20 and pass_napp eq 0
	2	NAPP	-999	GEOZONE 20	geozone eq 20 and pass_napp eq 0
	3	NAPP	-999	GEOZONE 20	geozone eq 20 and pass_napp eq 0
	4	NAPP	-999	GEOZONE 20	geozone eq 20 and pass_napp eq 0
37	1	NAPP	-999	GEOZONE 37	geozone eq 37 and pass_napp eq 0
	2	NAPP	-999	GEOZONE 37	geozone eq 37 and pass_napp eq 0
	3	NAPP	-999	GEOZONE 37	geozone eq 37 and pass_napp eq 0
	4	NAPP	-999	GEOZONE 37	geozone eq 37 and pass_napp eq 0
40	1	NAPP	-999	GEOZONE 40	geozone eq 40 and pass_napp eq 0
	2	NAPP	-999	GEOZONE 40	geozone eq 40 and pass_napp eq 0
	3	NAPP	-999	GEOZONE 40	geozone eq 40 and pass_napp eq 0
	4	NAPP	-999	GEOZONE 40	geozone eq 40 and pass_napp eq 0
48	1	NAPP	-999	GEOZONE 48	geozone eq 48 and pass_napp eq 0
	2	NAPP	-999	GEOZONE 48	geozone eq 48 and pass_napp eq 0
	3	NAPP	-999	GEOZONE 48	geozone eq 48 and pass_napp eq 0
	4	NAPP	-999	GEOZONE 48	geozone eq 48 and pass_napp eq 0
70	1	NAPP	-999	GEOZONE 70	geozone eq 70 and pass_napp eq 0
	2	NAPP	-999	GEOZONE 70	geozone eq 70 and pass_napp eq 0
	3	NAPP	-999	GEOZONE 70	geozone eq 70 and pass_napp eq 0
	4	NAPP	-999	GEOZONE 70	geozone eq 70 and pass_napp eq 0
71	1	NAPP	-999	GEOZONE 71	geozone eq 71 and pass_napp eq 0
	2	NAPP	-999	GEOZONE 71	geozone eq 71 and pass_napp eq 0
	3	NAPP	-999	GEOZONE 71	geozone eq 71 and pass_napp eq 0
	4	NAPP	-999	GEOZONE 71	geozone eq 71 and pass_napp eq 0
80	1	NAPP	-999	GEOZONE 80	geozone eq 80 and pass_napp eq 0
	2	NAPP	-999	GEOZONE 80	geozone eq 80 and pass_napp eq 0
	3	NAPP	-999	GEOZONE 80	geozone eq 80 and pass_napp eq 0
	4	NAPP	-999	GEOZONE 80	geozone eq 80 and pass_napp eq 0

In the case of the small proportion of un-estimated blocks, the mean value of the estimated blocks was applied on a domain basis to maintain the numerical consistency between NAPP, MPA and ANC (NAPP = MPA - ANC). This balance was maintained in blocks with a NAPP estimate but without S% estimates (MPA = S% x 30.6), and also in blocks without NAPP estimates. This was achieved by calculation of MPA using the median S% estimate on a domain basis and a default NAPP value based on the probability distribution of the NAPP estimates in such a way to maintain the numerical balance of the ANC/MPA ratio (Figure 10.67 and Figure 10.68).

```
* Re-assign default NAPP in unestimated blocks
  - assign corresponding MPA to maintain ANC/MPA in balance - blocks WITH NAPP but WITHOUT MPA (S_H)
if (pass_napp ge 1 and s_h le 0) then
  if (geozone eq 10) then
    mpa = 0.043 * 30.6
    napp = -72.61
    pass_napp = 9
  endif
  if (geozone eq 20) then
    mpa = 0.034 * 30.6
    napp = -5.97
    pass_napp = 9
  endif
  if (geozone eq 30) then
    mpa = 0.022 * 30.6
    napp = -35.27
    pass_napp = 9
  endif
```

NAPP estimate but no S estimate

Figure 10.67 – Extract of script showing the assignment of NAPP and MPA in the small proportion of blocks with a NAPP estimate but without a S% head assay estimate (MPA = S x 30.6).

```
* Re-assign default NAPP in unestimated blocks
  - assign corresponding MPA to maintain ANC/MPA in balance - blocks WITHOUT NAPP
if (pass_napp eq 0 and napp eq -999) then
  if (geozone eq 10) then
    mpa = 0.043 * 30.6
    napp = -72.61
    pass_napp = 9
  endif
  if (geozone eq 20) then
    mpa = 0.034 * 30.6
    napp = -5.97
    pass_napp = 9
  endif
  if (geozone eq 30) then
    mpa = 0.022 * 30.6
    napp = -35.27
    pass_napp = 9
  endif
```

No NAPP estimate

Figure 10.68 – Extract of script showing the assignment of NAPP and MPA in the small proportion of blocks without a NAPP estimate.

The NAPP, MPA and ANC estimates were used to designate potentially acid forming (PAF) or not acid forming (NAF) material in each block in the model, using an ANC:MPA ≥ 2 as shown in the Figure 10.69.

```
87   * PAF is based on ANC_MPA_RATIO, 1=PAF, 0=NAF
88   * PAF = 0 in BIF20 and CGS80 based on email from LWC dated 10/10/2023
89   if (napp ne -999 and mpa gt 0) then
90     anc = mpa - napp
91     if (anc lt 0) then
92       anc = 0
93       napp = mpa
94     endif
95     anc_mpa_ratio = anc / mpa
96     if (anc_mpa_ratio ge 2) then
97       paf = 0
98     else
99       paf = 1
100    endif
101  endif
102  if (geozone eq 20 or geozone eq 80) then
103    if (paf eq 1) then
104      paf = 0
105      anc_mpa_ratio = 2.2
106      anc = anc_mpa_ratio * mpa
107      napp = mpa - anc
108    endif
109  endif
110  EOF
```

Figure 10.68 – Extract of script showing the designation of material as PAF (paf = 1) or NAF (paf = 0) depending on the ANC:MPA. Domains BIF 20 and CGS 80 were hard coded as NAF on advice from Land Water Consulting (SIMEC environmental chemistry consultants).

11 Validation

All estimates were iteratively validated by means of traditional statistical techniques, as well as thorough visual comparative techniques. The appropriateness of the amount of smoothing incurred during estimation, using the nominated Kriging plans, was also checked using the Discrete Gaussian Change of Support Model.

11.1 Checks on Smoothing

Section 10.4.3 described the optimisation of the maximum number of samples for estimation. The use of the Discrete Gaussian Change of Support (DGCOS) Model to compare the smoothing incurred in the actual estimates to the theoretical smoothing that should be incurred, using grade-volume curves, was also discussed. The Discrete Gaussian method was chosen in preference to the Affine and Lognormal methods as it is more robust in its assumptions of the distribution of grades at different support.

Traditional DGCOS model smoothing comparisons is usually based on the data/block relationship encountered at the grade control drilling stage. For the purposes of checking the smoothing in the resource estimate using the current data/block relationship, however, the information effect (error incurred in estimating with an imperfect data/block relationship) is required to be included when deriving the theoretical grade-volume curve. The information effect (IE) was calculated by Kriging an idealised grid of 20 x 25 x 4m blocks, and then averaging the reported Kriging Variance (KV) for all blocks in the grid, for each iteration of samples used. Table 11.1 shows an example output from KNA, and the subsequent determination of the variance reduction factor (f) using Krige's Relationship, required to generate a theoretical grade/volume curve using the DGCOS model.

Table 11.1 – Example KNA output for SiO_2 in MTS 40 showing the calculation of the variance reduction factor (f).

No. Samples	KE	ZZ	Ave KV	BV	f
3	0.5995	0.7422	0.2944	0.7352	0.4408
4	0.7495	0.8676	0.1842	0.7352	0.5510
5	0.7599	0.8789	0.1765	0.7352	0.5587
6	0.7659	0.8850	0.1721	0.7352	0.5631
7	0.7917	0.9259	0.1531	0.7352	0.5821
8	0.7941	0.9302	0.1513	0.7352	0.5839
9	0.7955	0.9324	0.1503	0.7352	0.5849
10	0.8041	0.9552	0.1440	0.7352	0.5912
11	0.8050	0.9576	0.1433	0.7352	0.5919
12	0.8055	0.9589	0.1430	0.7352	0.5922
13	0.8081	0.9693	0.1411	0.7352	0.5941
14	0.8084	0.9705	0.1409	0.7352	0.5943
15	0.8085	0.9711	0.1407	0.7352	0.5945
16	0.8096	0.9770	0.1400	0.7352	0.5952
17	0.8098	0.9777	0.1399	0.7352	0.5953
18	0.8098	0.9781	0.1398	0.7352	0.5954
19	0.8104	0.9820	0.1393	0.7352	0.5959
20	0.8105	0.9825	0.1393	0.7352	0.5959
21	0.8106	0.9828	0.1393	0.7352	0.5959

Variance Reduction Factor (f) = Block Variance (BV) – Kriging Variance (KV). KE = Kriging Efficiency. ZZ = Slope of Regression.

The grade/volume curves of the Fe and SiO_2 estimate for domain MTS 40 were compared to the DGCOS estimate, and an alternate estimate using a minimum of 12 samples, a maximum of 24 samples, and a maximum of 8 samples per drill hole. The full charts, as well as versions zoomed in to enable the distinction between estimates, are shown in Figure 11.1 to Figure 11.10.

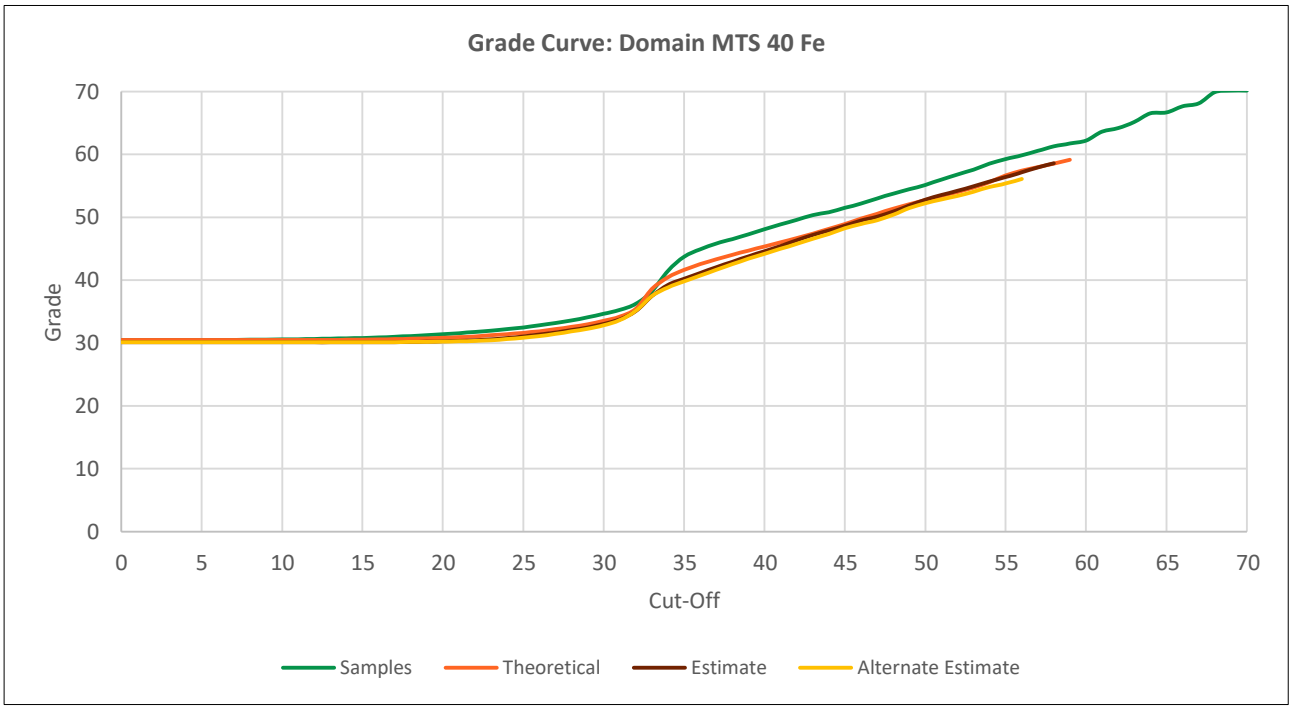


Figure 11.1 – Full grade curve showing the comparison for the Fe and DGCOS estimates.

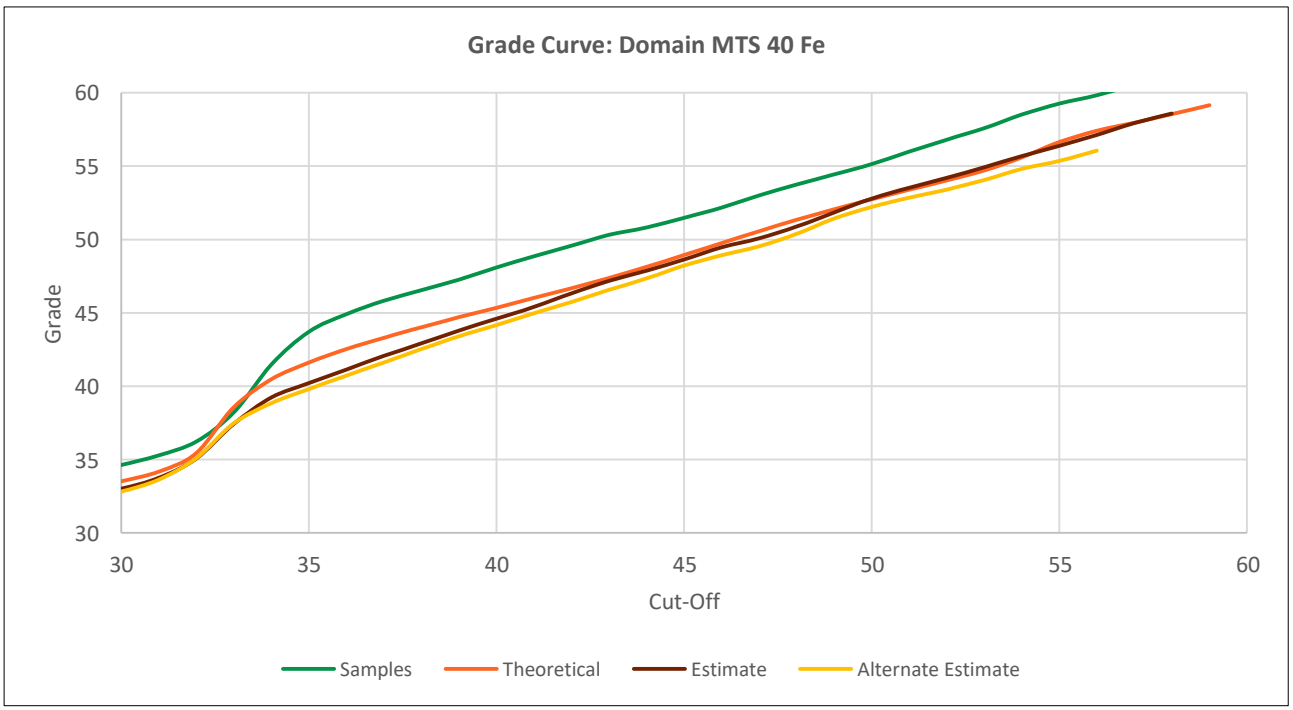


Figure 11.2 – Grade curve above 30% Fe cut-off showing the comparison for the Fe and DGCOS estimates.

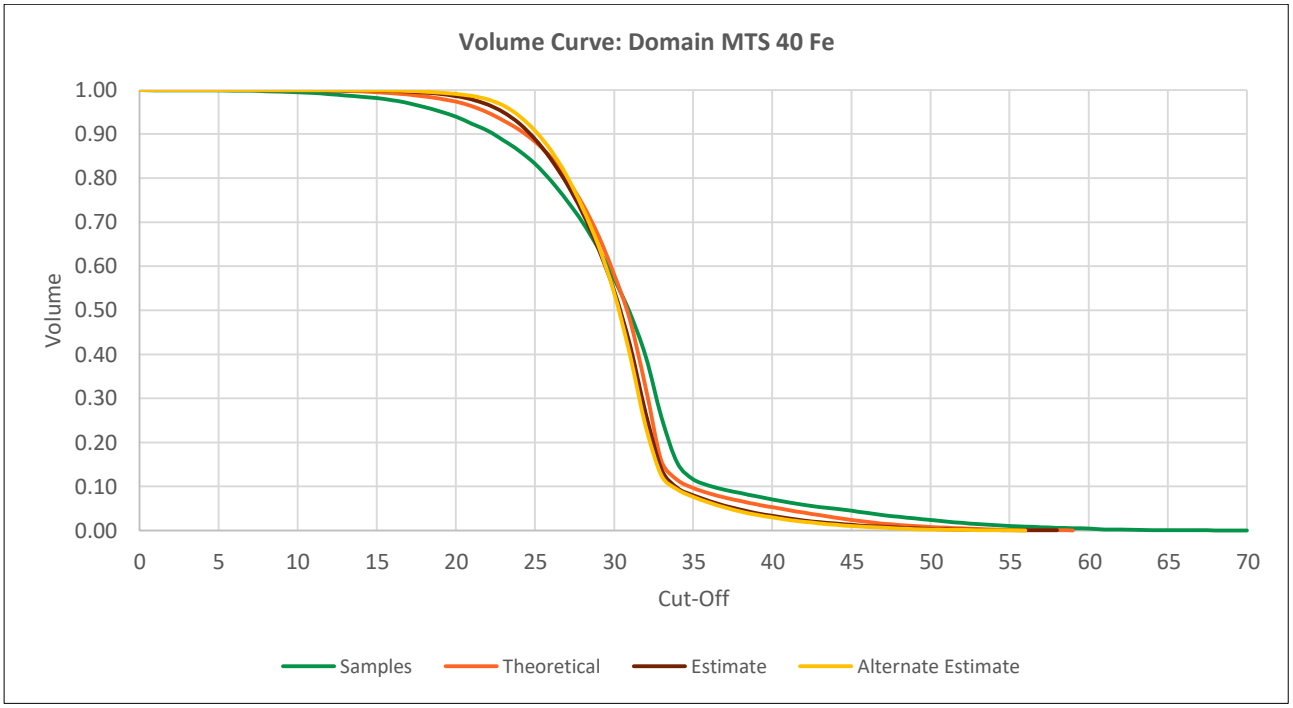


Figure 11.3 – Full volume curve showing the comparison for the Fe and DGCOS estimates.

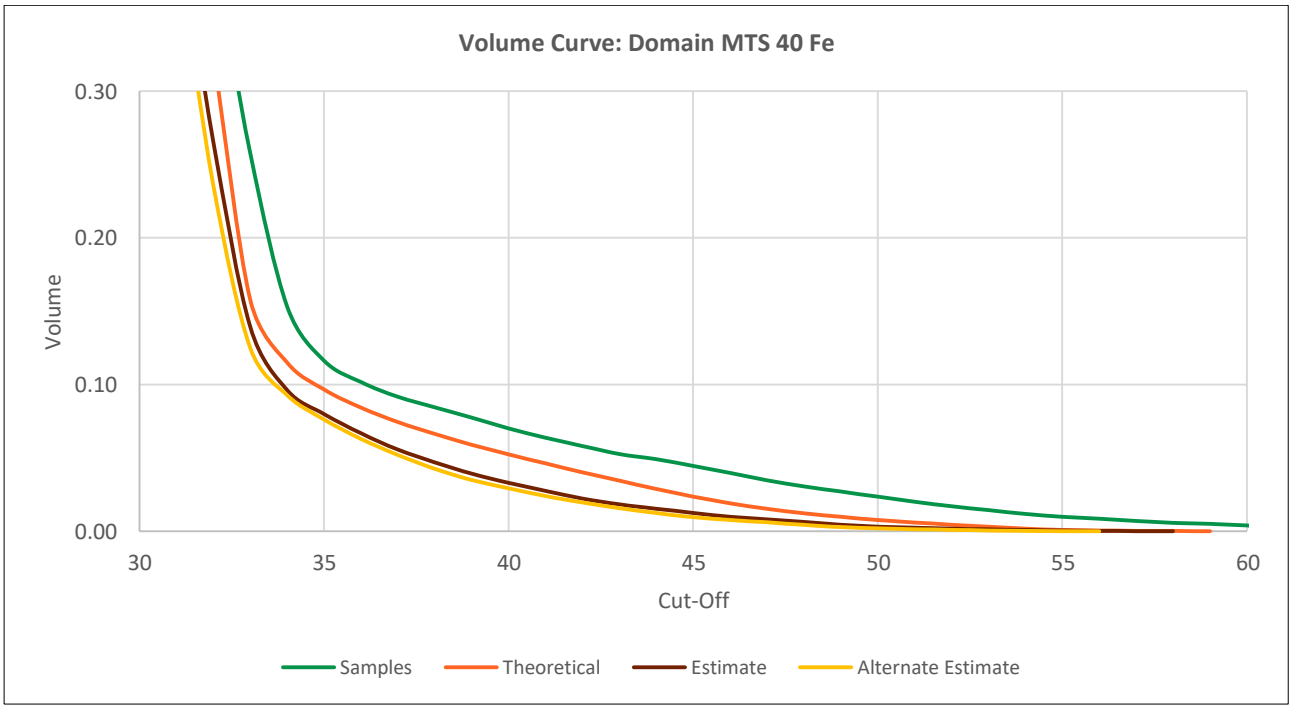


Figure 11.4 – Volume curve above 30% Fe cut-off showing the comparison for the Fe and DGCOS estimates.

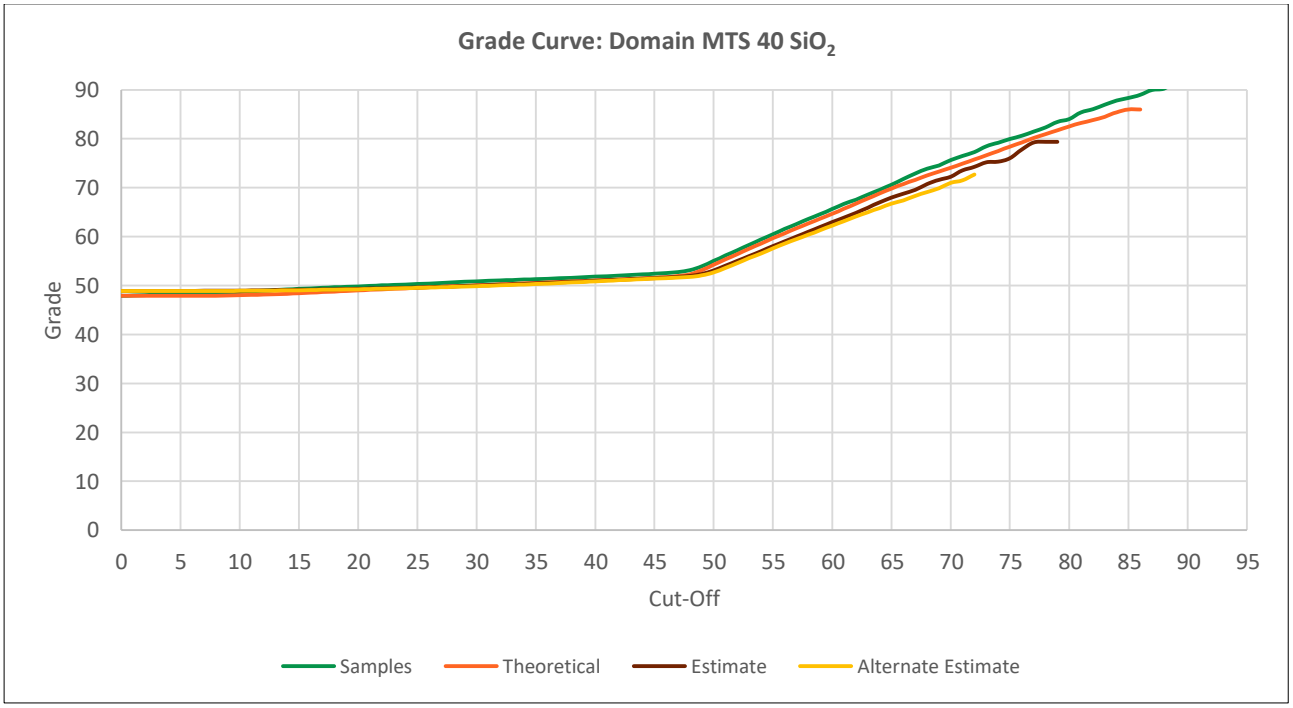


Figure 11.5 – Full grade curve showing the comparison for the SiO_2 and DGCOS estimates.

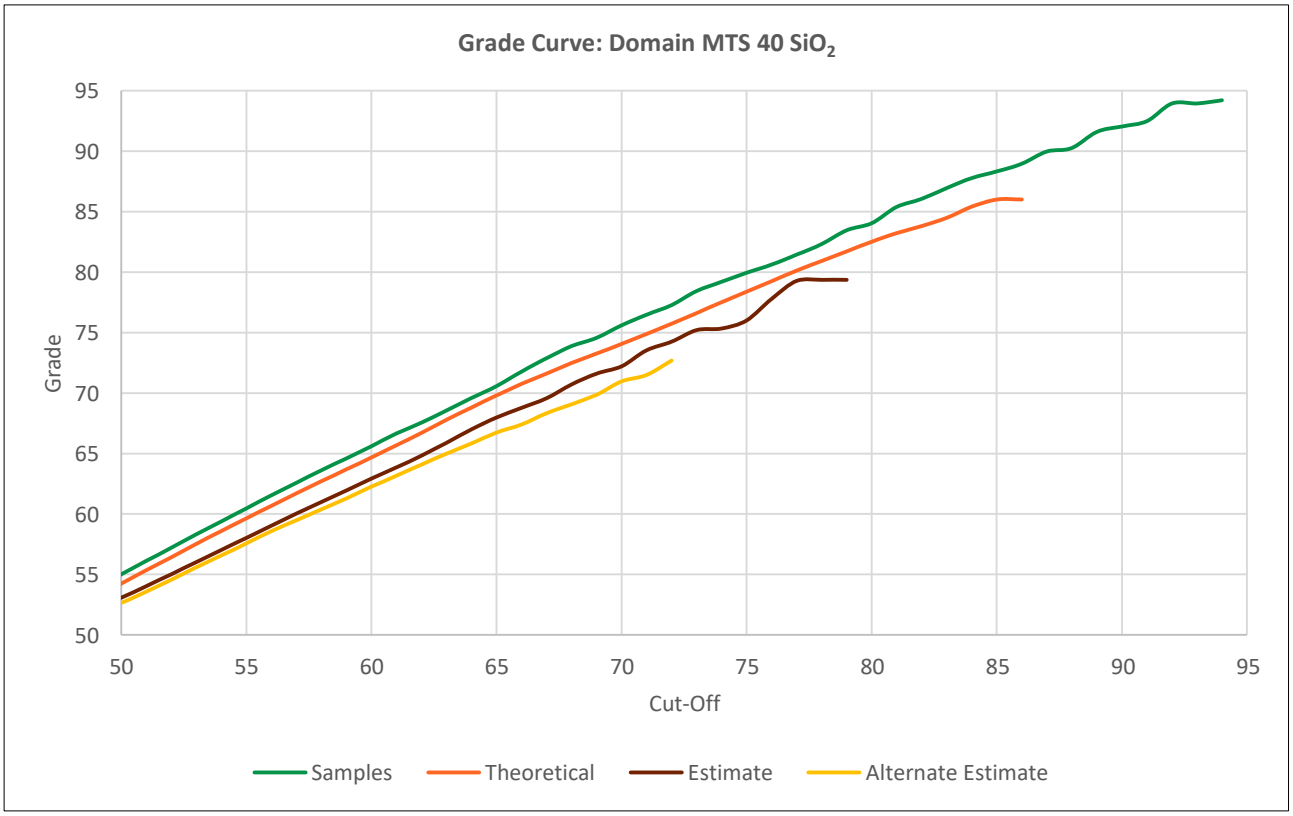


Figure 11.6 – Grade curve above 50% SiO_2 cut-off showing the comparison for the SiO_2 and DGCOS estimates.

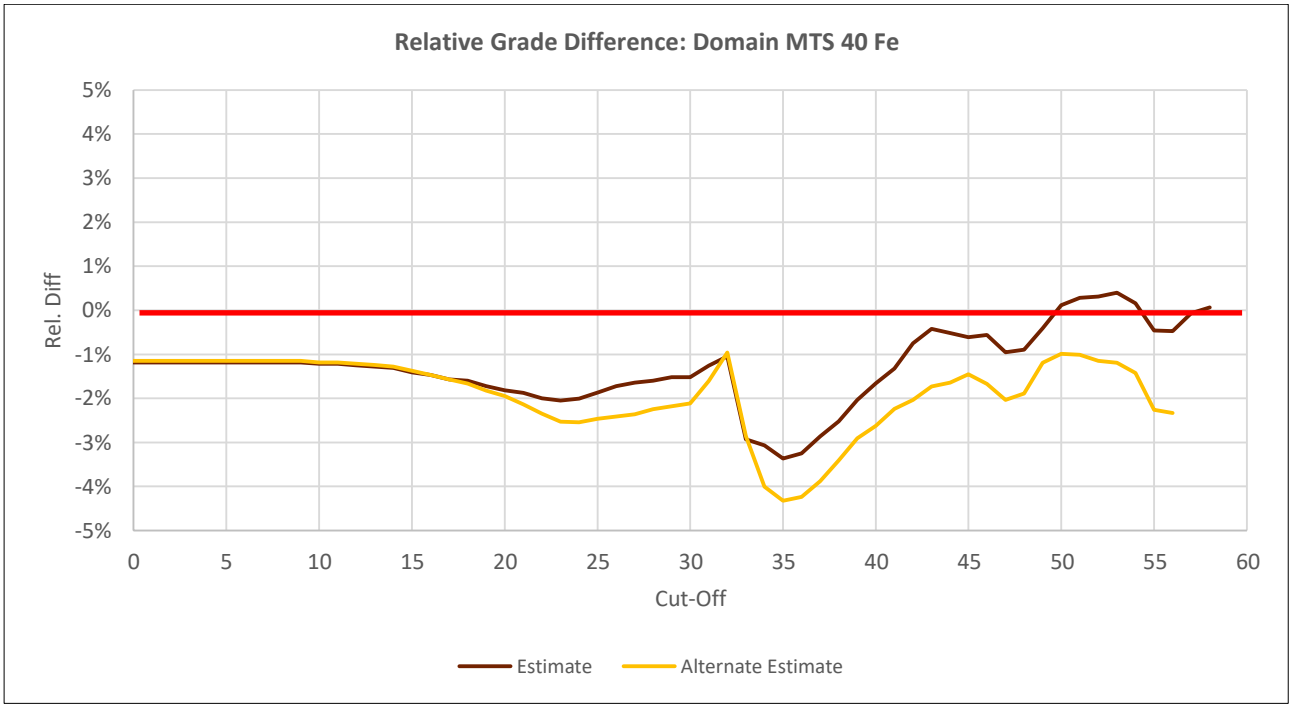


Figure 11.7 – Differential grade curve for the Fe estimates, relative to the DGCOS estimate. Note the alternate estimate (yellow) lies further away from the DGCOS (red) than the estimate (brown).

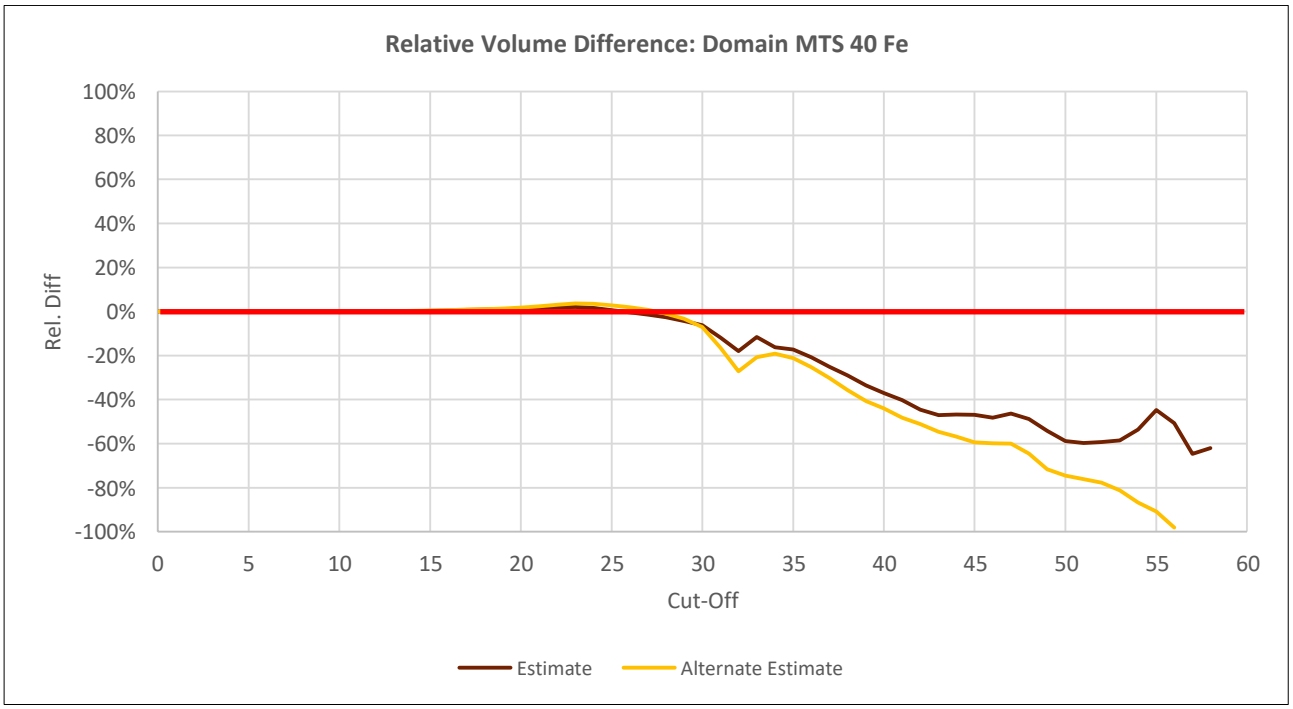


Figure 11.8 – Differential volume curve for the Fe estimates, relative to the DGCOS estimate. Note the alternate estimate (yellow) lies further away from the DGCOS (red) than the estimate (brown).

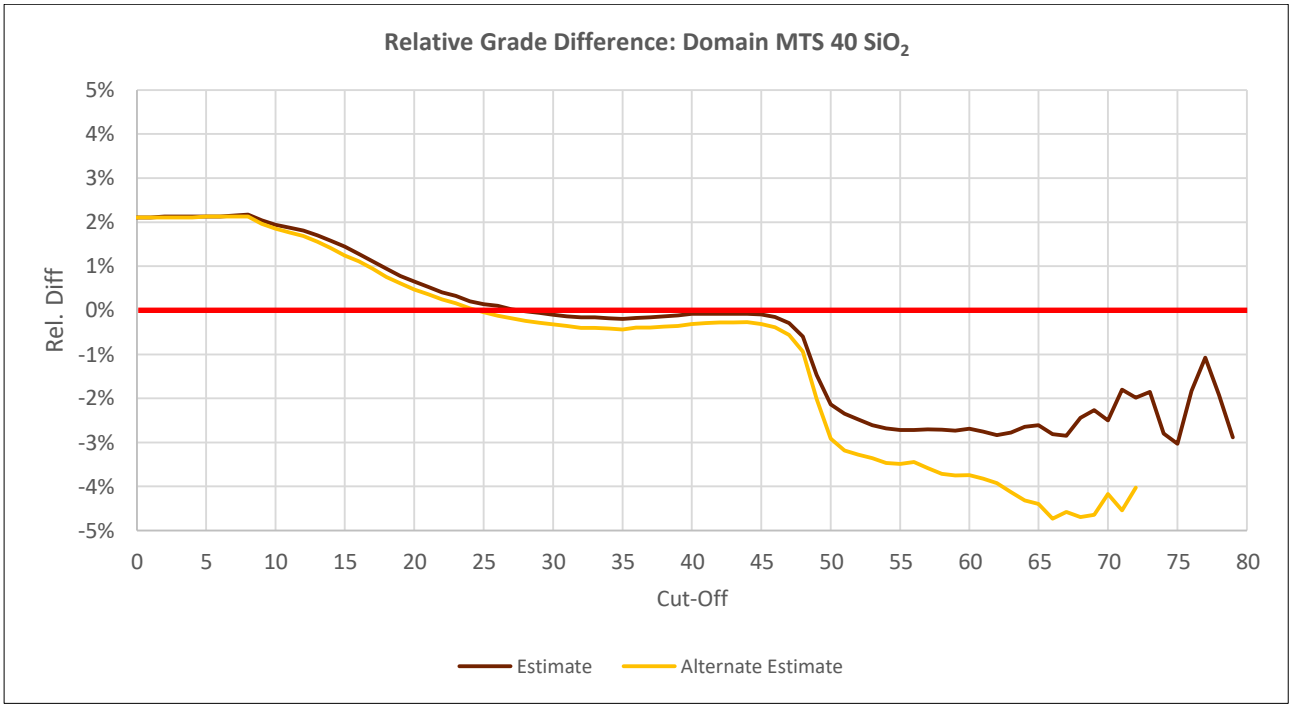


Figure 11.9 – Differential grade curve for the SiO_2 estimates, relative to the DGCOS estimate. Note the alternate estimate (yellow) lies further away from the DGCOS (red) than the estimate (brown).

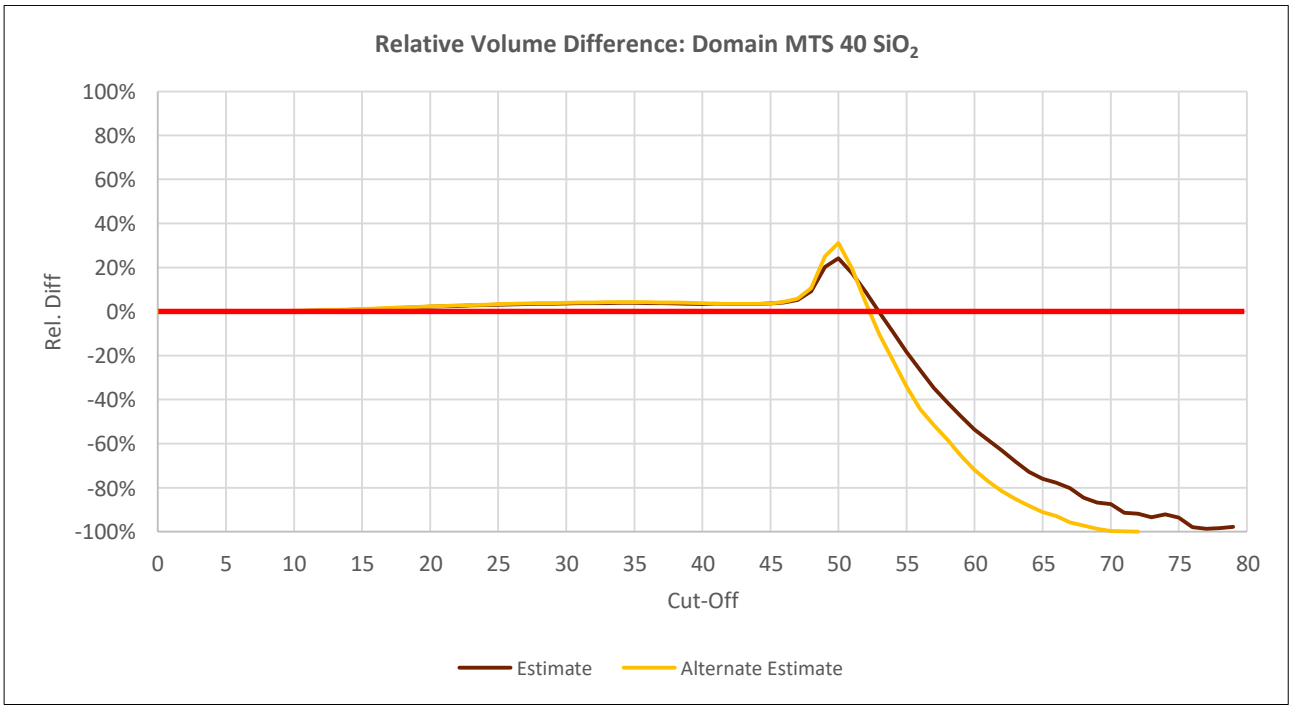


Figure 11.10 – Differential volume curve for the SiO_2 estimates, relative to the DGCOS estimate. Note the alternate estimate (yellow) lies further away from the DGCOS (red) than the estimate (brown).

The charts above clearly show that the estimates performed in this resource update, using the estimation methodology approach described in Section 10, delivers an appropriate amount of smoothing as objectively measured against the DGCOS model. The alternate estimate lies further away from the DGCOS model, being smoother than the estimate, and would thus be at risk of introducing conditional bias to an estimate.

11.2 Visual Validation

Significant effort was expended on visually validating the block estimates by comparing them against the drill hole composite sample grades. Comparisons were undertaken in cross-section, longitudinal section, and in plan view, across all elements estimated for every domain. For practical purposes the validation was limited to what would reasonably be mined, as determined from an earlier iteration of the final Whittle pit shell.

Sections showing head grade estimates were validated against the 2m head assay composites. Sections showing density estimates were validated against 2m density regression composites. Sections showing concentrate grade estimates were validated against the 4m and 8m concentrate grade composites. Sections showing NAPP estimates were validated against the 2m NAPP regression composites. The block estimates and sample composites are always coloured using the same legend.

Figure 11.11 to Figure 11.58 show examples of the visual validations performed for all estimates.

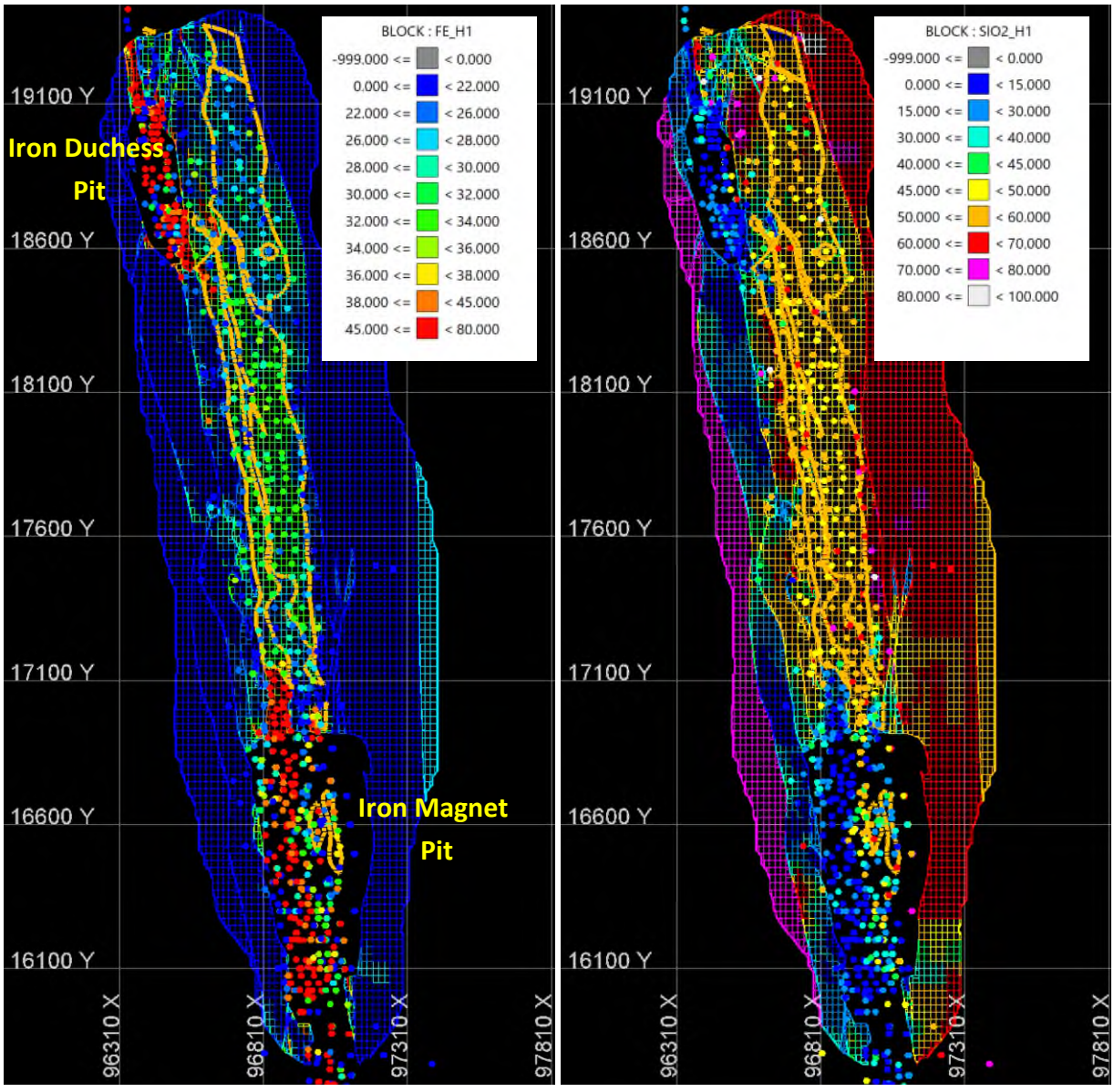


Figure 11.11 – Plan view across the Duchess South area at +150mRL showing Fe_H and SiO_2_H estimates versus sample composite grades. Orange outline is the MTS 40 domain. The location of haematite mineralisation, mostly depleted from the Duchess Pit and the Magnet Pit (formerly the Iron Duke Pit), is indicated by the red dots (samples) on the left most image. Clipping either side of the section is ±4m.

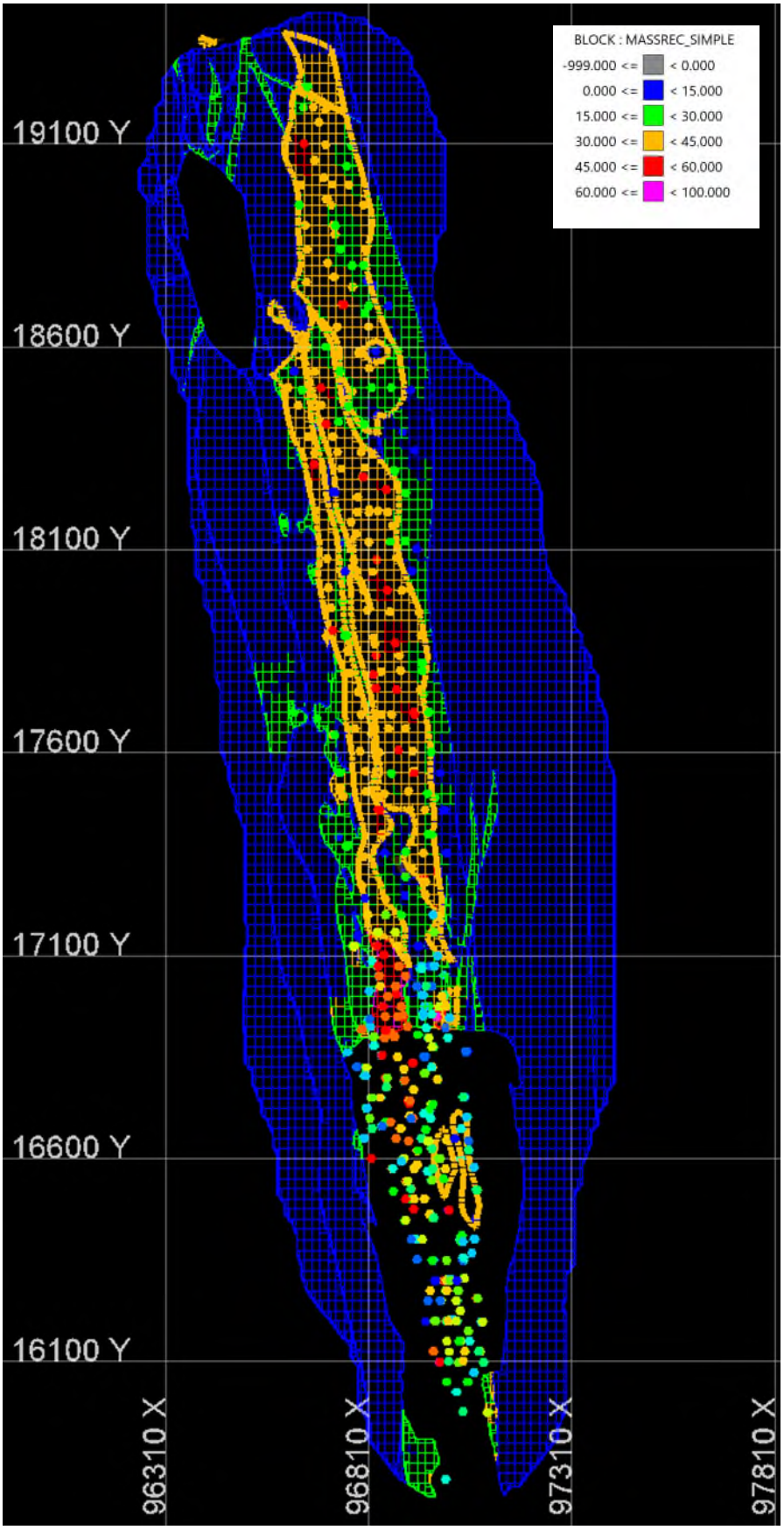


Figure 11.12 – Plan view across the Duchess South area at +150mRL showing mass recovery grade estimate versus sample composite grades. Orange outline is the MTS 40 domain. Clipping either side of the section is ±4m.

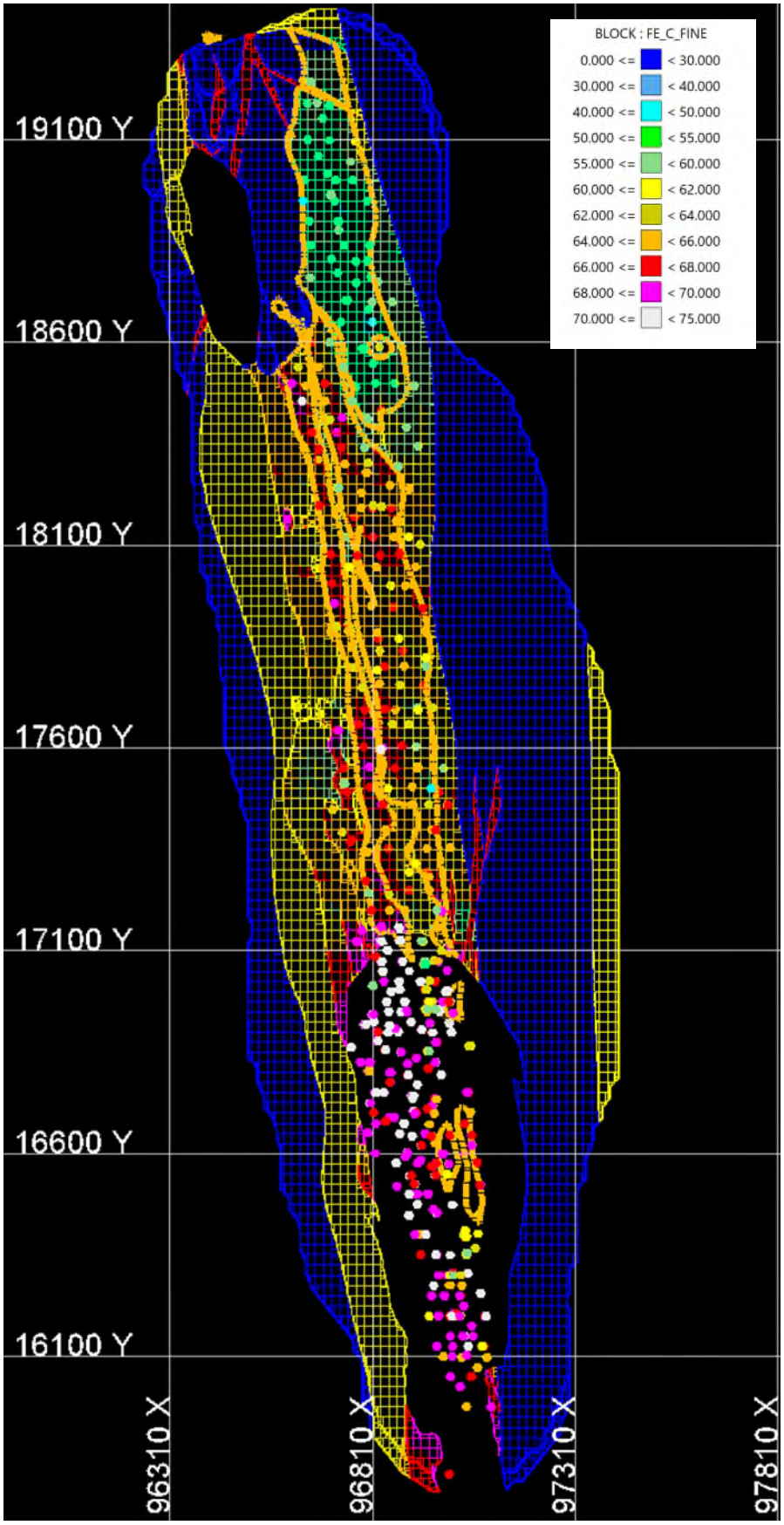


Figure 11.13 – Plan view across the Duchess South area at +150mRL showing Fe_C grade estimate versus sample composite grades. Orange outline is the MTS 40 domain. Clipping either side of the section is ±4m.

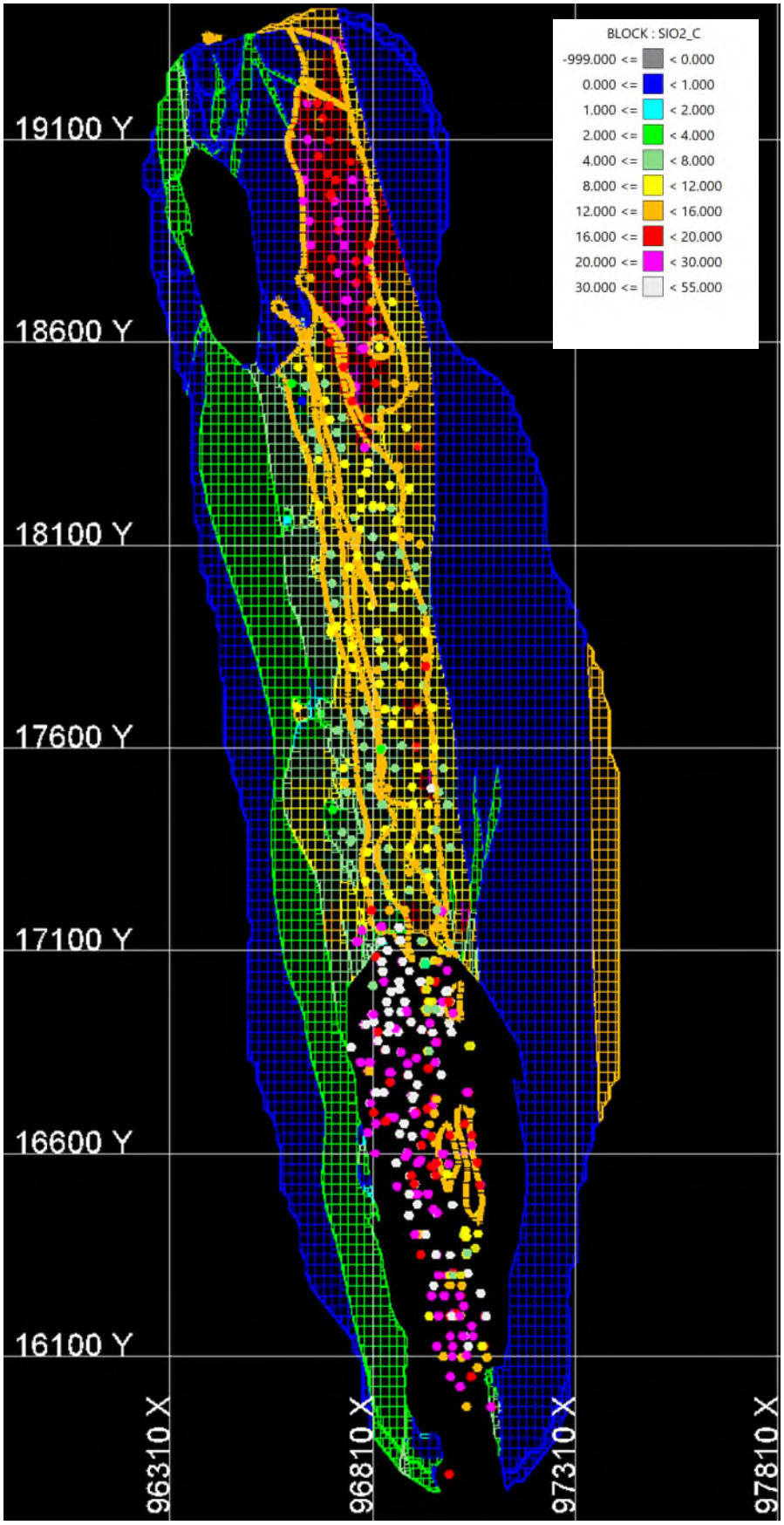


Figure 11.14 – Plan view across the Duchess South area at +150mRL showing SiO_2_C grade estimate versus sample composite grades. Orange outline is the MTS 40 domain. Clipping either side of the section is ±4m.

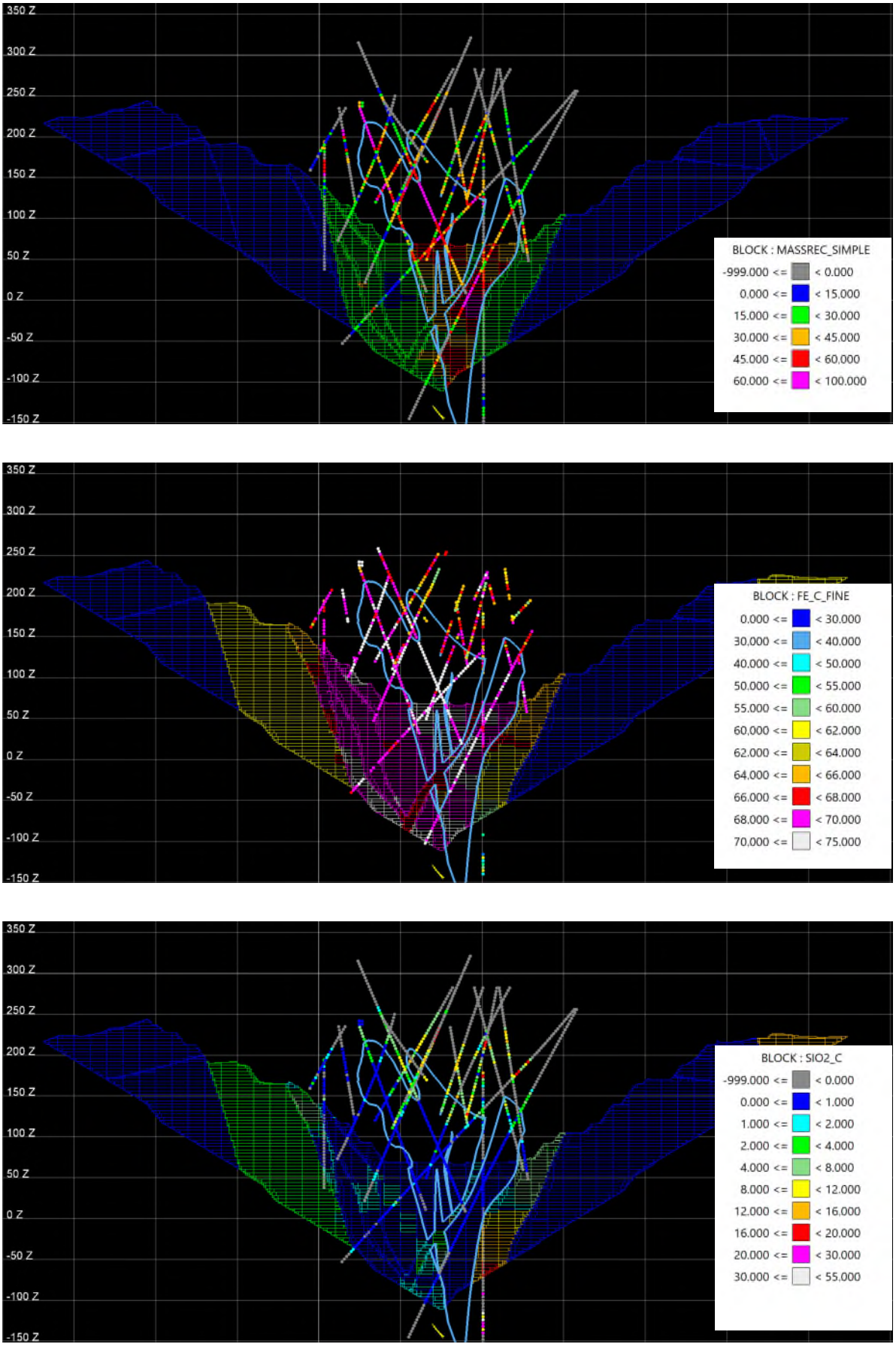


Figure 11.15 – Cross section through the Duchess South area at 16,591mN showing concentrate block estimates versus sample composite grades. Blue outline is the MTC 43 domain. Clipping either side of the section is ±20m.

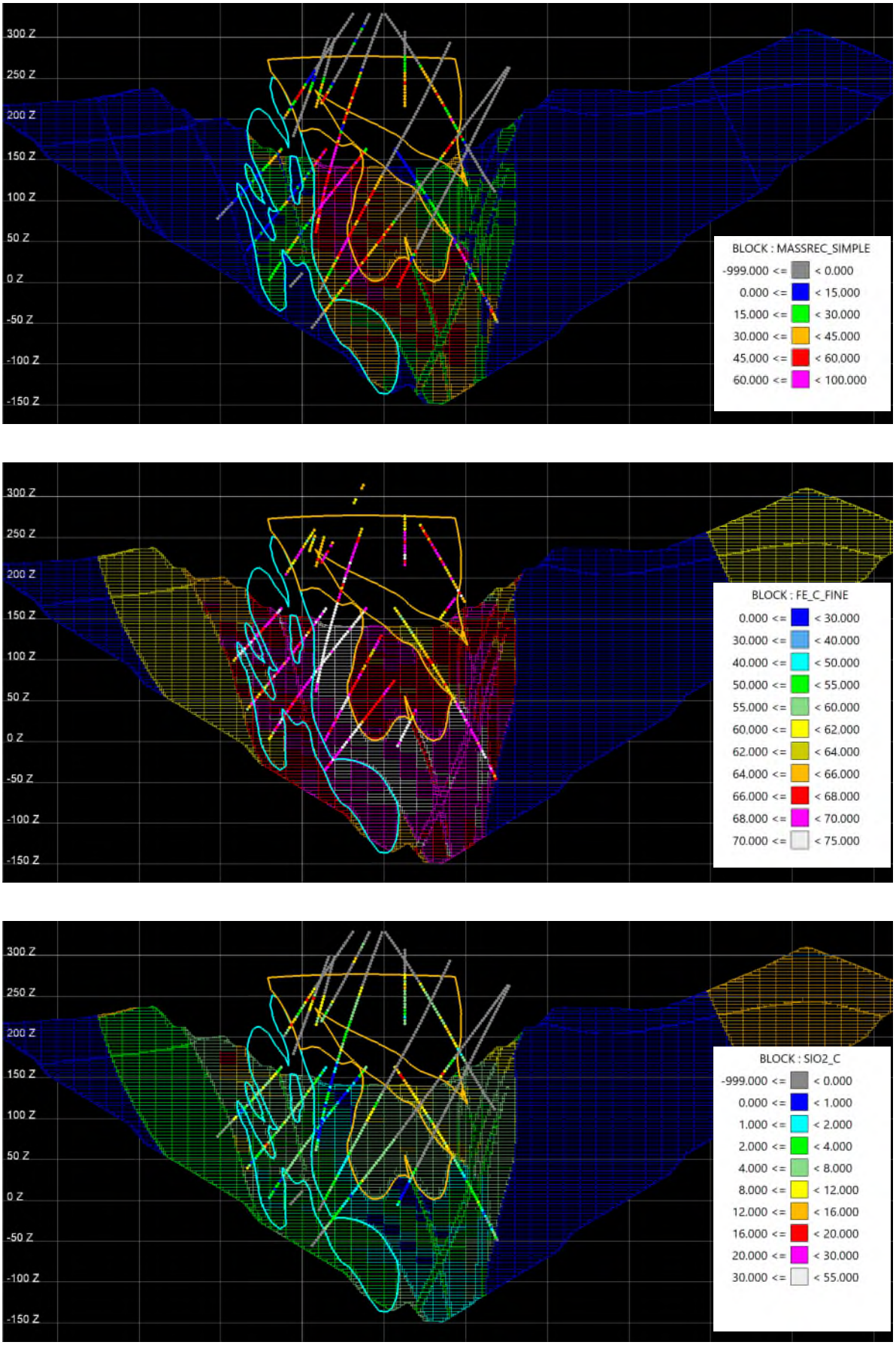


Figure 11.16 – Cross section through the Duchess South area at 17,110mN showing concentrate estimates versus sample composite grades. Light blue outline is the MSU 48 domain, orange outline is the MTS 40 domain. Clipping either side of the section is ±20m.

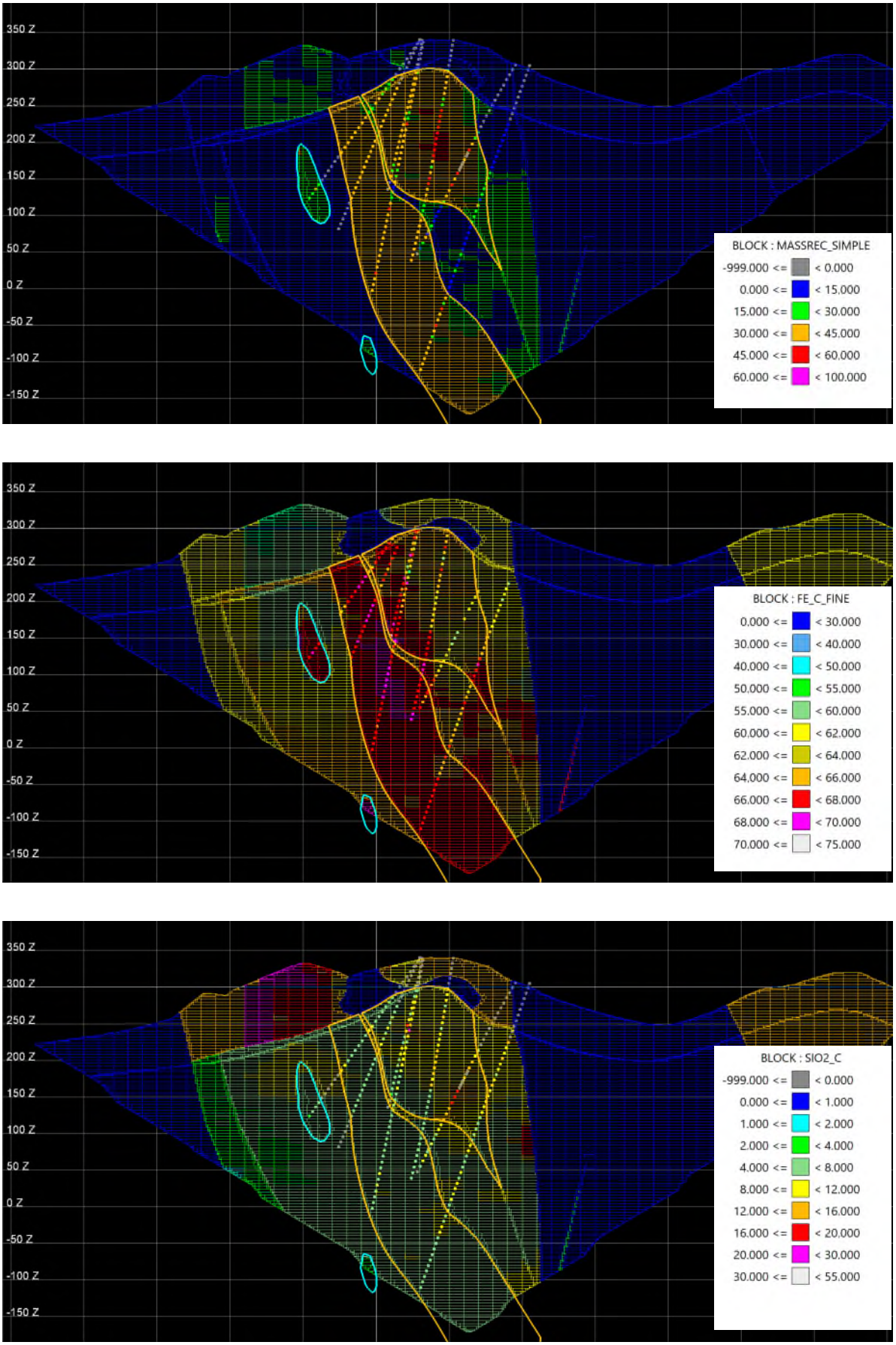


Figure 11.17 – Cross section through the Duchess South area at 17,595mN showing concentrate grade estimates versus sample composite grades. Light blue outline is the MSU 48 domain, orange outline is the MTS 40 domain. Clipping either side of the section is ±20m.

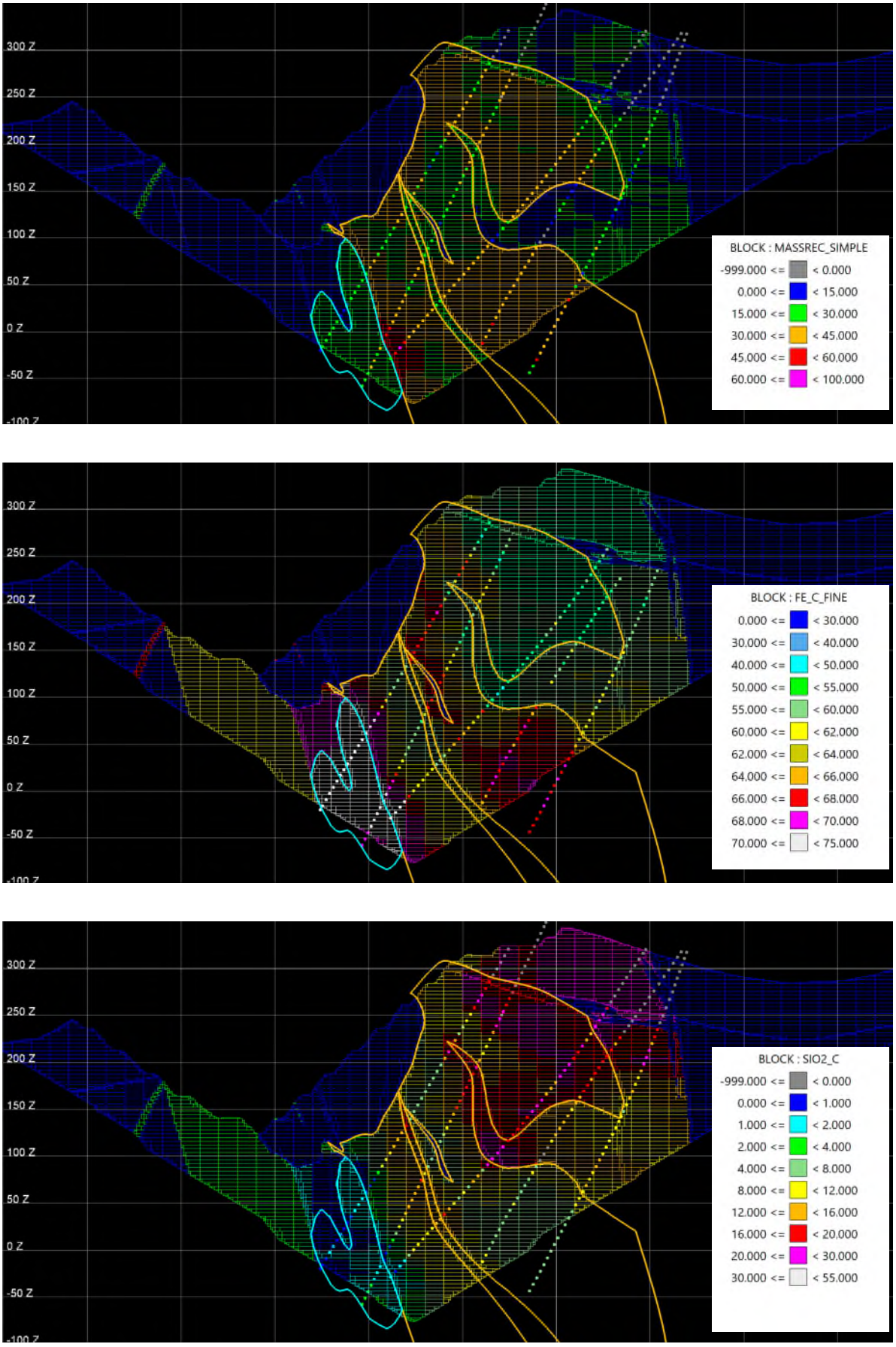


Figure 11.18 – Cross section through the Duchess South area at 18,593mN showing concentrate estimates versus sample composite grades. Light blue outline is the MSU 48 domain, orange outline is the MTS 40 domain. Clipping either side of the section is ±20m.

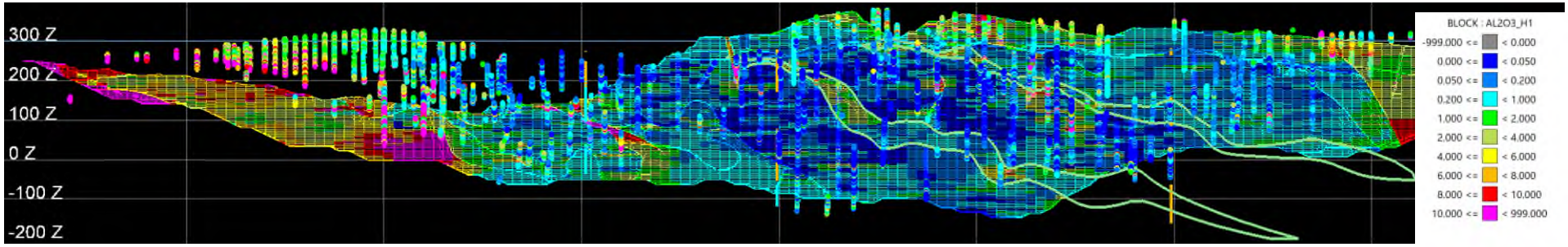


Figure 11.19 – Longitudinal section through the Duchess South area at 96,799mE showing Al_2O_3_H estimate versus sample composite grades. Light green outline is the SCH 46 domain. Clipping is ±20m either side of the section. View is looking west.

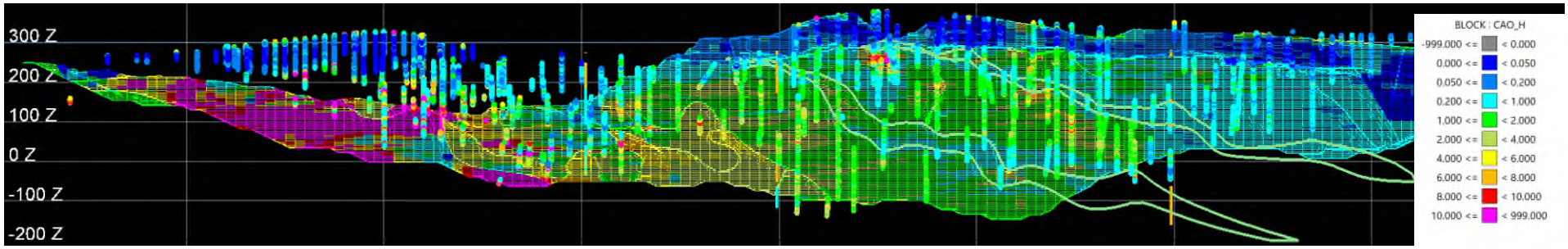


Figure 11.20 – Longitudinal section through the Duchess South area at 96,799mE showing CaO_H estimate versus sample composite grades. Light green outline is the SCH 46 domain. Clipping is ±20m either side of the section. View is looking west.

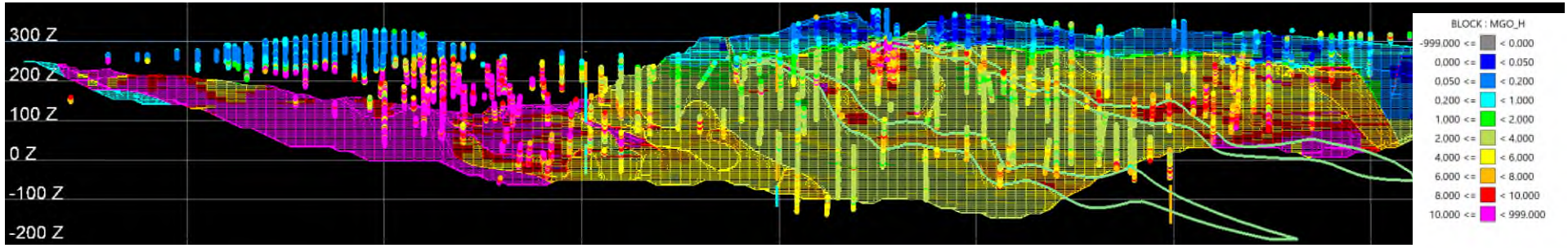


Figure 11.21 – Longitudinal section through the Duchess South area at 96,799mE showing MgO_H estimate versus sample composite grades. Light green outline is the SCH 46 domain. Clipping is ±20m either side of the section. View is looking west.

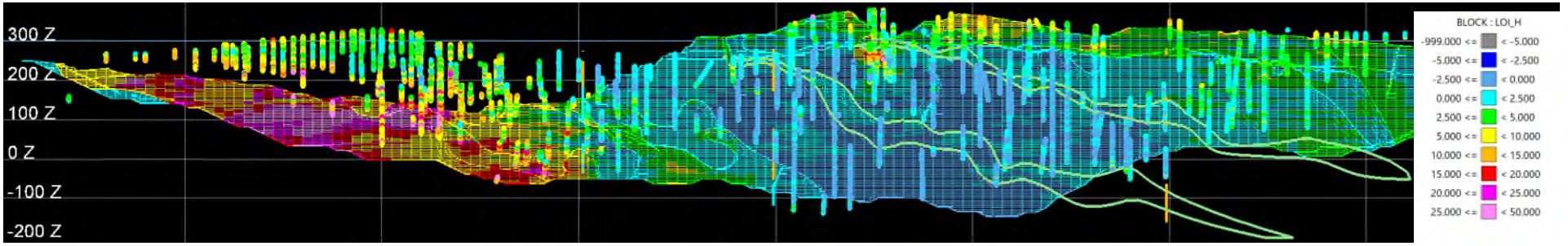


Figure 11.22 – Longitudinal section through the Duchess South area at 96,799mE showing LOI_H estimate versus sample composite grades. Light green outline is the SCH 46 domain. Clipping is ±20m either side of the section. View is looking west.

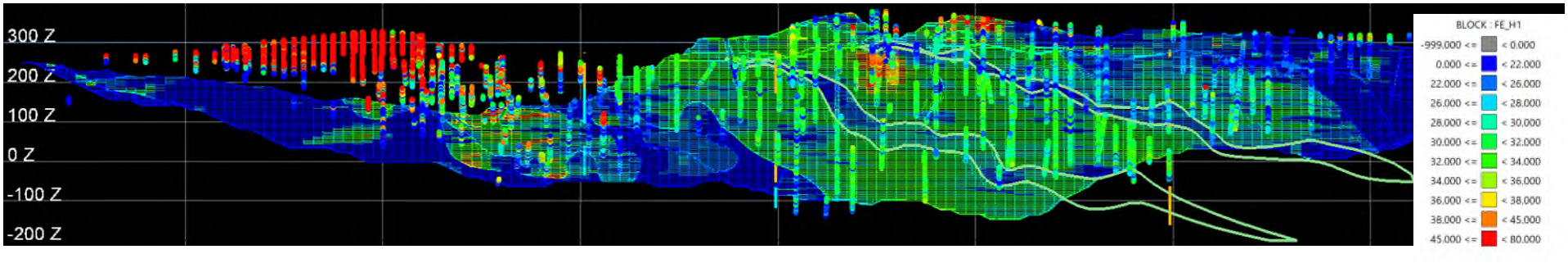


Figure 11.23 – Longitudinal section through the Duchess South area at 96,799mE showing Fe_H estimate versus sample composite grades. Light green outline is the SCH 46 domain. Clipping is ±20m either side of the section. View is looking west.

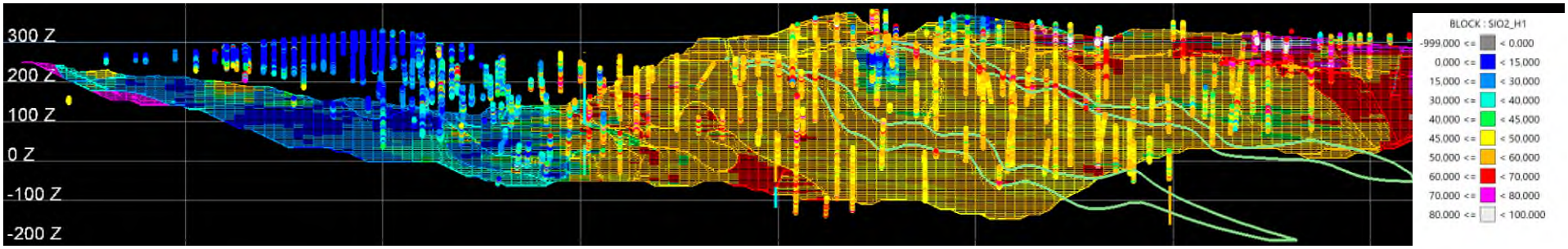


Figure 11.24 – Longitudinal section through the Duchess South area at 96,799mE showing SiO_2_H estimate versus sample composite grades. Light green outline is the SCH 46 domain. Clipping is ±20m either side of the section. View is looking west.

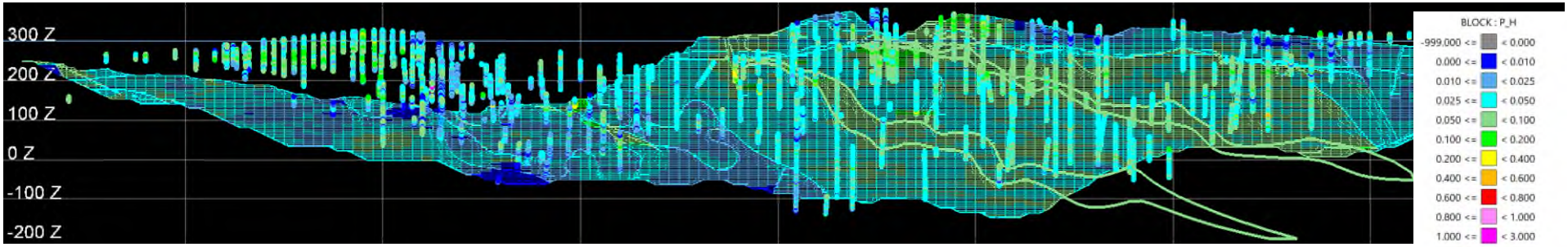


Figure 11.25 – Longitudinal section through the Duchess South area at 96,799mE showing P_H estimate versus sample composite grades. Light green outline is the SCH 46 domain. Clipping is ±20m either side of the section. View is looking west.

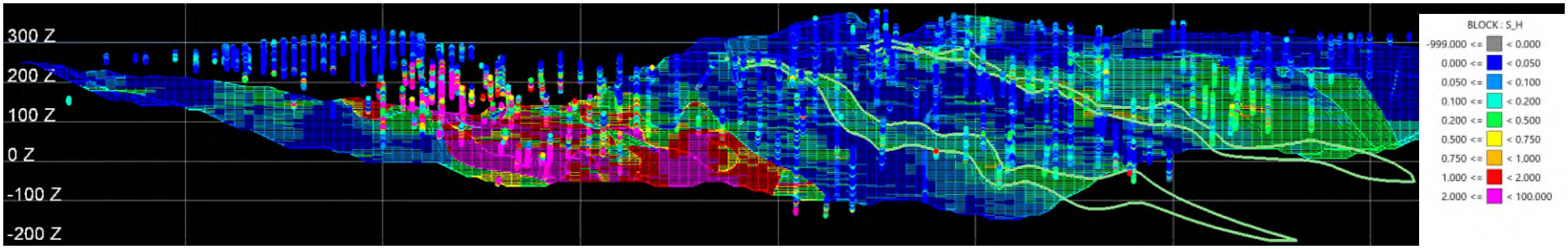


Figure 11.26 – Longitudinal section through the Duchess South area at 96,799mE showing S_H estimate versus sample composite grades. Light green outline is the SCH 46 domain. Clipping is ±20m either side of the section. View is looking west.

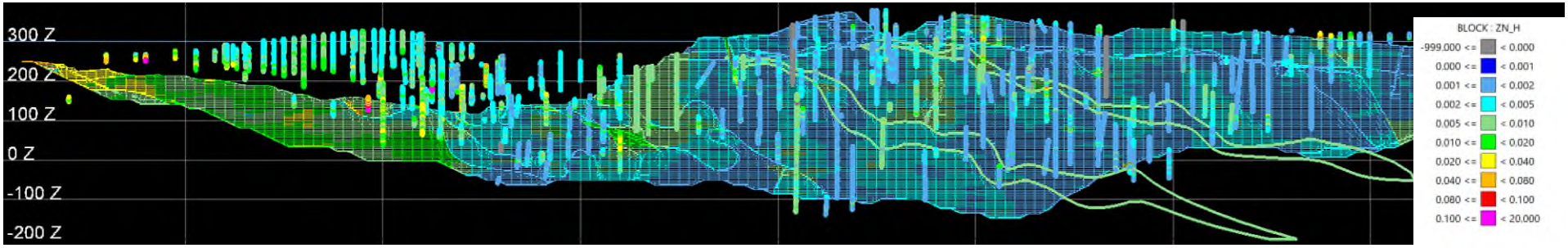


Figure 11.27 – Longitudinal section through the Duchess South area at 96,799mE showing Zn_H estimate versus sample composite grades. Light green outline is the SCH 46 domain. Clipping is ±20m either side of the section. View is looking west.

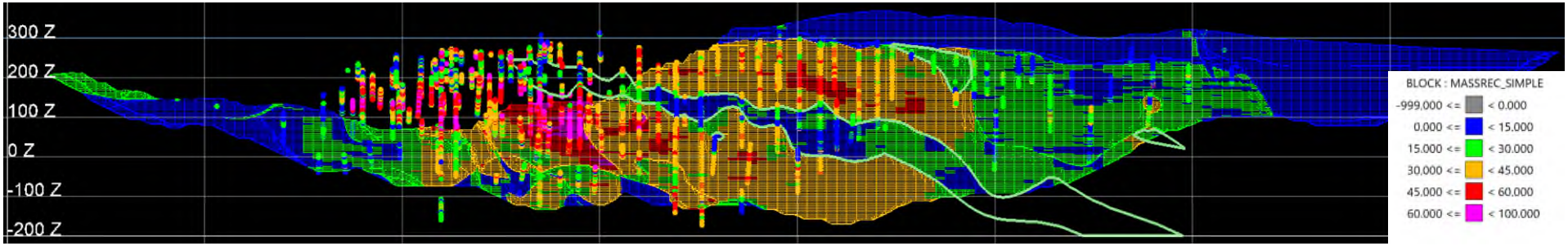


Figure 11.28 – Longitudinal section through the Duchess South area at 96,897mE showing mass recovery estimate versus sample composite grades. Light green outline is the SCH 46 domain. Clipping is ±20m either side of the section. View is looking west.

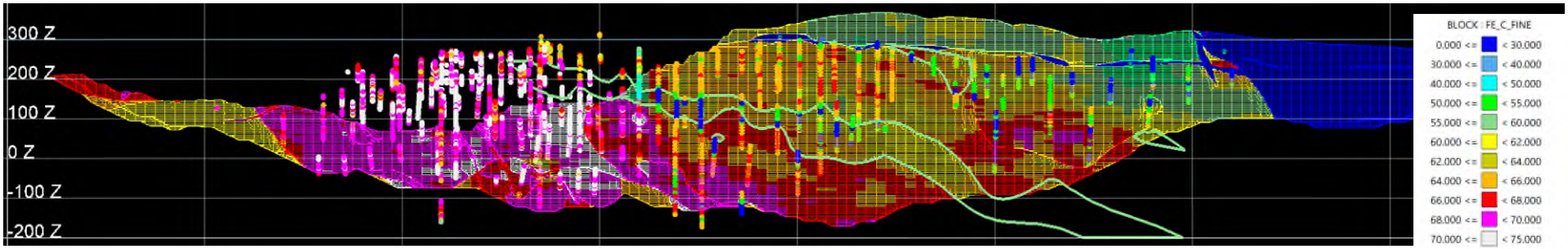


Figure 11.29 – Longitudinal section through the Duchess South area at 96,897mE showing Fe_C estimate versus sample composite grades. Light green is the SCH 46 domain. Clipping is ±20m either side of the section. View is looking west.

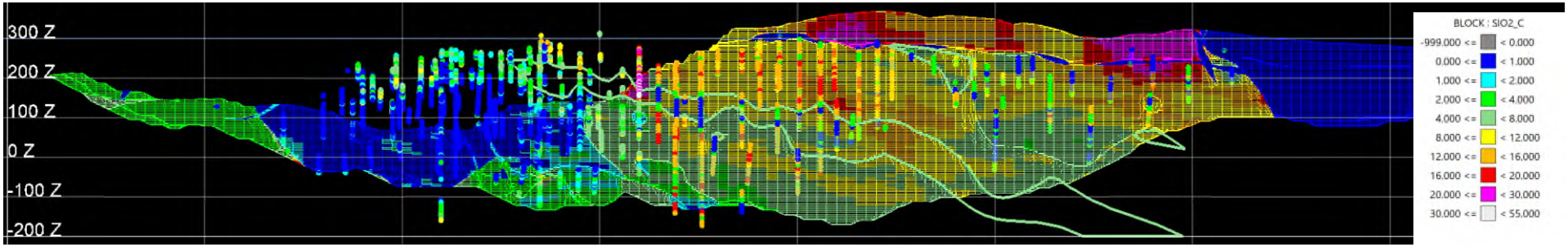


Figure 11.30 – Longitudinal section through the Duchess South area at 96,897mE showing SiO_2_C estimate versus sample composite grades. Light green outline is the SCH 46 domain. Clipping is ±20m either side of the section. View is looking west.

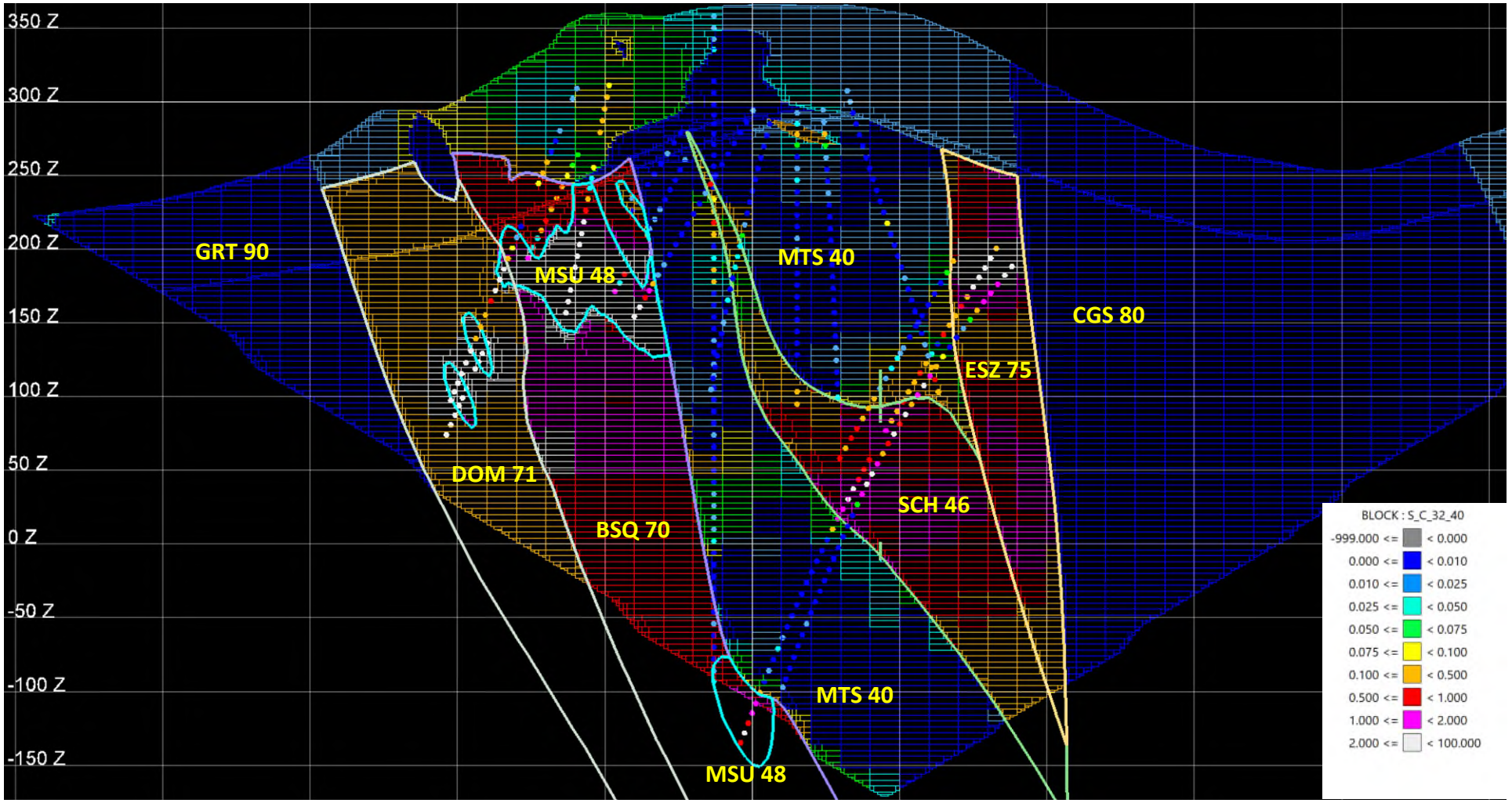


Figure 11.31 – Cross section through the Duchess South area at 17,720mN showing S_C estimate versus sample composite grades. The major domain outlines are annotated. Clipping is ±35m either side of the section.

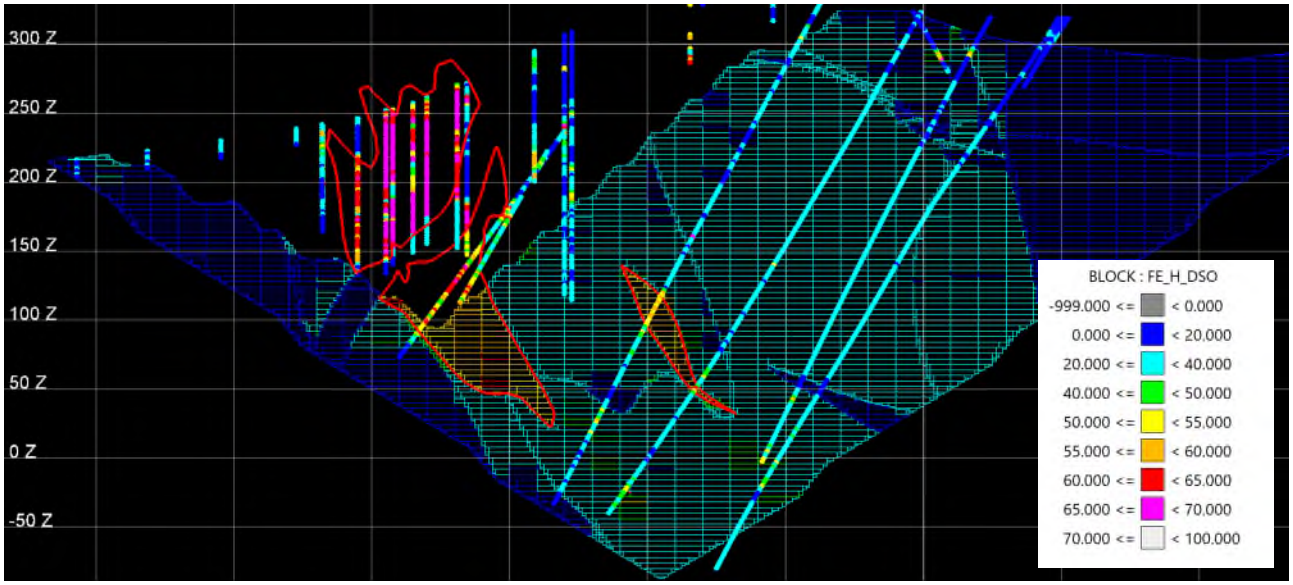


Figure 11.32 – Cross section through the Iron Duchess Pit at 18,811mN showing Fe_H estimate versus sample composite grades. Red outline is HEO 30 domain. Clipping is ±20m either side of the section.

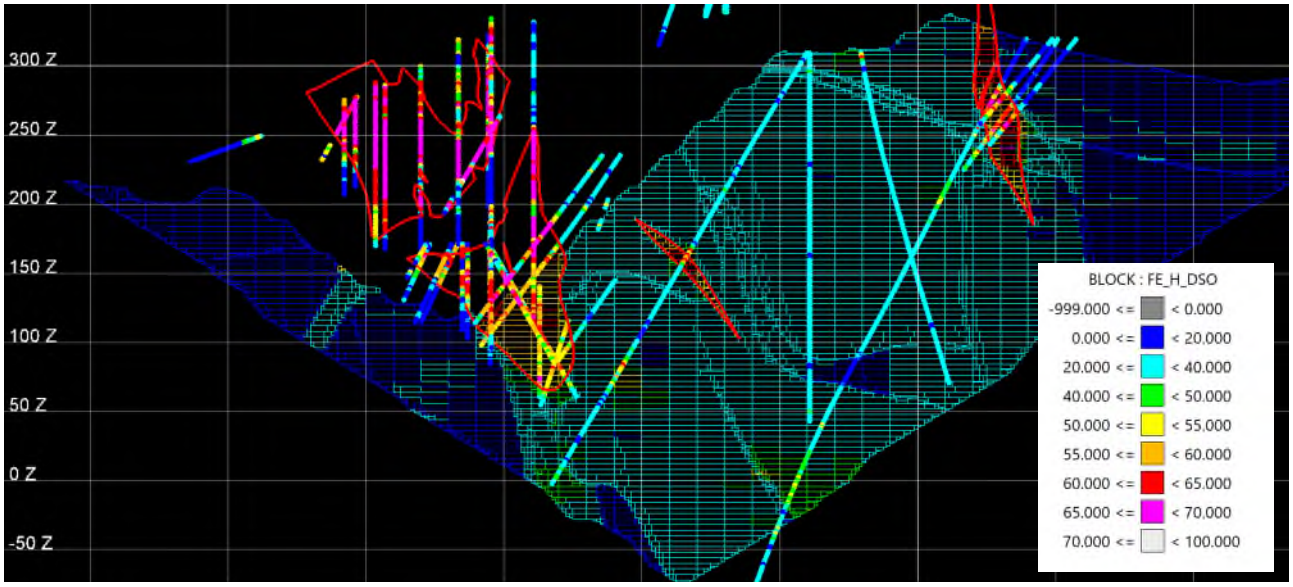


Figure 11.33 – Cross section through the Iron Duchess Pit at 18,668mN showing Fe_H estimate versus sample composite grades. Red outline is HEO 30 domain. Clipping is ±10m either side of the section.

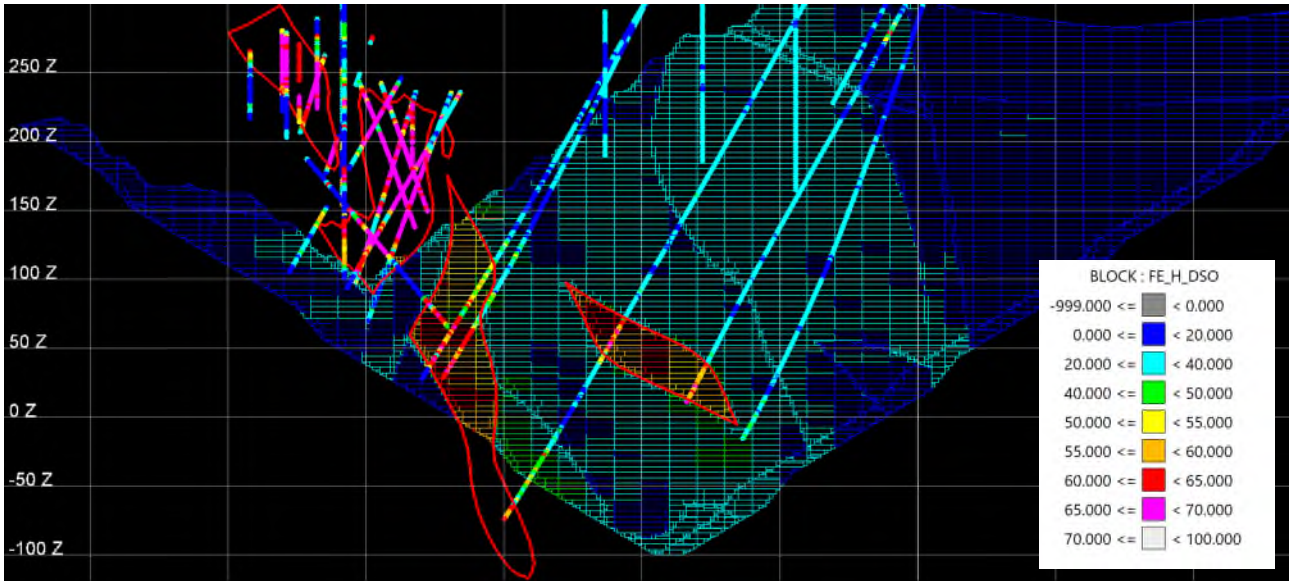


Figure 11.34 – Cross section through the Iron Duchess Pit at 18,989mN showing Fe_H estimate versus sample composite grades. Red outline is HEO 30 domain. Clipping is ±20m either side of the section.

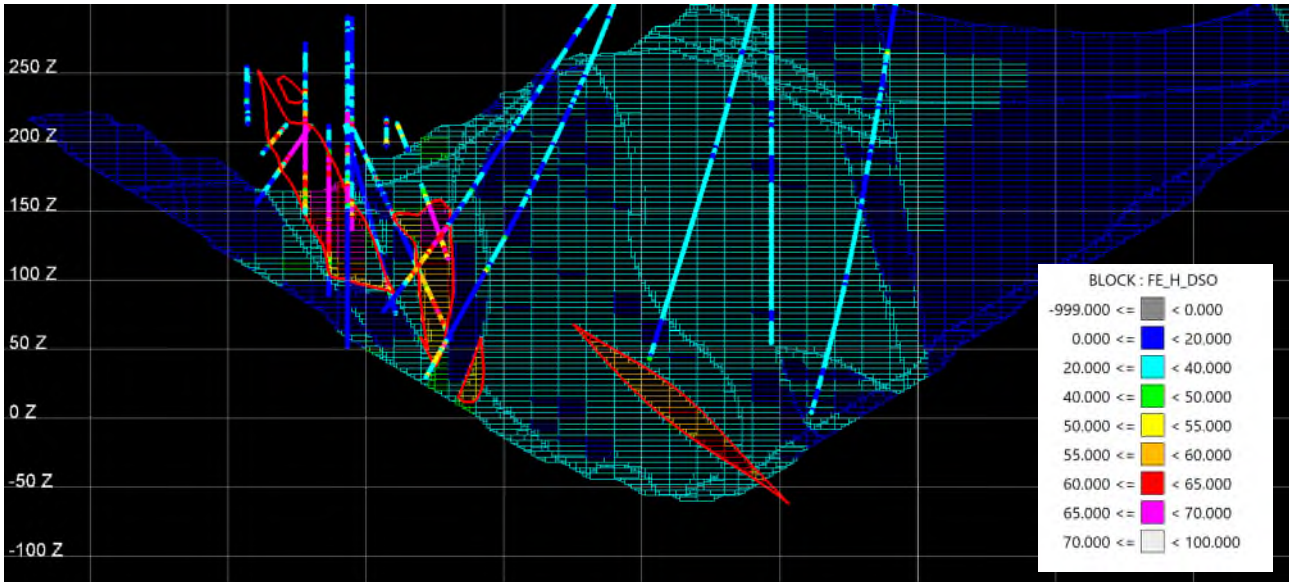


Figure 11.35 – Cross section through the Iron Duchess Pit at 19,105mN showing Fe_H estimate versus sample composite grades. Red outline is HEO 30 domain. Clipping is ±20m either side of the section.

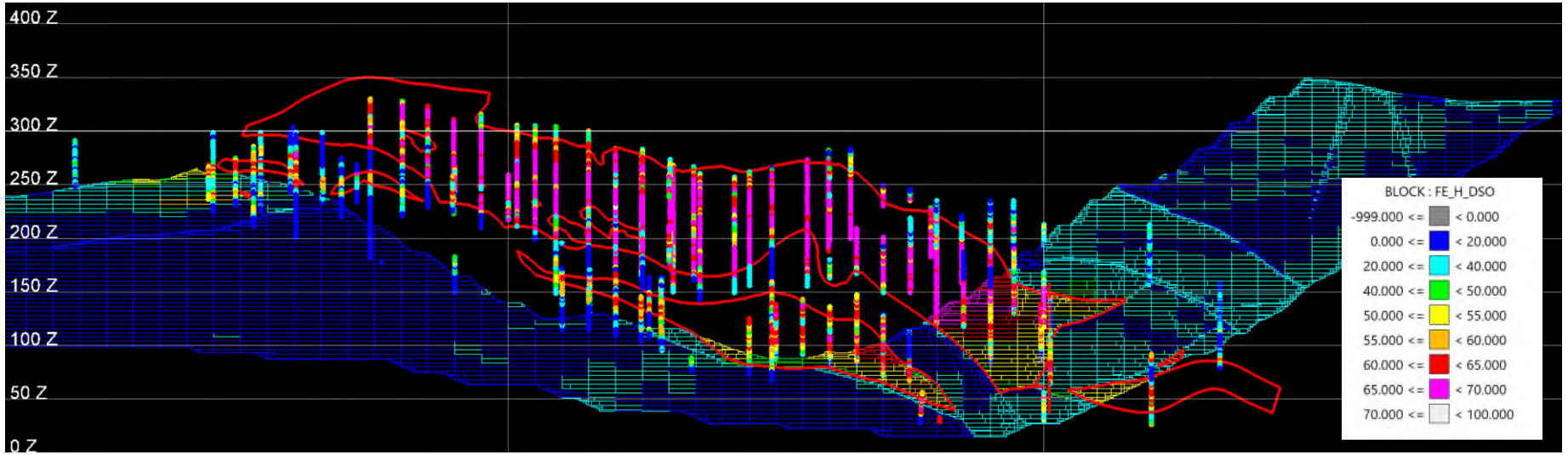


Figure 11.36 – Longitudinal section through the Iron Duchess Pit at 96,449mE showing Fe_H estimate versus sample composite grades. Red outline is HEO 30 domain. Clipping is ±20m either side of the section. View is looking west.

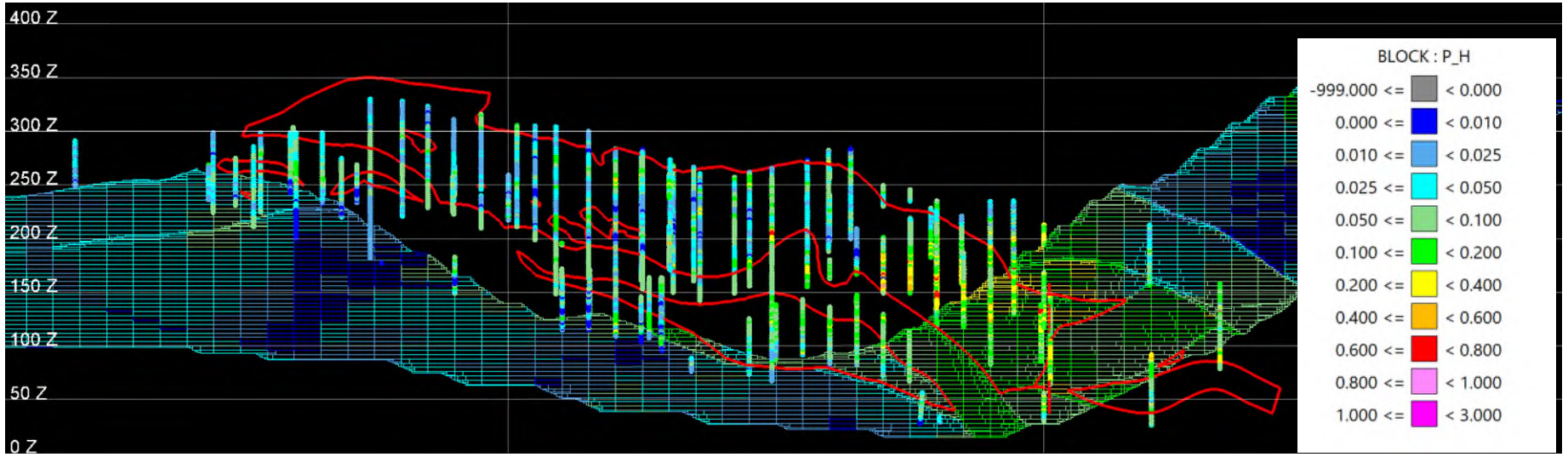


Figure 11.37 – Longitudinal section through the Iron Duchess Pit at 96,449mE showing P_H estimate versus sample composite grades. Red outline is HEO 30 domain. Clipping is ±20m either side of the section. View is looking west.

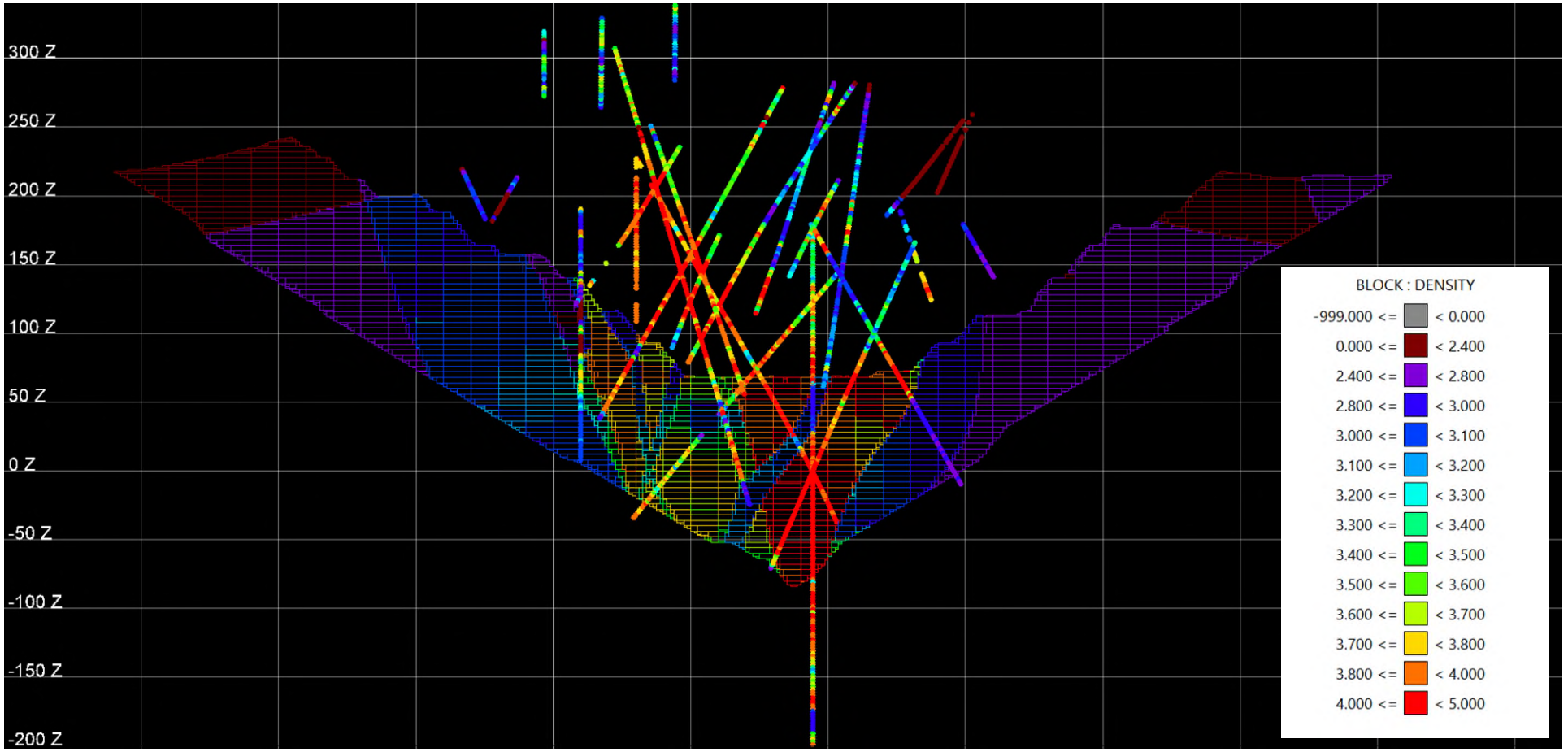


Figure 11.38 – Cross section through the Iron Magnet Pit at 16,506mN showing density estimate versus sample composite grades. Clipping is ±20m either side of the section.

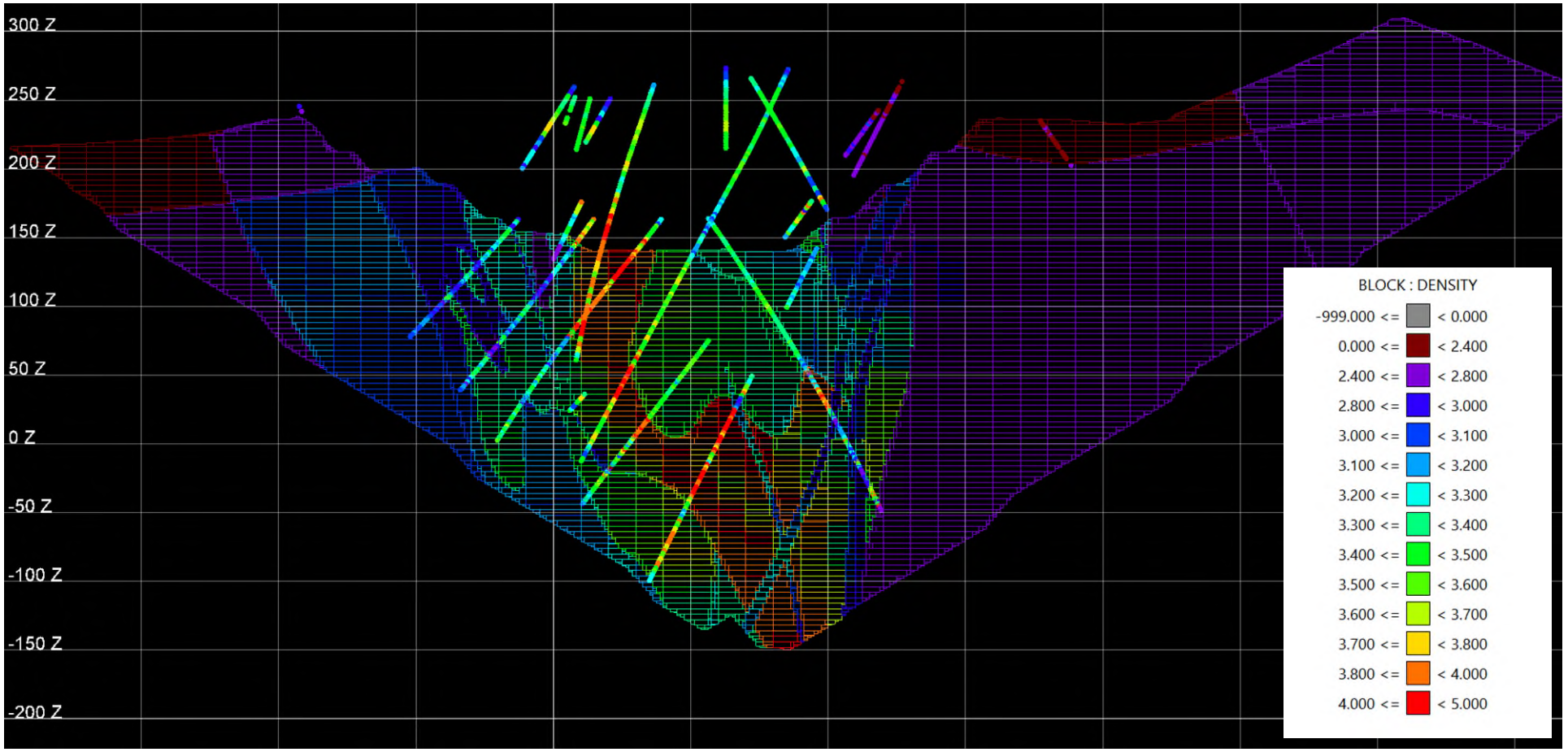


Figure 11.39 – Cross section through the Iron Magnet Pit at 17,105mN showing density estimate versus sample composite grades. Clipping is ±20m either side of the section.

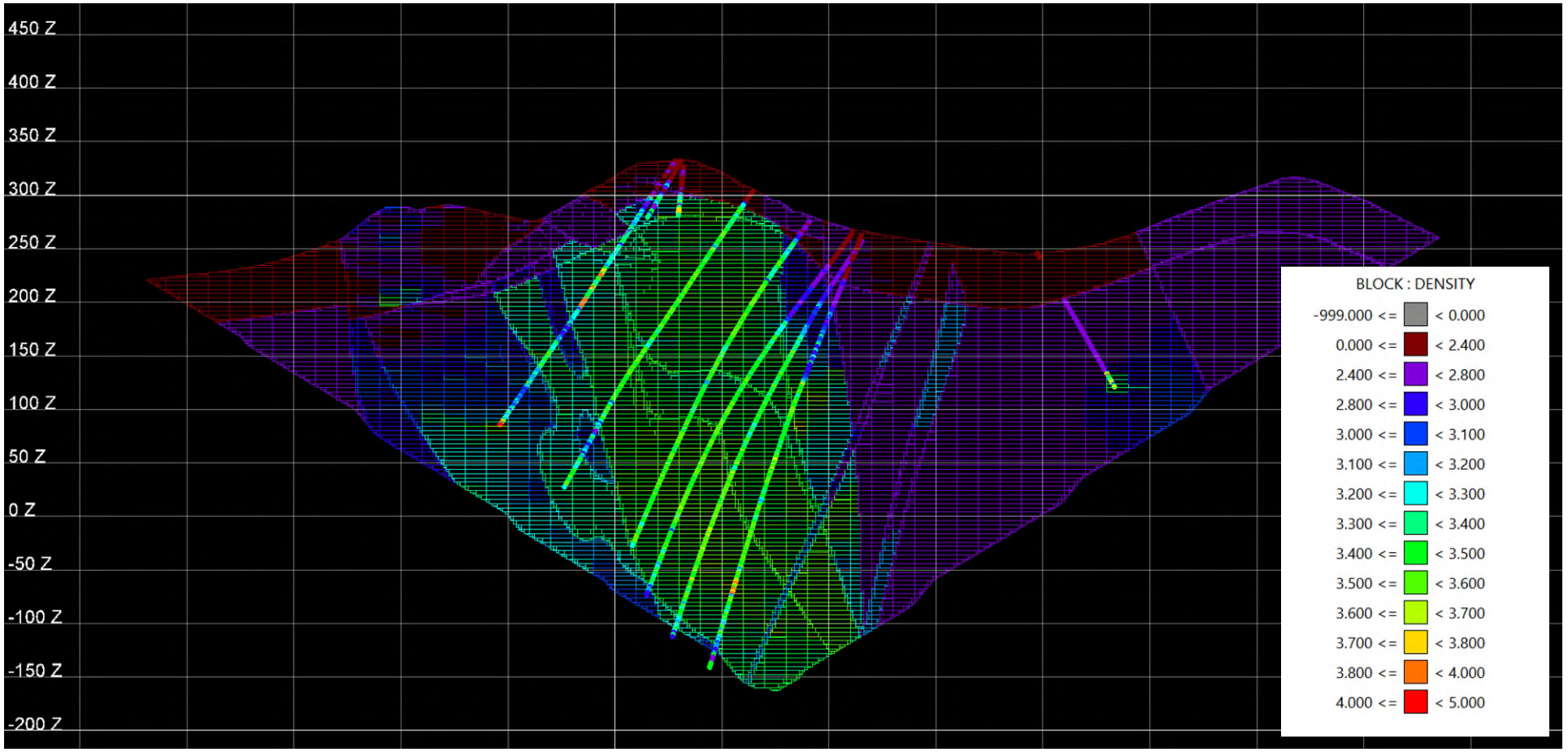


Figure 11.40 – Cross section through Duchess South at 17,478mN showing density estimate versus sample composite grades. Clipping is ±20m either side of the section.

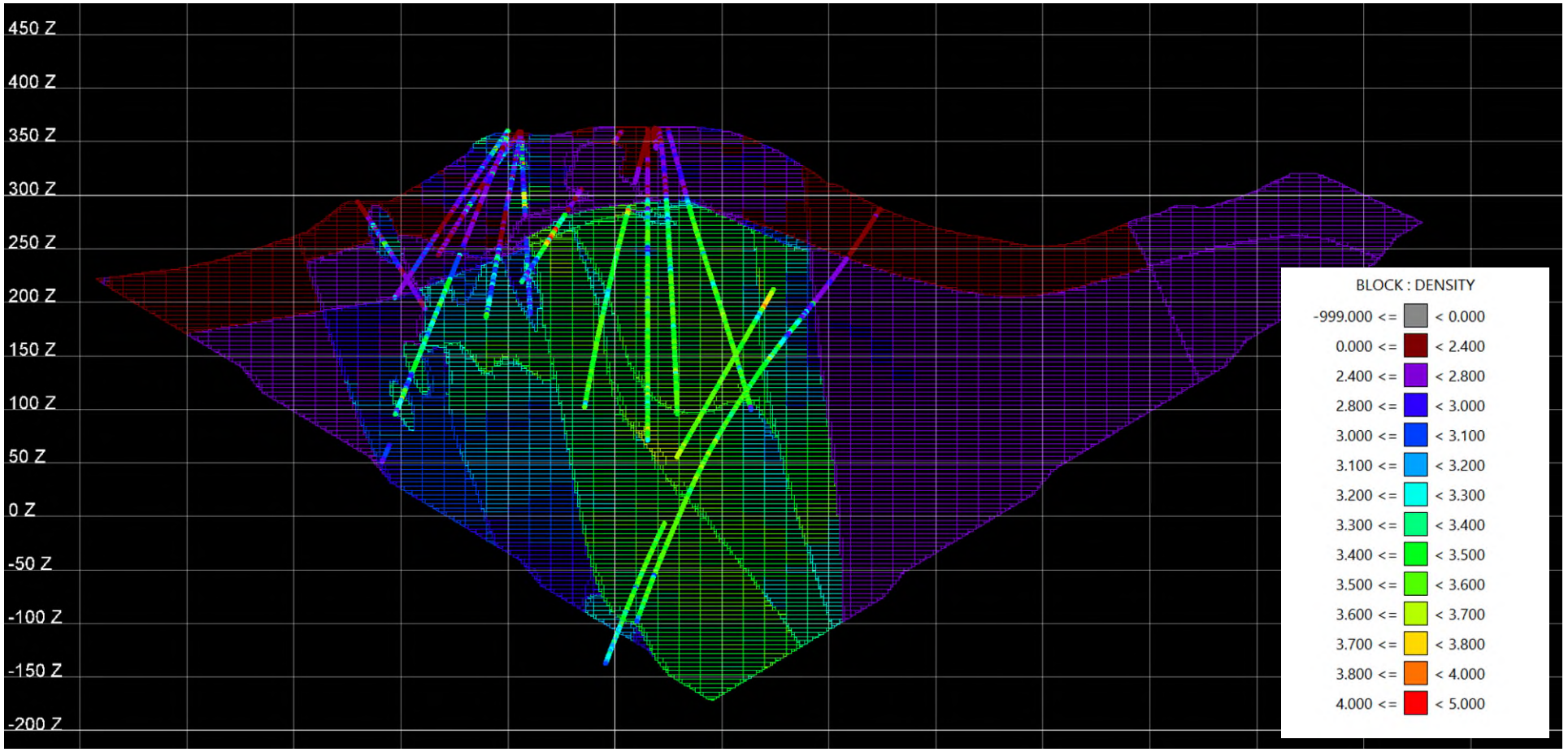


Figure 11.41 – Cross section through Duchess South at 17,711mN showing density estimate versus sample composite grades. Clipping is ±20m either side of the section.

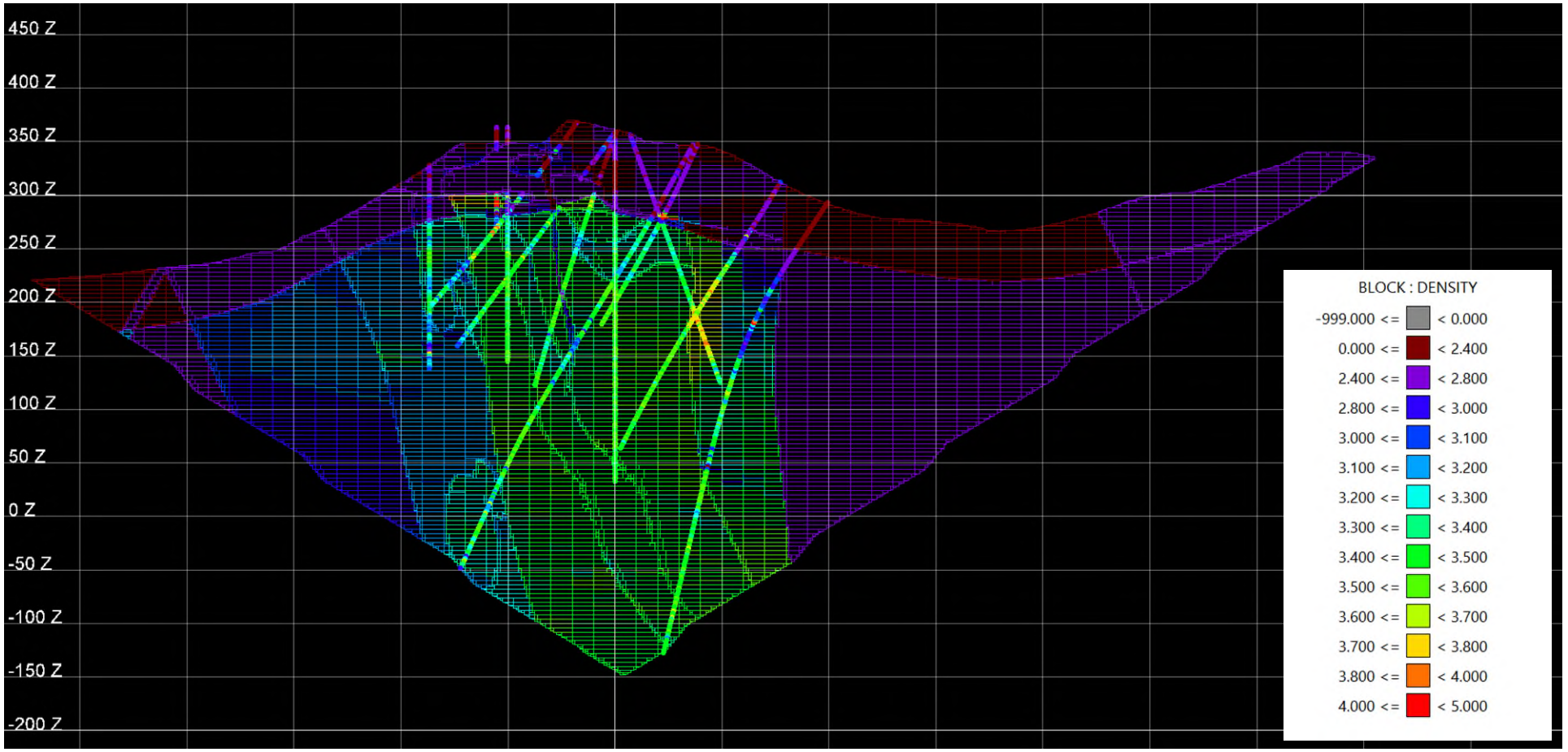


Figure 11.42 – Cross section through Duchess South at 18,115mN showing density estimate versus sample composite grades. Clipping is ±20m either side of the section.

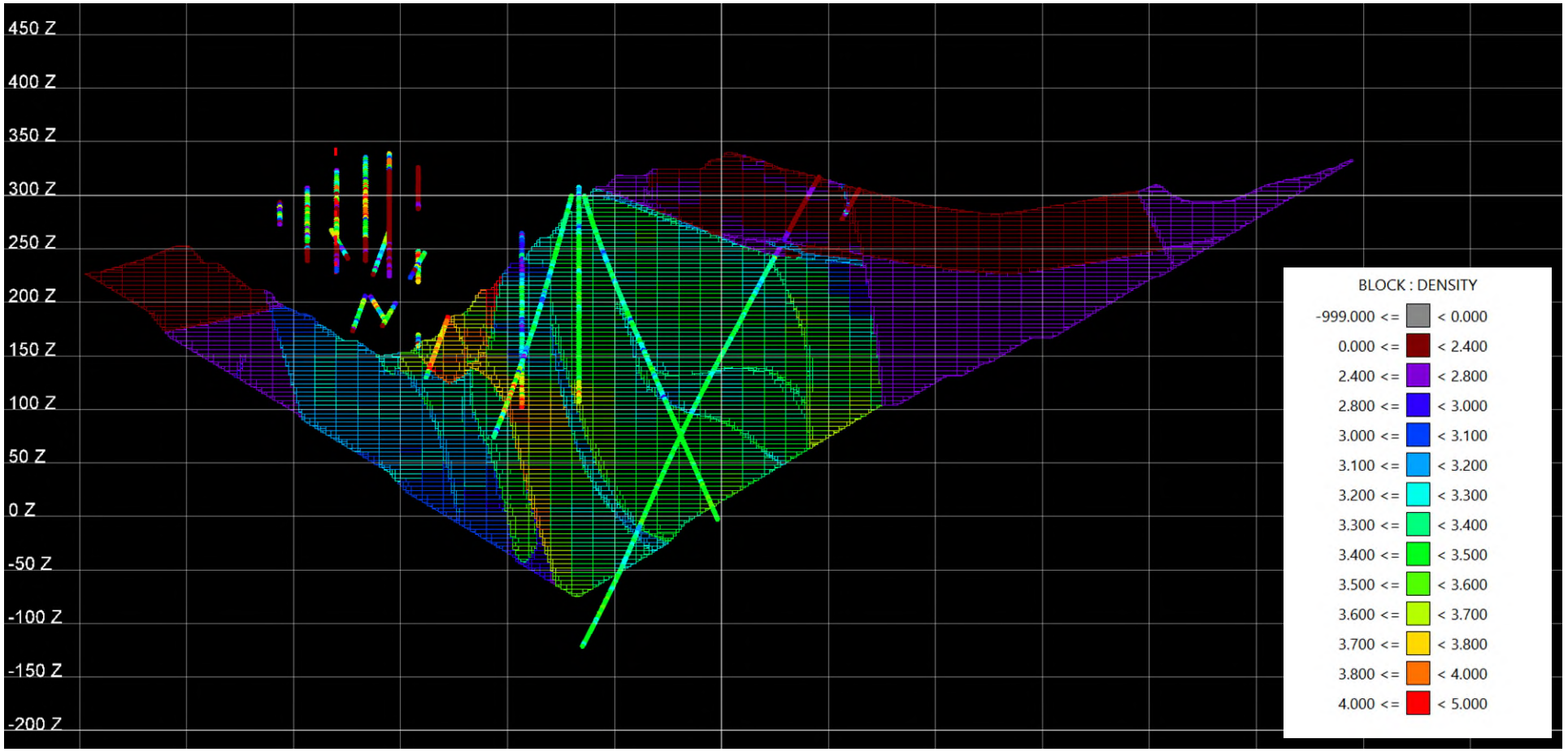


Figure 11.43 – Cross section through the Iron Duchess Pit at 18,545mN showing density estimate versus sample composite grades. Clipping is ±20m either side of the section.

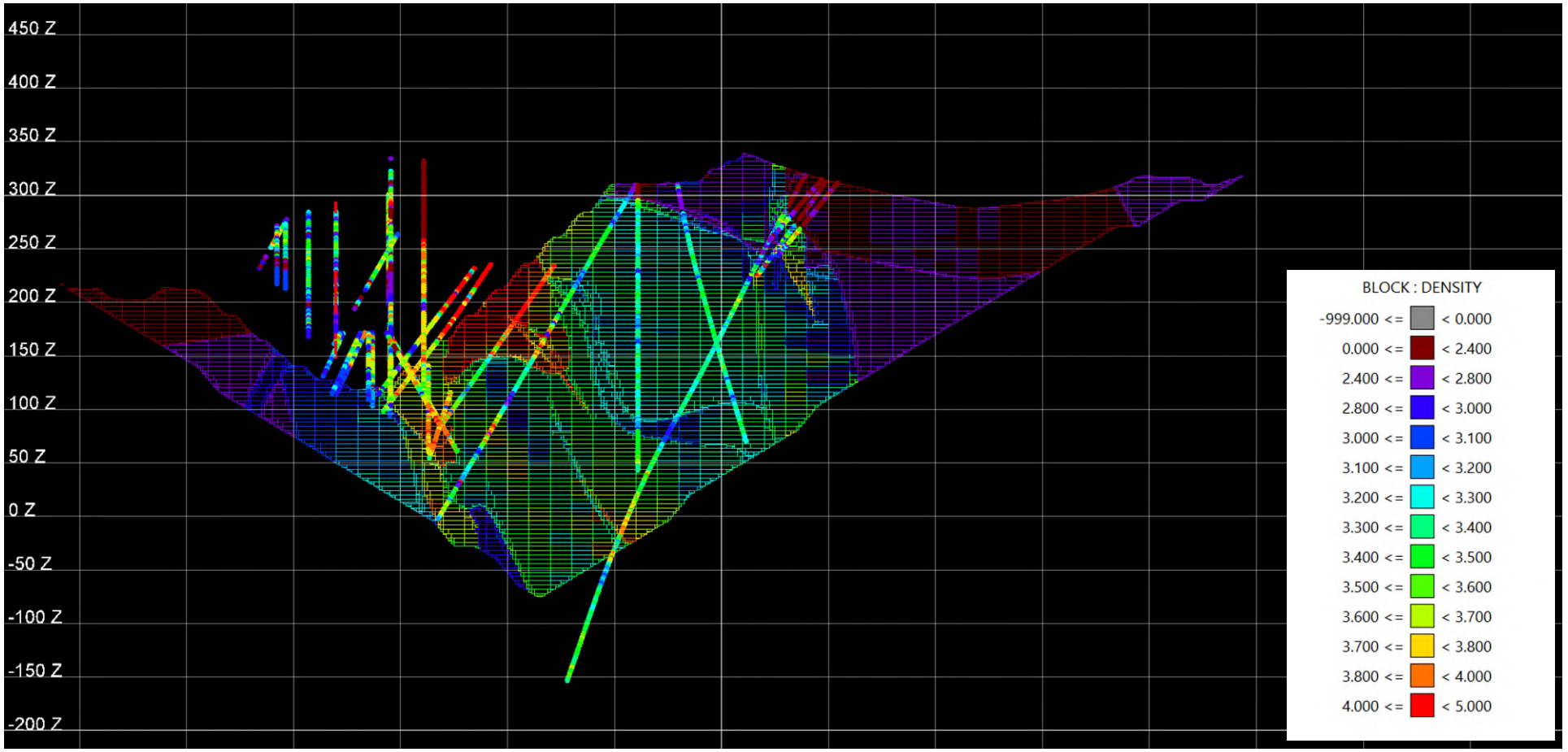


Figure 11.44 – Cross section through the Iron Duchess Pit at 18,661mN showing density estimate versus sample composite grades. Clipping is ±20m either side of the section.

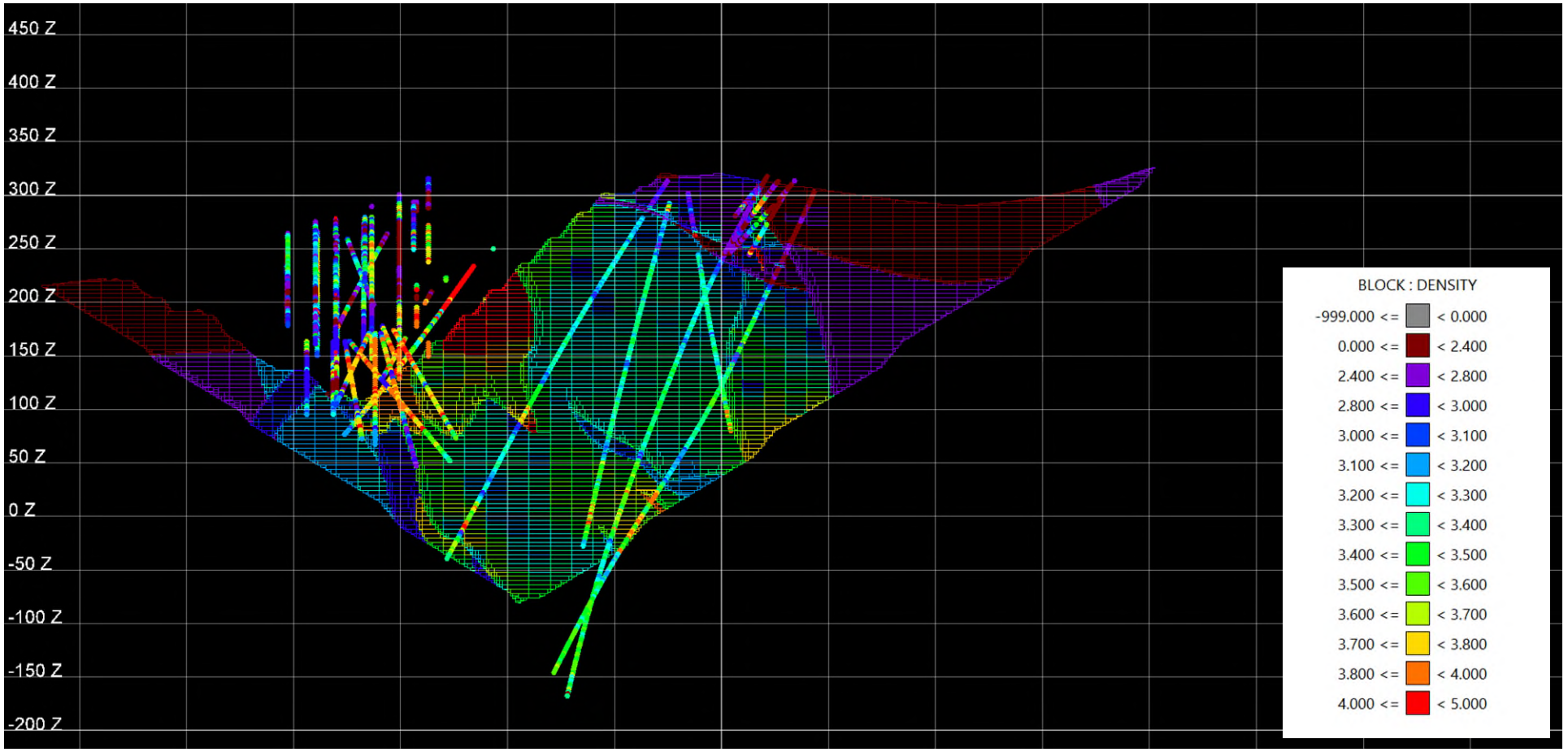


Figure 11.45 – Cross section through the Iron Duchess Pit at 18,748mN showing density estimate versus sample composite grades. Clipping is ±20m either side of the section.

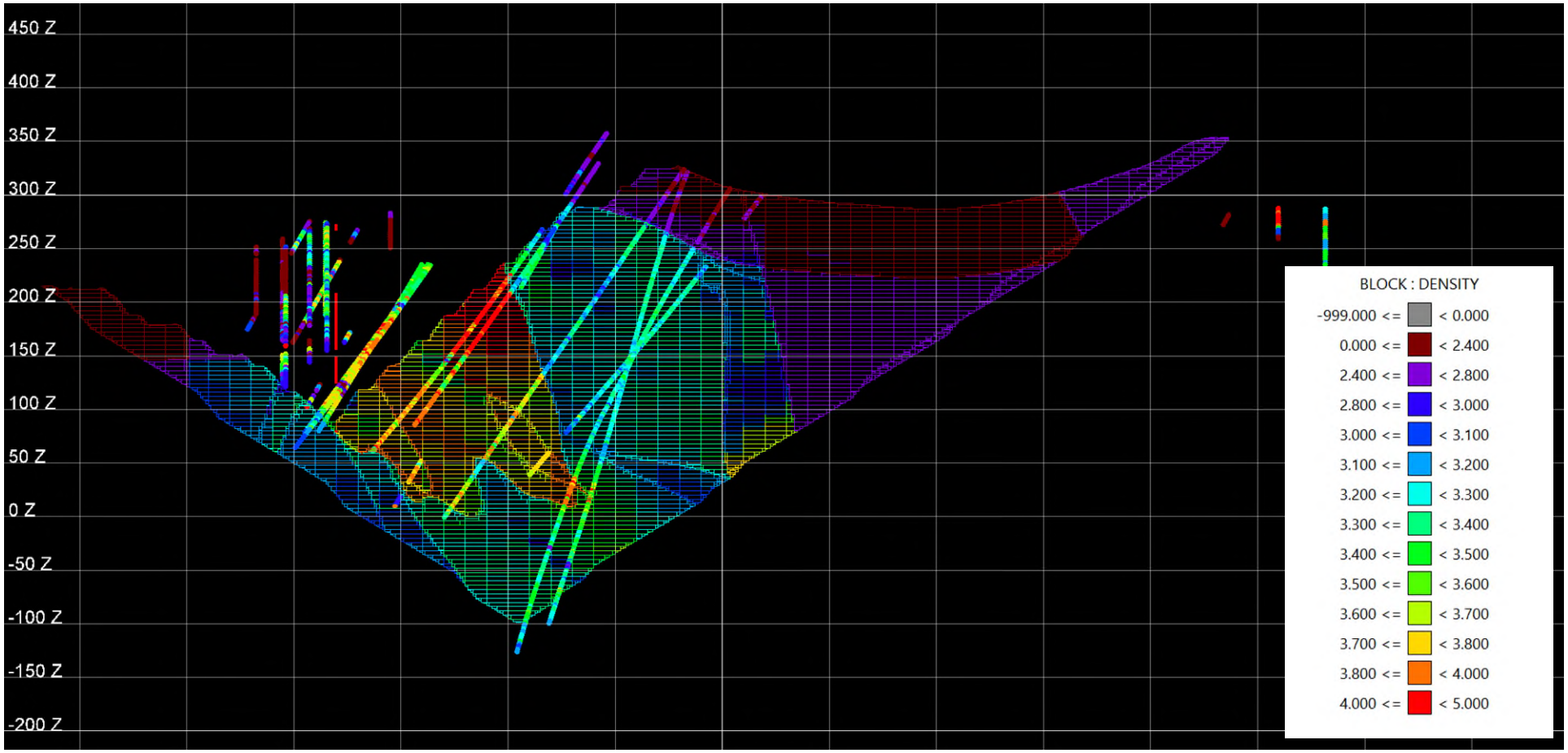


Figure 11.46 – Cross section through the Iron Duchess Pit at 18,877mN showing density estimate versus sample composite grades. Clipping is ±20m either side of the section.

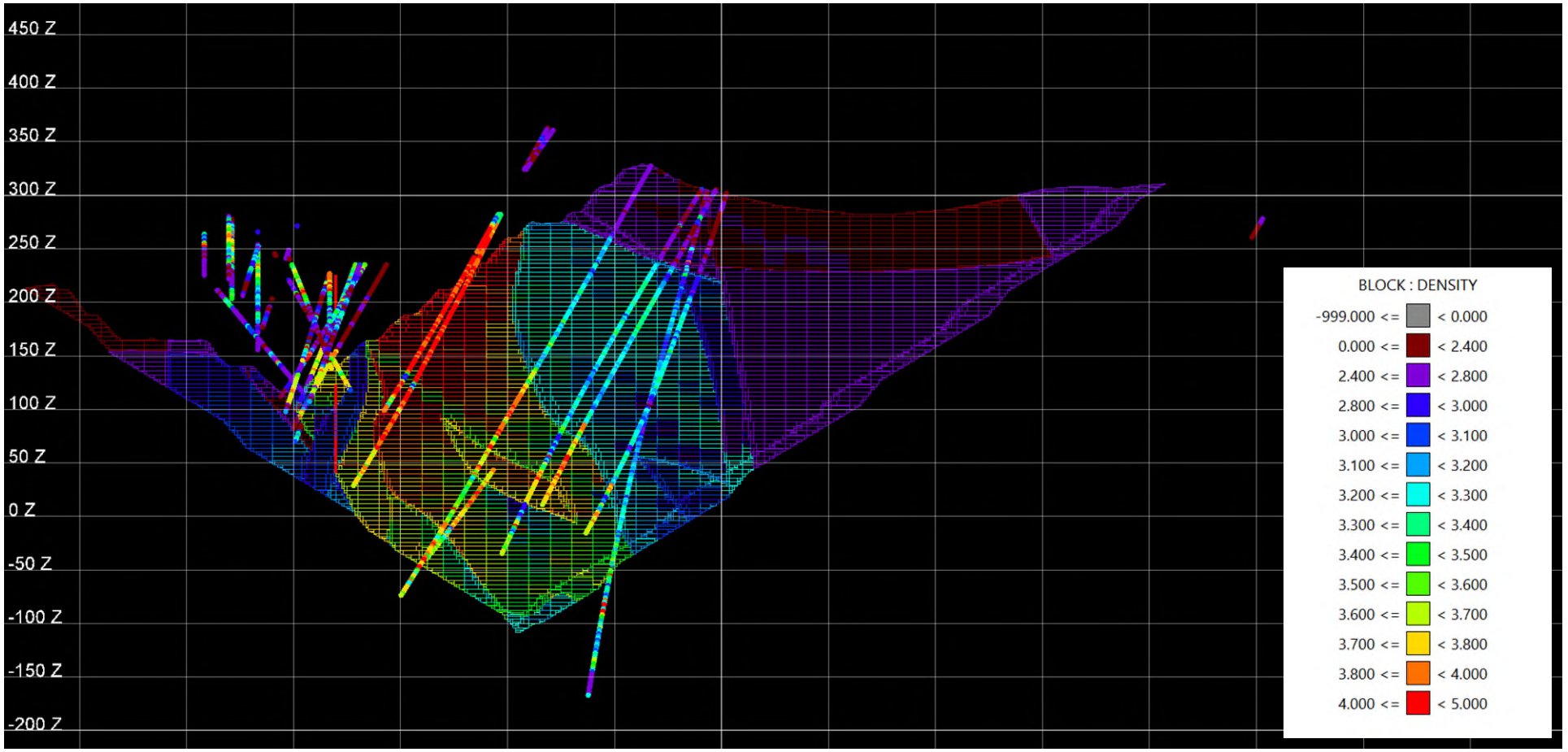


Figure 11.47 – Cross section through the Iron Duchess Pit at 19,020mN showing density estimate versus sample composite grades. Clipping is ±20m either side of the section.

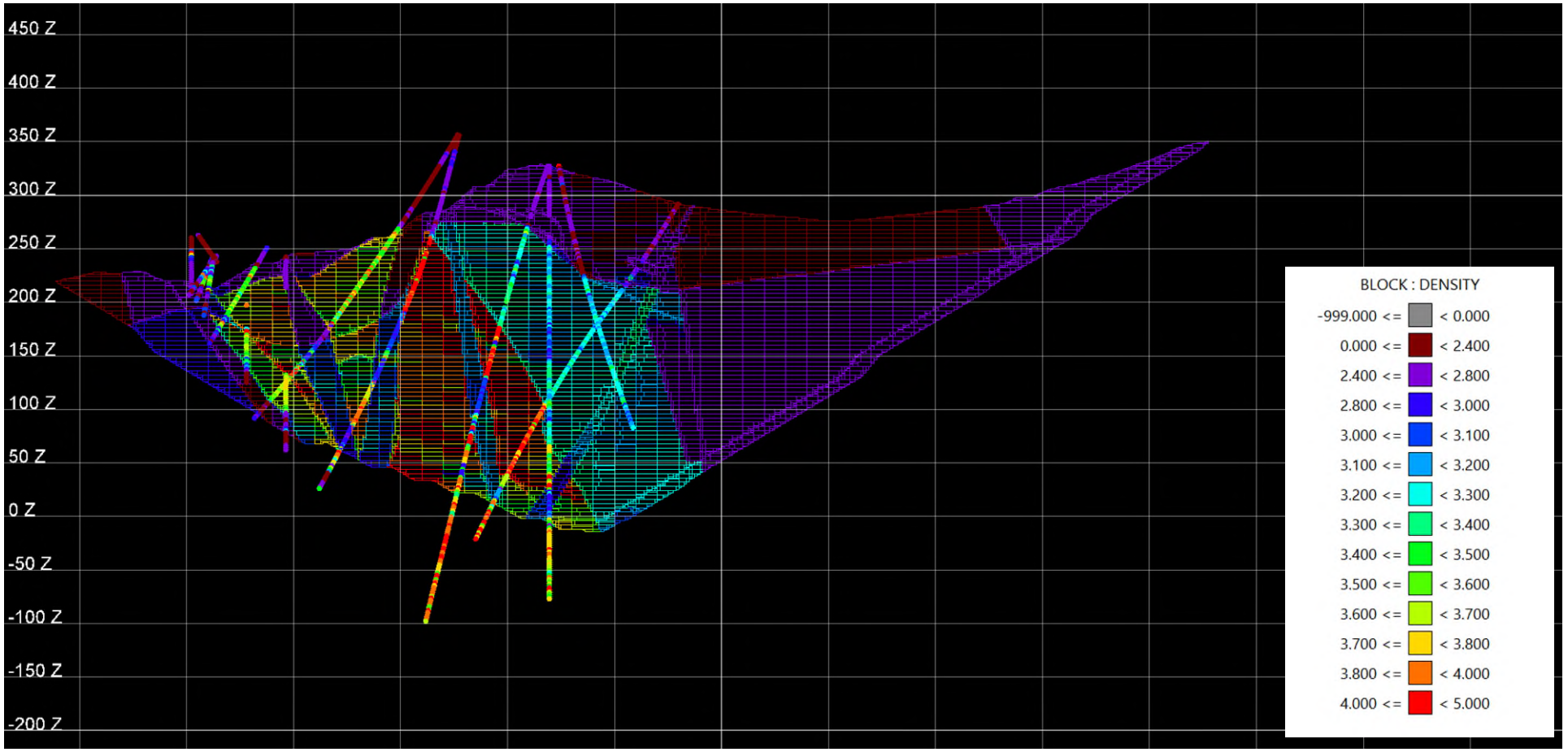


Figure 11.48 – Cross section through the Iron Duchess Pit at 19,192mN showing density estimate versus sample composite grades. Clipping is ±20m either side of the section.

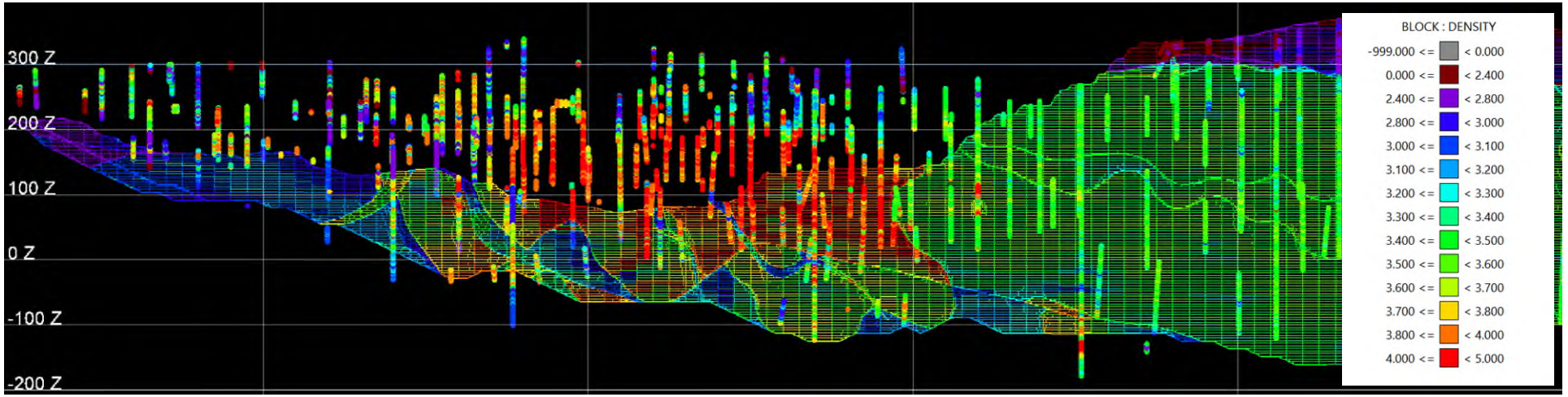


Figure 11.49 – Longitudinal section through the Iron Magnet Pit at 96,882mE showing density estimate versus sample composite grades. Clipping is ±20m either side of the section. View is looking west.

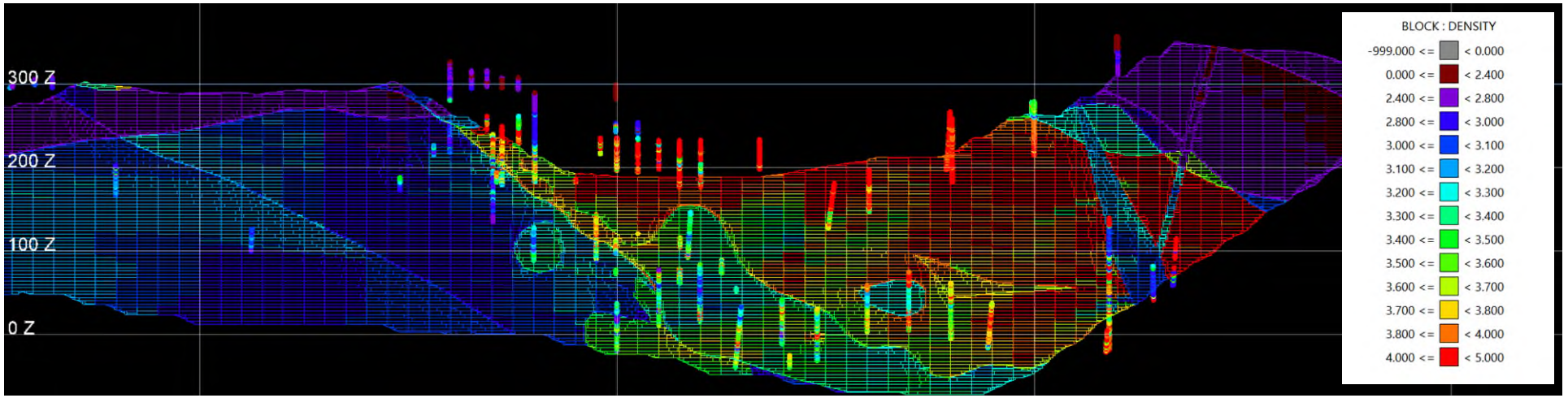


Figure 11.50 – Longitudinal section through the Iron Duchess Pit at 96,572mE showing density estimate versus sample composite grades. Clipping is ±20m either side of the section. View is looking west.

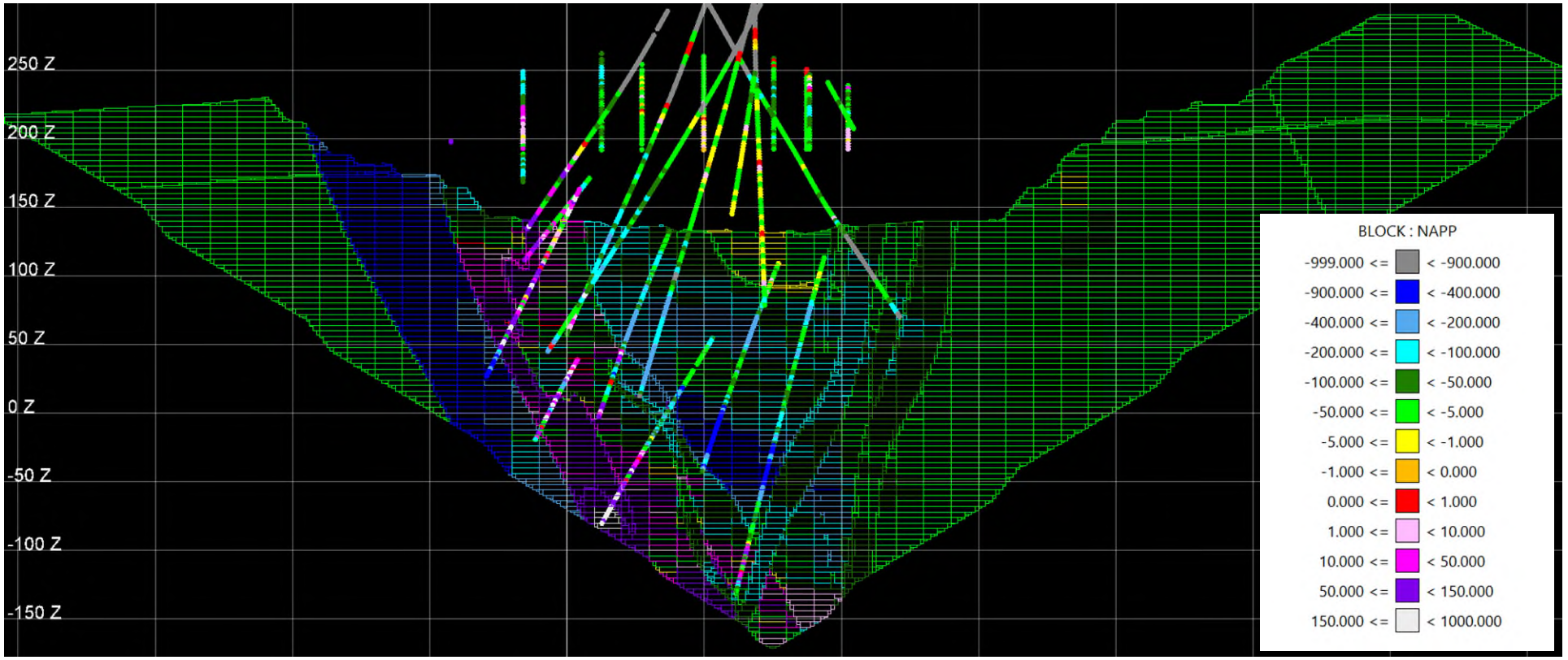


Figure 11.51 – Cross section through the Iron Magnet Pit at 16,925mN showing NAPP estimate versus sample composite grades. Clipping is ±20m either side of the section.

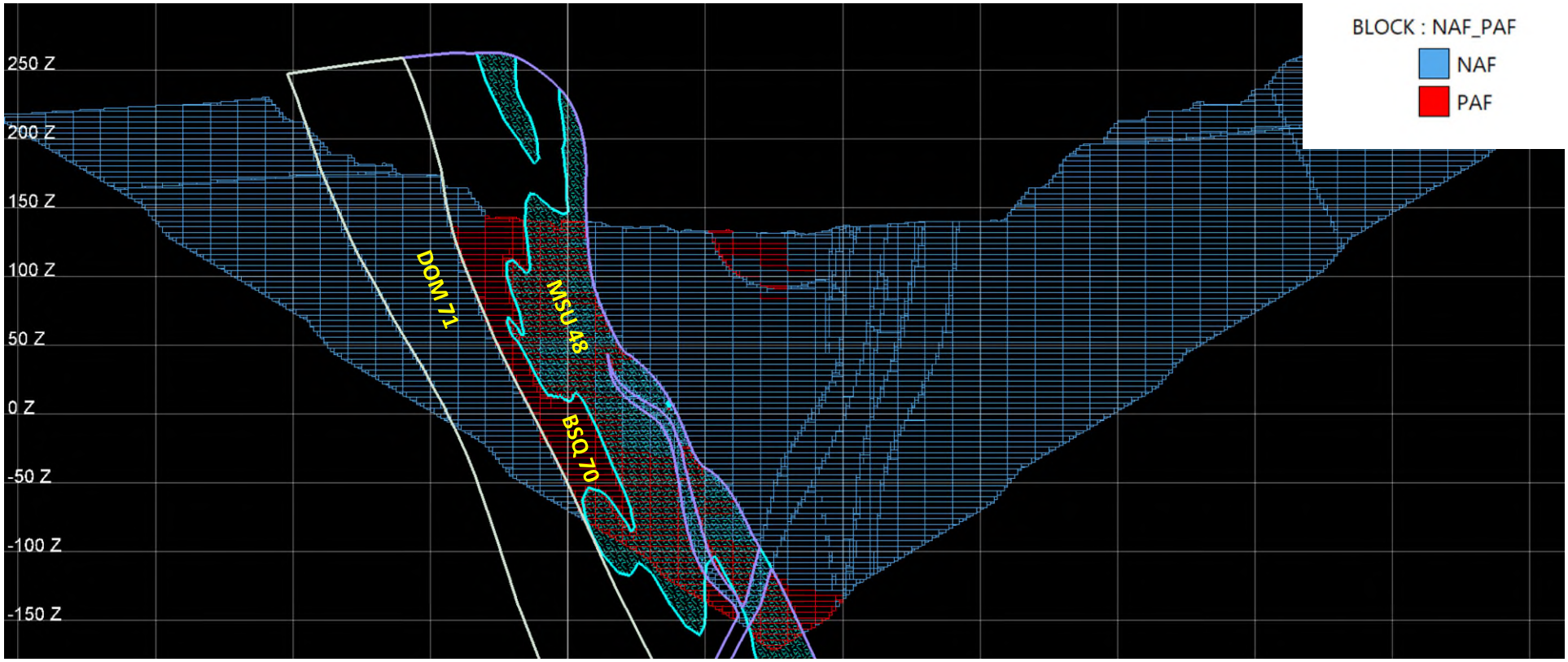


Figure 11.52 – Cross section through the Iron Magnet Pit at 16,925mN showing NAF and PAF designation based in part on the NAPP estimate in Figure 11.51. Key geological domains are annotated for clarity.

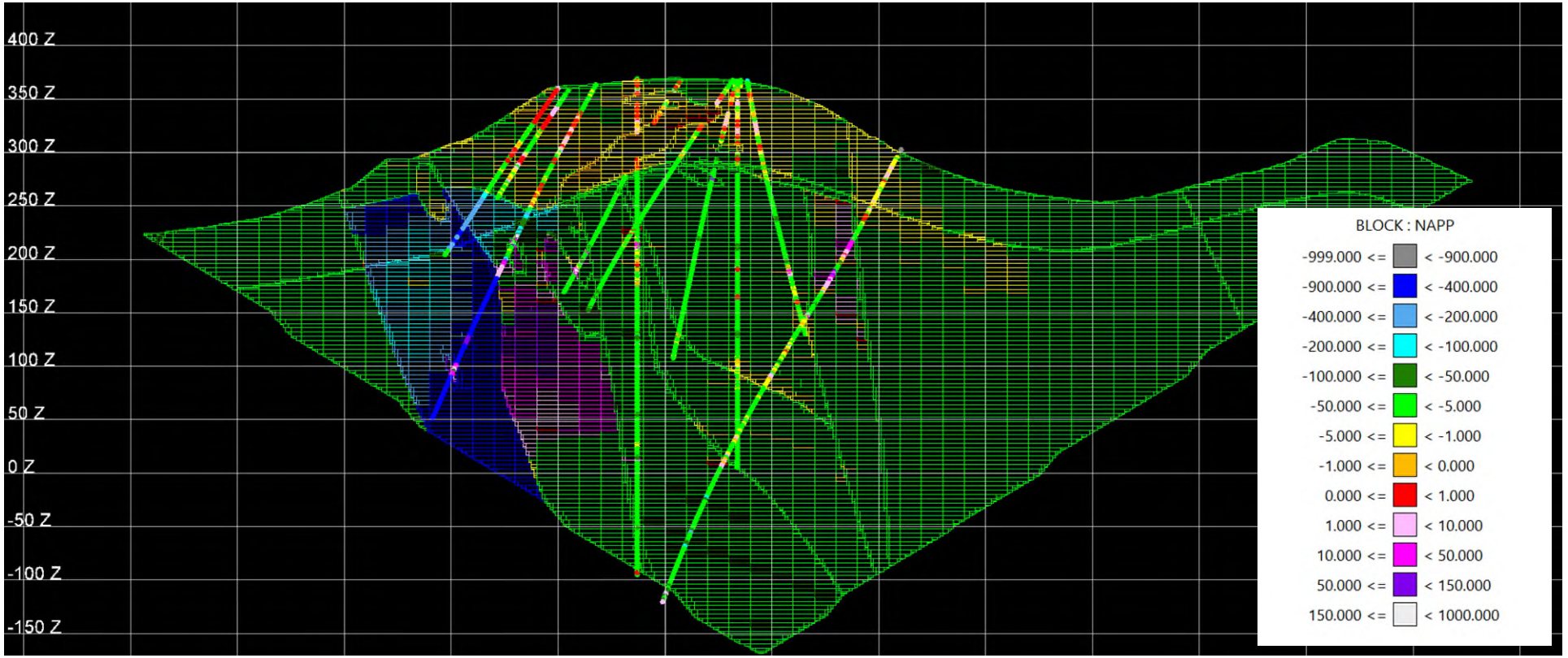


Figure 11.53 – Cross section through Duchess South at 17,742mN showing NAPP estimate versus sample composite grades. Clipping is ±20m either side of the section.

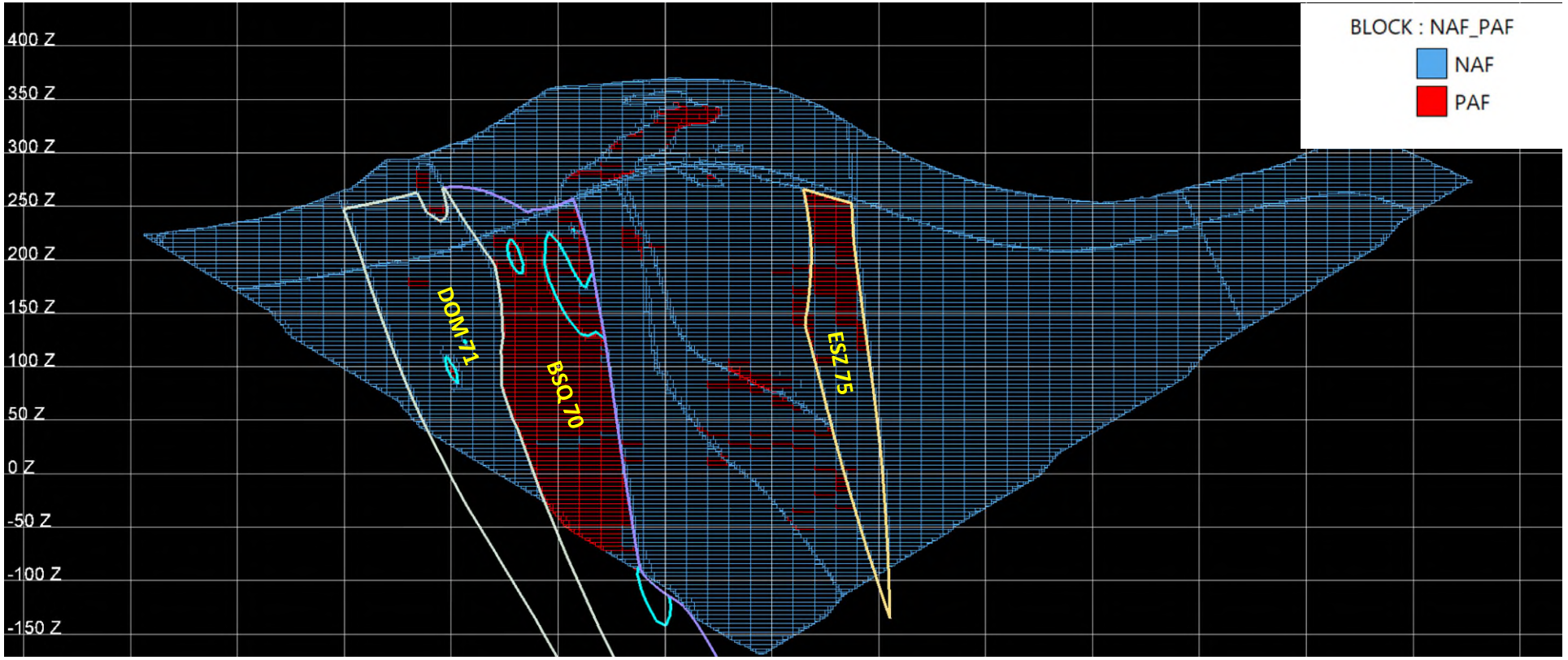


Figure 11.54 – Cross section through Duchess South at 17,742mN showing NAF and PAF designation based in part on the NAPP estimate in Figure 11.53. Key geological domains are annotated for clarity.

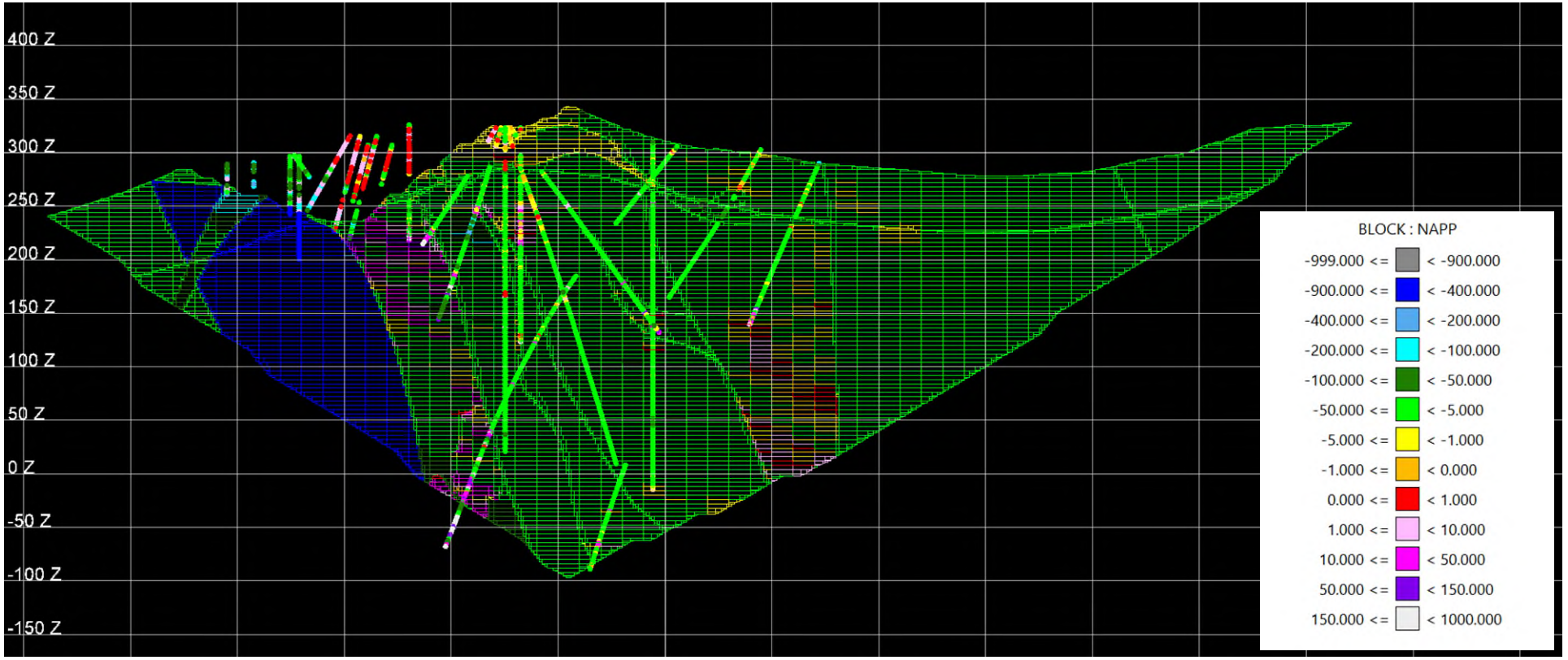


Figure 11.55 – Cross section through the Iron Duchess at Pit 18,391mN showing NAPP estimate versus sample composite grades. Clipping is ±20m either side of the section.

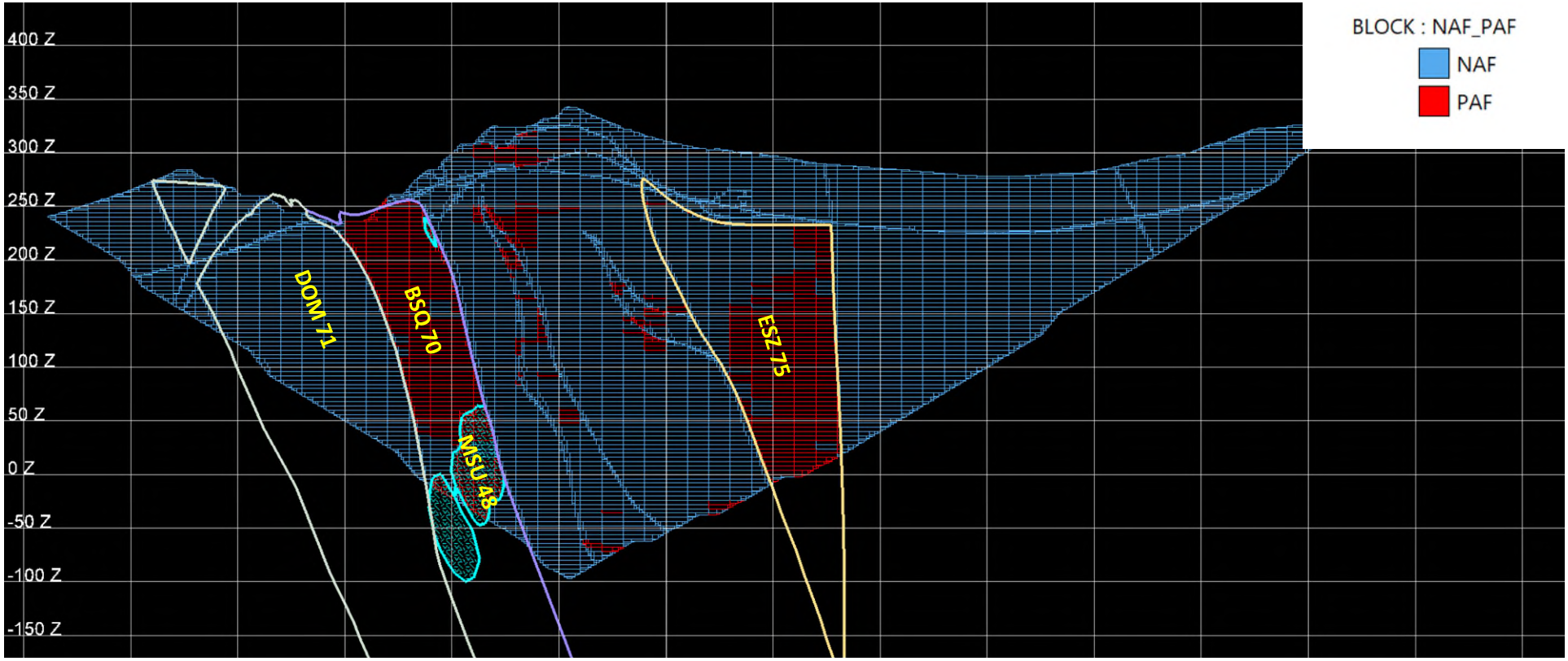


Figure 11.56 – Cross section the Iron Duchess at Pit 18,391mN showing NAF and PAF designation based in part on the NAPP estimate in Figure 11.55. Key geological domains are annotated for clarity.

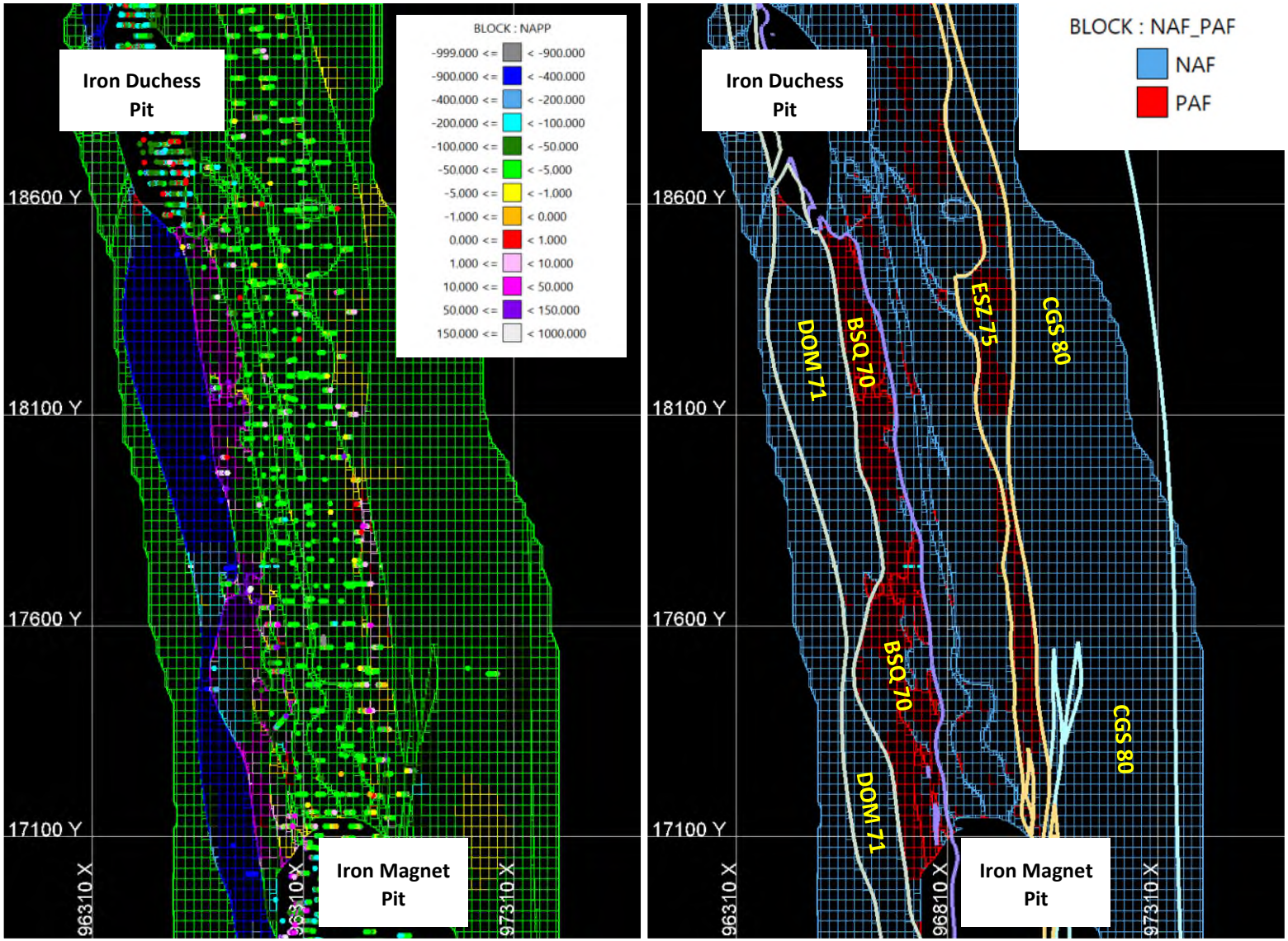


Figure 11.57 – Plan view across the Duchess South area at +150mRL showing NAPP estimate versus sample composite grades (LEFT) and the resulting NAF and PAF designation (RIGHT). Clipping either side of the section is ±4m. Key geological domains are annotated for clarity.

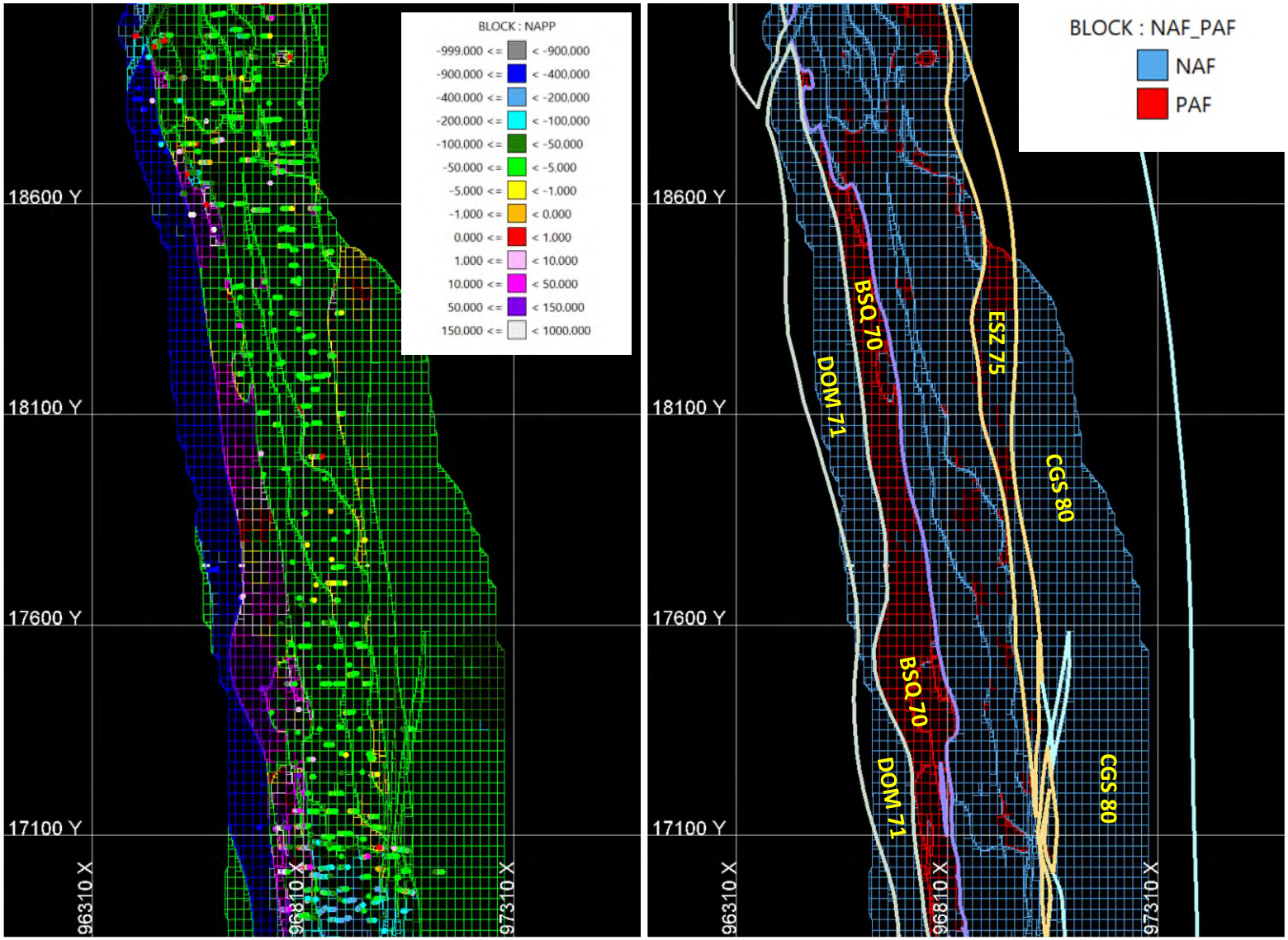


Figure 11.58 – Plan view across the Duchess South area at +60mRL showing NAPP estimate versus sample composite grades (LEFT) and the resulting NAF and PAF designation (RIGHT). Clipping either side of the section is ±4m. Key geological domains are annotated for clarity.

11.3 Statistical Validation

Estimates were also validated by comparing the declustered sample composites (using a nearest neighbour estimate) to the block estimates using a combination of general statistics, histograms, correlation matrices and scatter plots. Trends in mean grades for the declustered sample composites and block estimates were compared using swathe plots in the X, Y and Z direction and widths of 75 x 75 x 20m (XYZ directions).

Table 11.2 and Table 11.3 show an example of summary statistics for the declustered sample composites and block estimates, for both head and concentrate grades, for key estimates and domains.

Table 11.2 – Selected statistics for declustered samples and block head grade estimates in key domains.

_h		Declustered Samples			Block Estimates		
Element	Domain	Mean	StdDev	CV	Mean	StdDev	CV
Fe	HEO 30	56.975	6.499	0.114	56.453	6.888	0.122
	HEC 32	49.104	9.063	0.185	48.871	9.316	0.191
	MTS 40	29.667	5.027	0.169	29.565	5.201	0.176
	MTC 43	39.736	7.106	0.179	39.521	7.504	0.190
	SCH 46	25.993	4.118	0.158	25.998	4.314	0.166
	MSU 48	27.025	5.429	0.201	27.033	5.648	0.209
	BSQ 70	24.299	7.515	0.309	24.306	8.115	0.334
	ESZ 75	22.652	5.109	0.226	22.748	5.483	0.241
SiO_2	HEO 30	8.428	5.558	0.659	8.895	6.153	0.692
	HEC 32	7.231	4.924	0.681	7.583	5.302	0.699
	MTS 40	48.925	8.249	0.169	49.004	8.433	0.172
	MTC 43	17.056	12.627	0.740	17.257	13.099	0.759
	SCH 46	52.681	5.640	0.107	52.647	5.998	0.114
	MSU 48	42.524	14.464	0.340	42.316	14.891	0.352
	BSQ 70	40.790	15.818	0.388	40.624	16.484	0.406
	ESZ 75	56.940	9.835	0.173	56.765	10.510	0.185
P	HEO 30	0.070	0.050	0.709	0.070	0.050	0.707
	HEC 32	0.059	0.024	0.408	0.060	0.026	0.429
	MTS 40	0.053	0.018	0.335	0.054	0.020	0.364
	MTC 43	0.081	0.033	0.406	0.081	0.036	0.445
	SCH 46	0.053	0.016	0.303	0.054	0.017	0.317
	MSU 48	0.029	0.014	0.501	0.029	0.016	0.548
	BSQ 70	0.034	0.027	0.782	0.034	0.028	0.814
	ESZ 75	0.045	0.022	0.496	0.045	0.024	0.526
S	HEO 30	0.037	0.101	2.735	0.038	0.106	2.816
	HEC 32	0.167	0.493	2.949	0.175	0.554	3.164
	MTS 40	0.123	0.140	1.138	0.125	0.149	1.195
	MTC 43	0.143	0.240	1.685	0.142	0.239	1.681
	SCH 46	0.210	0.179	0.849	0.213	0.242	1.132
	MSU 48	1.811	1.678	0.927	1.849	1.800	0.974
	BSQ 70	1.510	1.453	0.963	1.534	1.558	1.016
	ESZ 75	0.037	0.101	2.735	0.220	0.140	0.634

Table 11.3 – Selected statistics for declustered samples and block concentrate grade estimates in key domains.

_c		Declustered Samples			Block Estimates		
Element	Domain	Mean	StdDev	CV	Mean	StdDev	CV
MASSREC	HEC 32	22.524	9.314	0.414	22.346	9.227	0.413
	MTS 40	32.923	7.019	0.213	31.961	7.731	0.242
	MTC 43	40.364	10.339	0.256	39.861	11.014	0.276
	SCH 46	17.509	5.568	0.318	17.716	6.146	0.347
	MSU 48	24.496	5.994	0.245	24.364	6.497	0.267
	BSQ 70	8.484	3.141	0.370	8.605	3.414	0.397
Fe	HEC 32	68.947	0.759	0.011	68.900	0.827	0.012
	MTS 40	63.203	6.059	0.096	63.312	6.068	0.096
	MTC 43	68.969	1.708	0.025	68.940	1.765	0.026
	SCH 46	62.528	3.679	0.059	62.764	3.615	0.058
	MSU 48	66.650	2.962	0.044	66.591	3.131	0.047
	BSQ 70	64.258	2.419	0.038	64.094	2.500	0.039
SiO_2	HEC 32	0.601	0.300	0.499	0.626	0.342	0.547
	MTS 40	10.045	4.483	0.446	9.948	4.581	0.460
	MTC 43	2.053	2.240	1.091	2.105	2.362	1.123
	SCH 46	10.560	3.765	0.357	10.382	3.784	0.365
	MSU 48	5.331	3.510	0.658	5.409	3.686	0.682
	BSQ 70	5.460	1.836	0.336	5.559	2.209	0.397
CaO	HEC 32	0.432	0.294	0.681	0.421	0.294	0.699
	MTS 40	0.134	0.118	0.879	0.128	0.114	0.891
	MTC 43	0.502	0.410	0.816	0.500	0.457	0.914
	SCH 46	0.208	0.151	0.725	0.198	0.148	0.748
	MSU 48	0.271	0.346	1.275	0.273	0.327	1.199
	BSQ 70	0.312	0.183	0.585	0.325	0.234	0.720
MgO	HEC 32	0.460	0.179	0.390	0.467	0.184	0.394
	MTS 40	1.062	1.248	1.176	1.036	1.254	1.210
	MTC 43	0.531	0.271	0.510	0.533	0.289	0.543
	SCH 46	1.380	0.912	0.661	1.343	0.941	0.700
	MSU 48	0.611	0.361	0.591	0.611	0.375	0.614
	BSQ 70	0.812	0.299	0.369	0.842	0.371	0.441
S	HEC 32	0.051	0.128	3.436	0.051	0.133	2.609
	MTS 40	0.062	0.114	3.788	0.066	0.143	2.167
	MTC 43	0.024	0.046	3.376	0.024	0.042	1.795
	SCH 46	0.420	0.456	2.002	0.409	0.448	1.094
	MSU 48	0.915	1.297	2.410	0.917	1.364	1.486
	BSQ 70	0.705	0.436	1.646	0.711	0.467	0.657

Relationships between elements in the estimated blocks were validated by comparing them to the observed relationships between elements in the declustered sample composites using correlation matrices and scatterplots, examples of which are shown in Figure 11.44 to Figure 11.51.

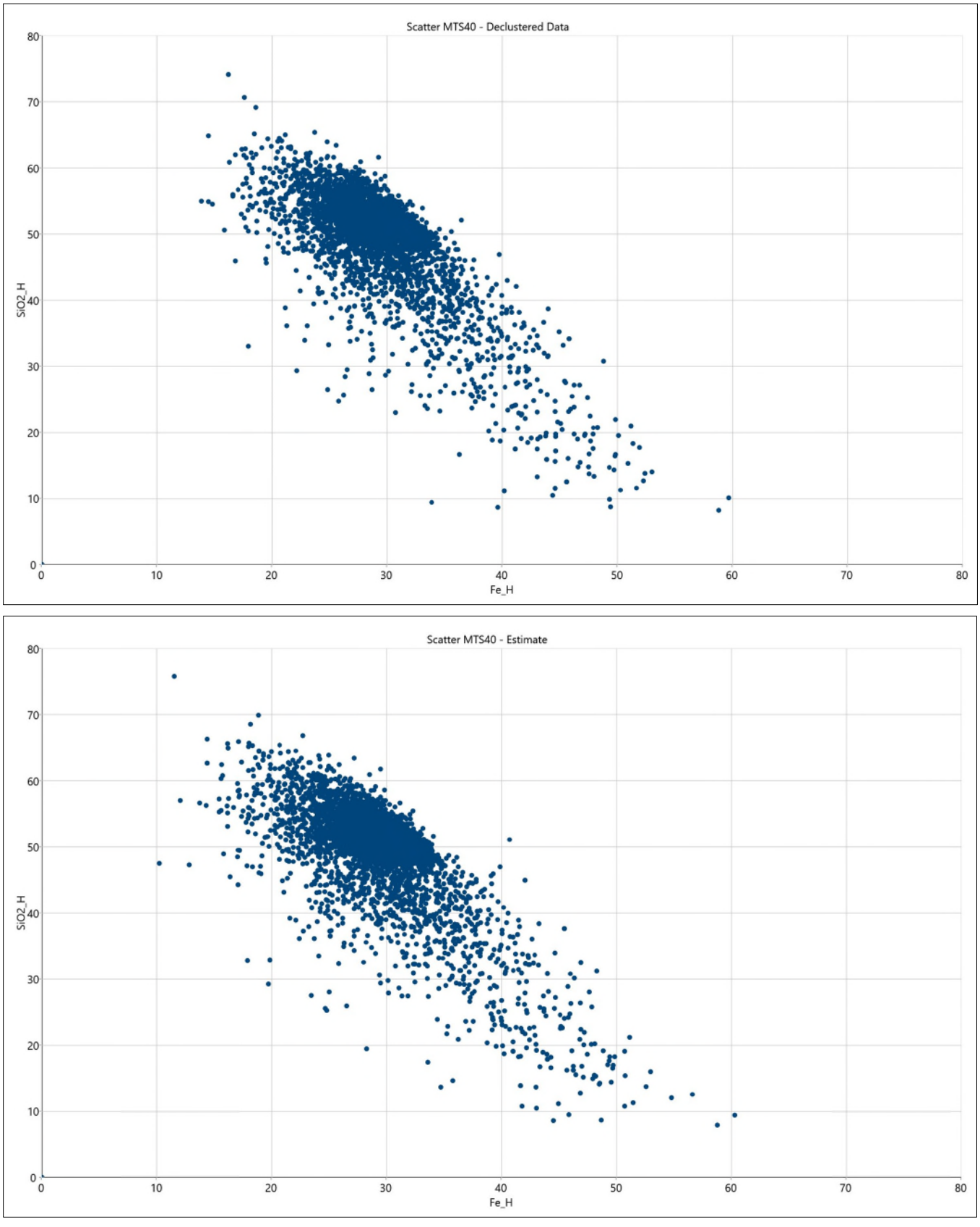


Figure 11.44 – Scatter plot of head Fe_H versus head SiO_2_H in domain MTS 40. Top chart = declustered samples. Bottom chart = block estimates.

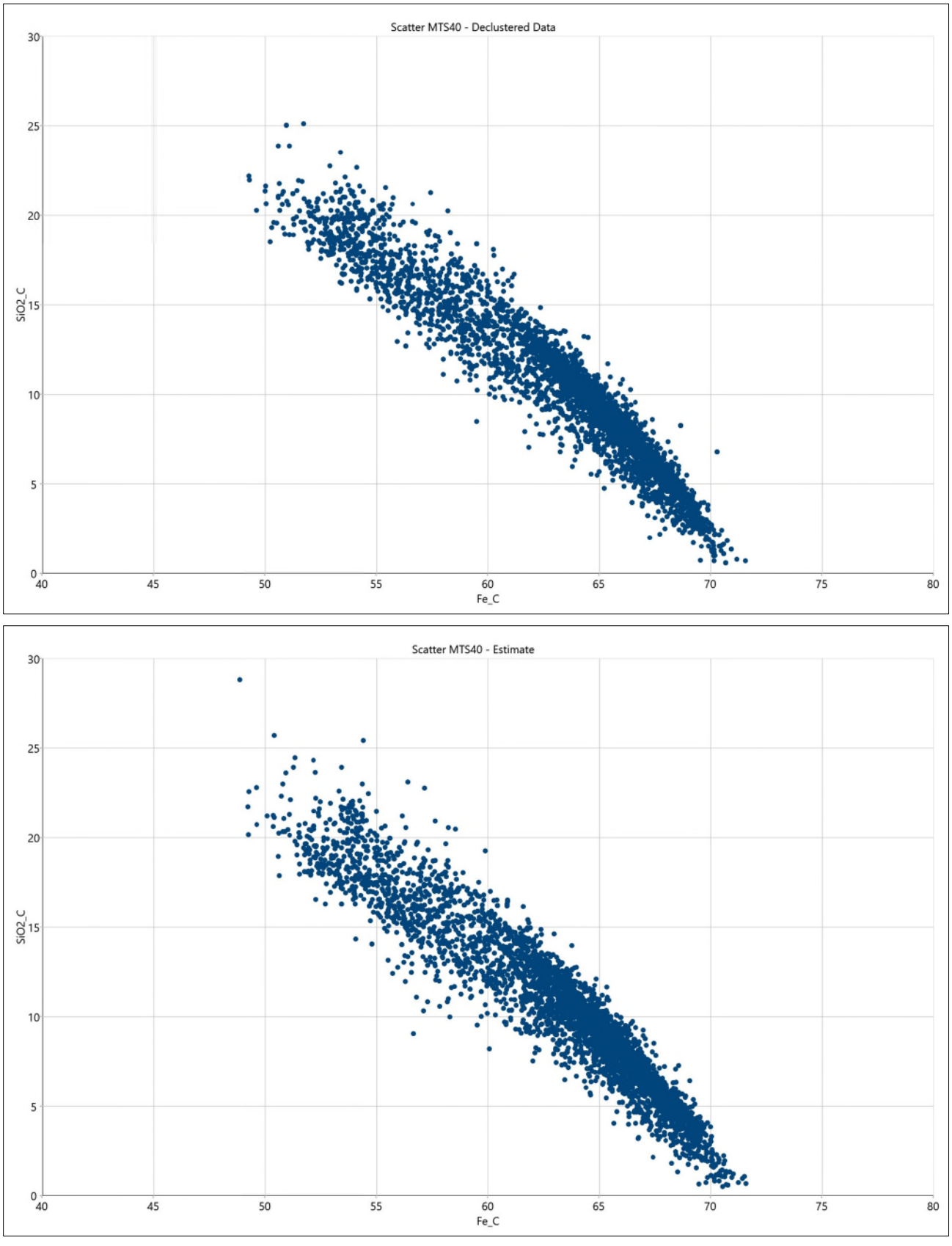


Figure 11.45 – Scatter plot of concentrate Fe_C versus concentrate SiO_2_C in domain MTS 40. Top chart = declustered samples. Bottom chart = block estimates.



Figure 11.46 – Scatter plot of mass recovery versus concentrate Fe_C in domain MTS 40. Top chart = declustered samples. Bottom chart = block estimates.

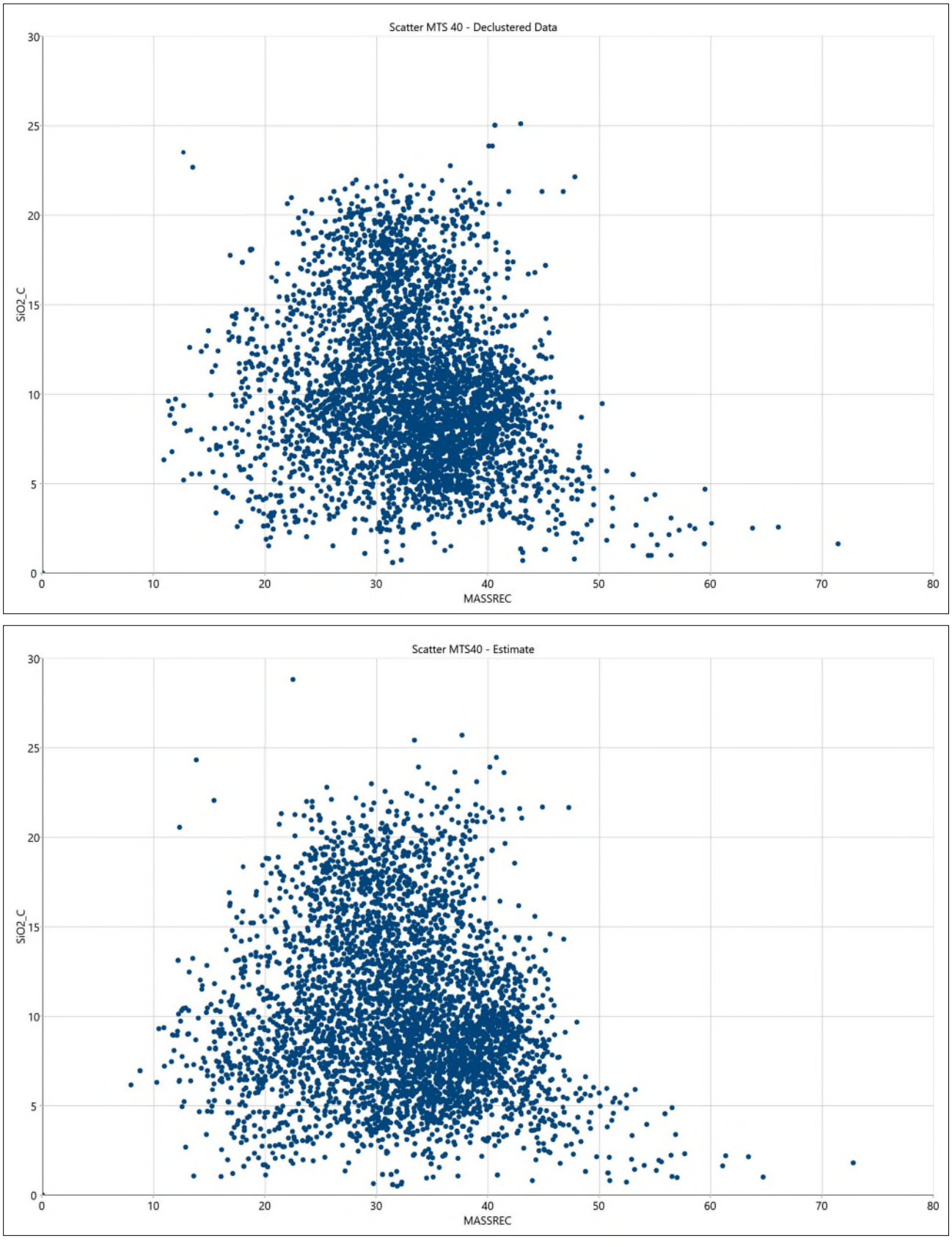


Figure 11.47 – Scatter plot of mass recovery versus concentrate SiO_2_C in domain MTS 40. Top chart = declustered samples. Bottom chart = block estimates.

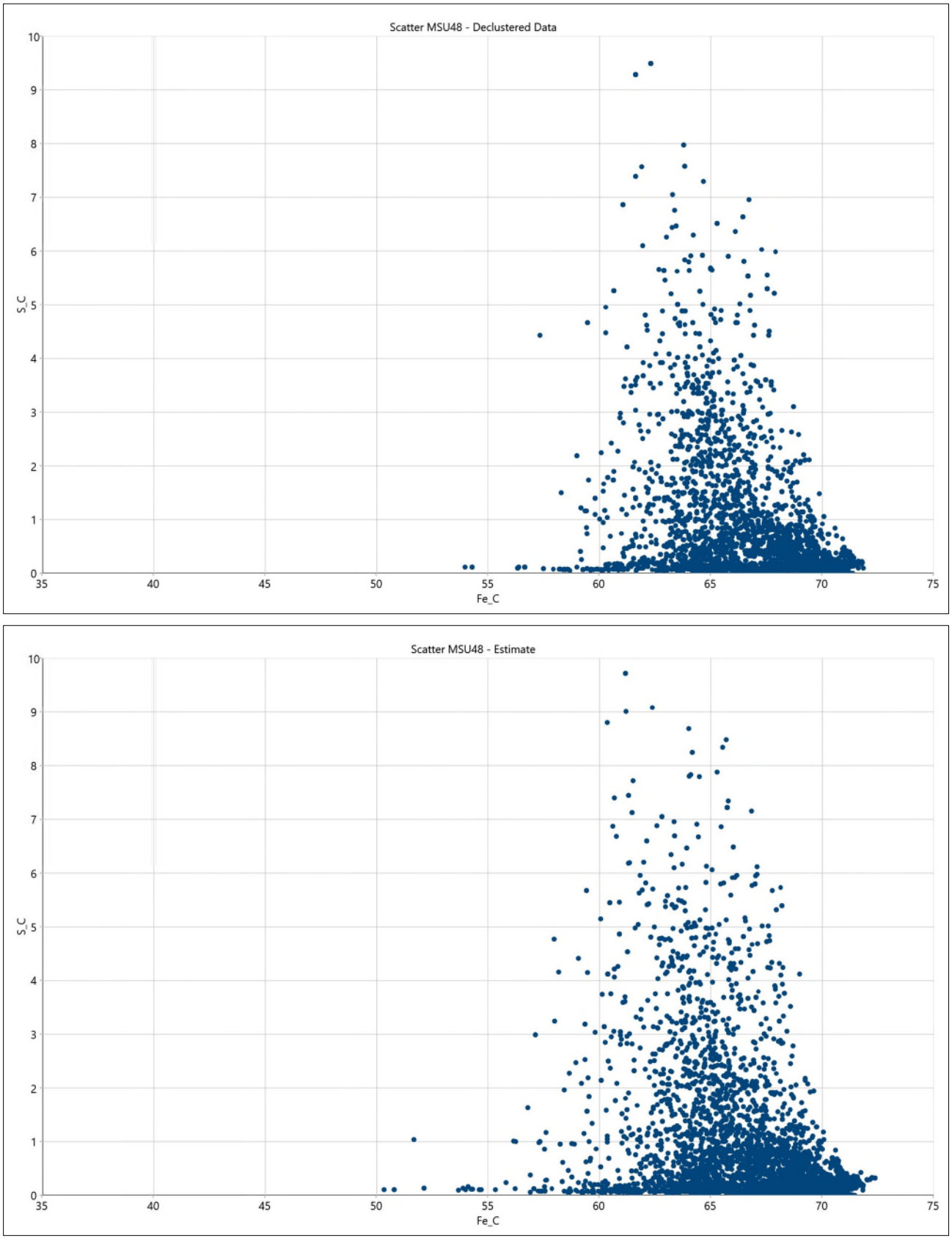
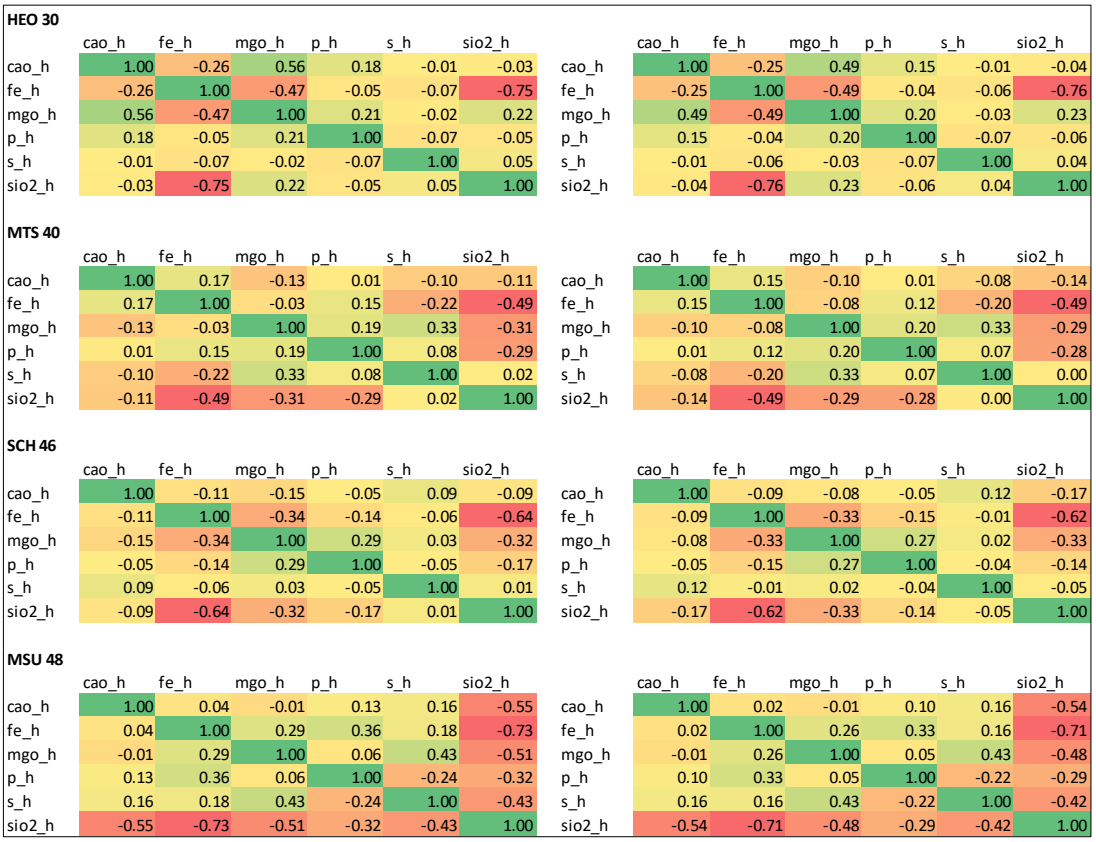


Figure 11.48– Scatter plot of concentrate Fe_C versus concentrate S_C in domain MSU 48. Top chart = declustered samples. Bottom chart = block estimates.



Figure 11.49– Scatter plot of mass recovery versus concentrate S_C in domain MSU 48. Top chart = declustered samples. Bottom chart = block estimates.



HEO 30

	cao_h	fe_h	mgo_h	p_h	s_h	sio2_h
cao_h	1.00	-0.26	0.56	0.18	-0.01	-0.03
fe_h	-0.26	1.00	-0.47	-0.05	-0.07	-0.75
mgo_h	0.56	-0.47	1.00	0.21	-0.02	0.22
p_h	0.18	-0.05	0.21	1.00	-0.07	-0.05
s_h	-0.01	-0.07	-0.02	-0.07	1.00	0.05
sio2_h	-0.03	-0.75	0.22	-0.05	0.05	1.00

	cao_h	fe_h	mgo_h	p_h	s_h	sio2_h
cao_h	1.00	-0.25	0.49	0.15	-0.01	-0.04
fe_h	-0.25	1.00	-0.49	-0.04	-0.06	-0.76
mgo_h	0.49	-0.49	1.00	0.20	-0.03	0.23
p_h	0.15	-0.04	0.20	1.00	-0.07	-0.06
s_h	-0.01	-0.06	-0.03	-0.07	1.00	0.04
sio2_h	-0.04	-0.76	0.23	-0.06	0.04	1.00

MTS 40

	cao_h	fe_h	mgo_h	p_h	s_h	sio2_h
cao_h	1.00	0.17	-0.13	0.01	-0.10	-0.11
fe_h	0.17	1.00	-0.03	0.15	-0.22	-0.49
mgo_h	-0.13	-0.03	1.00	0.19	0.33	-0.31
p_h	0.01	0.15	0.19	1.00	0.08	-0.29
s_h	-0.10	-0.22	0.33	0.08	1.00	0.02
sio2_h	-0.11	-0.49	-0.31	-0.29	0.02	1.00

	cao_h	fe_h	mgo_h	p_h	s_h	sio2_h
cao_h	1.00	0.15	-0.10	0.01	-0.08	-0.14
fe_h	0.15	1.00	-0.08	0.12	-0.20	-0.49
mgo_h	-0.10	-0.08	1.00	0.20	0.33	-0.29
p_h	0.01	0.12	0.20	1.00	0.07	-0.28
s_h	-0.08	-0.20	0.33	0.07	1.00	0.00
sio2_h	-0.14	-0.49	-0.29	-0.28	0.00	1.00

SCH 46

	cao_h	fe_h	mgo_h	p_h	s_h	sio2_h
cao_h	1.00	-0.11	-0.15	-0.05	0.09	-0.09
fe_h	-0.11	1.00	-0.34	-0.14	-0.06	-0.64
mgo_h	-0.15	-0.34	1.00	0.29	0.03	-0.32
p_h	-0.05	-0.14	0.29	1.00	-0.05	-0.17
s_h	0.09	-0.06	0.03	-0.05	1.00	0.01
sio2_h	-0.09	-0.64	-0.32	-0.17	0.01	1.00

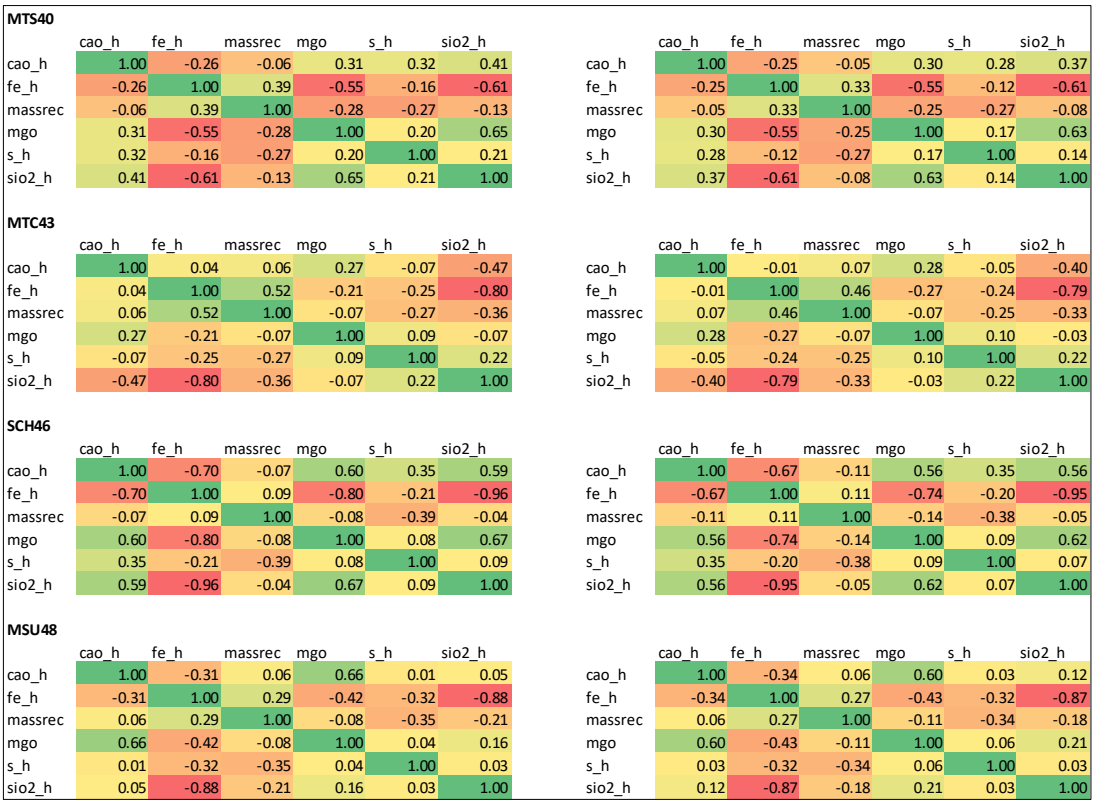
	cao_h	fe_h	mgo_h	p_h	s_h	sio2_h
cao_h	1.00	-0.09	-0.08	-0.05	0.12	-0.17
fe_h	-0.09	1.00	-0.33	-0.15	-0.01	-0.62
mgo_h	-0.08	-0.33	1.00	0.27	0.02	-0.33
p_h	-0.05	-0.15	0.27	1.00	-0.04	-0.14
s_h	0.12	-0.01	0.02	-0.04	1.00	-0.05
sio2_h	-0.17	-0.62	-0.33	-0.14	-0.05	1.00

MSU 48

	cao_h	fe_h	mgo_h	p_h	s_h	sio2_h
cao_h	1.00	0.04	-0.01	0.13	0.16	-0.55
fe_h	0.04	1.00	0.29	0.36	0.18	-0.73
mgo_h	-0.01	0.29	1.00	0.06	0.43	-0.51
p_h	0.13	0.36	0.06	1.00	-0.24	-0.32
s_h	0.16	0.18	0.43	-0.24	1.00	-0.43
sio2_h	-0.55	-0.73	-0.51	-0.32	-0.43	1.00

	cao_h	fe_h	mgo_h	p_h	s_h	sio2_h
cao_h	1.00	0.02	-0.01	0.10	0.16	-0.54
fe_h	0.02	1.00	0.26	0.33	0.16	-0.71
mgo_h	-0.01	0.26	1.00	0.05	0.43	-0.48
p_h	0.10	0.33	0.05	1.00	-0.22	-0.29
s_h	0.16	0.16	0.43	-0.22	1.00	-0.42
sio2_h	-0.54	-0.71	-0.48	-0.29	-0.42	1.00

Figure 11.50 – Pearson correlation matrices for head declustered samples (LEFT) and estimates (RIGHT) in key domains.



MTS40

	cao_h	fe_h	massrec	mgo	s_h	sio2_h
cao_h	1.00	-0.26	-0.06	0.31	0.32	0.41
fe_h	-0.26	1.00	0.39	-0.55	-0.16	-0.61
massrec	-0.06	0.39	1.00	-0.28	-0.27	-0.13
mgo	0.31	-0.55	-0.28	1.00	0.20	0.65
s_h	0.32	-0.16	-0.27	0.20	1.00	0.21
sio2_h	0.41	-0.61	-0.13	0.65	0.21	1.00

	cao_h	fe_h	massrec	mgo	s_h	sio2_h
cao_h	1.00	-0.25	-0.05	0.30	0.28	0.37
fe_h	-0.25	1.00	0.33	-0.55	-0.12	-0.61
massrec	-0.05	0.33	1.00	-0.25	-0.27	-0.08
mgo	0.30	-0.55	-0.25	1.00	0.17	0.63
s_h	0.28	-0.12	-0.27	0.17	1.00	0.14
sio2_h	0.37	-0.61	-0.08	0.63	0.14	1.00

MTC43

	cao_h	fe_h	massrec	mgo	s_h	sio2_h
cao_h	1.00	0.04	0.06	0.27	-0.07	-0.47
fe_h	0.04	1.00	0.52	-0.21	-0.25	-0.80
massrec	0.06	0.52	1.00	-0.07	-0.27	-0.36
mgo	0.27	-0.21	-0.07	1.00	0.09	-0.07
s_h	-0.07	-0.25	-0.27	0.09	1.00	0.22
sio2_h	-0.47	-0.80	-0.36	-0.07	0.22	1.00

	cao_h	fe_h	massrec	mgo	s_h	sio2_h
cao_h	1.00	-0.01	0.07	0.28	-0.05	-0.40
fe_h	-0.01	1.00	0.46	-0.27	-0.24	-0.79
massrec	0.07	0.46	1.00	-0.07	-0.25	-0.33
mgo	0.28	-0.27	-0.07	1.00	0.10	-0.03
s_h	-0.05	-0.24	-0.25	0.10	1.00	0.22
sio2_h	-0.40	-0.79	-0.33	-0.03	0.22	1.00

SCH46

	cao_h	fe_h	massrec	mgo	s_h	sio2_h
cao_h	1.00	-0.70	-0.07	0.60	0.35	0.59
fe_h	-0.70	1.00	0.09	-0.80	-0.21	-0.96
massrec	-0.07	0.09	1.00	-0.08	-0.39	-0.04
mgo	0.60	-0.80	-0.08	1.00	0.08	0.67
s_h	0.35	-0.21	-0.39	0.08	1.00	0.09
sio2_h	0.59	-0.96	-0.04	0.67	0.09	1.00

	cao_h	fe_h	massrec	mgo	s_h	sio2_h
cao_h	1.00	-0.67	-0.11	0.56	0.35	0.56
fe_h	-0.67	1.00	0.11	-0.74	-0.20	-0.95
massrec	-0.11	0.11	1.00	-0.14	-0.38	-0.05
mgo	0.56	-0.74	-0.14	1.00	0.09	0.62
s_h	0.35	-0.20	-0.38	0.09	1.00	0.07
sio2_h	0.56	-0.95	-0.05	0.62	0.07	1.00

MSU48

	cao_h	fe_h	massrec	mgo	s_h	sio2_h
cao_h	1.00	-0.31	0.06	0.66	0.01	0.05
fe_h	-0.31	1.00	0.29	-0.42	-0.32	-0.88
massrec	0.06	0.29	1.00	-0.08	-0.35	-0.21
mgo	0.66	-0.42	-0.08	1.00	0.04	0.16
s_h	0.01	-0.32	-0.35	0.04	1.00	0.03
sio2_h	0.05	-0.88	-0.21	0.16	0.03	1.00

	cao_h	fe_h	massrec	mgo	s_h	sio2_h
cao_h	1.00	-0.34	0.06	0.60	0.03	0.12
fe_h	-0.34	1.00	0.27	-0.43	-0.32	-0.87
massrec	0.06	0.27	1.00	-0.11	-0.34	-0.18
mgo	0.60	-0.43	-0.11	1.00	0.06	0.21
s_h	0.03	-0.32	-0.34	0.06	1.00	0.03
sio2_h	0.12	-0.87	-0.18	0.21	0.03	1.00

Figure 11.51 – Pearson correlation matrices for concentrate declustered samples (LEFT) and estimates (RIGHT) in key domains.

Figure 11.52 to Figure 11.57 shows examples of cumulative frequency curves comparing the distributions of the declustered samples and block estimates for key estimates across several domains.

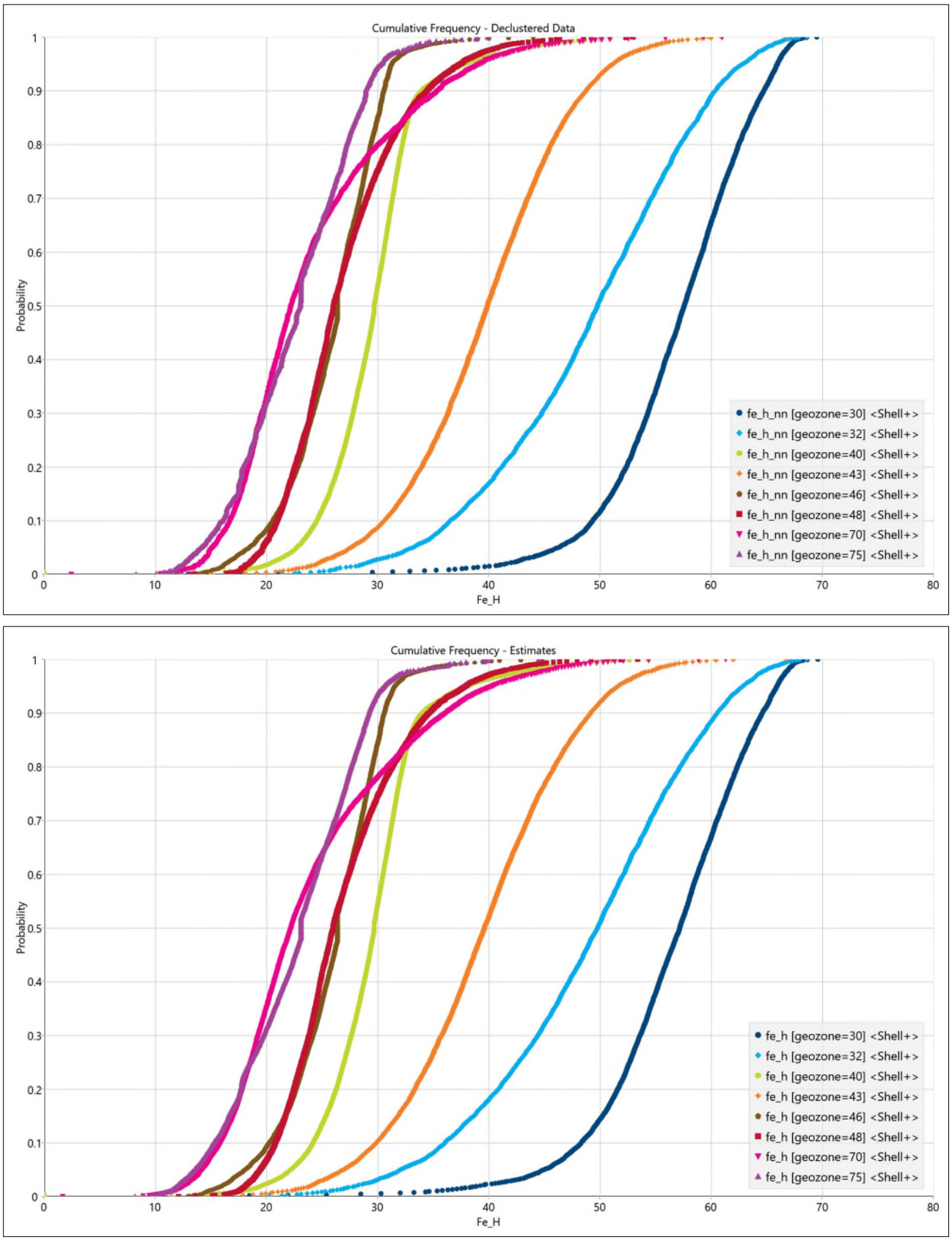


Figure 11.52 – Cumulative frequency curves for head Fe_H estimates. Top chart = declustered samples. Bottom chart = estimated blocks.

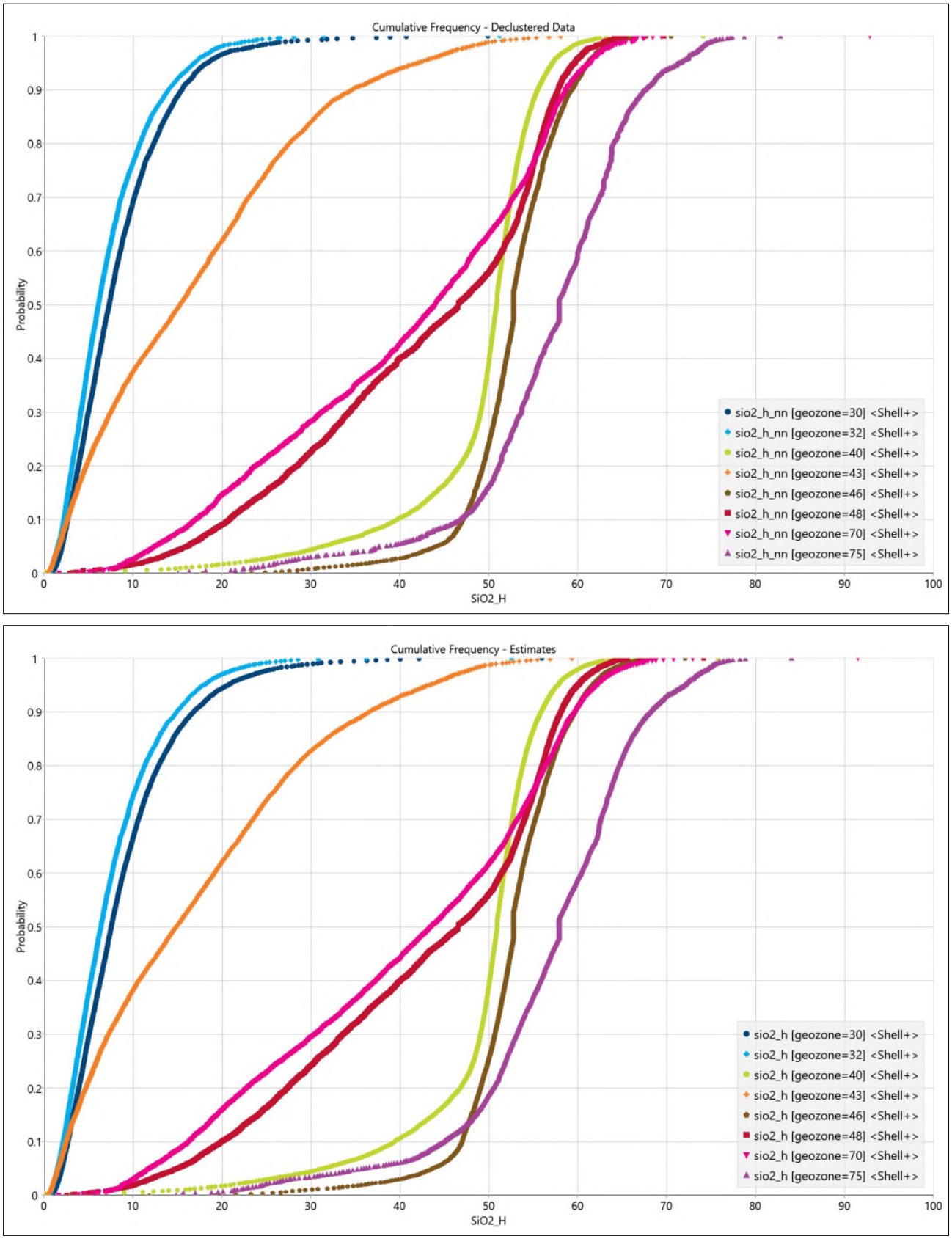


Figure 11.53 – Cumulative frequency curves for head SiO_2_H estimates. Top chart = declustered samples. Bottom chart = estimated blocks.

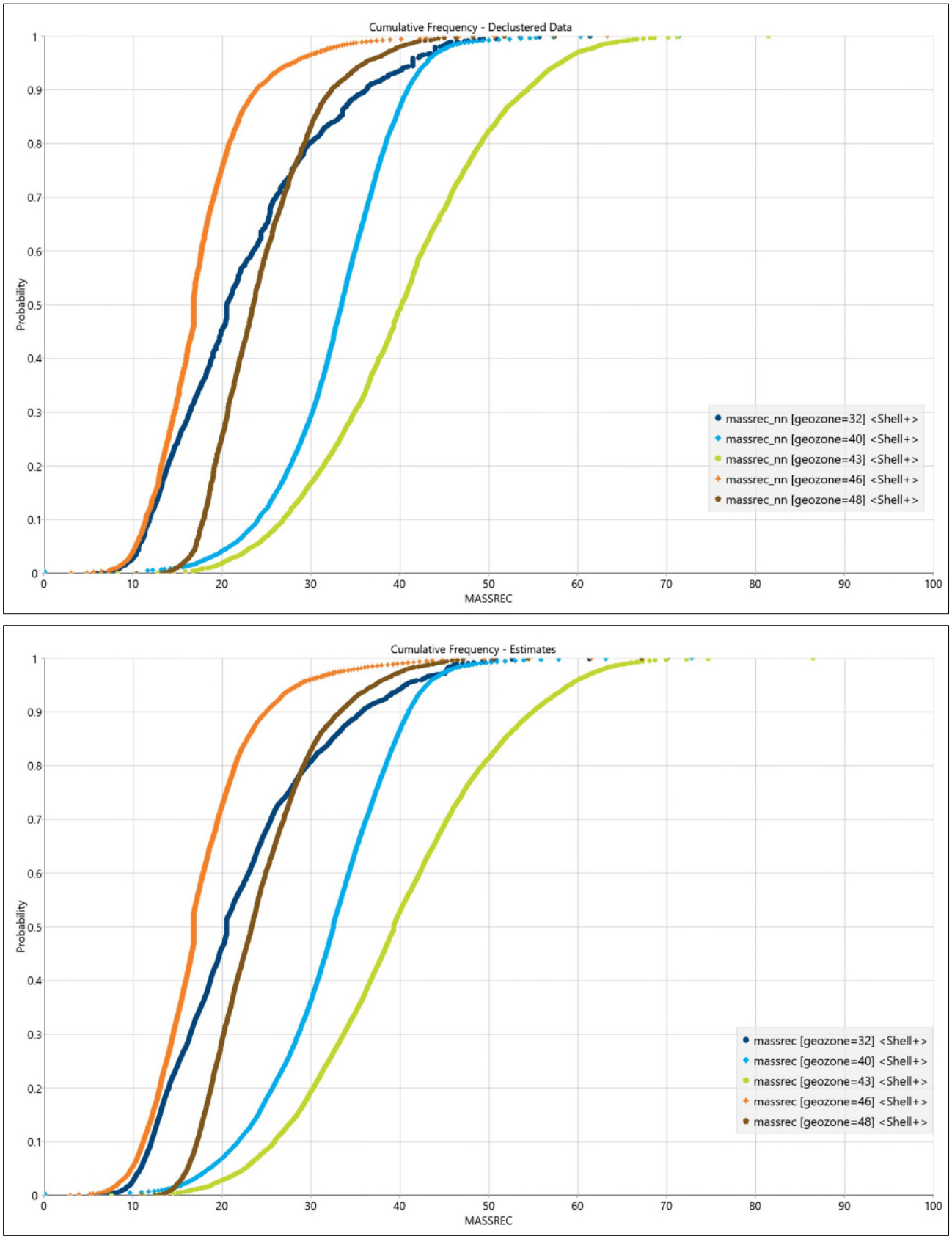


Figure 11.54 – Cumulative frequency curves for mass recovery estimates. Top chart = declustered samples. Bottom chart = estimated blocks.

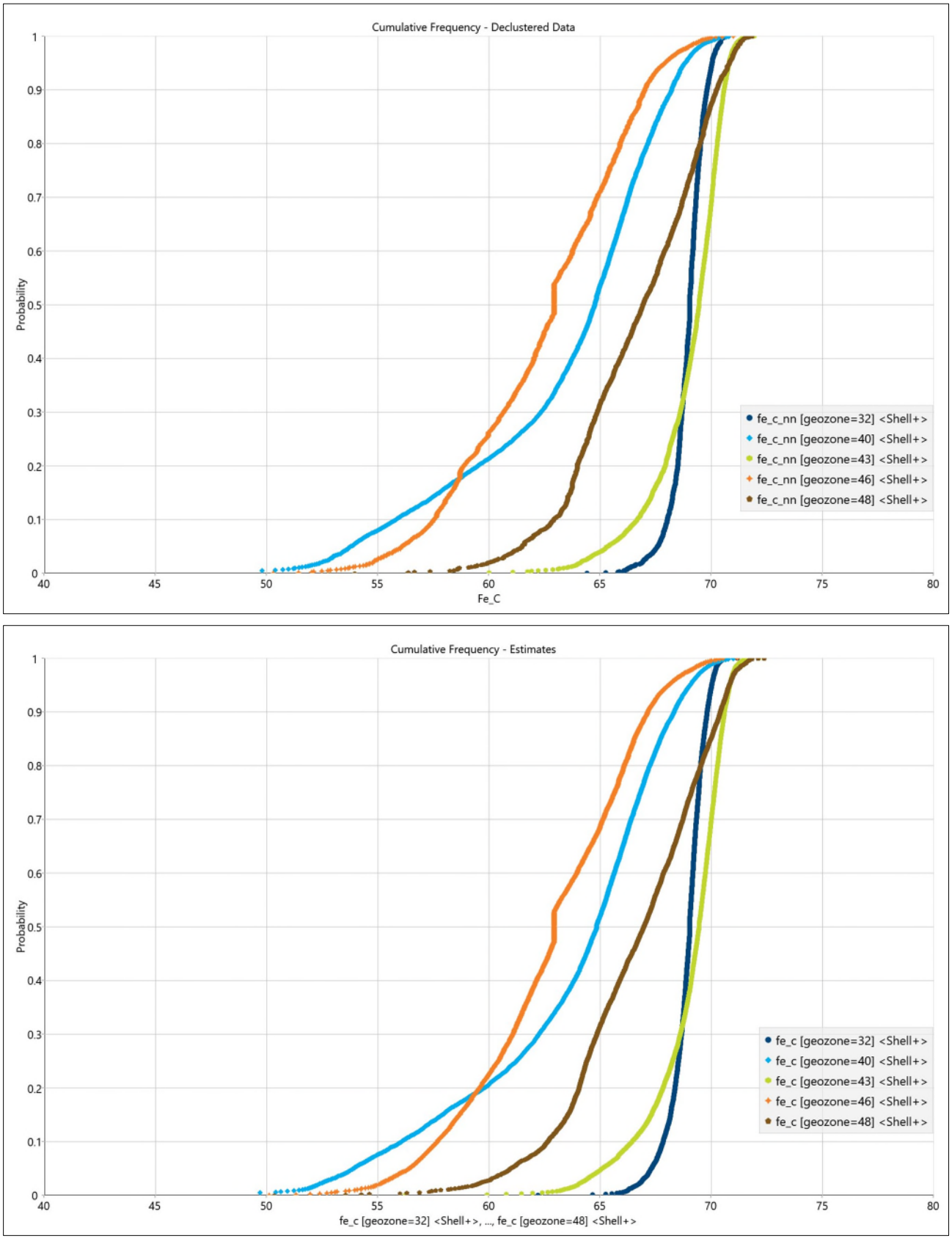


Figure 11.55 – Cumulative frequency curves for concentrate Fe_C estimates. Top chart = declustered samples. Bottom chart = estimated blocks.

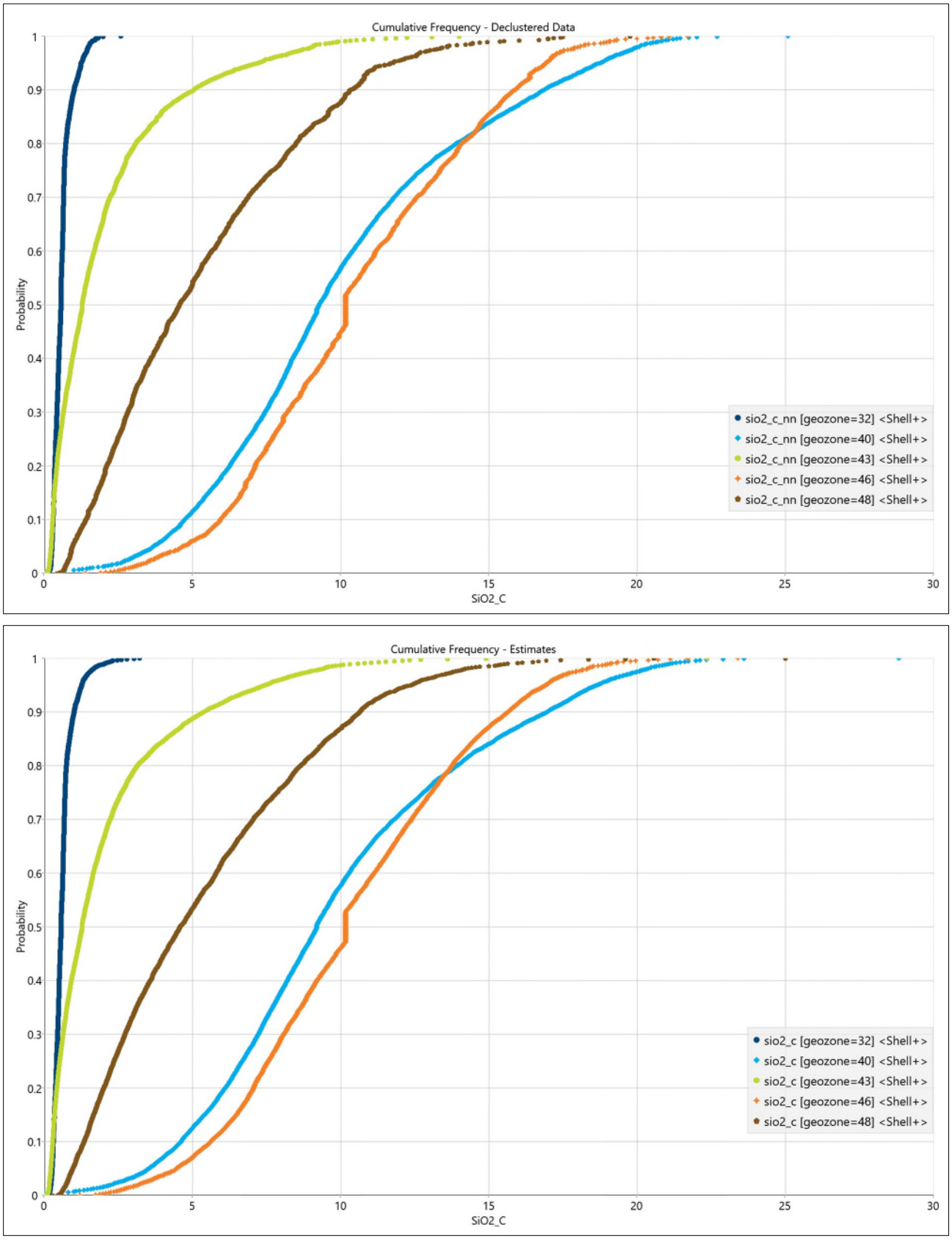


Figure 11.56 – Cumulative frequency curves for concentrate SiO_2_C estimates. Top chart = declustered samples. Bottom chart = estimated blocks.

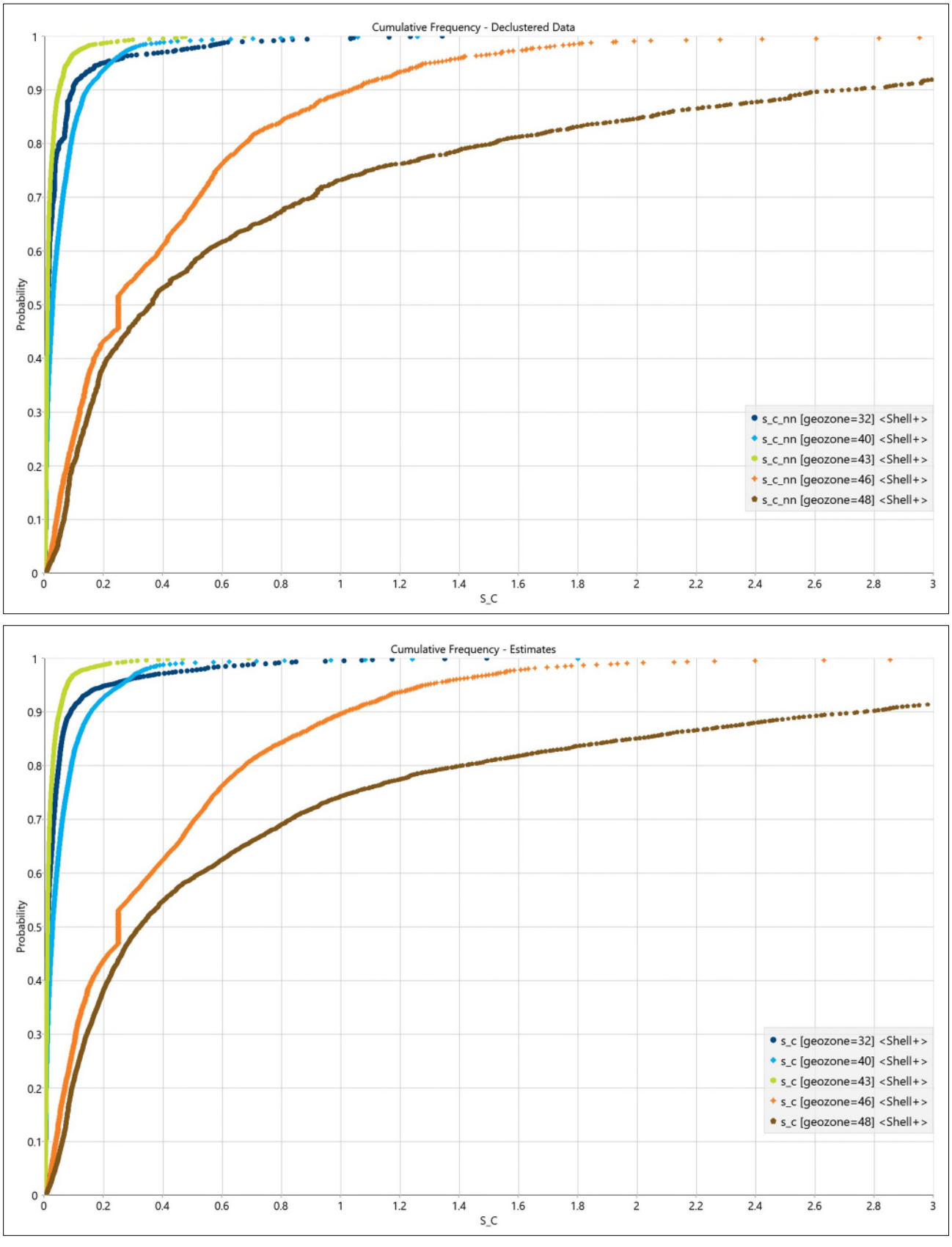


Figure 11.57 – Cumulative frequency curves for concentrate S_C estimates. Top chart = declustered samples. Bottom chart = estimated blocks. Charts clipped to 3% S.

Trends in mean grades for the declustered sample composites and block estimates were compared using swathe plots in the X, Y and Z direction and widths of 75 x 75 x 25m (XYZ directions). Several examples of swathe plots are shown in Figure 11.58 to Figure 11.87.

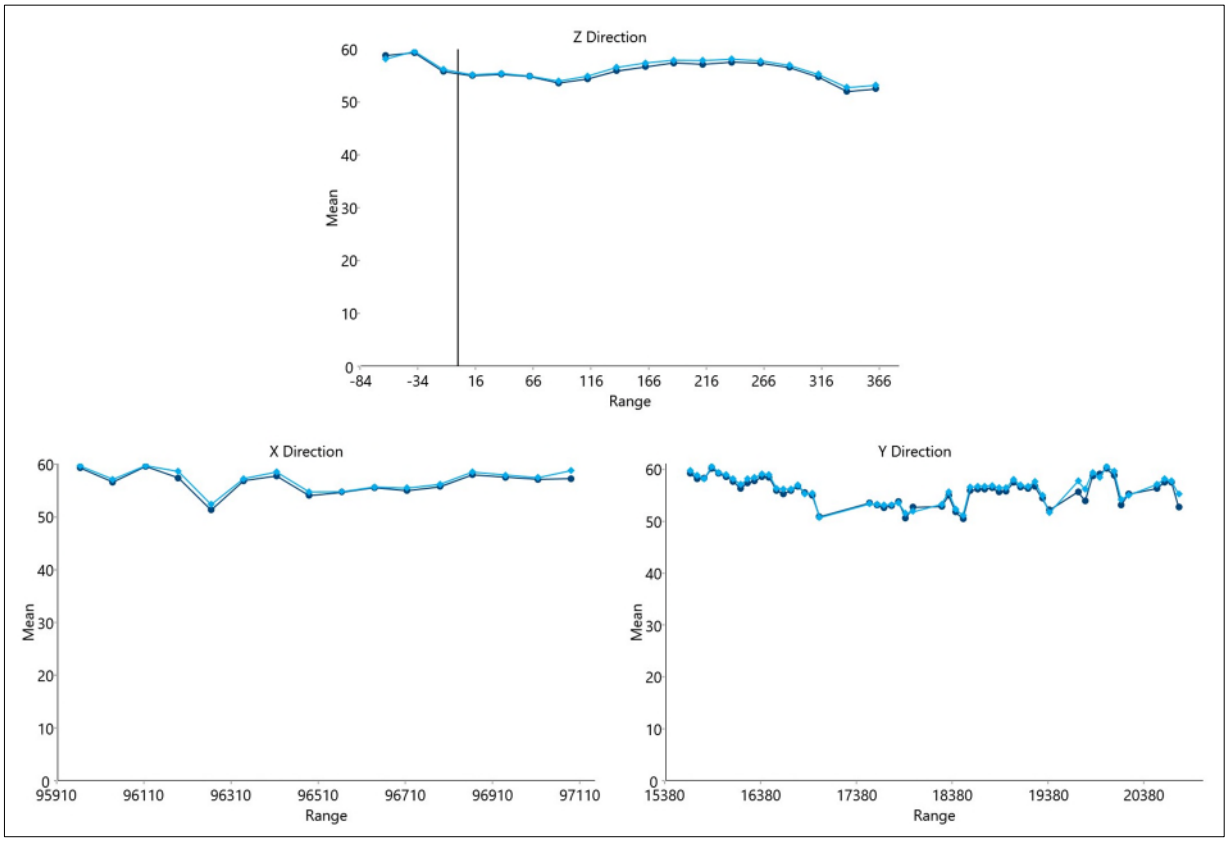


Figure 11.58 – Swathe plot for Fe_H in domain HEO 30. Light blue = declustered samples. Dark blue = estimates.

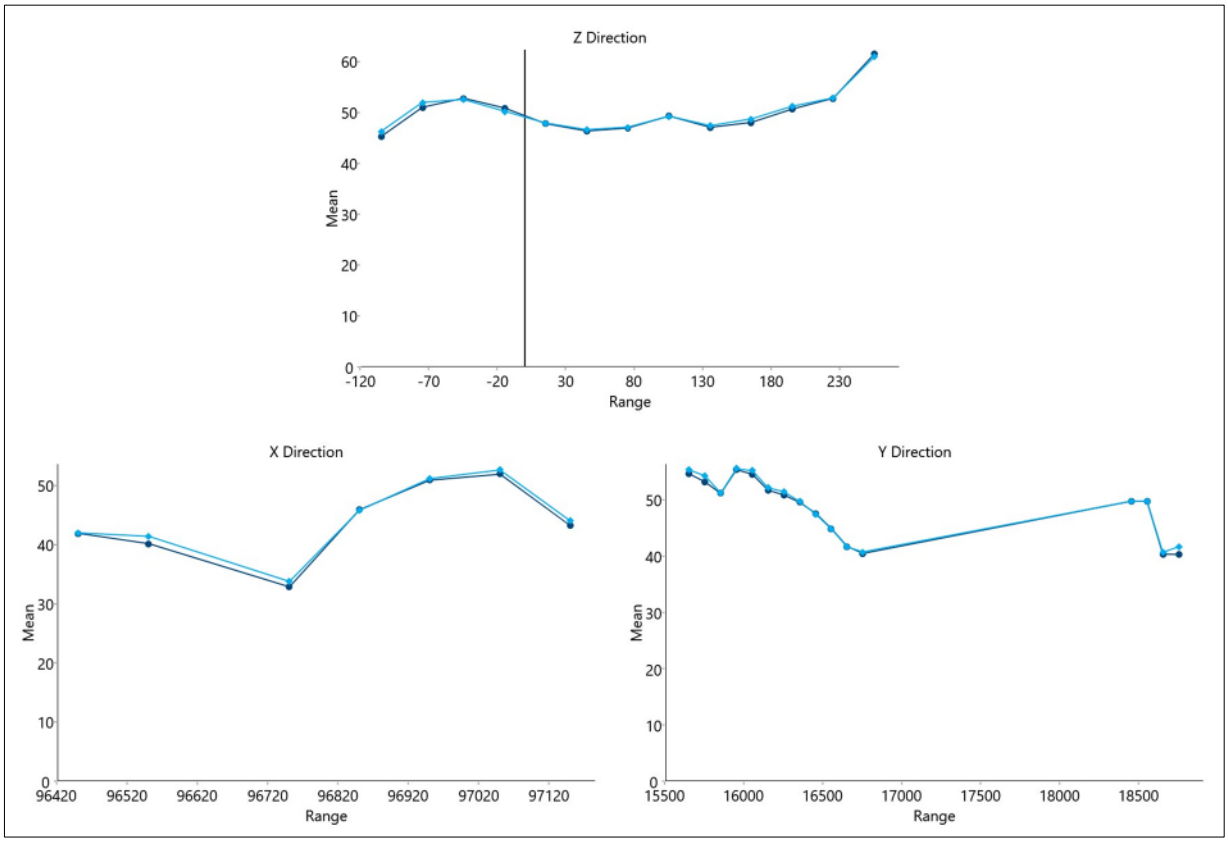


Figure 11.59 – Swathe plot for Fe_H in domain HEC 32. Light blue = declustered samples. Dark blue = estimates.

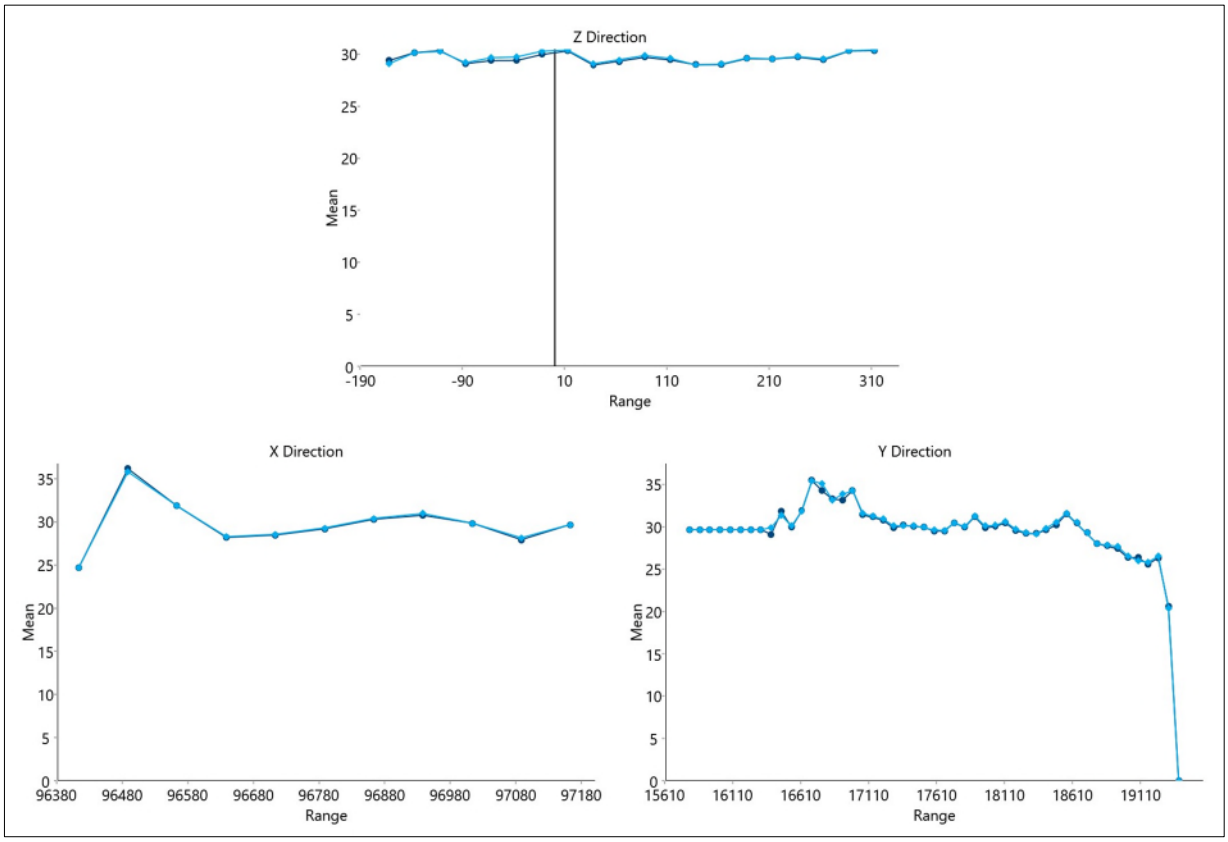


Figure 11.60 – Swathe plot for Fe_H in domain MTS 40. Light blue = declustered samples. Dark blue = estimates.

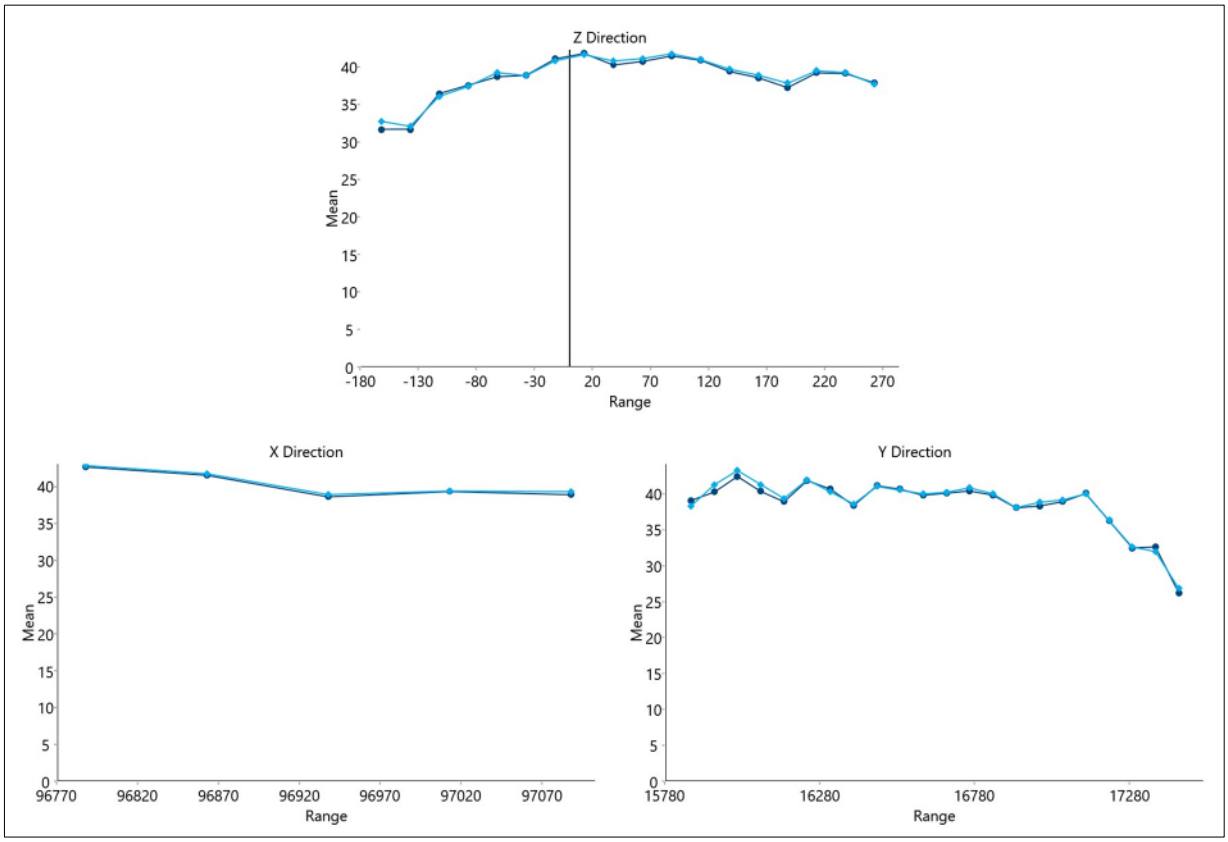


Figure 11.61 – Swathe plot for Fe_H in domain MTC 43. Light blue = declustered samples. Dark blue = estimates.

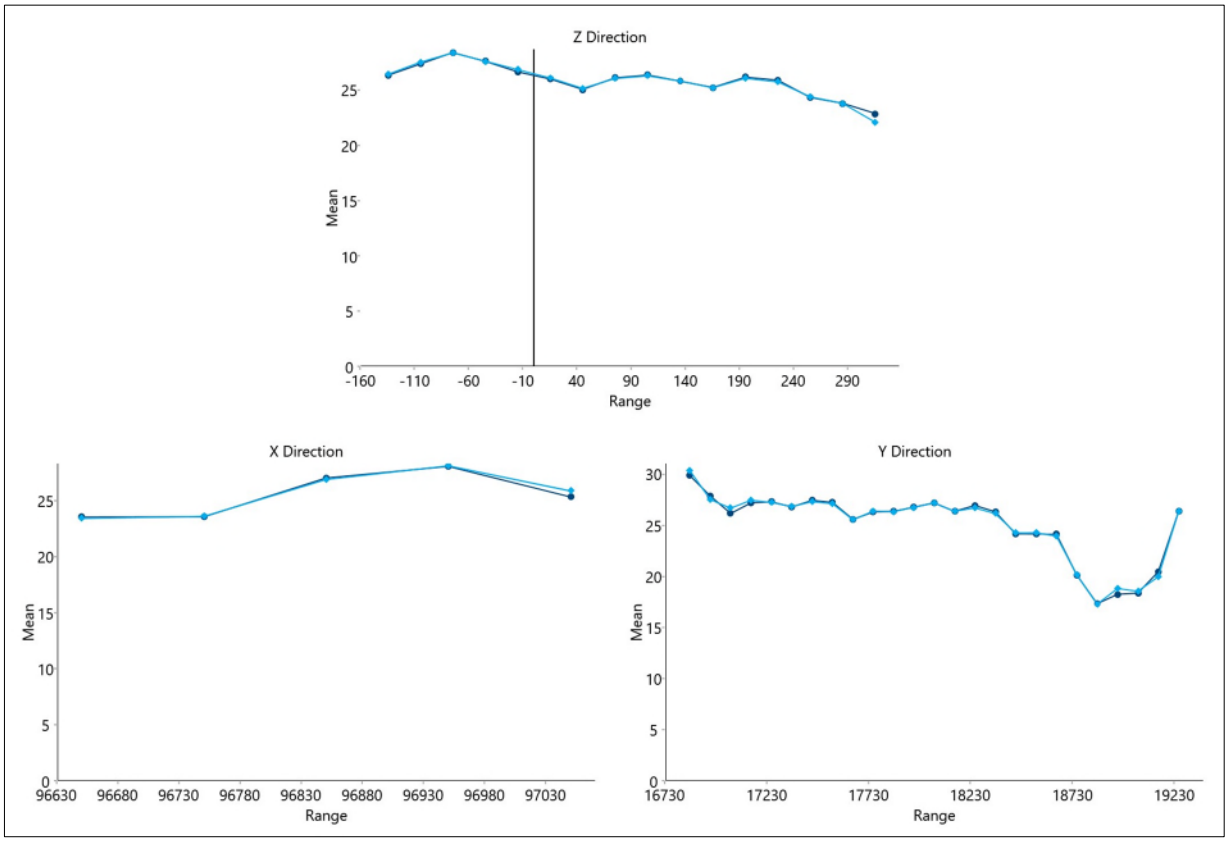


Figure 11.62– Swathe plot for Fe_H in domain SCH 46. Light blue = declustered samples. Dark blue = estimates.

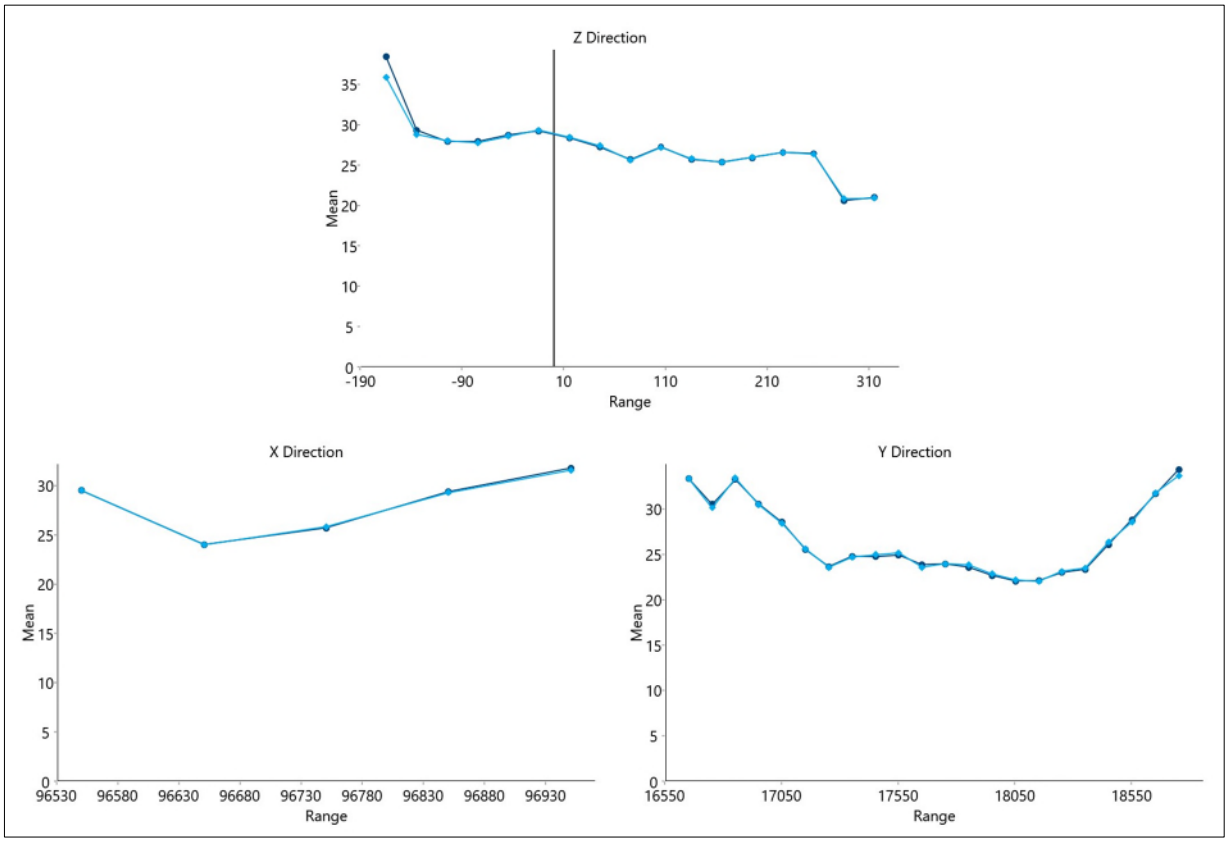


Figure 11.63 – Swathe plot for Fe_H in domain MSU 48. Light blue = declustered samples. Dark blue = estimates.

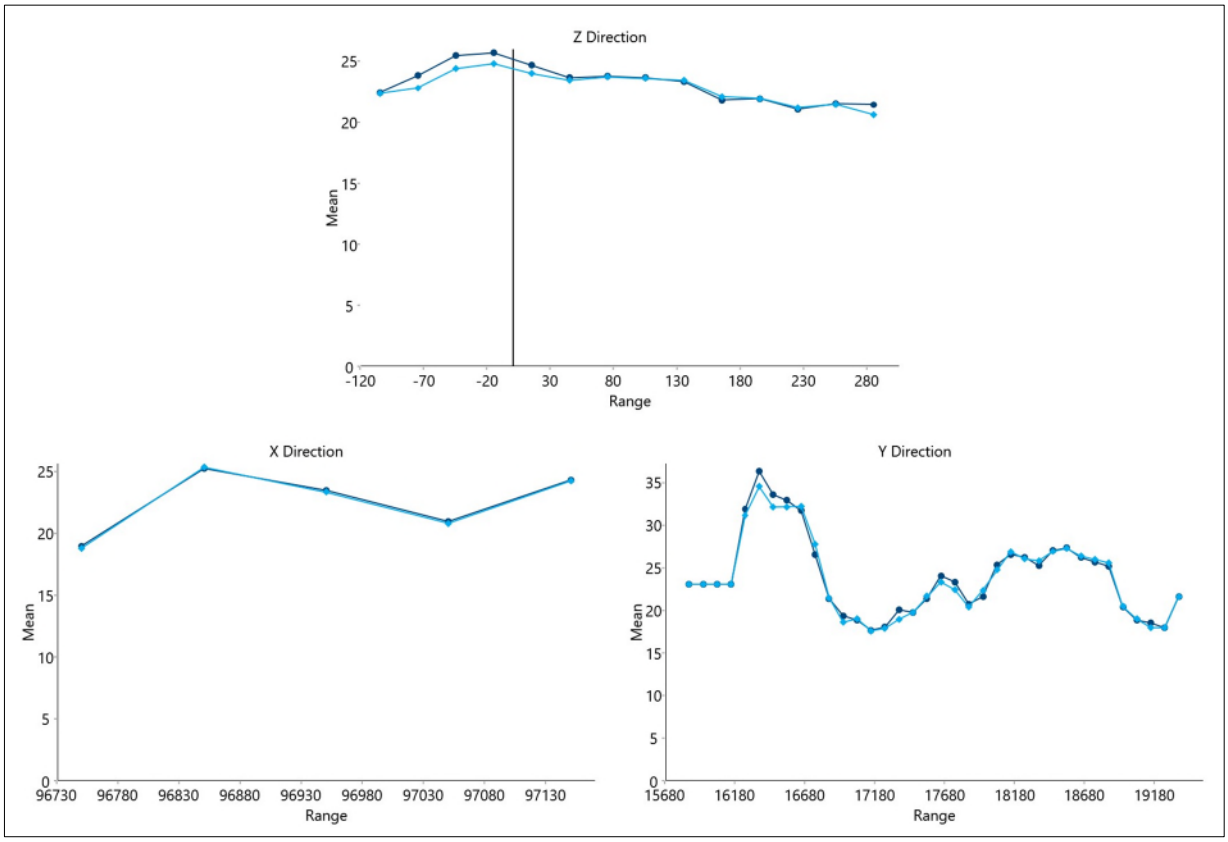


Figure 11.64 – Swathe plot for Fe_H in domain ESZ 75. Light blue = declustered samples. Dark blue = estimates.

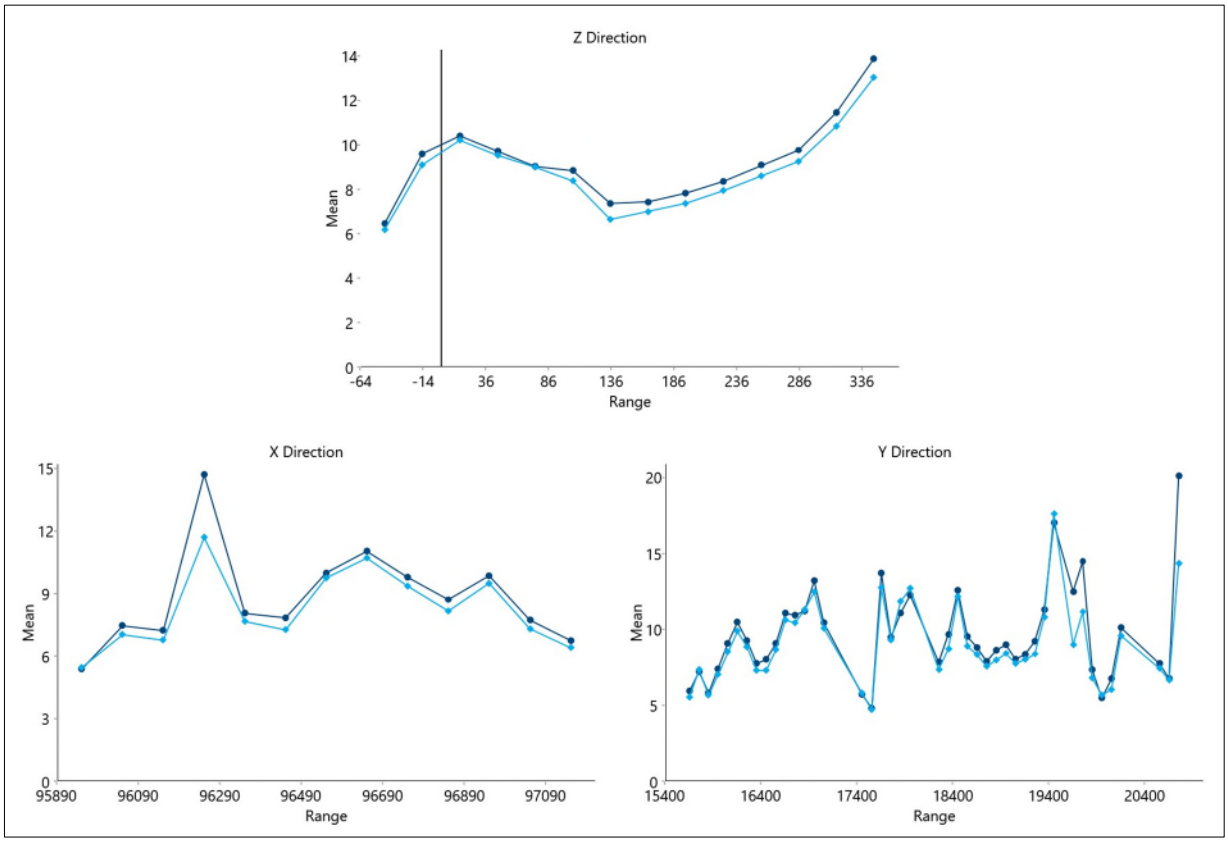


Figure 11.65 – Swathe plot for SiO_2_H in domain HEO 30. Light blue = declustered samples. Dark blue = estimates.

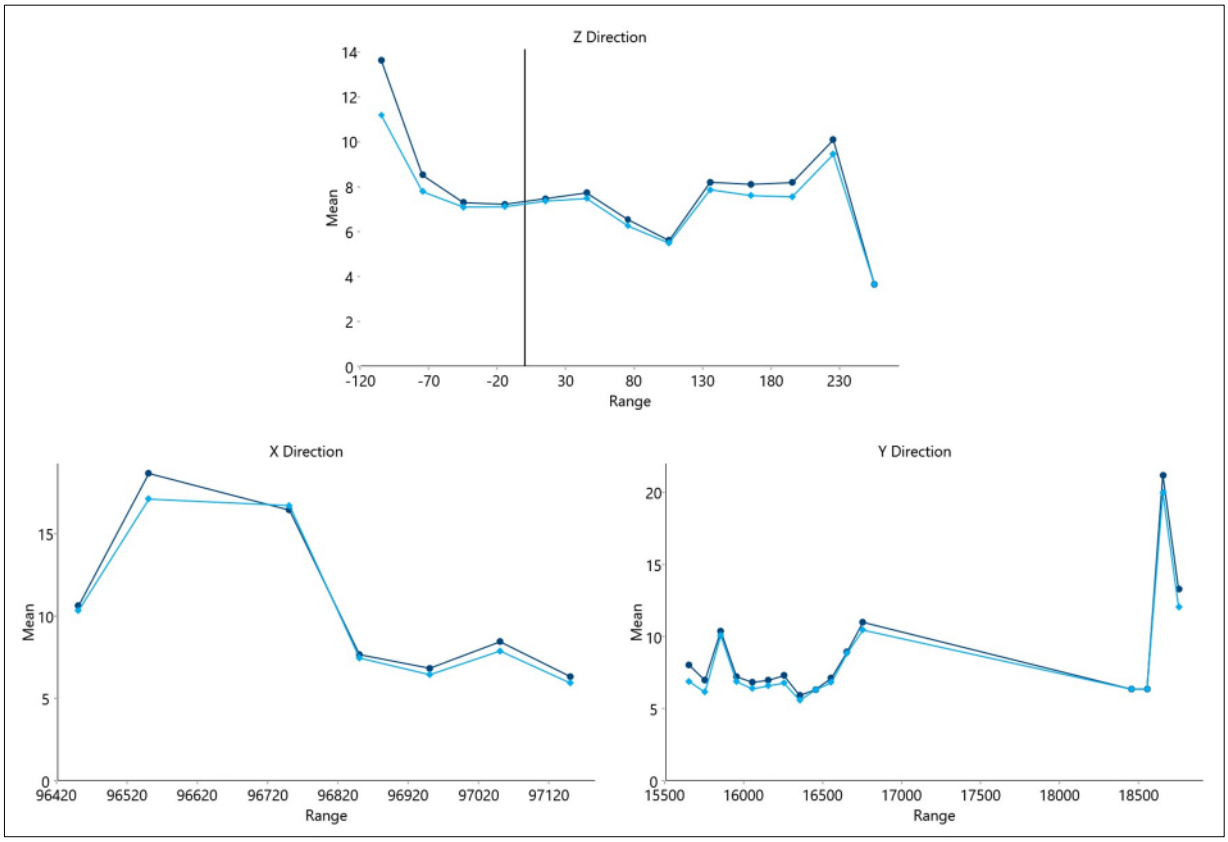


Figure 11.66 – Swathe plot for SiO_2_H in domain HEC 32. Light blue = declustered samples. Dark blue = estimates.

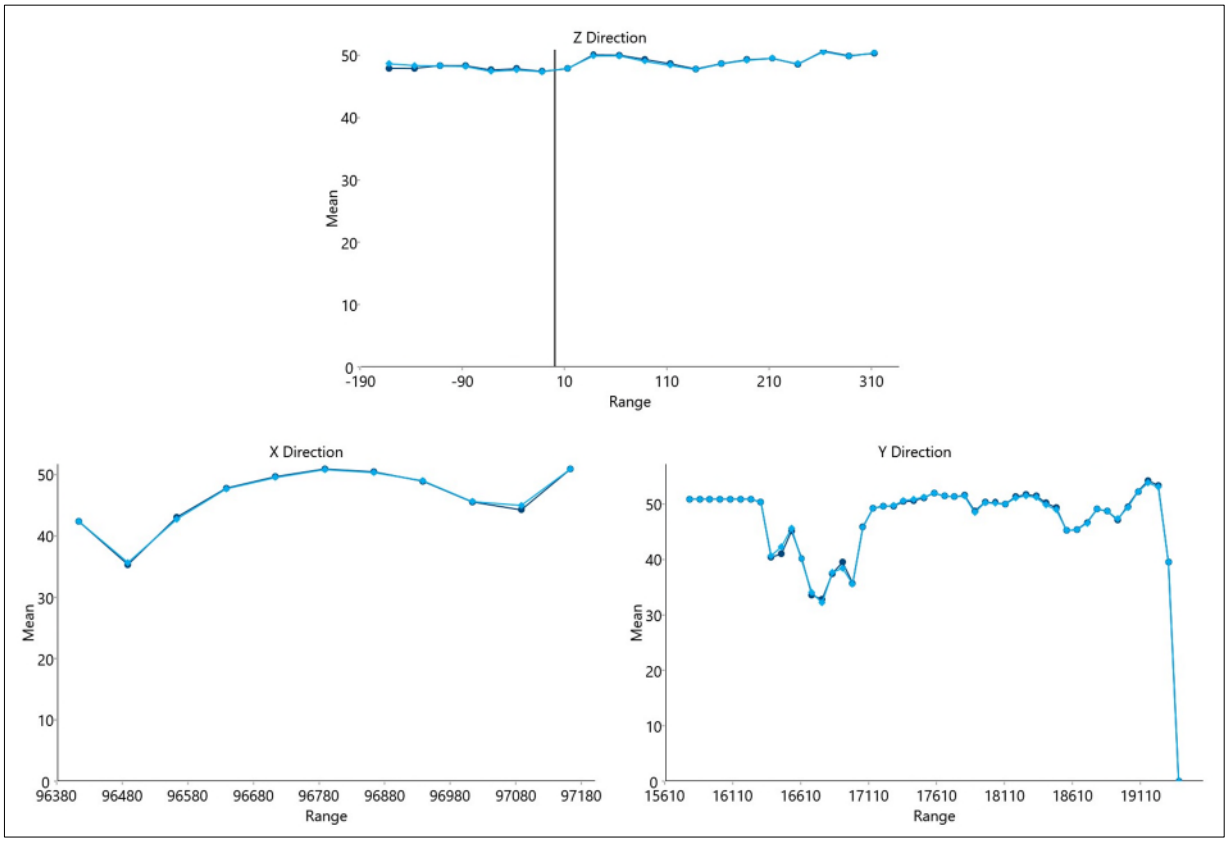


Figure 11.67 – Swathe plot for SiO_2_H in domain MTS 40. Light blue = declustered samples. Dark blue = estimates.

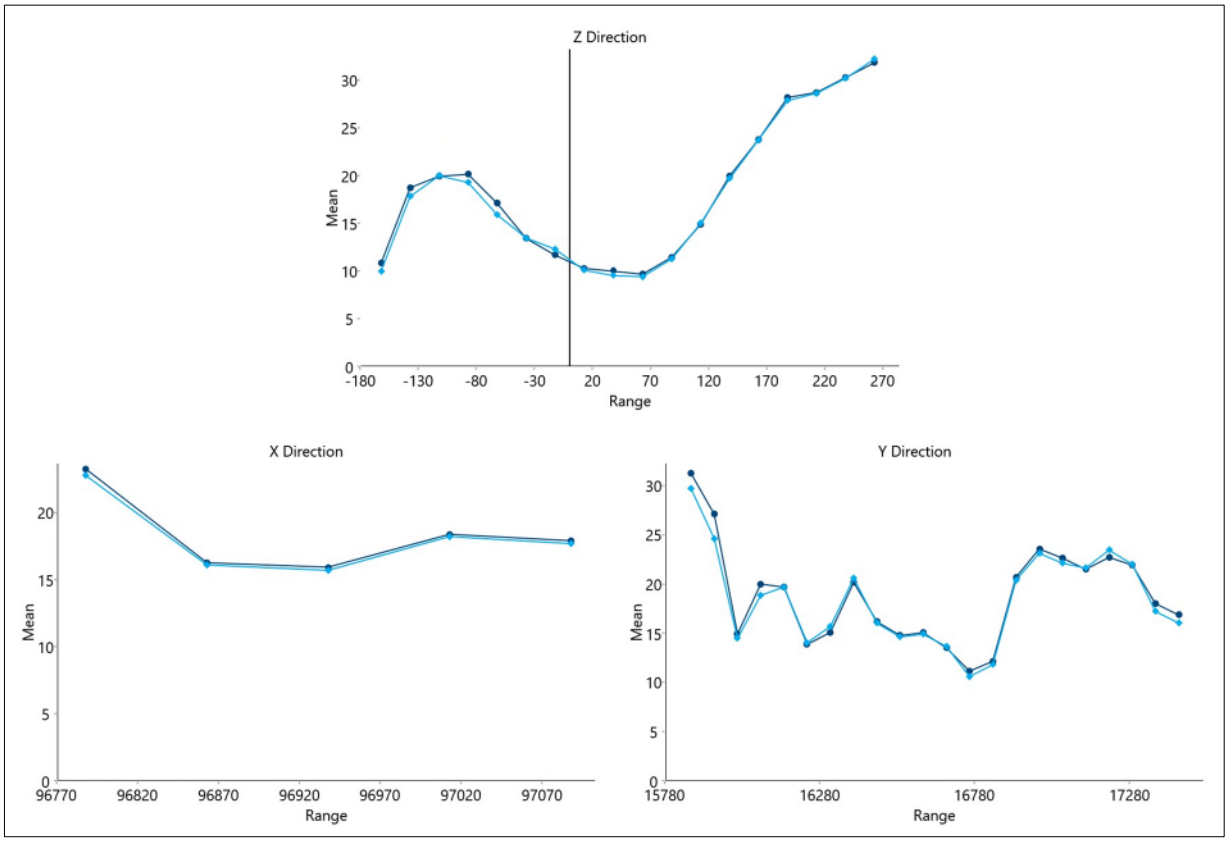


Figure 11.68 – Swathe plot for SiO_2_H in domain MTC 43. Light blue = declustered samples. Dark blue = estimates.

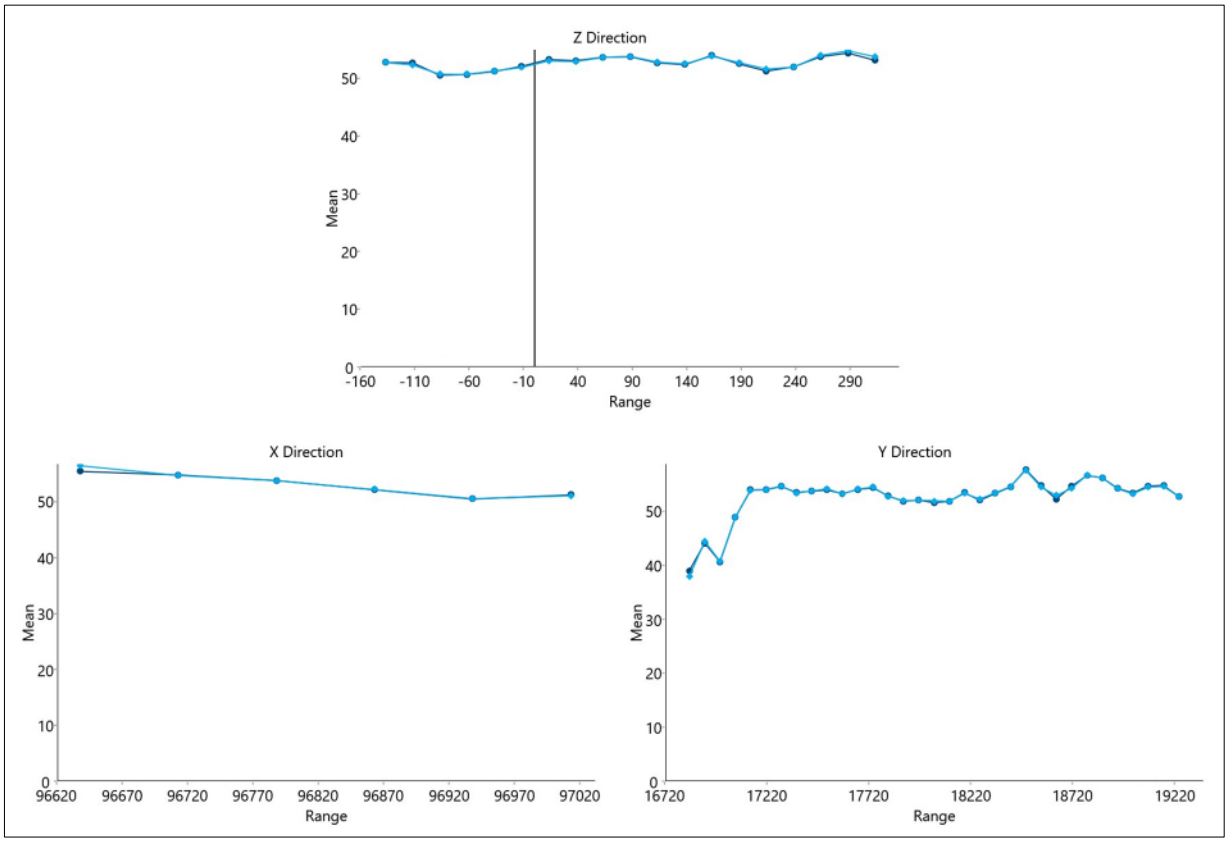


Figure 11.69– Swathe plot for SiO_2_H in domain SCH 46. Light blue = declustered samples. Dark blue = estimates.

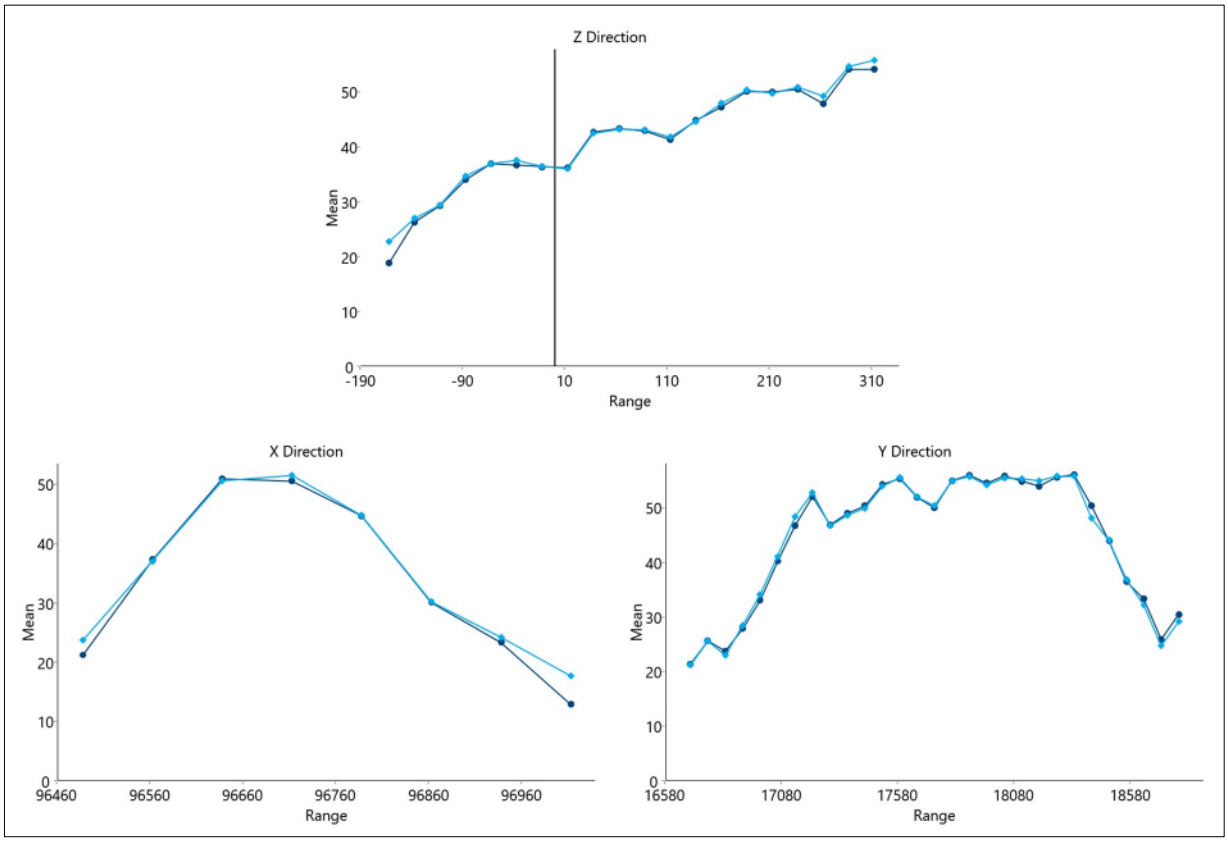


Figure 11.70 – Swathe plot for SiO_2_H in domain MSU 48. Light blue = declustered samples. Dark blue = estimates.

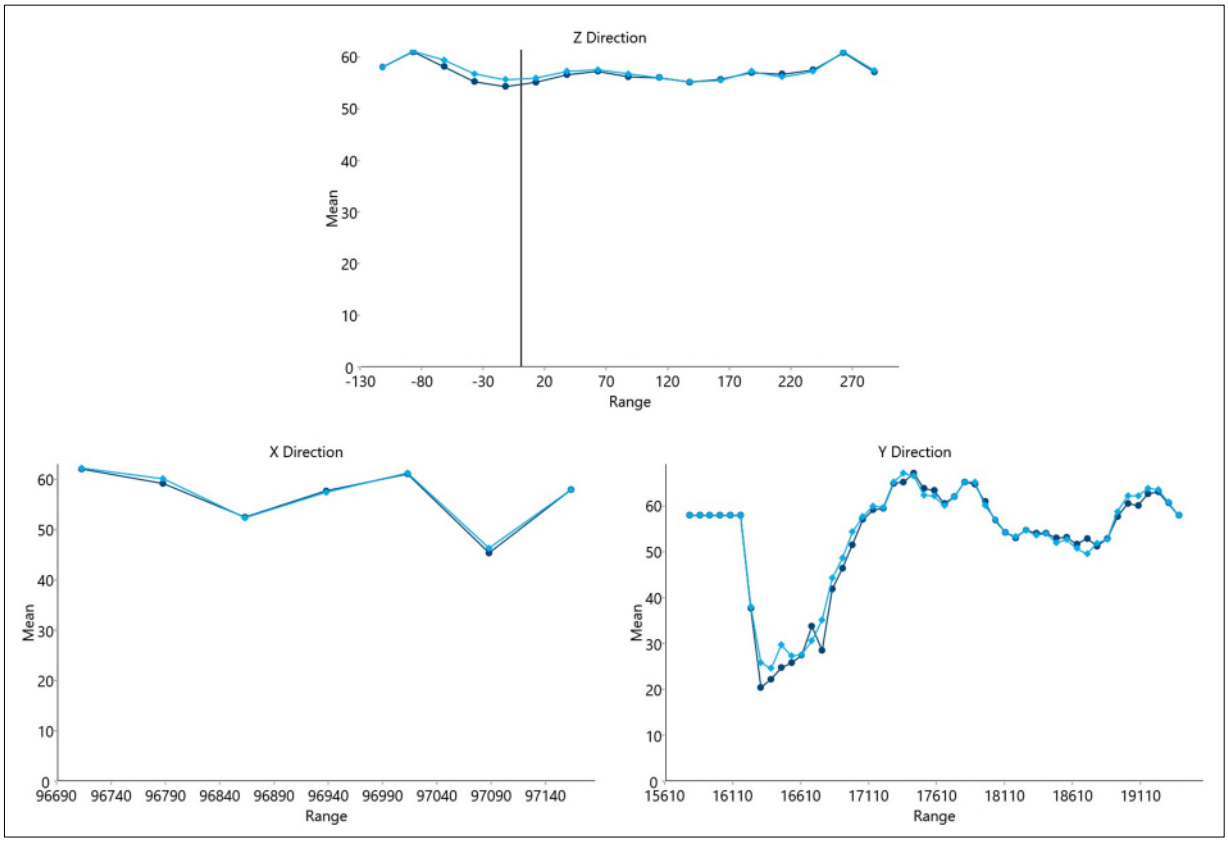


Figure 11.71 – Swathe plot for SiO_2_H in domain ESZ 75. Light blue = declustered samples. Dark blue = estimates.

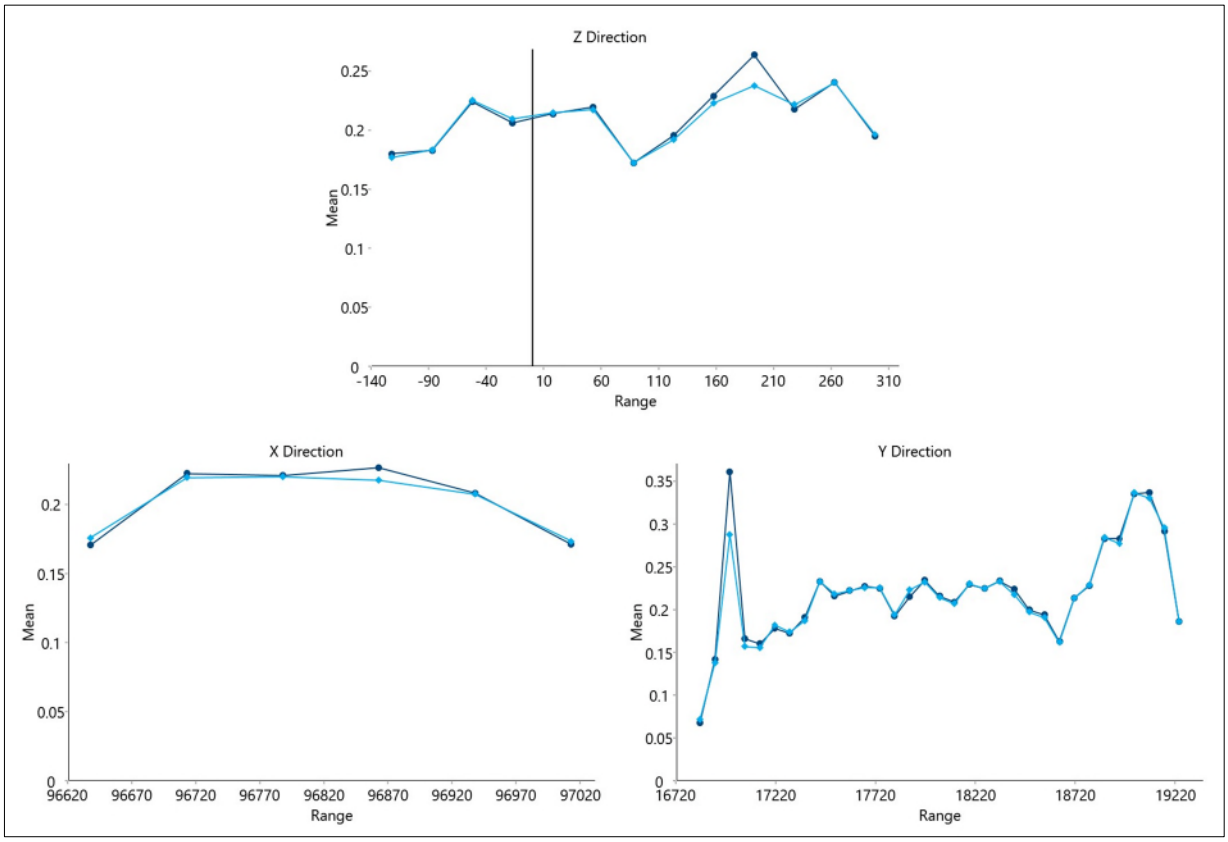


Figure 11.72 – Swathe plot for S_H in domain SCH 46. Light blue = declustered samples. Dark blue = estimates.

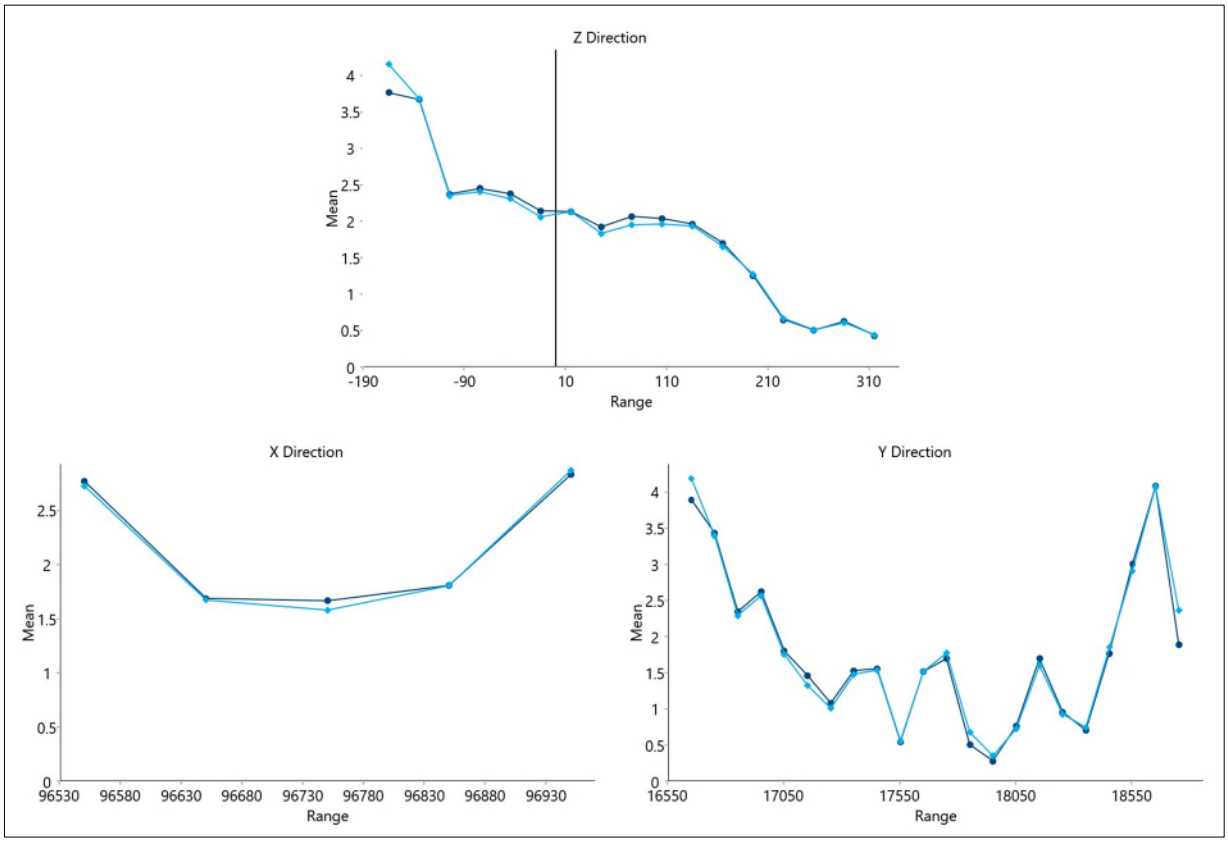


Figure 11.73 – Swathe plot for S_H in domain MSU 48. Light blue = declustered samples. Dark blue = estimates.

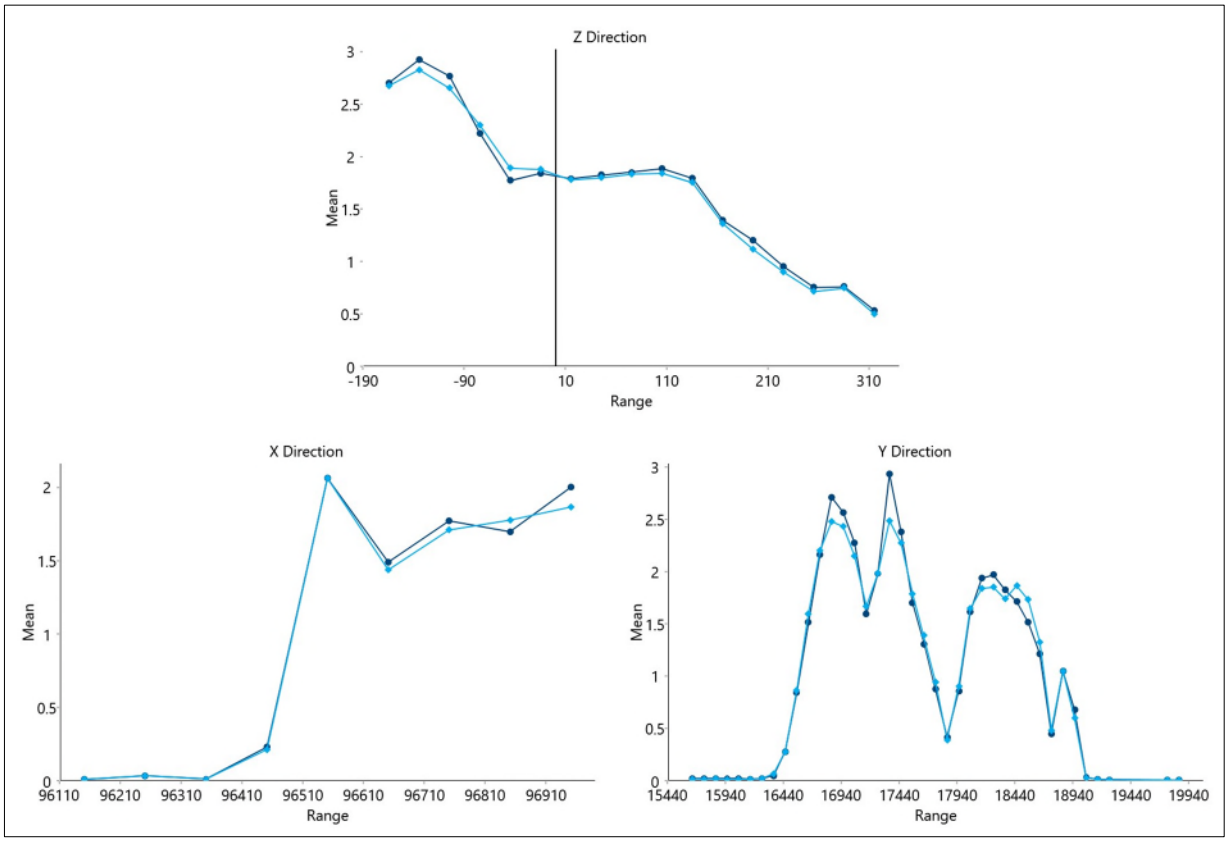


Figure 11.74 – Swathe plot for S_H in domain BSQ 70. Light blue = declustered samples. Dark blue = estimates.

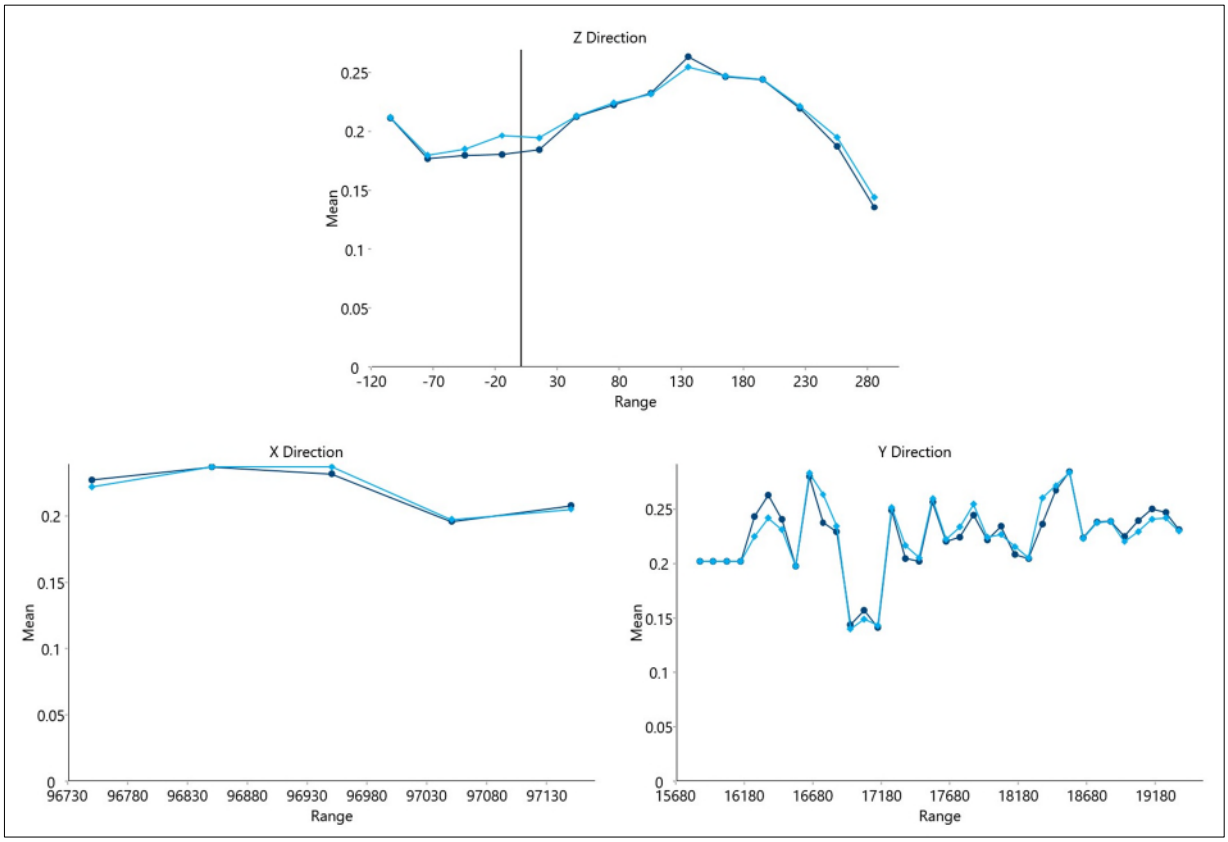


Figure 11.75 – Swathe plot for S_H in domain ESZ 75. Light blue = declustered samples. Dark blue = estimates.

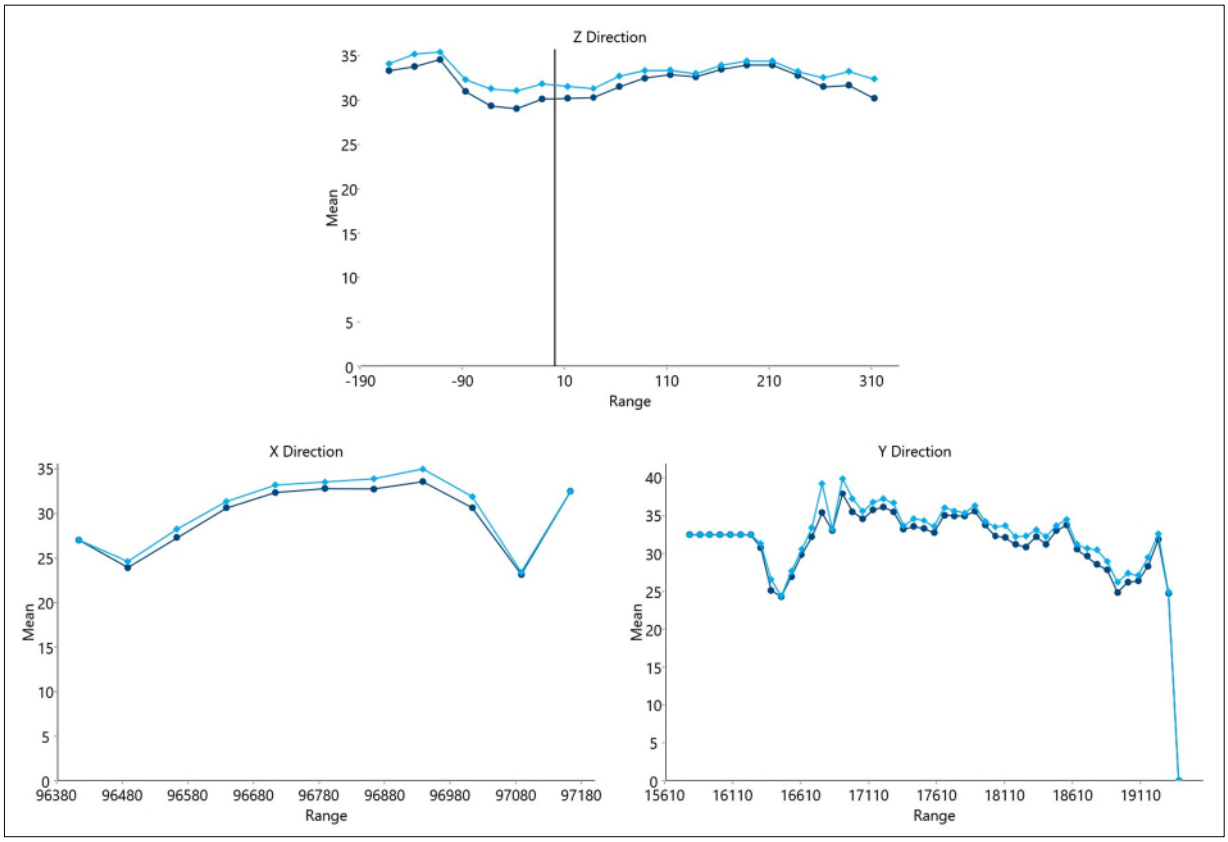


Figure 11.76 – Swathe plot for MASSREC in domain MTS 40. Light blue = declustered samples. Dark blue = estimates.

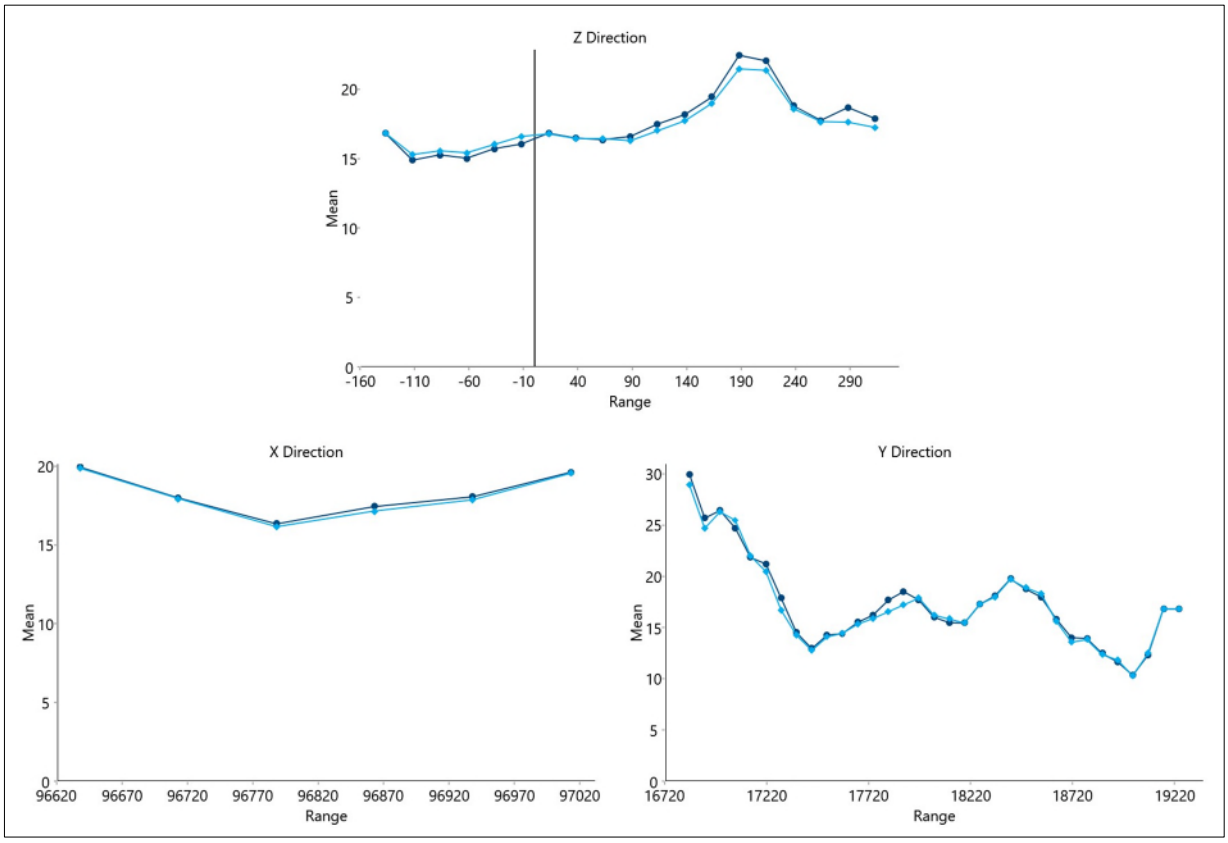


Figure 11.77 – Swathe plot for MASSREC in domain SCH 46. Light blue = declustered samples. Dark blue = estimates.

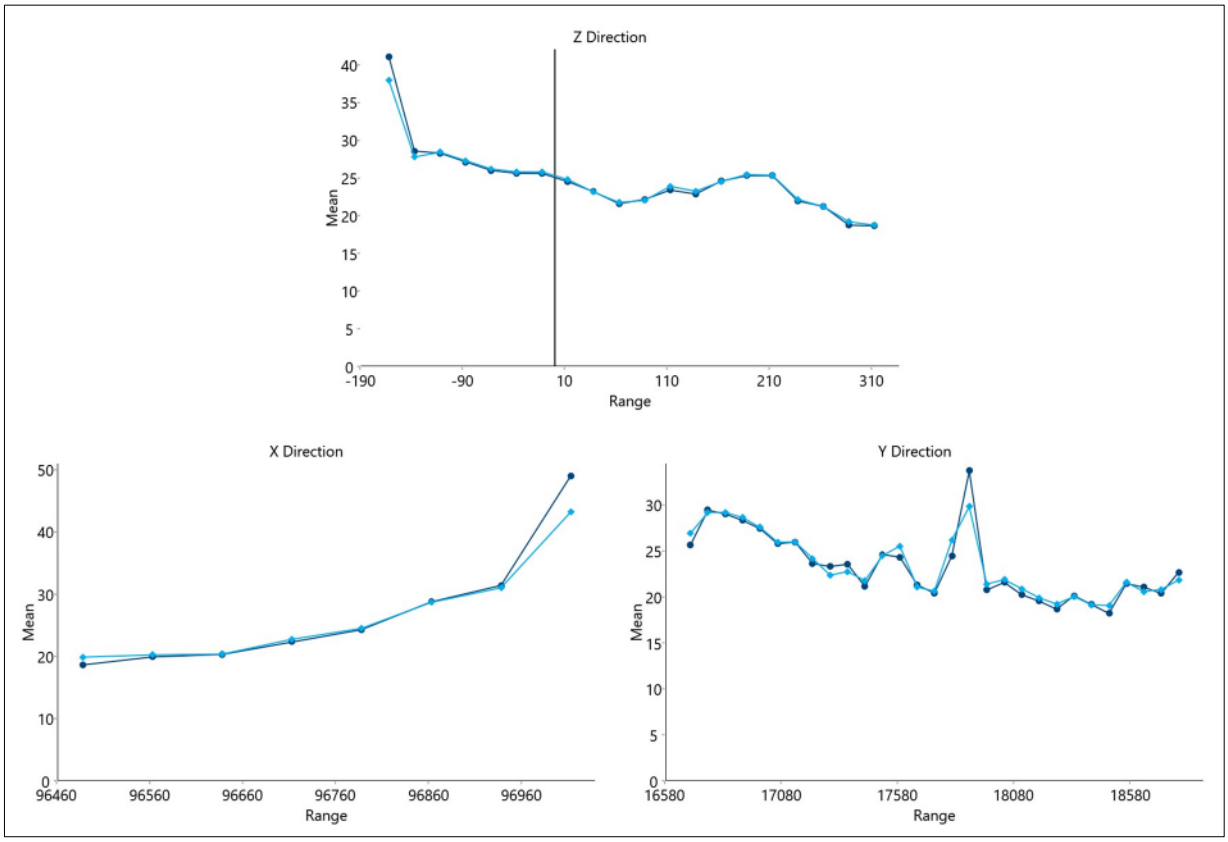


Figure 11.78 – Swathe plot for MASSREC in domain MSU 48. Light blue = declustered samples. Dark blue = estimates.

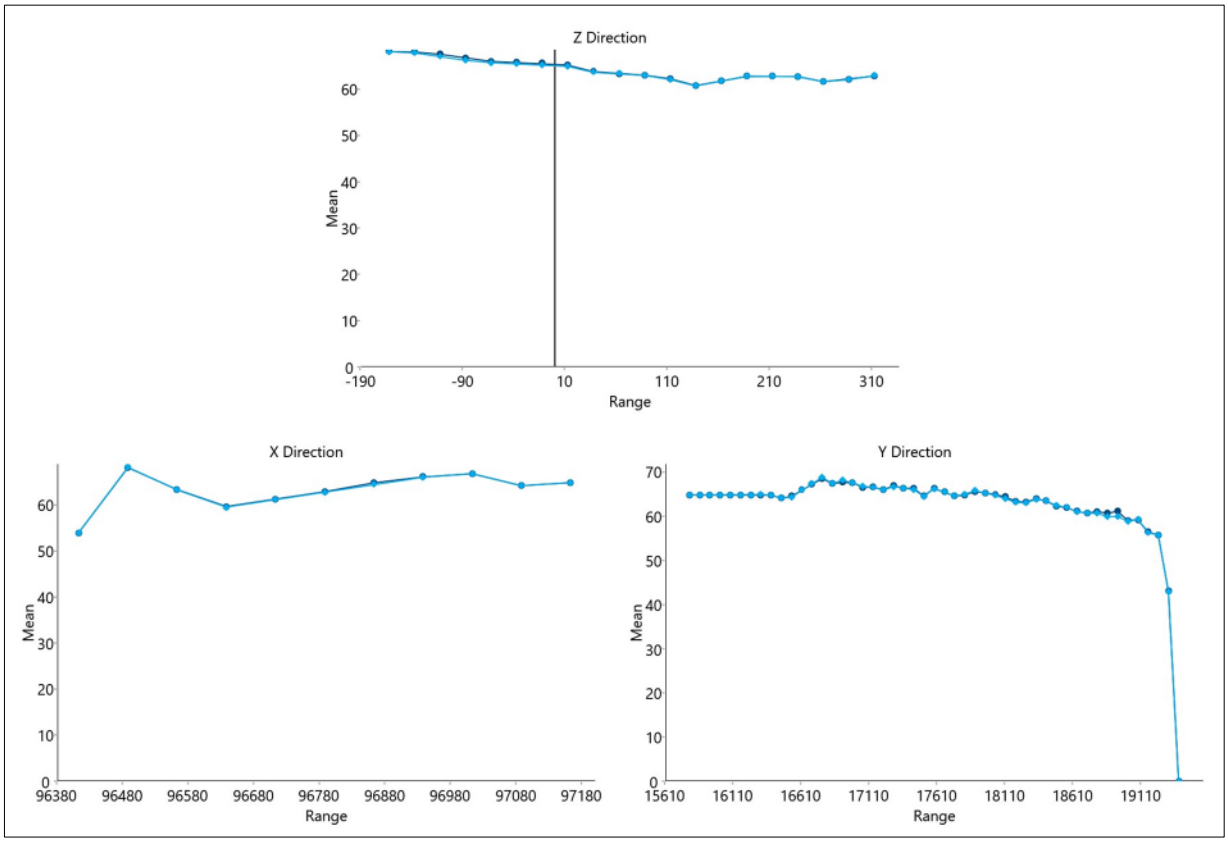


Figure 11.79 – Swathe plot for Fe_C in domain MTS 40. Light blue = declustered samples. Dark blue = estimates.

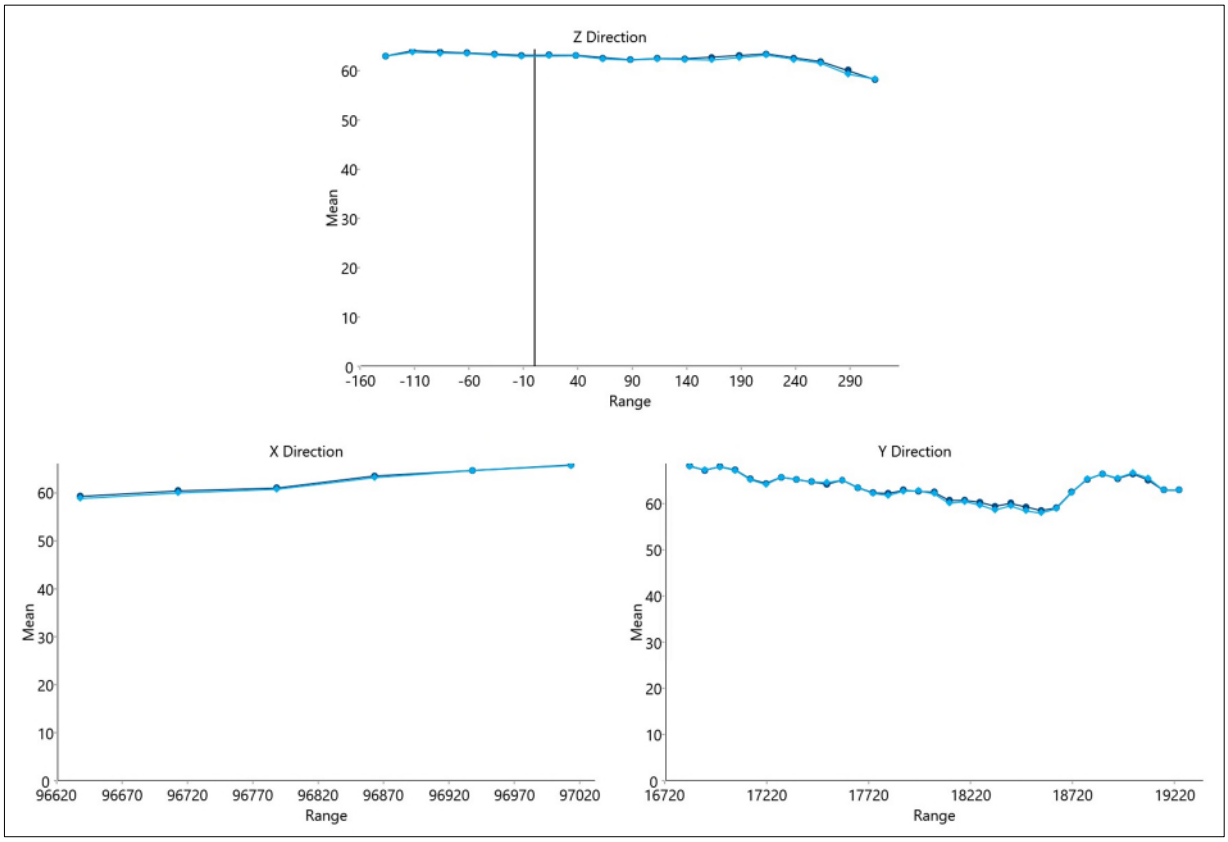


Figure 11.80 – Swathe plot for Fe_C in domain SCH 46. Light blue = declustered samples. Dark blue = estimates.

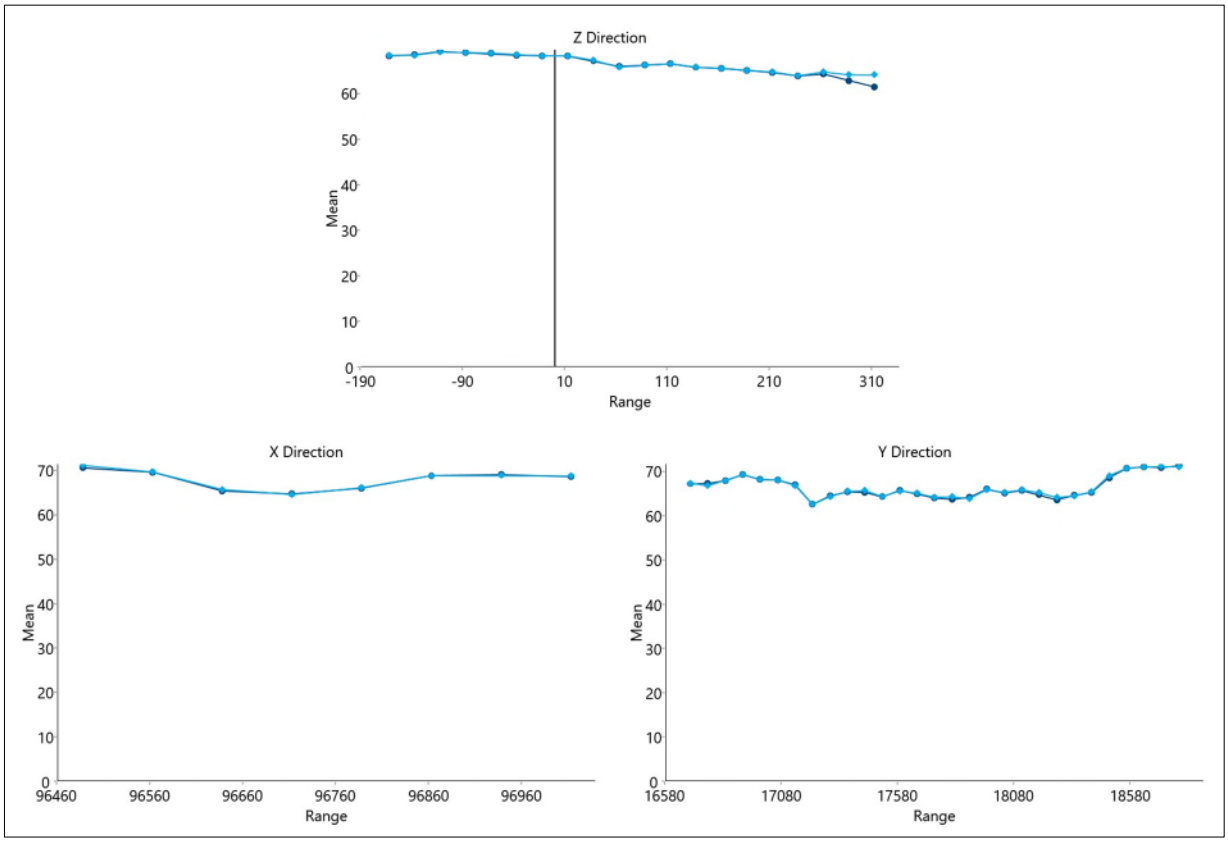


Figure 11.81 – Swathe plot for Fe_C in domain MSU 48. Light blue = declustered samples. Dark blue = estimates.

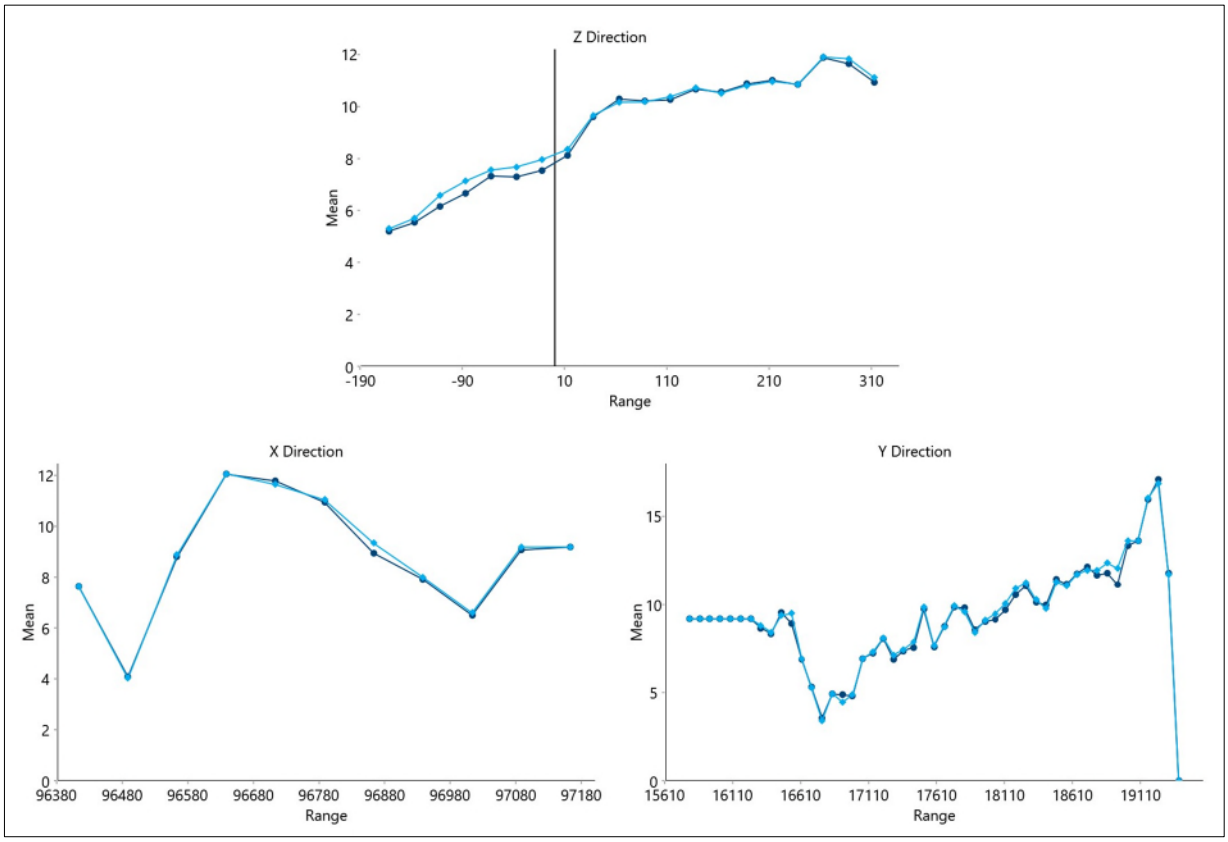


Figure 11.82 – Swathe plot for SiO_2_C in domain MTS 40. Light blue = declustered samples. Dark blue = estimates.

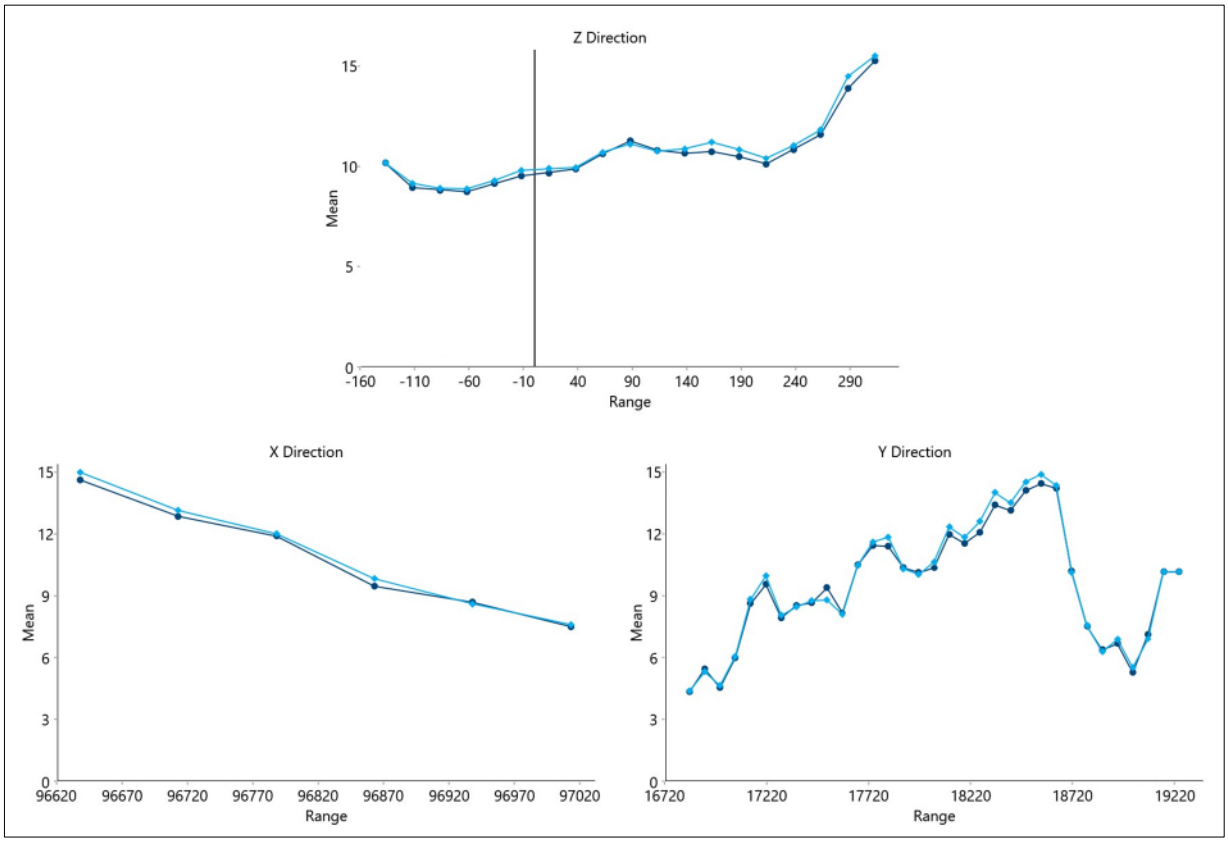


Figure 11.83 – Swathe plot for SiO_2_C in domain SCH 46. Light blue = declustered samples. Dark blue = estimates.

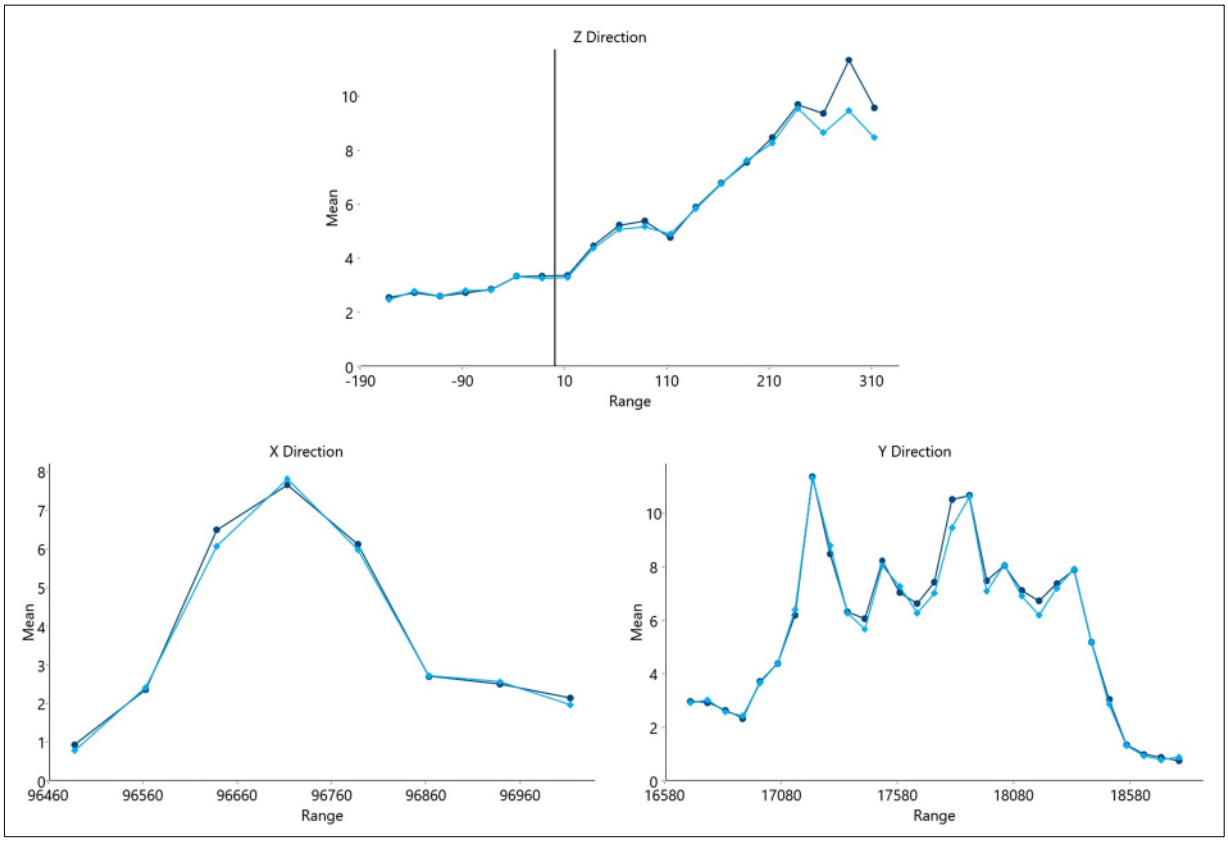


Figure 11.84 – Swathe plot for SiO_2_C in domain MSU 48. Light blue = declustered samples. Dark blue = estimates.

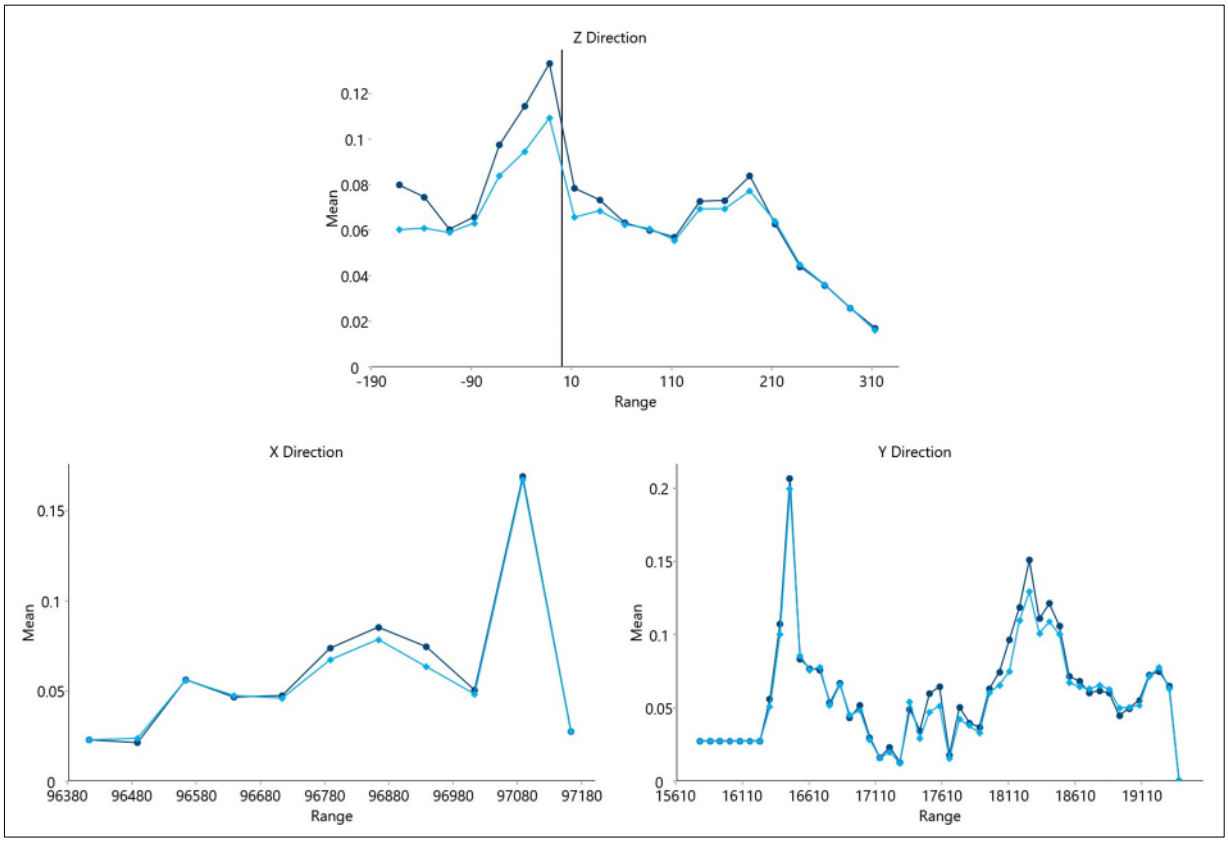


Figure 11.85 – Swathe plot for S_C in domain MTS 40. Light blue = declustered samples. Dark blue = estimates.

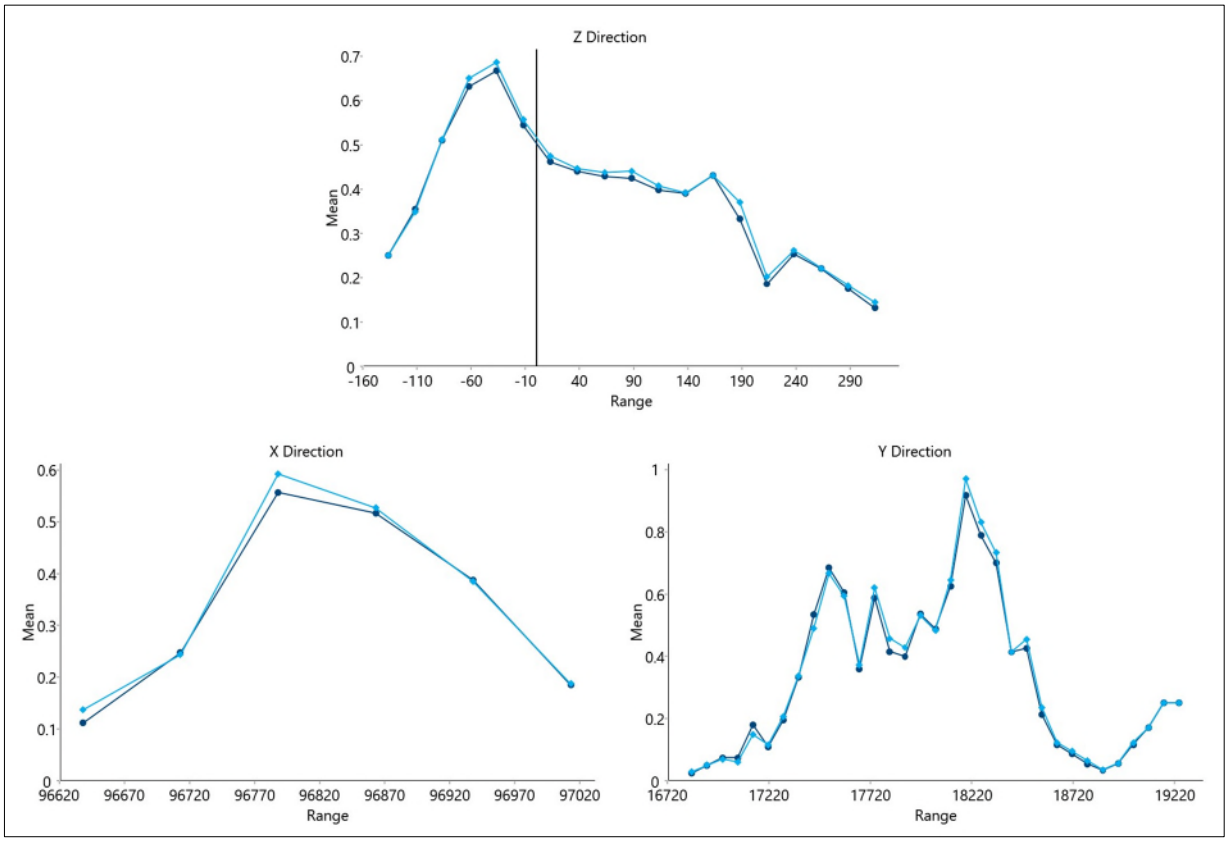


Figure 11.86 – Swathe plot for S_C in domain SCH 46. Light blue = declustered samples. Dark blue = estimates.

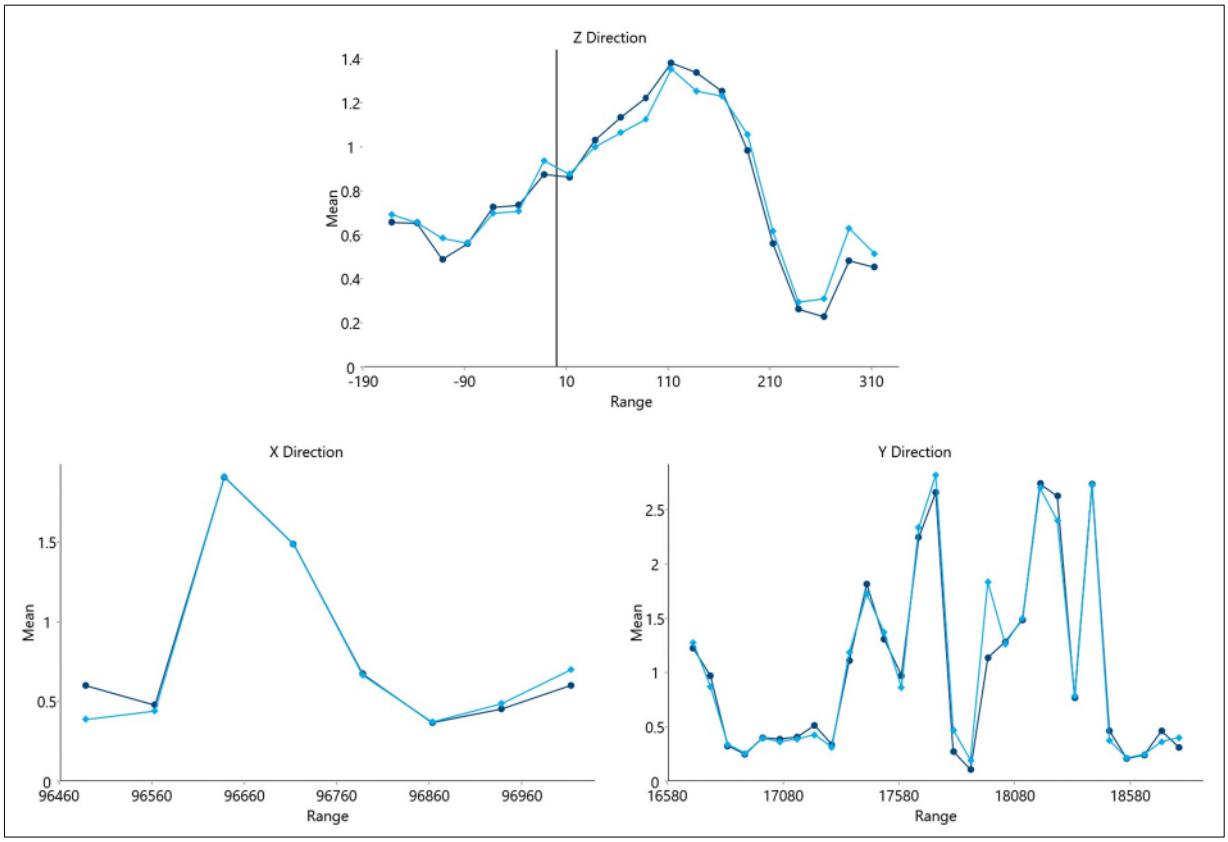


Figure 11.87 – Swathe plot for S_C in domain MSU 48. Light blue = declustered samples. Dark blue = estimates.

Table 11.4 shows the summary statistics for density estimates. Figure 11.88 and Figure 11.89 shows the frequency curves for density for the declustered sample composites and block estimates in the weathered and unweathered zones. Figure 11.90, Figure 11.91, and Figure 11.92 show that the relationships between analytes and density as observed in the sample composites, have been preserved in the block estimates.

Trends in mean grades for the declustered sample composites and block estimates were compared using swathe plots in the X, Y and Z direction using swathe widths of 75x75x25m (XYZ directions). Several examples are shown in Figure 11.93 to Figure 11.99.

Table 11.4 – Statistics for declustered samples and block density estimates by weathering zone and domain.

		Declustered Samples			Block Estimates		
Element	Domain	Mean	StdDev	CV	Mean	StdDev	CV
Weathered Density	AMP 10	2.42	0.242	0.099	2.45	0.253	0.104
	BIF 20	2.56	0.254	0.098	2.59	0.286	0.110
	HE0 30	3.24	0.343	0.106	3.23	0.363	0.113
	HEC 32	3.00	0.279	0.093	3.02	0.294	0.098
	HBF 37	3.50	0.170	0.049	3.50	0.197	0.056
	MTS 40	3.18	0.311	0.098	3.17	0.346	0.109
	MTC 43	3.07	0.257	0.084	3.08	0.273	0.089
	SCH 46	2.70	0.136	0.050	2.71	0.122	0.045
	MSU 48	2.91	0.138	0.047	2.92	0.142	0.049
	BSQ 70	2.57	0.161	0.062	2.58	0.165	0.064
	DOM 71	2.57	0.057	0.022	2.57	0.058	0.023
	ESZ 75	2.35	0.191	0.081	2.37	0.204	0.086
	CGS 80	2.31	0.128	0.060	2.13	0.130	0.061
Unweathered Density	AMP 10	3.13	0.250	0.080	3.13	0.265	0.085
	BIF 20	2.78	0.284	0.102	2.77	0.302	0.109
	HE0 30	3.57	0.232	0.065	3.57	0.246	0.069
	HEC 32	3.68	0.198	0.054	3.65	0.223	0.061
	HBF 37	3.91	0.274	0.070	3.89	0.305	0.078
	MTS 40	3.38	0.142	0.042	3.38	0.147	0.043
	MTC 43	3.75	0.263	0.070	3.75	0.278	0.074
	SCH 46	3.37	0.132	0.039	3.37	0.137	0.041
	MSU 48	3.39	0.153	0.045	3.40	0.155	0.046
	BSQ 70	3.04	0.218	0.072	3.04	0.213	0.070
	DOM 71	3.06	0.081	0.026	3.06	0.083	0.027
	ESZ 75	3.20	0.278	0.087	3.20	0.294	0.092
	CGS 80	2.61	0.105	0.040	2.60	0.103	0.039

* MBF 47 assigned 2.71 in weathered zone and 3.19 in unweathered zone

* GRT 90 assigned 2.30 1in weathered zone and 2.70 in unweathered zone

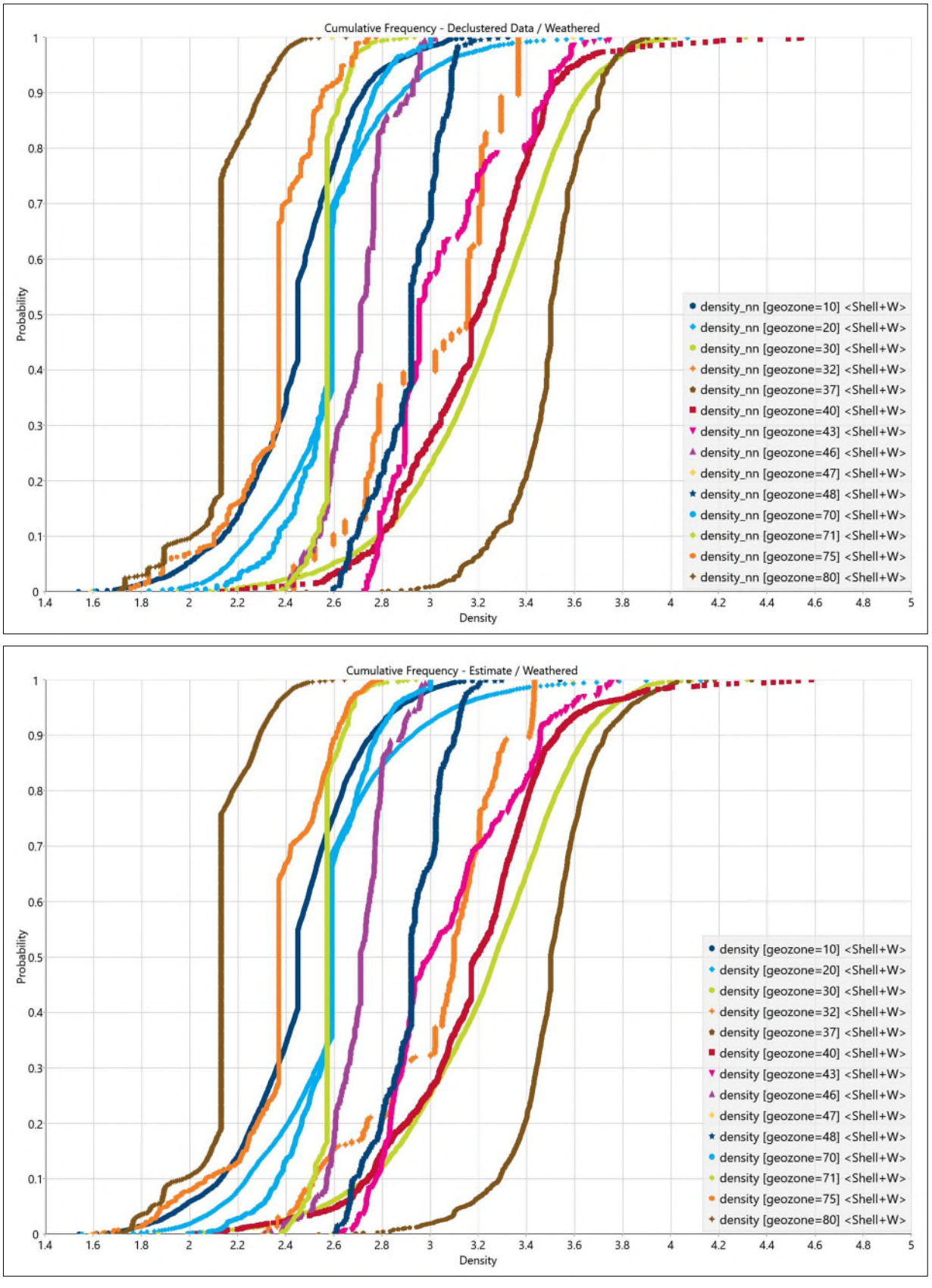


Figure 11.88 – Cumulative frequency curves for declustered density samples (TOP) and density estimate (BOTTOM) for the weathered part of the deposit.

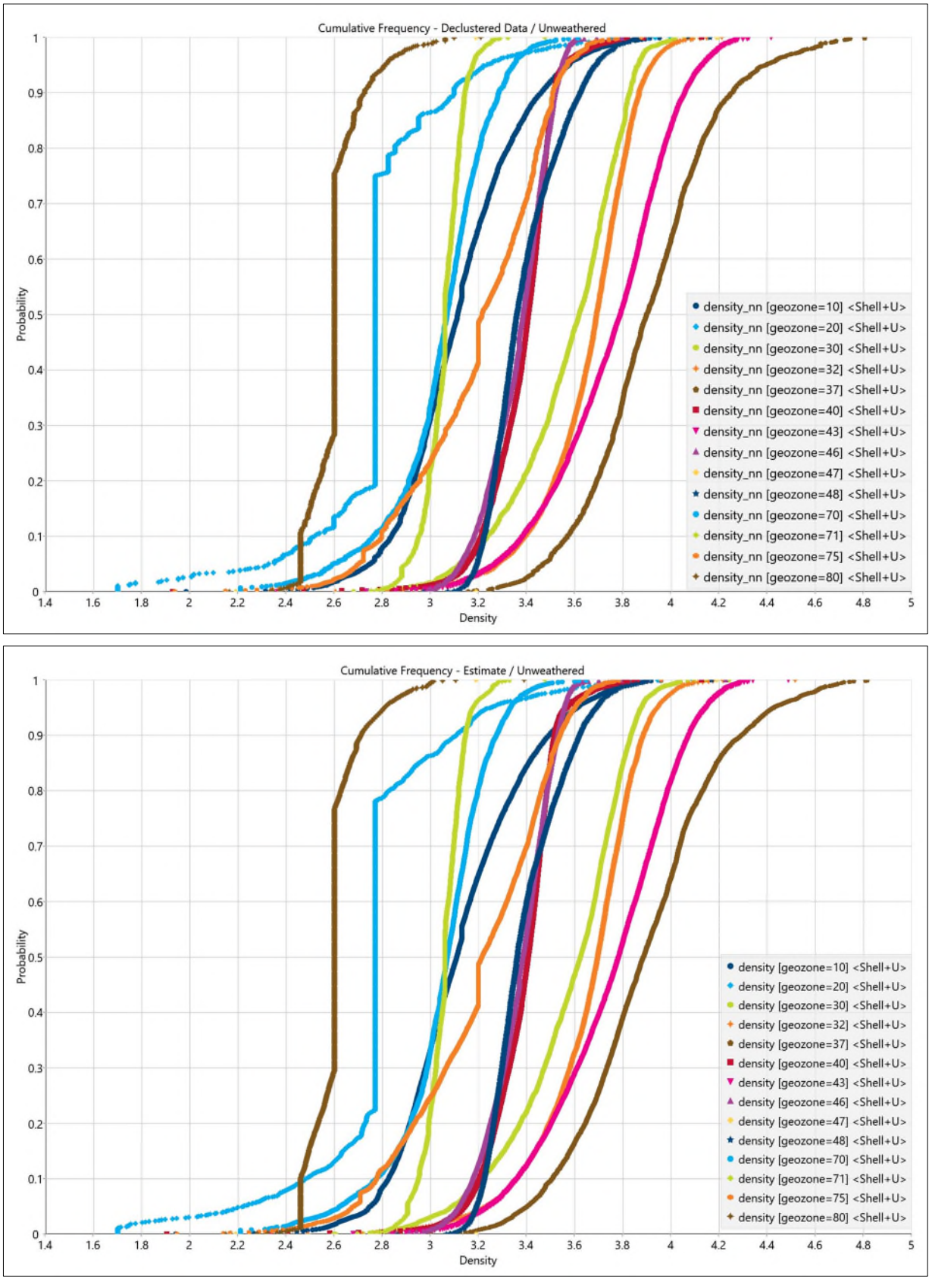


Figure 11.89 – Cumulative frequency curves for declustered density samples (TOP) and density estimate (BOTTOM) for the unweathered part of the deposit.

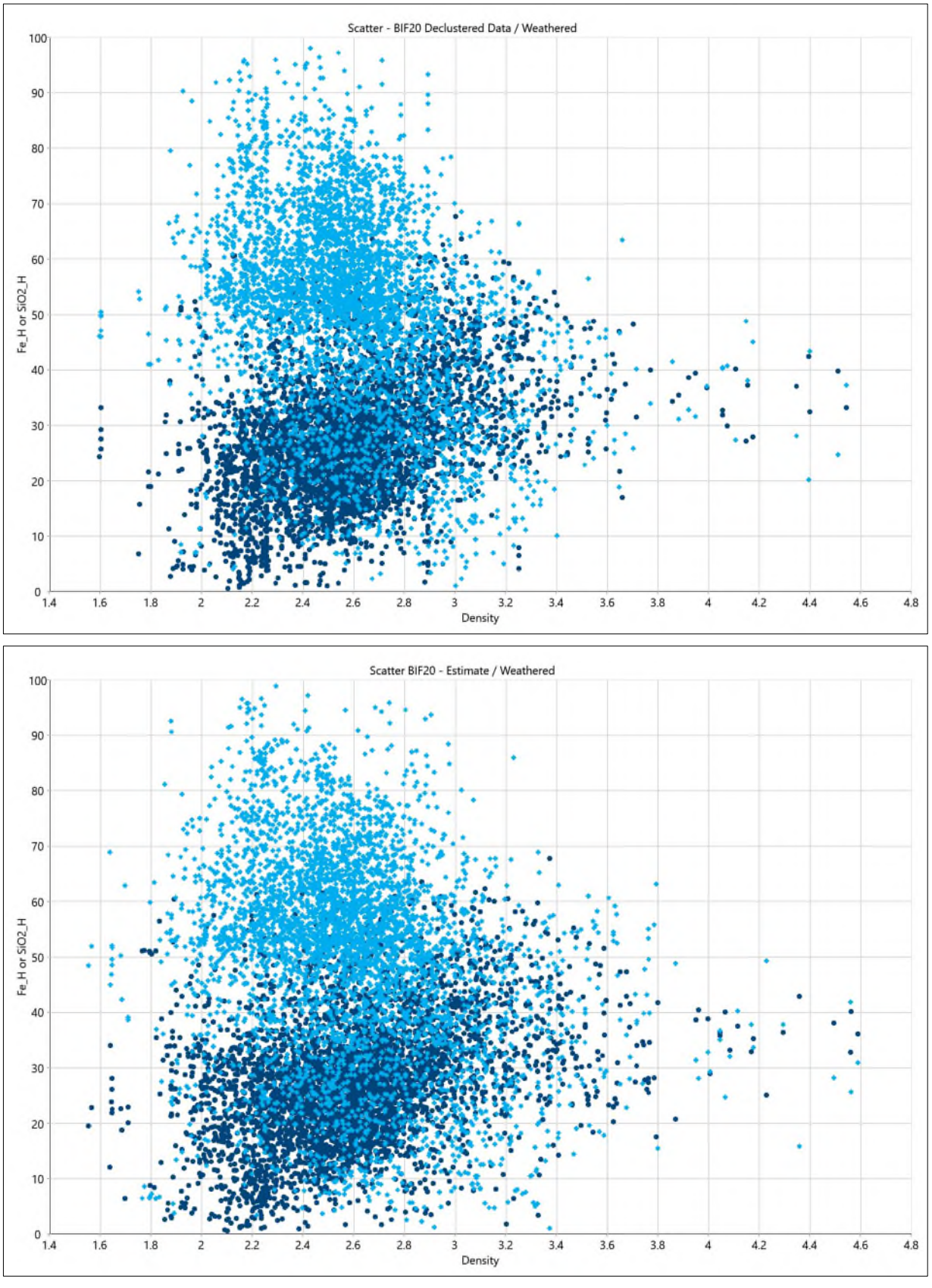


Figure 11.90 – Scatter plot of density versus Fe_H (dark blue) and SiO2_H (light blue) for declustered composites (TOP) and estimates (BOTTOM) for the weathered portion of domain BIF 20.

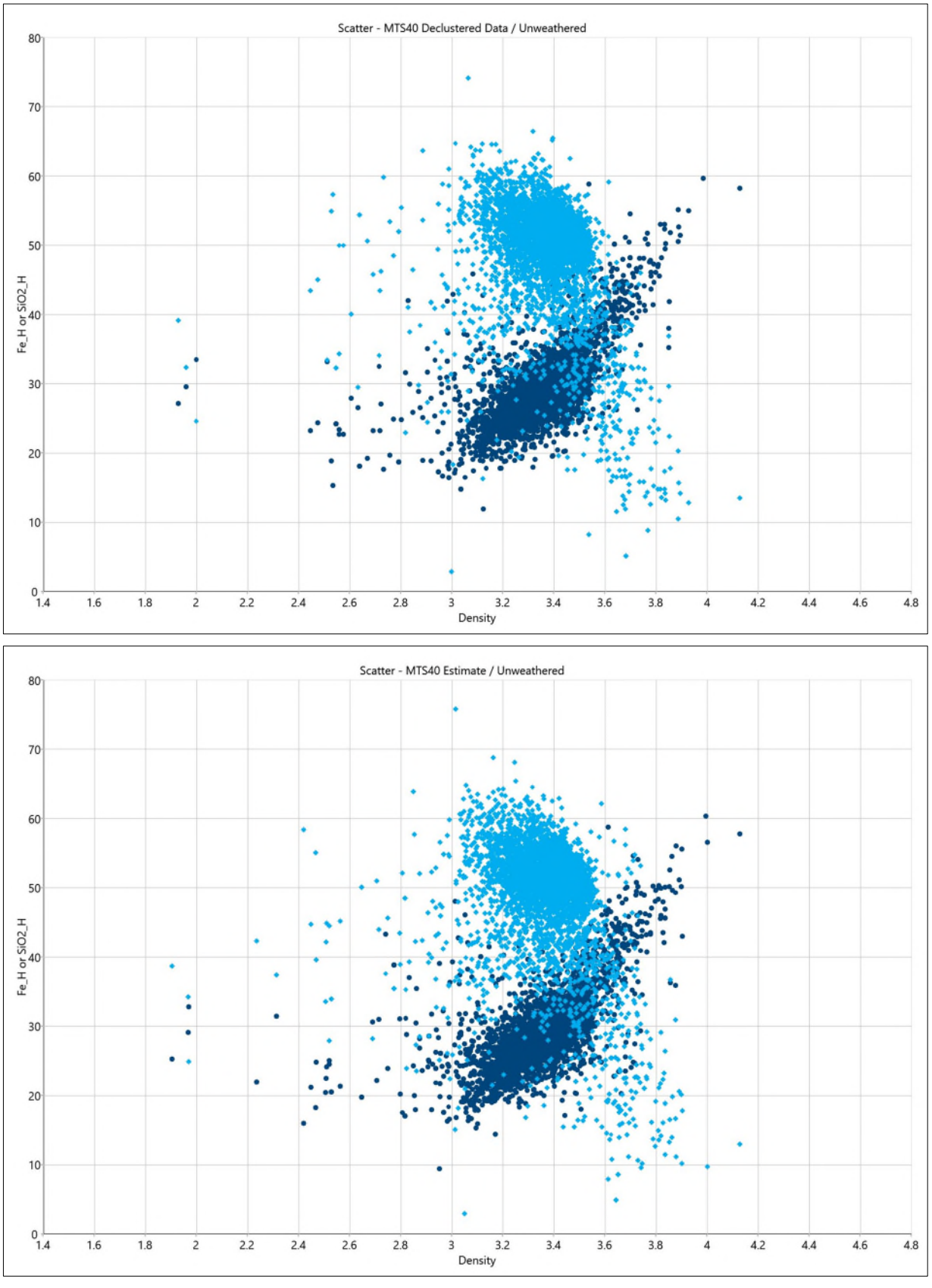


Figure 11.91 – Scatter plot of density versus Fe_H (dark blue) and SiO2_H (light blue) for declustered composites (TOP) and estimates (BOTTOM) for the unweathered portion of domain MTS 40.

	HEO 30		MTS 40		MSU 48		ESZ 75	
	Declustered Data density	Block Estimate density	Declustered Data density	Block Estimate density	Declustered Data density	Block Estimate density	Declustered Data density	Block Estimate density
al2o3_h	-0.06	-0.09	-0.08	-0.07	-0.32	-0.36	0.08	0.13
cao_h	-0.16	-0.13	0.40	0.39	-0.46	-0.44	-0.16	-0.11
density	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
fe_h	0.08	0.11	0.60	0.65	0.59	0.56	-0.26	-0.16
k2o_h	-0.12	-0.13	0.00	0.04	-0.34	-0.38	0.00	0.07
loi_h	-0.17	-0.21	-0.22	-0.18	0.27	0.24	-0.22	-0.17
mgo_h	-0.15	-0.14	-0.19	-0.20	0.29	0.22	-0.29	-0.22
mn_h	-0.14	-0.13	-0.30	-0.25	-0.18	-0.24	-0.02	-0.04
na2o_h	-0.34	-0.35	-0.14	-0.16	-0.40	-0.40	-0.38	-0.37
p_h	-0.26	-0.24	-0.01	0.06	0.29	0.25	-0.11	0.01
s_h	-0.16	-0.16	-0.44	-0.42	-0.01	0.02	-0.10	-0.14
sio2_h	0.05	0.02	-0.43	-0.47	-0.50	-0.46	0.28	0.20
tio2_h	-0.10	-0.12	-0.01	0.02	-0.41	-0.44	-0.07	0.04

Figure 11.92 – Pearson correlation matrices for declustered density samples and density estimates in key domains.

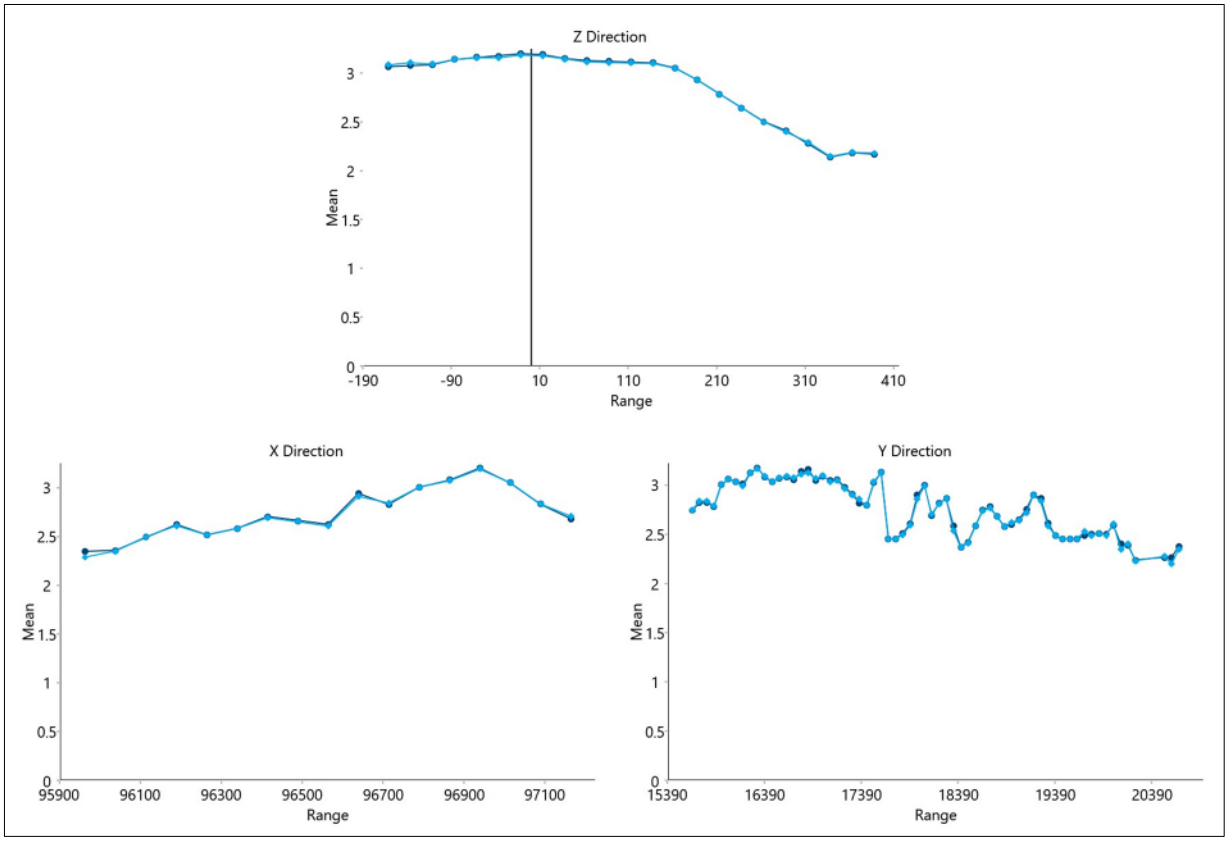


Figure 11.93 – Swathe plot for density domain AMP 10. Light blue = declustered samples. Dark blue = estimates.

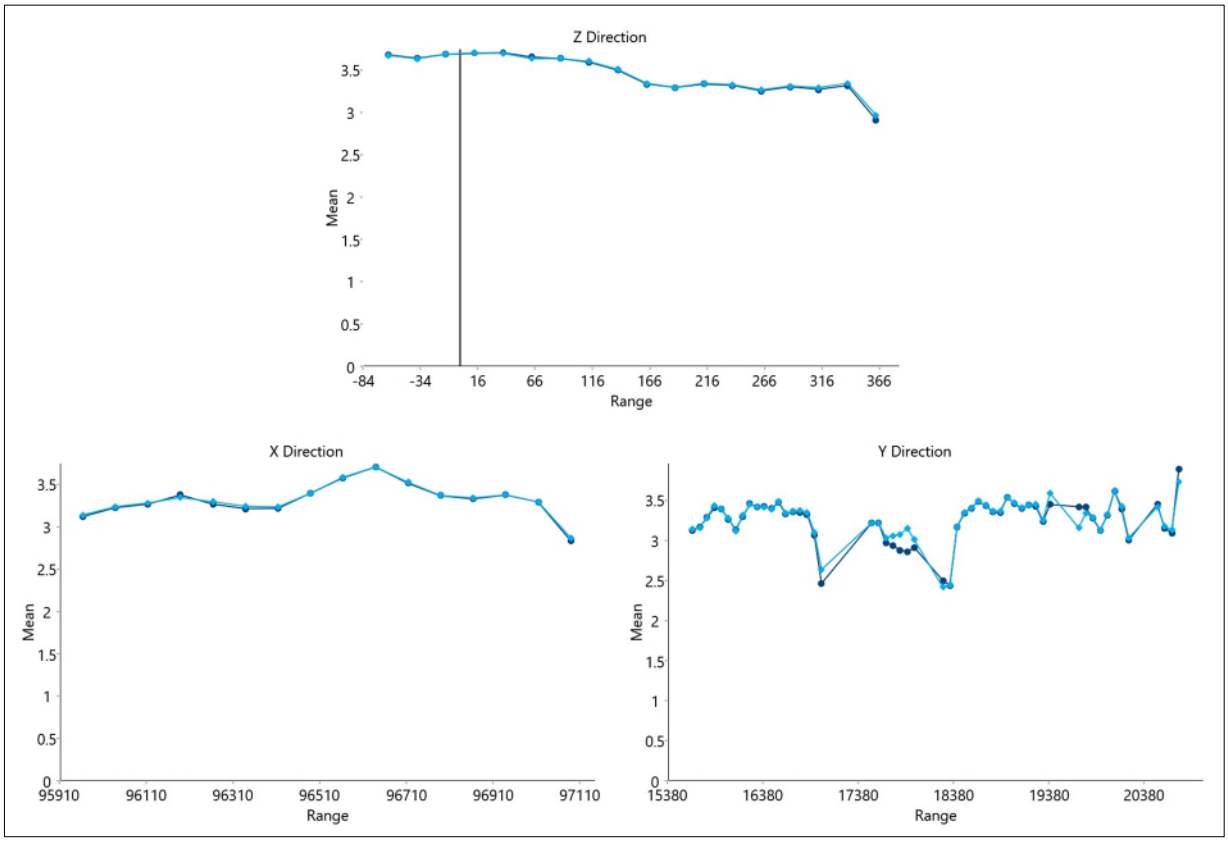


Figure 11.94 – Swathe plot for density domain HEO 30. Light blue = declustered samples. Dark blue = estimates.

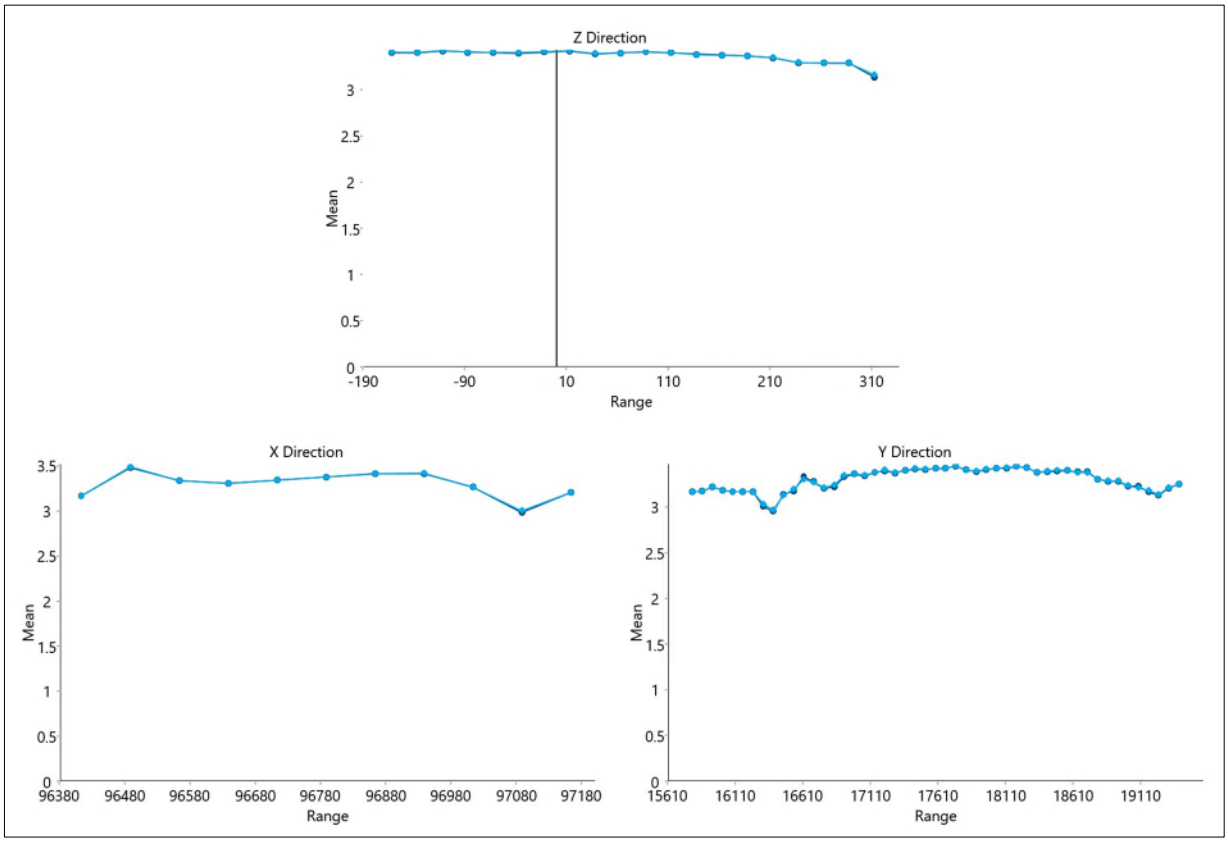


Figure 11.95 – Swathe plot for density domain MTS 40. Light blue = declustered samples. Dark blue = estimates.

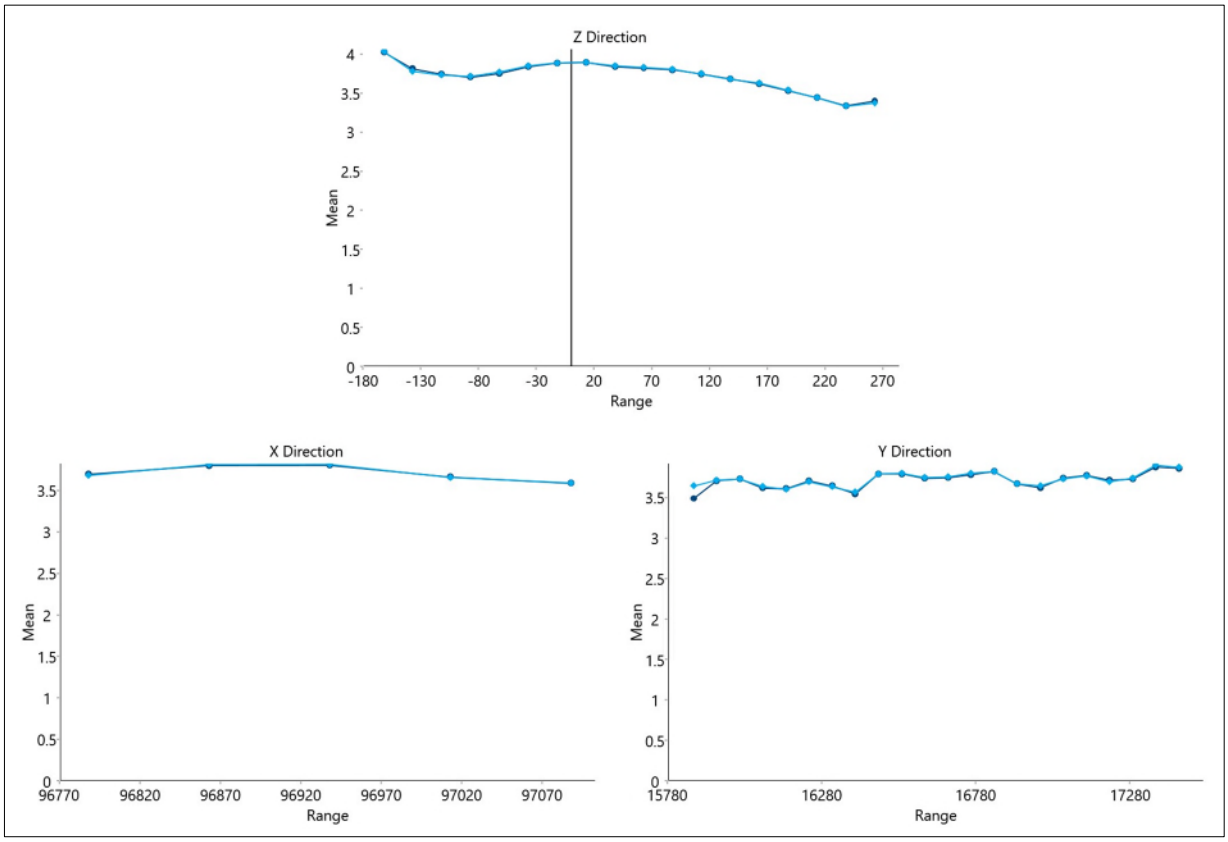


Figure 11.96 – Swathe plot for density domain MTC 43. Light blue = declustered samples. Dark blue = estimates.

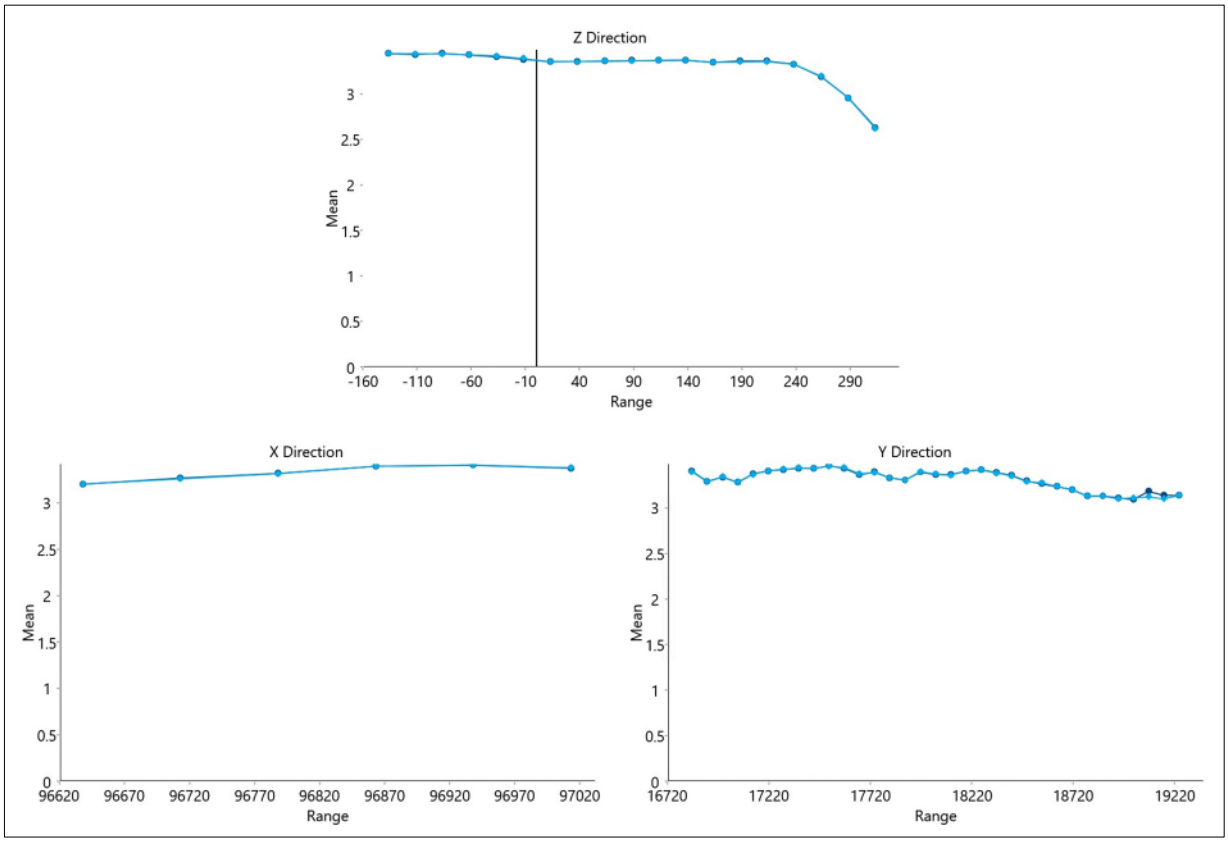


Figure 11.97 – Swathe plot for density domain SCH 46. Light blue = declustered samples. Dark blue = estimates.

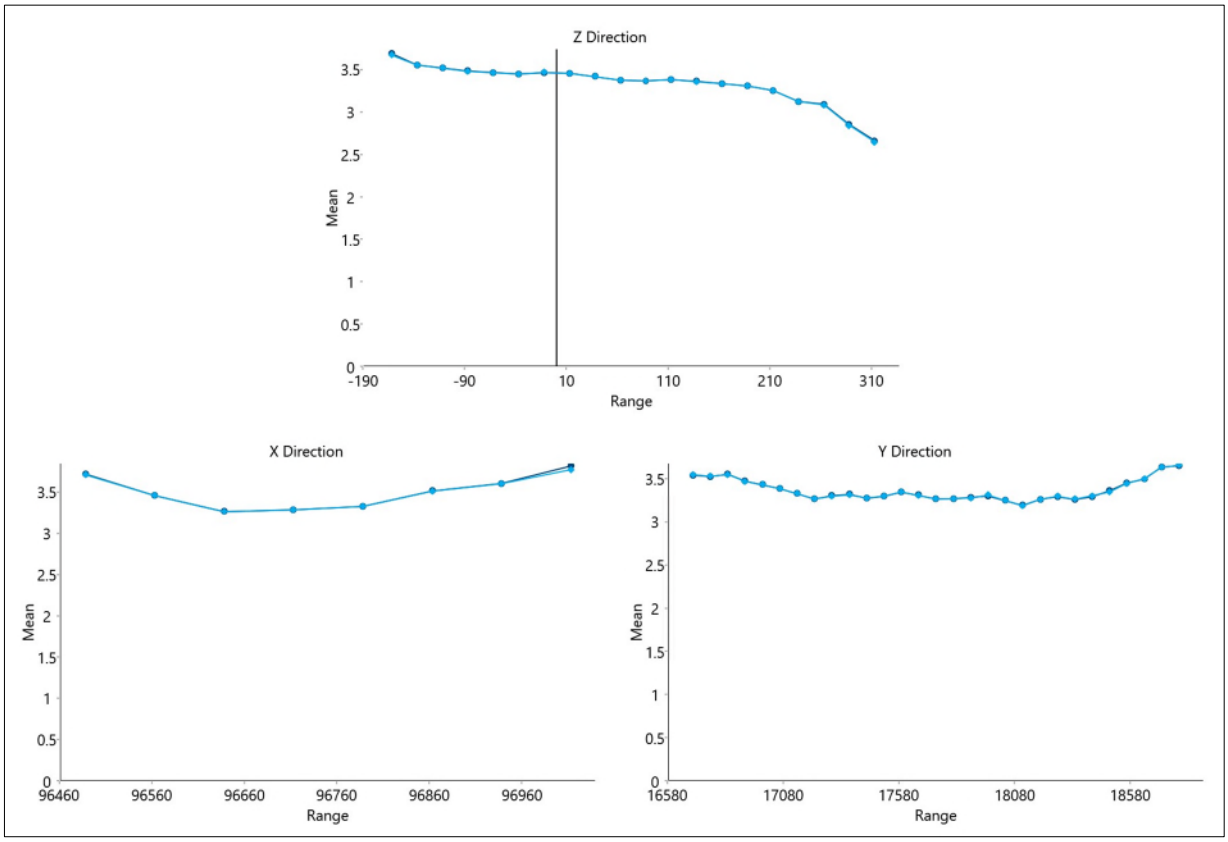


Figure 11.98 – Swathe plot for density domain MSU 48. Light blue = declustered samples. Dark blue = estimates.

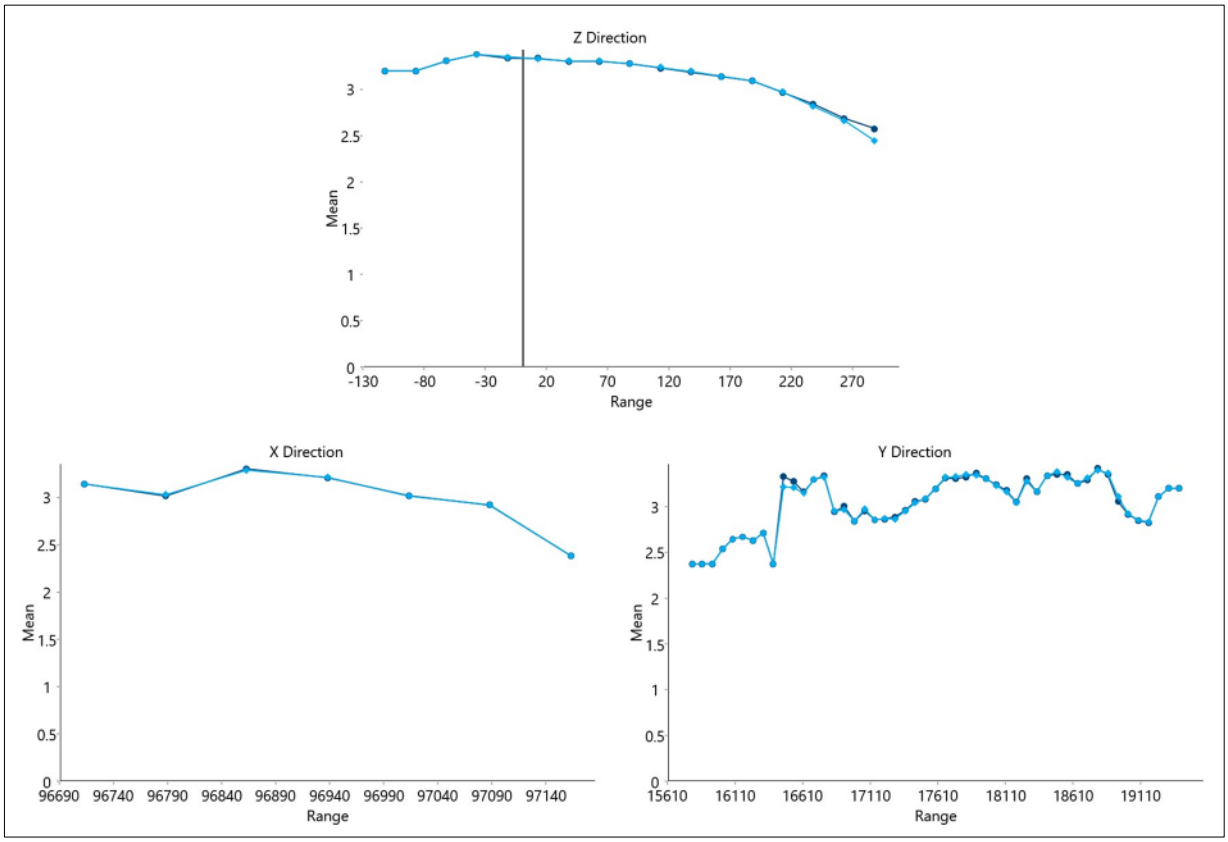


Figure 11.99 – Swathe plot for density domain ESZ 75. Light blue = declustered samples. Dark blue = estimates.

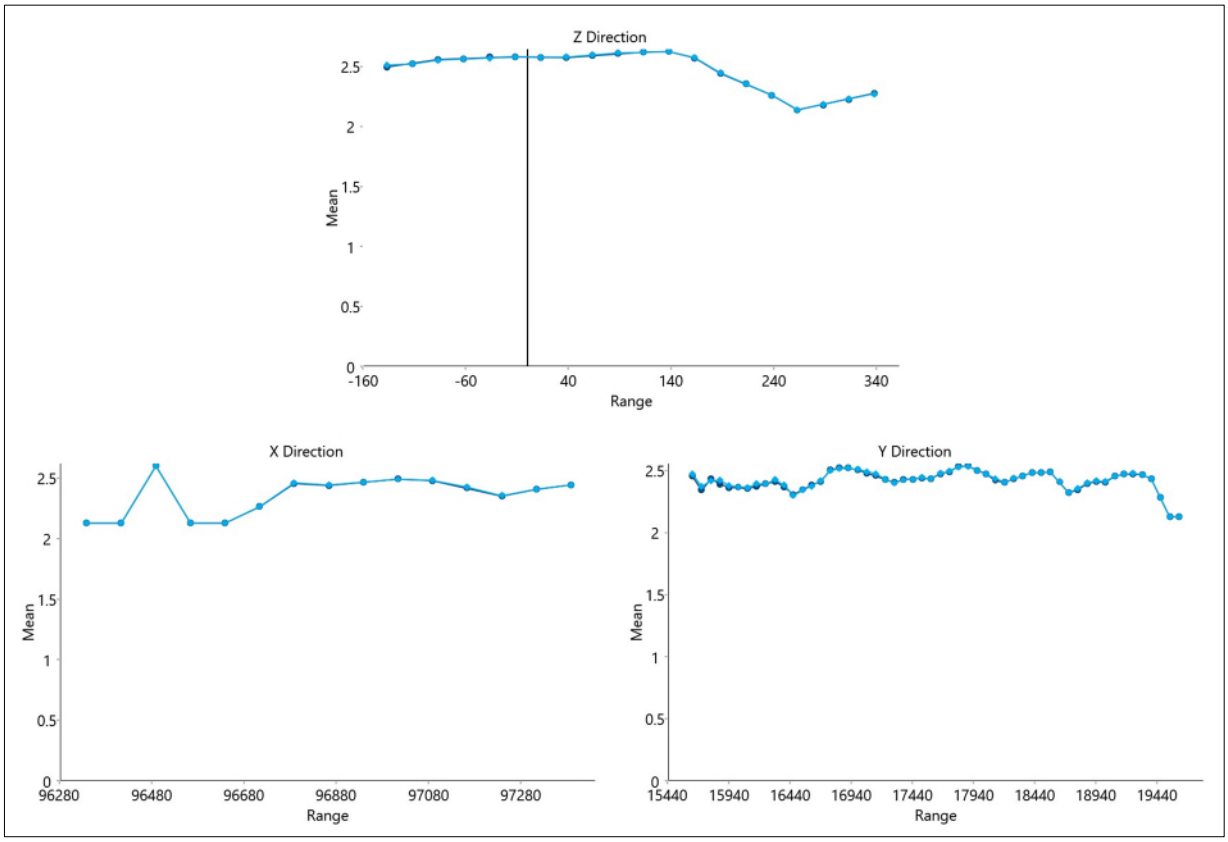


Figure 11.100 – Swathe plot for density domain CGS 80. Light blue = declustered samples. Dark blue = estimates.

Table 11.5 shows the summary statistics for NAPP (net acid production potential in kg H_2SO_4) estimates.

Table 11.5 – Statistics for declustered samples and block estimates of NAPP by geological domain.

		Declustered Samples			Block Estimates		
Element	Domain	Mean	StdDev	CV	Mean	StdDev	CV
NAPP	AMP 10	-81.865	48.913	-0.597	-81.642	50.779	-0.622
	BIF 20	-11.680	15.183	-1.300	-11.968	15.975	-1.335
	HE0 30	-41.076	32.732	-0.797	-40.897	33.797	-0.826
	HEC 32	-122.061	91.016	-0.746	-118.158	91.252	-0.772
	HBF 37	-27.025	18.674	-0.691	-27.015	19.816	-0.734
	MTS 40	-19.346	16.061	-0.830	-19.319	18.025	-0.933
	MTC 43	-149.298	123.847	-0.830	-146.813	126.299	-0.860
	SCH 46	-14.181	11.553	-0.815	-14.182	15.485	-1.092
	MBF 47	-8.902	8.104	-0.910	-9.187	9.018	-0.982
	MSU 48	-20.178	77.708	-3.851	-19.428	82.868	-4.265
	BSQ 70	-44.297	94.974	-2.144	-43.091	97.943	-2.273
	DOM 71	-542.376	195.161	-0.360	-535.875	203.108	-0.379
	ESZ 75	-16.769	18.182	-1.084	-16.837	18.895	-1.122
	CGS 80	-30.307	27.850	-0.919	-30.524	28.084	-0.920

* GRT 90 assigned default NAPP of -16 kg H_2SO_4

Figure 11.101 shows the major analytical relationships observed in the declustered composites being honoured in the block estimates, for the major domains contributing to nett acid generation and nett acid neutralising capacity.

	Declustered Data				Block Estimate				
MSU 48		cao_h	mgo_h	napp	s_h		cao_h	mgo_h	napp	s_h
	cao_h	1.00	-0.01	-0.57	0.16	cao_h	1.00	-0.01	-0.59	0.16
	mgo_h	-0.01	1.00	0.22	0.43	mgo_h	-0.01	1.00	0.22	0.43
	napp	-0.57	0.22	1.00	0.24	napp	-0.59	0.22	1.00	0.29
	s_h	0.16	0.43	0.24	1.00	s_h	0.16	0.43	0.29	1.00
BSQ 70		cao_h	mgo_h	napp	s_h		cao_h	mgo_h	napp	s_h
	cao_h	1.00	0.25	0.36	0.12	cao_h	1.00	0.28	0.34	0.11
	mgo_h	0.25	1.00	-0.07	0.02	mgo_h	0.28	1.00	-0.03	0.03
	napp	0.36	-0.07	1.00	0.57	napp	0.34	-0.03	1.00	0.58
	s_h	0.12	0.02	0.57	1.00	s_h	0.11	0.03	0.58	1.00
DOM 71		cao_h	mgo_h	napp	s_h		cao_h	mgo_h	napp	s_h
	cao_h	1.00	0.51	-0.40	0.22	cao_h	1.00	0.49	-0.41	0.19
	mgo_h	0.51	1.00	-0.12	-0.21	mgo_h	0.49	1.00	-0.11	-0.18
	napp	-0.40	-0.12	1.00	-0.20	napp	-0.41	-0.11	1.00	-0.18
	s_h	0.22	-0.21	-0.20	1.00	s_h	0.19	-0.18	-0.18	1.00
CGS 80		cao_h	mgo_h	napp	s_h		cao_h	mgo_h	napp	s_h
	cao_h	1.00	0.40	-0.59	0.18	cao_h	1.00	0.40	-0.63	0.16
	mgo_h	0.40	1.00	-0.46	0.19	mgo_h	0.40	1.00	-0.47	0.16
	napp	-0.59	-0.46	1.00	-0.03	napp	-0.63	-0.47	1.00	-0.03
	s_h	0.18	0.19	-0.03	1.00	s_h	0.16	0.16	-0.03	1.00

Figure 11.101 – Pearson correlation matrices for declustered NAPP samples and NAPP estimates for major analytes in the MSU 48, BSQ 70, DOM 71 and CGS 80 domains.

Trends in mean grades for the declustered sample composites and block estimates were compared using swathe plots in the X, Y and Z direction using swathe widths of 75x75x25m (XYZ directions). Several examples are shown in Figure 11.102 to Figure 11.107.

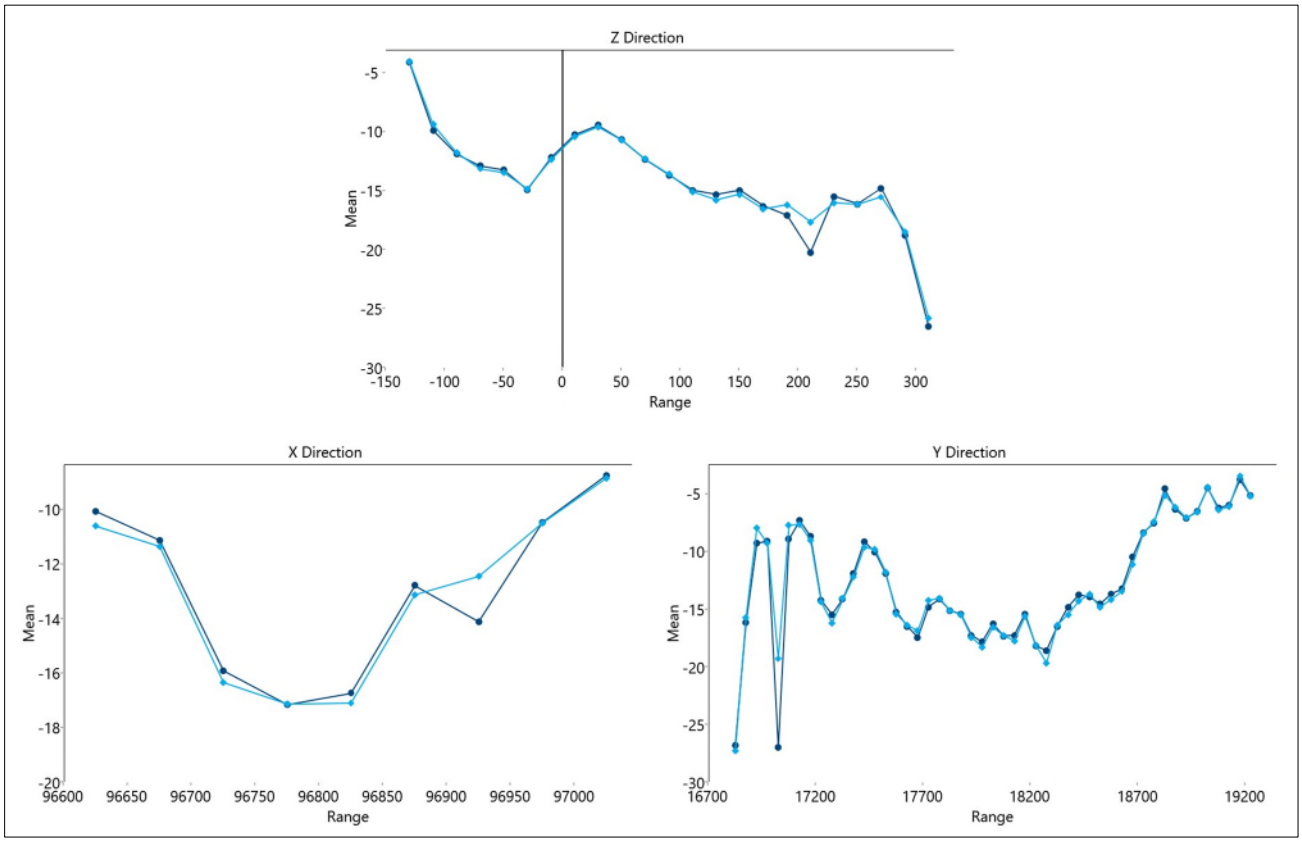


Figure 11.102 – Swathe plot for NAPP domain SCH 46. Light blue = declustered samples. Dark blue = estimates.

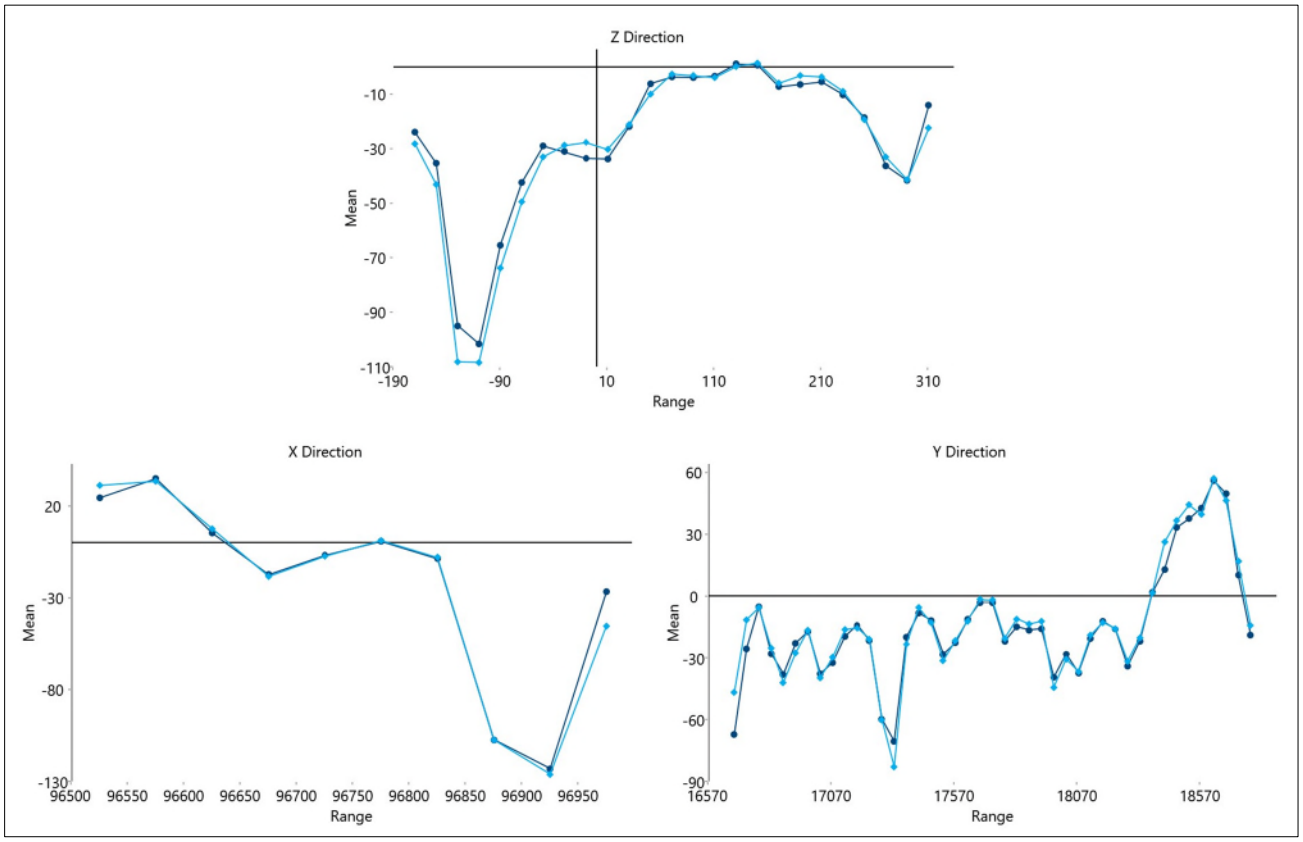


Figure 11.103 – Swathe plot for NAPP domain MSU 48. Light blue = declustered samples. Dark blue = estimates.

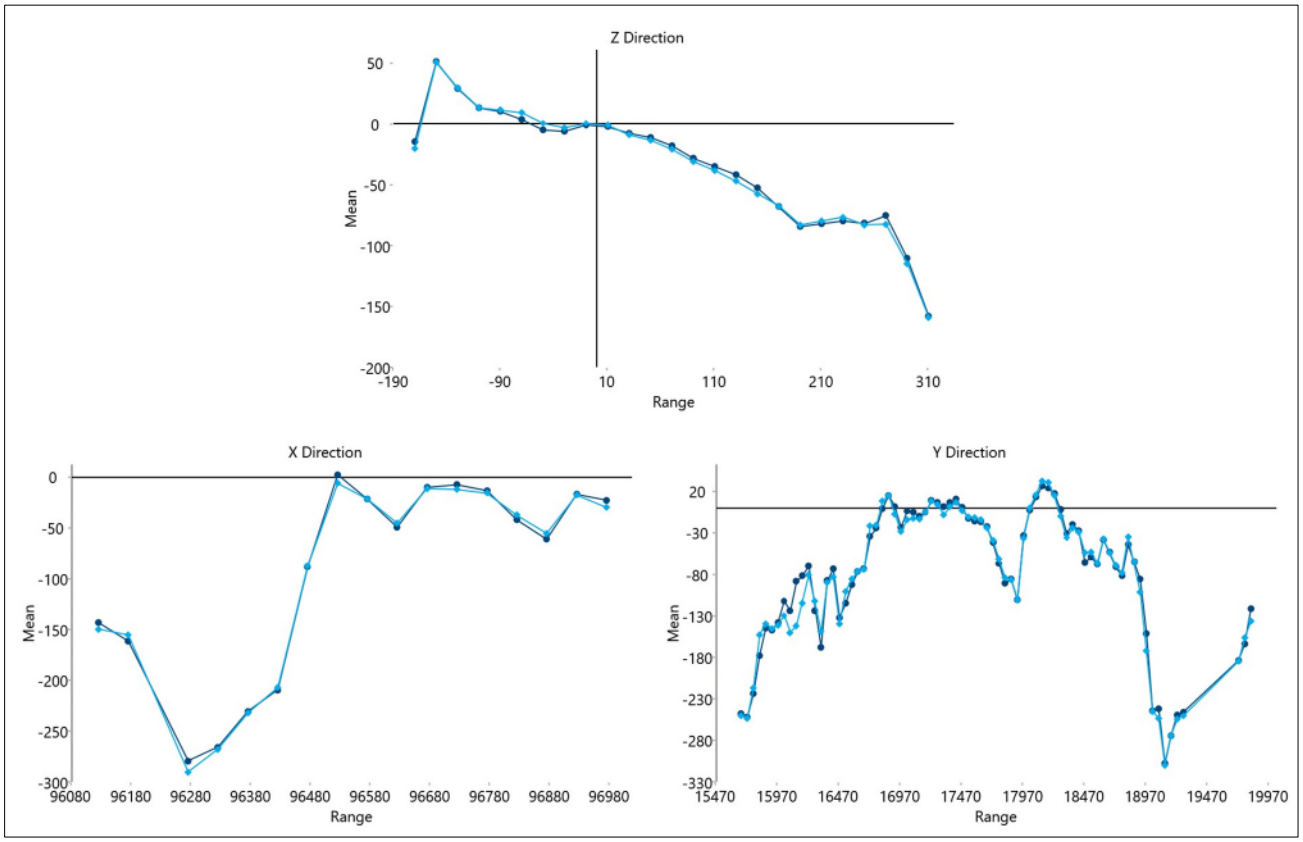


Figure 11.104 – Swathe plot for NAPP domain BSQ 70. Light blue = declustered samples. Dark blue = estimates.

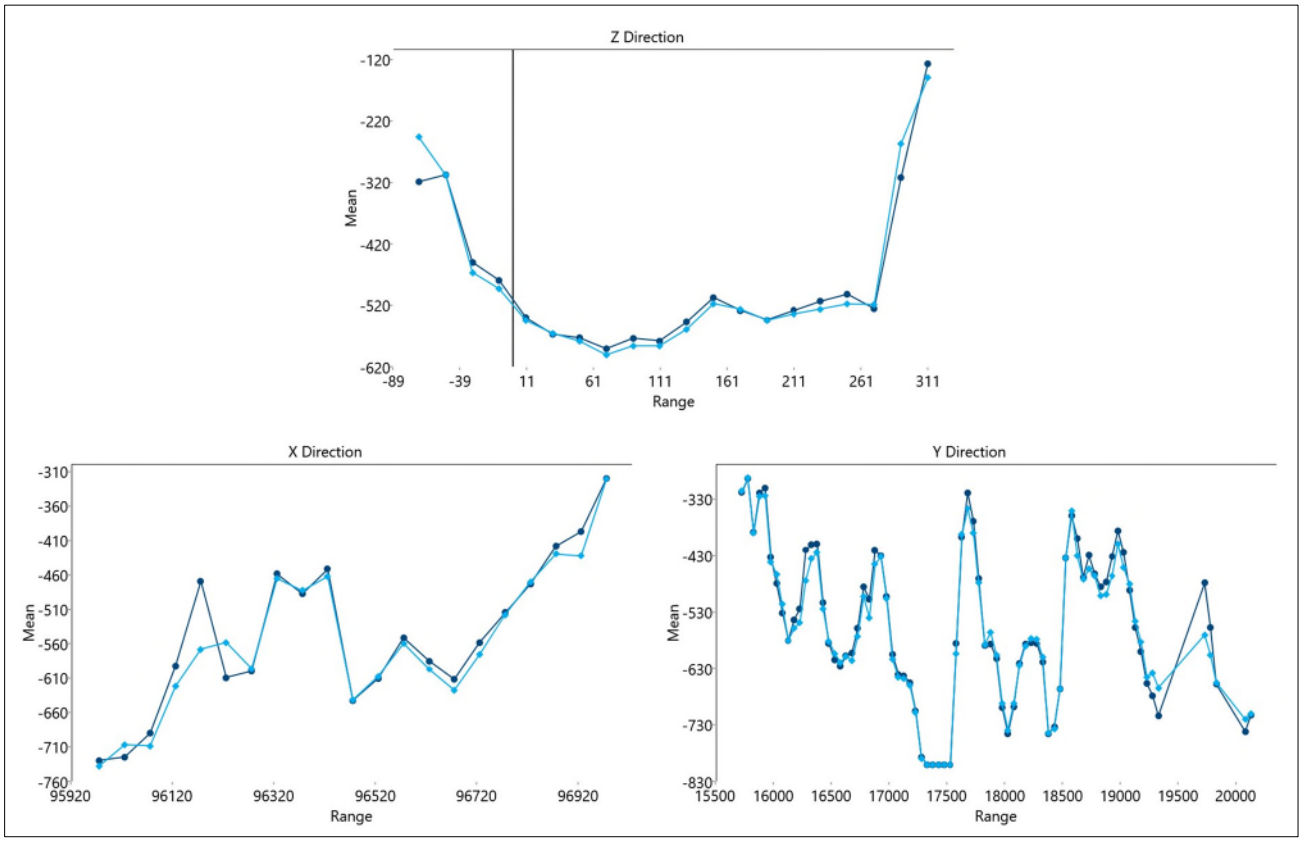


Figure 11.105 – Swathe plot for NAPP domain DOM 71. Light blue = declustered samples. Dark blue = estimates.

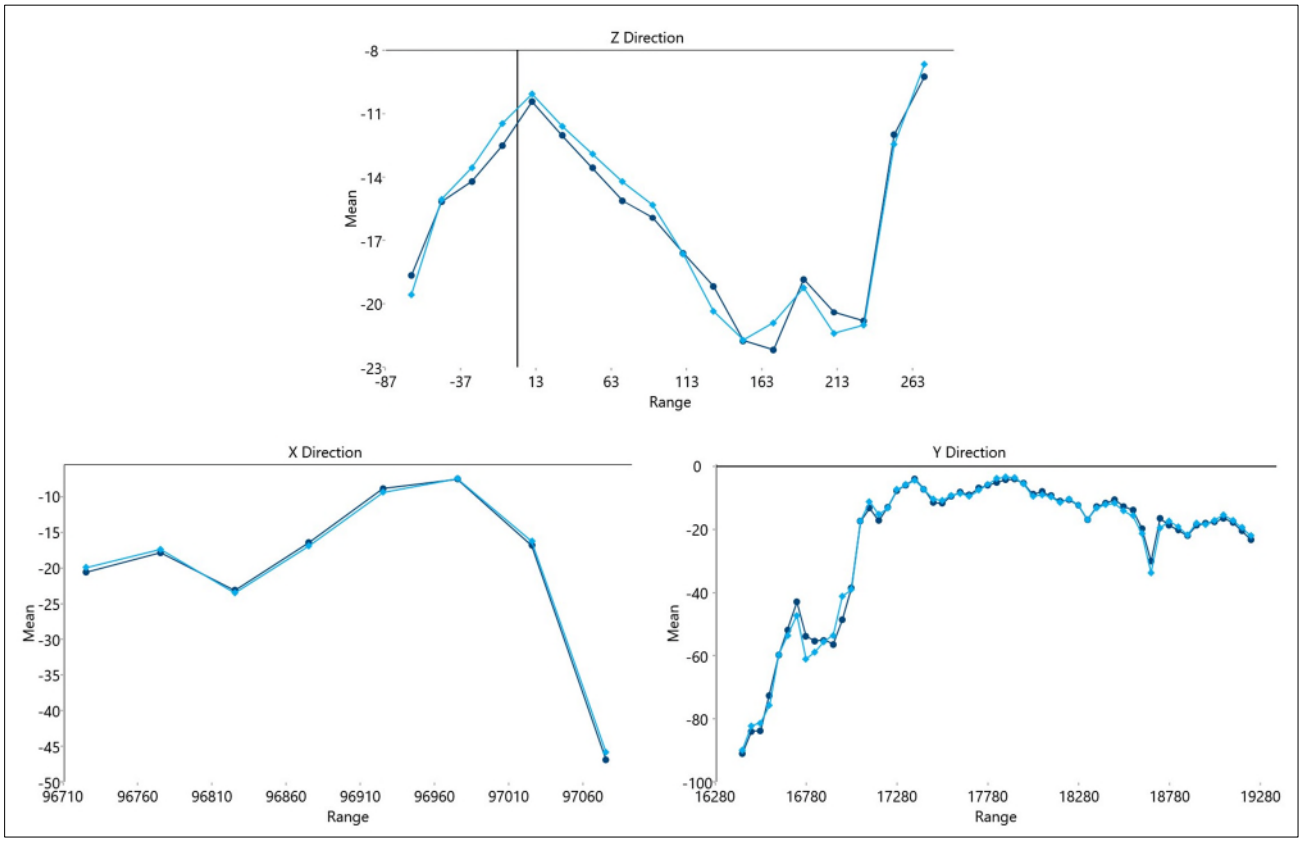


Figure 11.106 – Swathe plot for NAPP domain ESZ 75. Light blue = declustered samples. Dark blue = estimates.

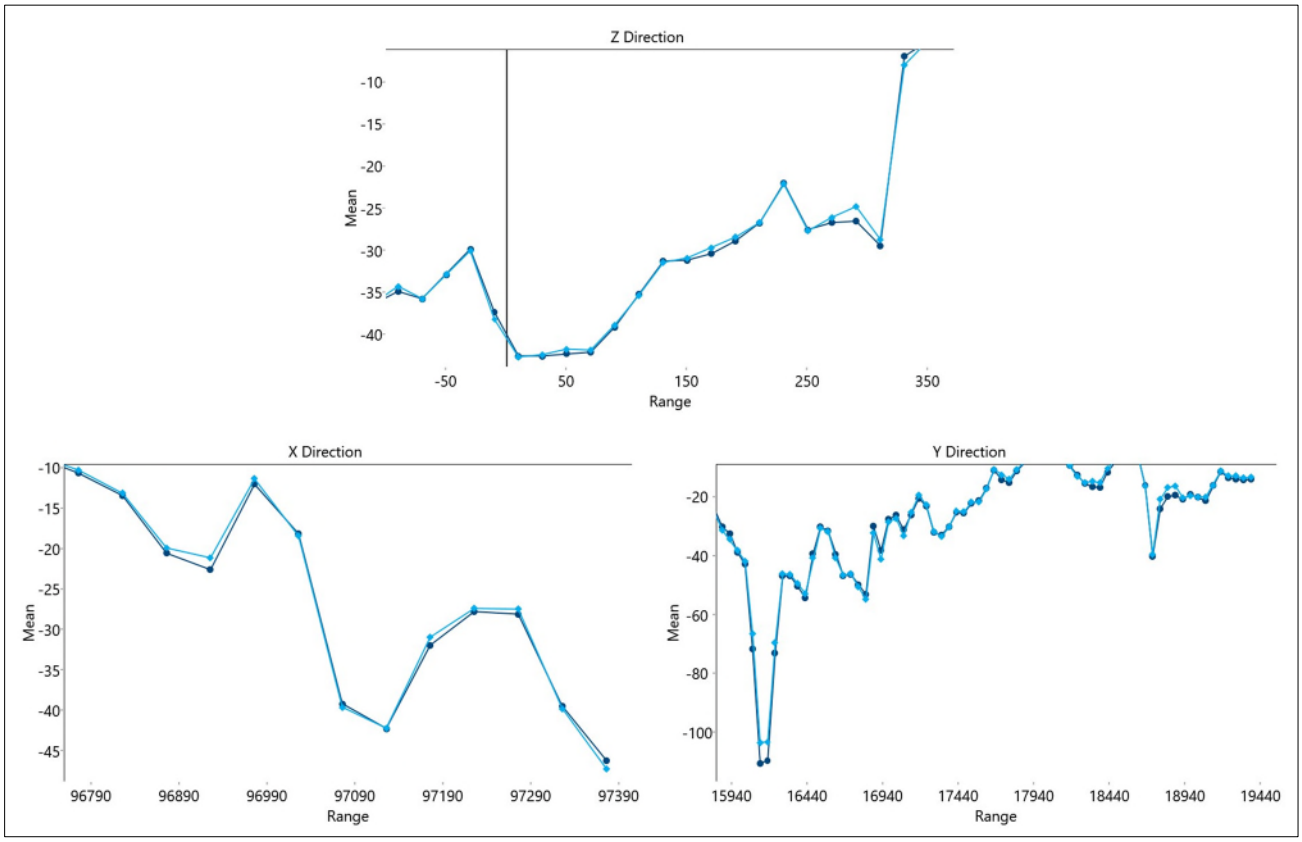


Figure 11.107 – Swathe plot for NAPP domain CGS 80. Light blue = declustered samples. Dark blue = estimates.

12 Metallurgical and Mineral Processing Studies

The existing processing configuration at the SMR concentrator produces around 2.0 Mtpa of magnetite concentrate at 40% yield. The focus of the current mineral processing studies is to be able to process lower mass recovery and higher silica material than is not achievable with the current plant configuration.

Previous test work has focused on MTS and MTC units with mass recovery equal to and above the median of current production grades. Initial test samples reported grind liberation SiO_2 less than or equal to the 75th percentile. Later test work explored mineralogy from the MSU, SCH and MBIF units that differs to MTS, or outliers to the previous test work such as grind liberation of SiO_2 up to 26% – exceeding the 95th percentile of drill core tested by the SIMEC grind liberation method.

The recent test work confirmed that the proposed flowsheet can achieve direct reduction specification generally regardless of feed composition, and for problematic material, there are possible beneficiation options to achieve direct reduction specification, such as improved reverse floatation.

12.1 Metallurgical Test Work

The mineralisation defined in the reported mineral resource estimate has some similar metallurgical characteristics to ore mined in contiguous geological areas and similar lithologies (MTC, MTS and MTT) in the existing Iron Magnet Pit. Along strike and at depth, north of the Iron Magnet Pit, however, the orebody is almost exclusively dominated by massive MTS with lesser occurrences of SCH, both been noted to have increased silica content. Current test work for metallurgical beneficiation is detailed in the following key reports, and summarised below:

- SIMEC MAG015-0043 Duchess South Preliminary Ore Characterisation dated 19 March 2020, S Kneebone
- HATCH RC/DD test work review and geometallurgical characterisation dated 2 March 2020 Report Number H362065-0000-210-066-0001
- SIMEC Memorandum SRK Request for Information dated 20 March 2020, S Kneebone.
- MEP 2 Metallurgical Test Work Update – MgO and Comminution Summary dated 24 February 2022, S Kneebone

Duchess South is dominated by magnetite silica (MTS) ore which has previously been considered waste to low-grade ore (LGO) within the current concentrator's capability. MTS ore does not typically obtain adequate liberation of iron from SiO_2 at the current concentrator's specified grind size of p80 38 µm and thus does not obtain satisfactory grade through a conventional magnetic separation circuit. Grind liberation requirements are beyond the comminution capability of the concentrator and in most cases would result in a poor performing pellet, with grind liberation below 20 µm. With the introduction of flotation, however, magnetite silica (MTS) ore can be beneficiated to direct reduction grade while maintaining high iron recovery. Test work selected to validate the above principle and further optimise flotation response was based on five composite samples representing MTS, MTC and MTT – the lithologies as described in Table 12.1 and shown in Figure 12.1. The initial test work program design, shown in Table 12.2 was intended to assess any differences in ore comminution behaviour and the flotation grade and recovery achievable for preliminary conversion of grind liberation data from a magnetic separation circuit to a flotation circuit.

Table 12. 1 – Composite test work lithology and ore type.

Composite ID	Ore Type	Drill Hole	Composite Meterage
MTS Initial	MTS – initial flotation	DS039RD	109.5 – 182.5m
MTS H	MTS – high silica	DS048RD	185 – 250m
MTS M	MTS – medium silica	DS054RD	242 – 306m
MTS L	MTS – low silica	DS039RD	226 – 339.5m
MTC D/S	MTS/MTC/MTT	DS054RD	130 – 212m

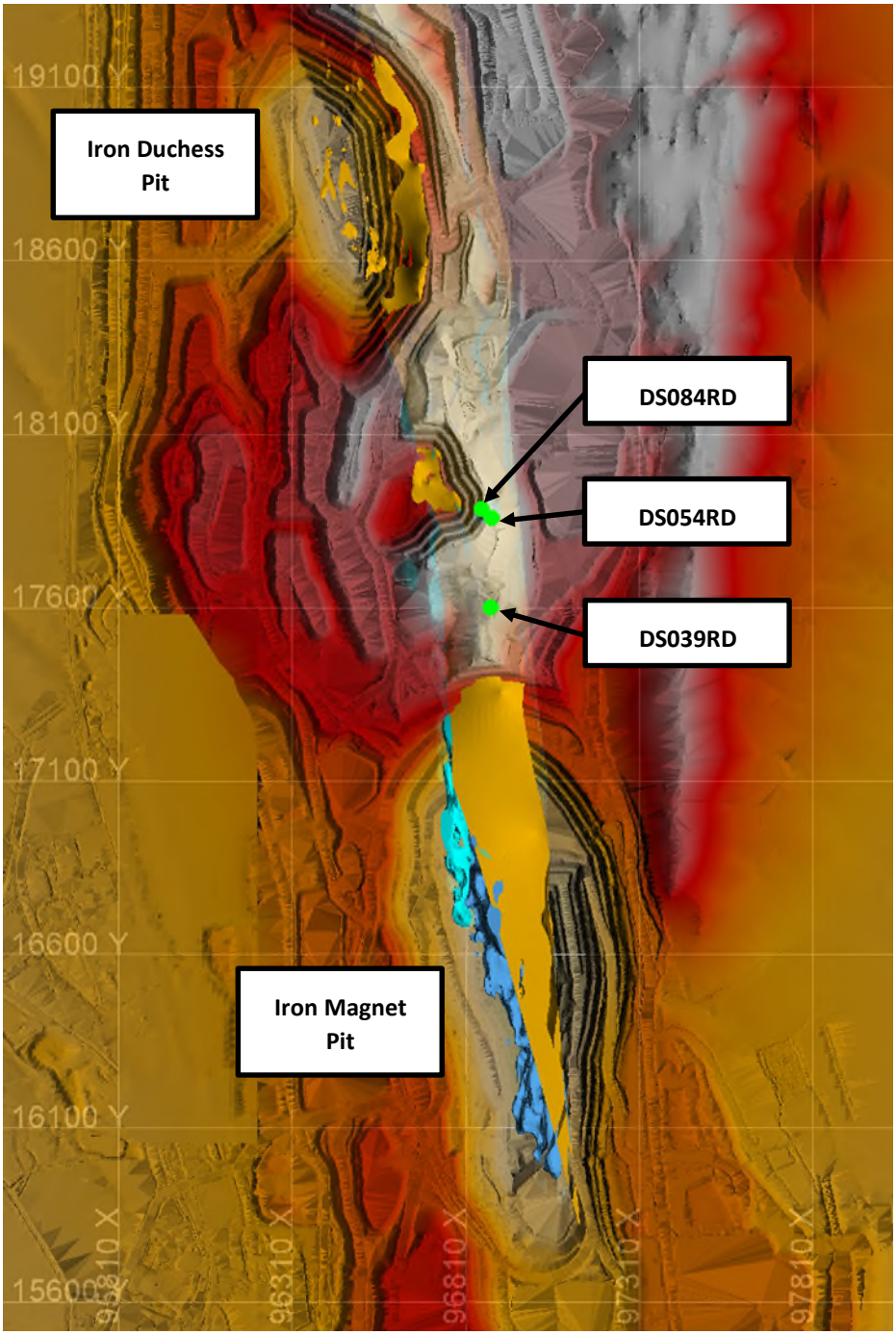


Figure 12.1 – Location of metallurgical test work composites. Orange wireframe = MTS. Blue wireframe = MTC. Light blue wireframe = MSU.

Table 12.2 – Duchess South test work program categories.

Characterisation	Comminution	LIMS	Flotation
• DTR @ p80 500 µm, 125 µm, 53 µm, 38 µm , 25 µm • Head Assay XRF, SATMAGAN, SG	• Bond Abrasion Index • Bond Ball Mill Work Index • UCS	• Rougher LIMS • 2-Pass Cleaner LIMS • Note: conducted at p80 38 µm	• Rougher Sighter Tests • Rougher-Regrind – Cleaner Reverse Flotation Sighter Tests

LIMS = Low Intensity Magnetic Separation

The results of the test work showed that all samples tested could achieve direct reduction grade, with iron recovery through flotation ranging from 92.2% to 97.1%. Grades exceeding 70% Fe are expected to be achieved for all MTS similar in composition to that tested given the binary nature of iron and silica present. The flotation program has proven that ores requiring liberation below 20 µm can be readily beneficiated. It is noted that no other deleterious elements were of material significance.

12.2 Proposed Flow Sheet and Capital Costs

A proposed high-level flowsheet/block diagram showing the treatment methodology, mass flow and expected grades by area is shown in Figure 12. 2. The current concentrator is shown as the LIMS & Regrind Circuit.

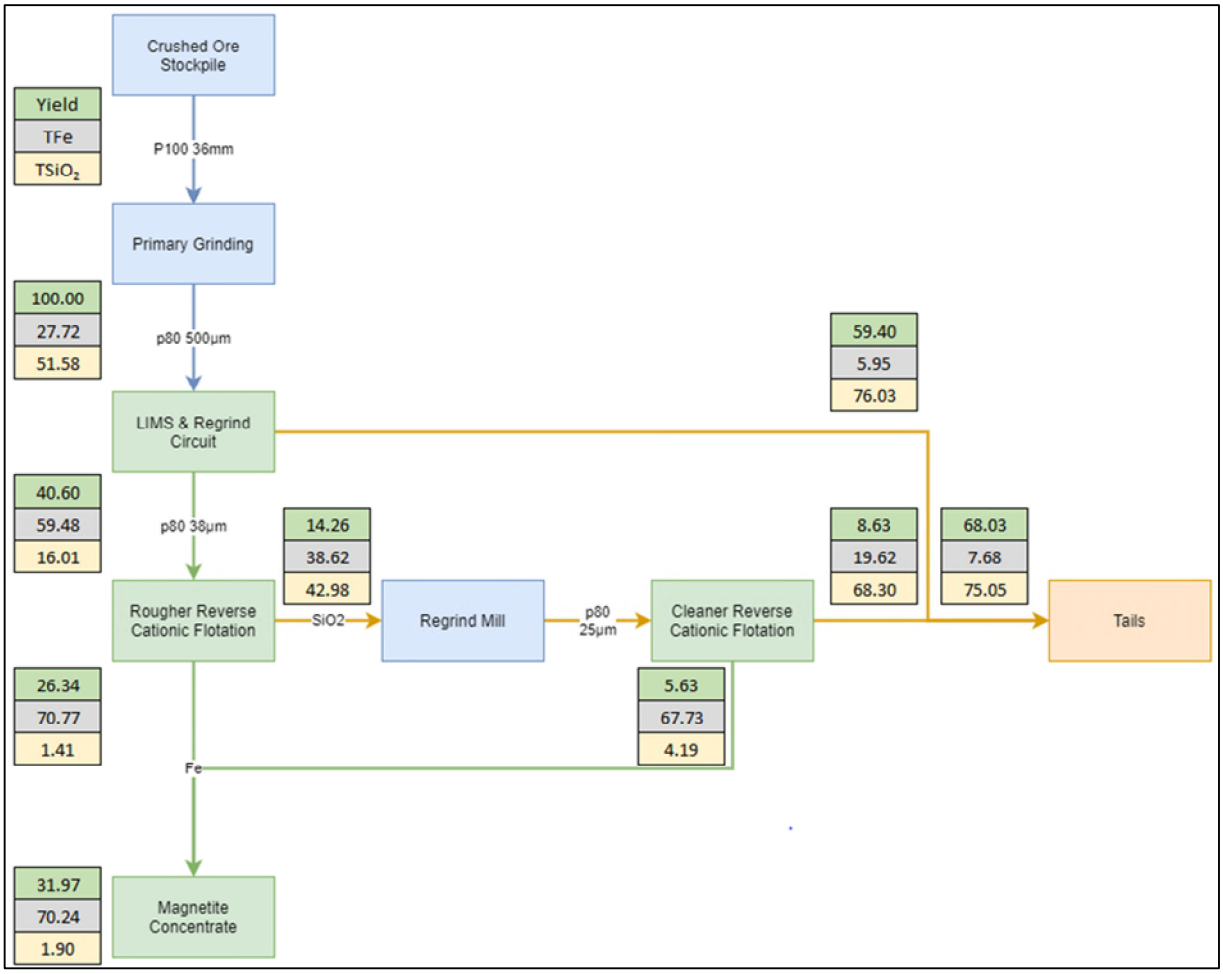


Figure 12.2 – Proposed high-level metallurgical flowsheet.

Initial CAPEX for a flotation plant treating Duchess South ore is estimated at A$55–62 million and consists of 3 Eriez spraged column cells (2 x rougher-scavenger and 1 x cleaner), a Glencor IsaMill for regrinding, as well as ancillary equipment such as reagent pumps and conditioning tanks. Figure 12.3 shows the proposed process flow for the flotation plant, and Figure 12.4 shows a 3D model of the proposed flotation plant.

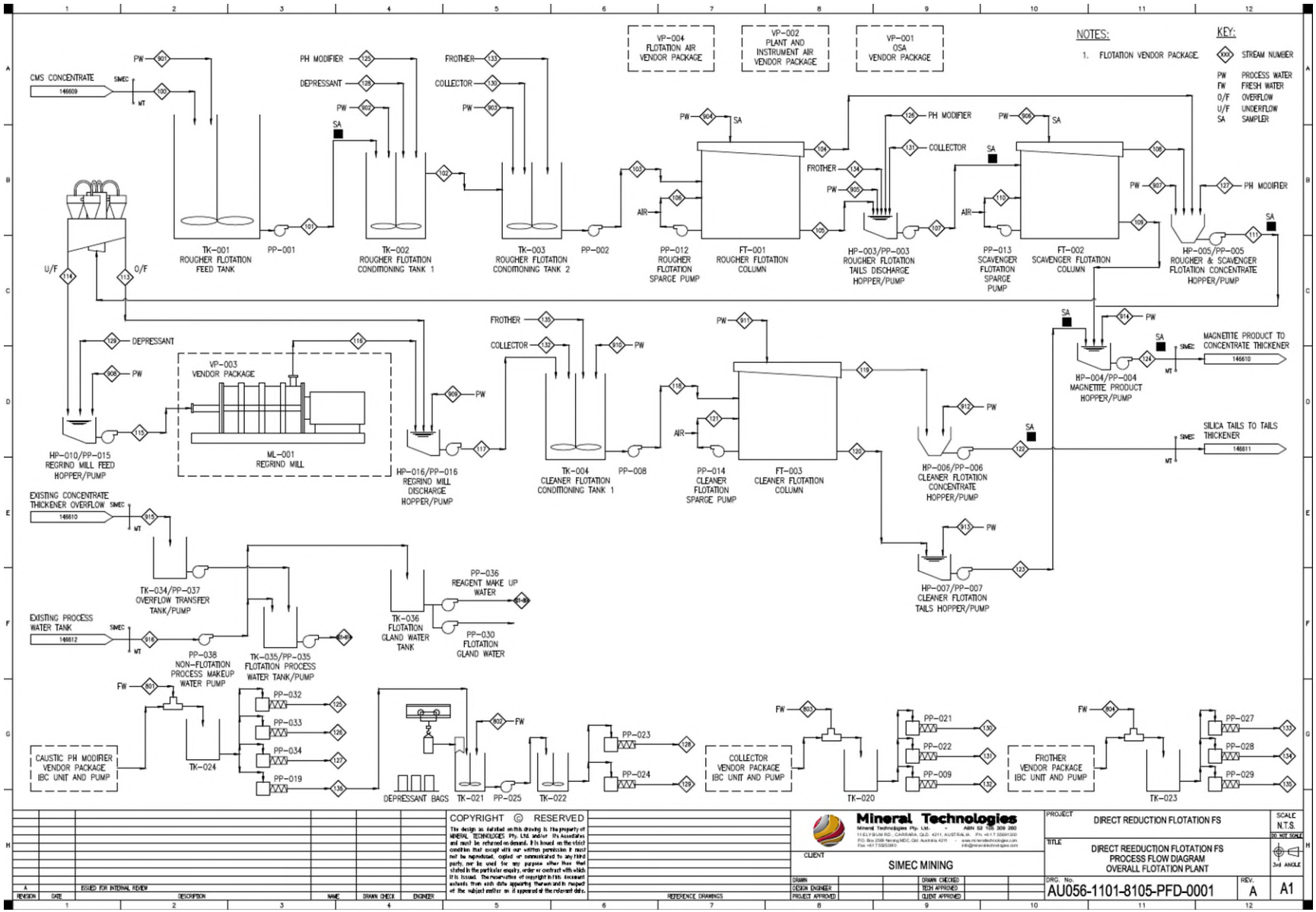


Figure 12.3 – Proposed process flow for the flotation plant.



Figure 12.4 – Perspective 3D model showing the layout of the flotation plant.

12.3 Current Magnetite Flotation Projects Globally

Current similar flotation processes (i.e., application of reverse cationic or anionic flotation for removal of SiO_2) include the Brazilian iron ore industry where it has been used since 1970, and ArcelorMittal's Kryvyi Mine in Ukraine. More recently, in Australia, reverse flotation is used at Karara's 8mtpa concentrator in Western Australia. Reverse cationic or anionic silica flotation is now the common processing option for reducing silica in magnetite concentrate to direct reduction grade.

Eriez flotation columns and Glencore's IsaMill are both proven technology with multiple industrial applications worldwide. SIMEC has an operating IsaMIll in the existing SMR operation and is well versed in its operability and maintainability. A list of reference sites for Eriez iron ore flotation technology is listed in Table 12.3 and Table 12.4.

Table 12.3 – Global iron ore producers using Eriez reverse flotation technology (1991-2000).

Year	Customer	Country	Product	Duty	Quantity
1991	Samarco	Brazil	Mineral Column	Scavenger	1
1991	Samarco	Brazil	Mineral Column	Cleaner	4
1992	Kobe Steel	Venezuela	Test Column	Testing	1
1992	USS Mintac	United States	Mineral Column	Scavenger	1
1993	CSN	Brazil	Mineral Column	Cleaner	1
1993	CSN	Brazil	Mineral Column	Rougher	3
1993	Kudremuhk Iron Ore	India	Mineral Column	Cleaner	1
1993	Minera Del Norte	Mexico	Mineral Column	Cleaner	2
1994	Vale	Brazil	Mineral Column	Rougher	1
1994	Vale	Brazil	Mineral Column	Cleaner	1
1994	Vale	Brazil	Mineral Column	Rougher	6
1994	Vale	Brazil	Mineral Column	Cleaner	3
1994	Vale	Brazil	Mineral Column	Cleaner	1
1994	Vale	Brazil	Mineral Column	Rougher	1
1994	Vale	Brazil	Mineral Column	Rougher	2
1994	Vale	Brazil	Mineral Column	Cleaner	1
1995	Kudremuhk Iron Ore	India	Mineral Column	Rougher	1
1995	Samarco	Brazil	Mineral Column	Rougher	1
1995	Samarco	Brazil	Mineral Column	Cleaner	1
1995	Samarco	Brazil	Mineral Column	Cleaner	1
1995	Samarco	Brazil	Mineral Column	Rougher	1
1996	Kudremuhk Iron Ore	India	Mineral Column	Cleaner	6
1996	Vale	Brazil	Mineral Column	Rougher	1
1997	Samarco	Brazil	Mineral Column	Scavenger	2
1997	Samarco	Brazil	Mineral Column	Cleaner	3
1997	Samarco	Brazil	Mineral Column	Scavenger	2
1997	Samarco	Brazil	RSP	RSP	3
1997	Samarco	Brazil	Mineral Column	Cleaner	3
1997	Samarco	Brazil	RSP	RSP	2
1999	Mineracao Brasileira Reunidas	Brazil	Mineral Column	Rougher	1
1999	Vale	Brazil	Mineral Column	Scavenger	1
1999	Vale	Brazil	Mineral Column	Cleaner	1
1999	Vale	Brazil	Mineral Column	Rougher	1
1999	Vale	Brazil	Mineral Column	Scavenger	1
2000	Kobe Steel	Iran	Mineral Column	Testing	1

Table 12.4 – Global iron ore producers using Eriez reverse flotation technology (2003-2012).

Year	Customer	Country	Product	Duty	Quantity
2003	Oskol	Russia	Test Column	Testing	1
2004	Mikhailovsky GOK	Russia	Mineral Column	Scavenger	2
2004	Mikhailovsky GOK	Russia	Mineral Column	Cleaner	2
2004	Mikhailovsky GOK	Russia	Mineral Column	Rougher	4
2004	Vale	Brazil	Mineral Column	Rougher	3
2004	Vale	Brazil	Mineral Column	Scavenger	2
2004	Vale	Brazil	Mineral Column	Cleaner	3
2005	CSN	Brazil	Mineral Column	Rougher	2
2006	London Mining LLC	India	Cross-Flow	Sizing	1
2006	Samarco	Brazil	Mineral Column	Cleaner	2
2006	Samarco	Brazil	Mineral Column	Cleaner	2
2006	Samarco	Brazil	Mineral Column	Scavenger	2
2006	Samarco	Brazil	Mineral Column	Scavenger	2
2006	Vale	Brazil	Mineral Column	Pilot	1
2006	Vale	Brazil	Mineral Column	Rougher	6
2006	Vale	Brazil	Mineral Column	Scavenger	2
2006	Vale	Brazil	Mineral Column	Cleaner	4
2006	Vale	Brazil	Mineral Column	Cleaner	1
2007	Inguletsky	Russia	Test Column	Testing	1
2008	Ferrous Resources	Brazil	Test Column	Testing	2
2008	Ferrous Resources	Brazil	Test Column	Testing	1
2010	Samarco	Brazil	Mineral Column	Rougher	4
2010	Samarco	Brazil	Mineral Column	Rougher	4
2012	Anglo American	Brazil	Test Column	Testing	1
2012	Anglo American	Brazil	Test Column	Testing	1
2012	Anglo American	Brazil	Test Column	Testing	1
2012	Samarco	Brazil	Mineral Column	Cleaner	1
2012	Samarco	Brazil	Mineral Column	Scavenger	1
2012	Samarco	Brazil	Mineral Column	Rougher	7
2012	Samarco	Brazil	Mineral Column	Scavenger	2
2012	Samarco	Brazil	Mineral Column	Rougher	1
2012	Usiminas	Brazil	Mineral Column	Cleaner	10
2012	Vale	Brazil	Mineral Column	Rougher	2
2012	Vale	Brazil	Mineral Column	Rougher	1

The current SIMEC terminology for the overall metallurgical project is called MEP (Magnetite Expansion Project) which incorporates two phases.

MEP Stage 1 includes the following activities:

- brownfields expansion of the magnetite concentrator from 2.2 mtpa concentrate make rate to 2.5 mtpa with plant commissioning in FY23.

- completion of a flotation study to unlock the Duchess South magnetite resource and underpin a 20+ year operation.
- brownfields expansion of the pellet plant from 1.75 Mtpa pellet make rate to 2.5 Mtpa with plant commissioning in Q1 FY26.

MEP Stage 2 requires further study as it exists at a conceptual level only and includes:

- new magnetite concentrator for 4.5mtpa.
- definition of a long-term tailings strategy.
- upgrade to non-process infrastructure.

12.4 Metallurgical Processing – RPEEE

The studies summarised in the previous sections demonstrate that the test work described shows the potential for the economic extraction of magnetite by industry recognised processing techniques used both locally and globally, and within the appropriate mineralised units. The optimal shells developed to constrain the mineral resources (refer to Section 13) use costs and concepts associated with the proposed processing regime.

Thus, a mass recovery greater than 15% and Fe head grade greater than 15% and SiO_2 head grade less than 70% and a SiO_2 concentrate grade of less than 30% are considered to meet the broad metallurgical processing criteria of reasonable prospects for eventual economic extraction (RPEEE).

13 Optimisation for RPEEE Analysis

A pit optimisation model was run using Whittle software as the basis for defining an optimum pit shell for reporting material which has reasonable prospects for eventual economic extraction (RPEEE). The work is documented in technical memorandum ***Duchess South RPEEE Pit Shell Optimisation – October 2023 Model*** and is in Appendix 7. A summary of the process is presented below.

13.1 Inputs

A mining model was developed from the final validated resource model using the existing mine modelling process, and accounts for mining depletion, ore selectivity parameters, dilution, haematite product and magnetite product definitions. Additional business model value drivers for mining and processing, including for potential acid forming material, were added and model validated against established criteria. The process is documented in technical memorandum ***DUCHESS SOUTH MINING MODEL -dm _2310b1_mm*** and is in Appendix 8.

The resulting mining model was subject to Whittle optimisation to define several shells for a range of revenue factors based on costs and revenue calculations in the RPM Global update to SIMEC Business Model Version 1.18 (SIM1_WCPL_Business_Model_v1.18_MH_1.8% Silica Option_Contract_Mining_Costs.xlsb).

The major revenue inputs for the business model are listed in Table 13.1.

Table 13.1 – Business model revenue inputs.

Model Input	Units	Value
FX	AUD:USD	0.76
58% IO Price – CFR China	USD/dmt	66.24
62% IO Price – CFR China	USD/dmt	72.00
65% IO Price – CFR China	USD/dmt	79.20
Lump Premium (64% basis)	USD/dmt	7.32
Mab Con – 1.8 SiO_2 premium	USD/dmt	9.84
BF Pellet Premium	USD/dmt	30.76
Royalties	% mine gate revenue	5.35%

13.2 Pit Shell Constraints

Pit shells were constrained by a 30m buffer from the southern model limit as well as the Cooks Ranged Heritage Area.

13.3 Pit Shell Results

The pit shells are generated at a range of revenue factors (RF) from 0.50 to 2.00 at 0.02 increments. The revenue factor adjustment is applied to the revenue component of the pit value model, which is roughly equivalent to assessing the pit at a range of lower to higher product prices. The resulting concentric pit shells indicate areas of the resource with higher to lower relative value per unit of mining activity.

The RPEEE Whittle model RF 1.00 and RF 1.62 pit shells relative to the mining model extent and pit shell constraints are shown in Figure 13.1. The Iron Duchess South pit limit, including Iron Magnet at the south and Iron Duchess in the north, is spatially very similar to the previous resource model.

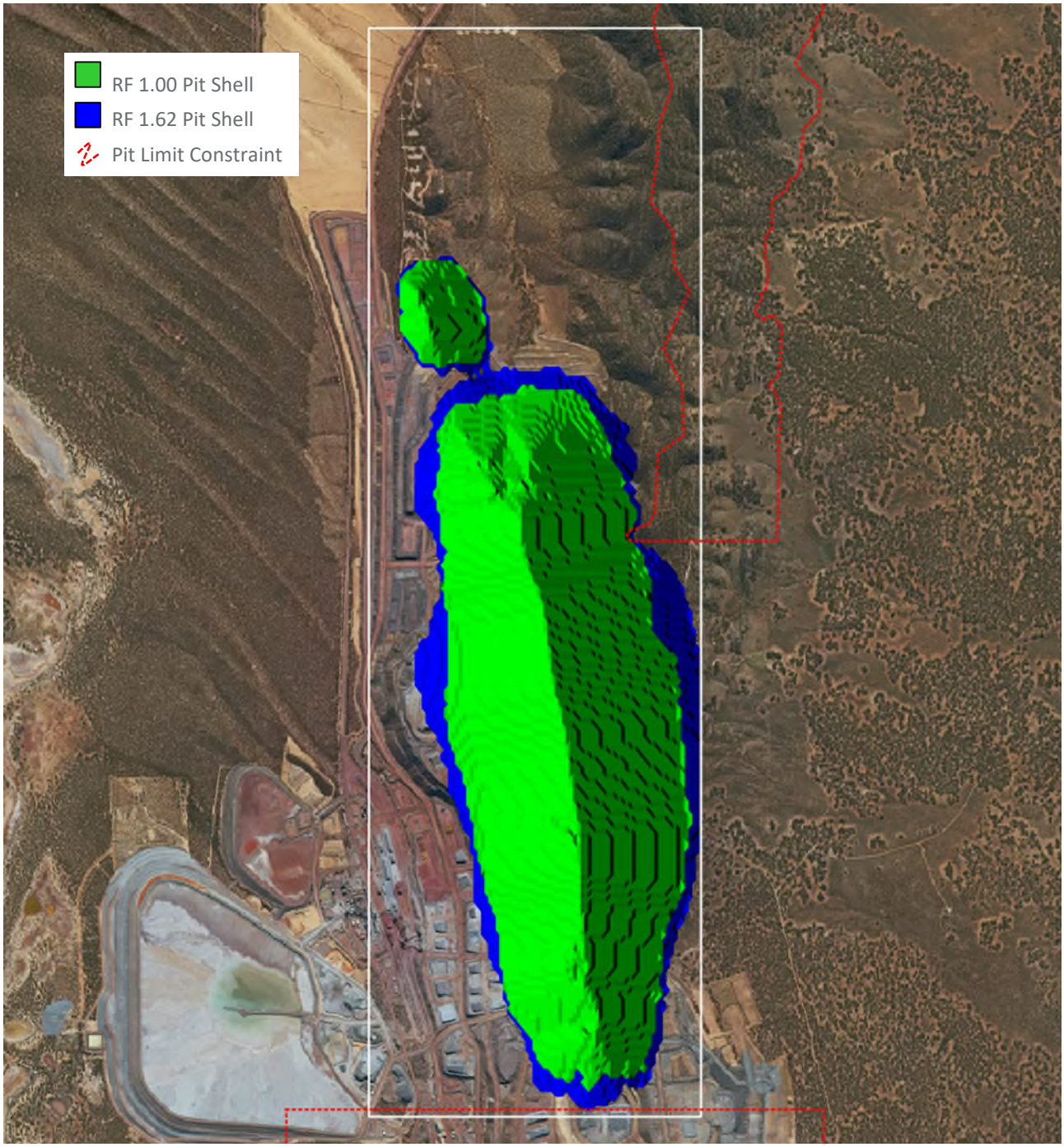


Figure 13.1 – Pit shells for RF=1.00 (green) and RF=1.62 (blue). The pit shell exclusion zones are shown in red. The optimisation model extents are shown in white.

This base case pit shell (RF=1.00) contains 1.64B dmt of rock with an estimated 633M dmt of economic ore feed at an overall strip ratio of 1.60 and delivering a total undiscounted cash flow of AU$5.81B. The economic ore feed mass is comprised of 12.1M dmt of haematite and 621M dmt of magnetite. A summary report of the pit shell physicals is shown in Table 13.2.

Table 13.2 – Pit shell physicals reported relative to the base revenue factor.

Pit Shell	Revenue Factor	Pit Mass (dmt)	Waste Mass (dmt)	Ore Mass (dmt)	HEM Mass (dmt)	MAG Mass (dmt)	Strip Ratio (w:o)
1	0.50	6,888,749	940,284	5,948,465	289,557	5,658,908	0.16
2	0.52	14,198,475	1,906,040	12,292,435	328,559	11,963,876	0.16
3	0.54	18,898,967	2,907,473	15,991,494	398,196	15,593,298	0.18
4	0.56	25,378,751	4,622,614	20,756,137	472,663	20,283,474	0.22
5	0.58	33,316,551	7,065,230	26,251,321	472,663	25,778,658	0.27
6	0.60	55,459,364	14,248,261	41,211,103	472,663	40,738,440	0.35
7	0.62	79,798,943	25,141,638	54,657,305	529,073	54,128,232	0.46
8	0.64	106,247,413	37,736,118	68,511,295	542,446	67,968,849	0.55
9	0.66	327,390,934	140,455,001	186,935,933	1,315,624	185,620,309	0.75
10	0.68	415,269,914	182,886,798	232,383,116	1,753,605	230,629,511	0.79
11	0.70	483,253,676	217,337,761	265,915,915	1,981,647	263,934,268	0.82
12	0.72	600,175,374	275,442,477	324,732,897	2,632,454	322,100,443	0.85
13	0.74	733,990,329	346,530,427	387,459,902	3,625,064	383,834,838	0.89
14	0.76	816,944,515	395,611,874	421,332,641	3,787,634	417,545,007	0.94
15	0.78	871,587,261	431,891,794	439,695,467	4,684,048	435,011,419	0.98
16	0.80	938,861,343	473,534,256	465,327,087	4,689,583	460,637,504	1.02
17	0.82	1,122,263,760	612,821,963	509,441,797	9,764,274	499,677,523	1.20
18	0.84	1,187,288,983	657,571,072	529,717,911	10,072,206	519,645,705	1.24
19	0.86	1,240,754,957	696,042,083	544,712,874	10,072,206	534,640,668	1.28
20	0.88	1,278,656,032	723,229,170	555,426,862	10,370,677	545,056,185	1.30
21	0.90	1,361,645,740	785,104,360	576,541,380	10,489,661	566,051,719	1.36
22	0.92	1,387,478,726	805,797,980	581,680,746	10,712,659	570,968,087	1.39
23	0.94	1,483,910,929	882,658,899	601,252,030	11,597,461	589,654,569	1.47
24	0.96	1,566,846,170	948,952,766	617,893,404	11,762,570	606,130,834	1.54
25	0.98	1,581,504,032	960,070,221	621,433,811	11,762,570	609,671,241	1.54
26	**1.00**	**1,644,396,500**	**1,011,456,733**	**632,939,767**	**12,123,876**	**620,815,891**	**1.60**
27	1.02	1,693,871,885	1,051,445,699	642,426,186	12,123,876	630,302,310	1.64
28	1.04	1,728,810,931	1,079,816,855	648,994,076	12,223,163	636,770,913	1.66
29	1.06	1,774,531,603	1,118,231,532	656,300,071	12,337,606	643,962,465	1.70
30	1.08	1,795,810,404	1,136,594,670	659,215,734	12,540,705	646,675,029	1.72
31	1.10	1,865,948,760	1,196,467,797	669,480,963	12,695,743	656,785,220	1.79
32	1.12	1,892,916,150	1,219,113,373	673,802,777	12,902,932	660,899,845	1.81
33	1.14	1,923,679,187	1,245,527,749	678,151,438	13,104,214	665,047,224	1.84
34	1.16	1,994,606,070	1,306,720,612	687,885,458	13,257,399	674,628,059	1.90
35	1.18	2,019,473,511	1,328,567,932	690,905,579	13,413,825	677,491,754	1.92
36	1.20	2,045,675,507	1,351,579,124	694,096,383	13,519,854	680,576,529	1.95
37	1.22	2,068,052,272	1,370,418,629	697,633,643	13,534,239	684,099,404	1.96
38	1.24	2,095,243,166	1,394,516,304	700,726,862	13,574,766	687,152,096	1.99
39	1.26	2,139,852,332	1,433,637,593	706,214,739	13,760,323	692,454,416	2.03

Pit Shell	Revenue Factor	Pit Mass (dmt)	Waste Mass (dmt)	Ore Mass (dmt)	HEM Mass (dmt)	MAG Mass (dmt)	Strip Ratio (w:o)
40	1.28	2,171,445,867	1,462,239,541	709,206,326	14,113,216	695,093,110	2.06
41	1.30	2,185,754,125	1,474,806,790	710,947,335	14,176,997	696,770,338	2.07
42	1.32	2,208,038,946	1,494,893,954	713,144,992	14,339,042	698,805,950	2.10
43	1.34	2,229,526,435	1,513,968,684	715,557,751	14,597,775	700,959,976	2.12
44	1.36	2,233,275,963	1,517,262,163	716,013,800	14,597,775	701,416,025	2.12
45	1.38	2,235,358,739	1,519,122,748	716,235,991	14,597,775	701,638,216	2.12
46	1.40	2,238,250,627	1,521,756,808	716,493,819	14,597,775	701,896,044	2.12
47	1.42	2,241,109,706	1,524,136,143	716,973,563	14,597,775	702,375,788	2.13
48	1.44	2,258,276,224	1,539,732,715	718,543,509	14,666,550	703,876,959	2.14
49	1.46	2,275,863,427	1,555,592,557	720,270,870	14,717,585	705,553,285	2.16
50	1.48	2,298,345,933	1,576,108,279	722,237,654	14,792,653	707,445,001	2.18
51	1.50	2,303,851,882	1,581,070,341	722,781,541	14,792,653	707,988,888	2.19
52	1.52	2,309,481,082	1,586,336,015	723,145,067	14,892,614	708,252,453	2.19
53	1.54	2,315,205,584	1,591,351,003	723,854,581	14,892,614	708,961,967	2.20
54	1.56	2,319,115,312	1,595,023,629	724,091,683	14,930,048	709,161,635	2.20
55	1.58	2,342,573,227	1,616,113,486	726,459,741	15,130,920	711,328,821	2.22
56	1.60	2,357,091,224	1,629,301,874	727,789,350	15,289,099	712,500,251	2.24
57	1.62	2,363,365,542	1,635,200,210	728,165,332	15,292,400	712,872,932	2.25
58	1.64	2,365,262,731	1,636,946,371	728,316,360	15,309,421	713,006,939	2.25
59	1.66	2,366,275,085	1,637,851,666	728,423,419	15,309,421	713,113,998	2.25
60	1.68	2,388,720,556	1,657,962,844	730,757,712	15,440,314	715,317,398	2.27
61	1.70	2,395,822,807	1,664,464,852	731,357,955	15,470,920	715,887,035	2.28
62	1.72	2,453,985,272	1,718,628,975	735,356,297	16,287,599	719,068,698	2.34
63	1.74	2,462,223,110	1,726,381,796	735,841,314	16,389,612	719,451,702	2.35
64	1.76	2,472,439,034	1,735,987,871	736,451,163	16,537,430	719,913,733	2.36
65	1.78	2,474,150,468	1,737,584,389	736,566,079	16,537,430	720,028,649	2.36
66	1.80	2,474,814,178	1,738,175,997	736,638,181	16,542,167	720,096,014	2.36
67	1.82	2,478,183,195	1,741,407,008	736,776,187	16,623,274	720,152,913	2.36
68	1.84	2,478,988,727	1,742,166,662	736,822,065	16,626,850	720,195,215	2.36
69	1.86	2,493,031,490	1,754,969,002	738,062,488	16,661,264	721,401,224	2.38
70	1.88	2,499,508,751	1,760,891,099	738,617,652	16,661,264	721,956,388	2.38
71	1.90	2,500,016,206	1,761,364,544	738,651,662	16,663,196	721,988,466	2.38
72	1.92	2,503,085,840	1,764,227,831	738,858,009	16,663,196	722,194,813	2.39
73	1.94	2,509,963,434	1,770,723,379	739,240,055	16,732,397	722,507,658	2.40
74	1.96	2,511,548,948	1,772,214,670	739,334,278	16,746,755	722,587,523	2.40
75	1.98	2,512,967,640	1,773,568,934	739,398,706	16,746,755	722,651,951	2.40
76	2.00	2,525,926,350	1,785,521,172	740,405,178	16,834,726	723,570,452	2.41

13.4 Selection of RPEEE Shell

Pit shell 57 (RF=1.62) was selected as the RPEEE shell based on a long-term IO Fe 62% price of USD117/dmt. The price was selected on the principles of:

- Objective selection criteria
- Long-term view based on a long-term project of +15 years
- Stable resource immune from short-term operational fluctuations

Data for 62% Index Fe SPOT prices over the last 40 years (www.marketindex.com) were downloaded and analysed. Data for the most recent 15 years as of 31 December 2022 was ranked, the top and bottom 5th percentiles removed, and the average of the remaining 90% used to guide the nominated price on which the shell was selected (Figure 13.2).

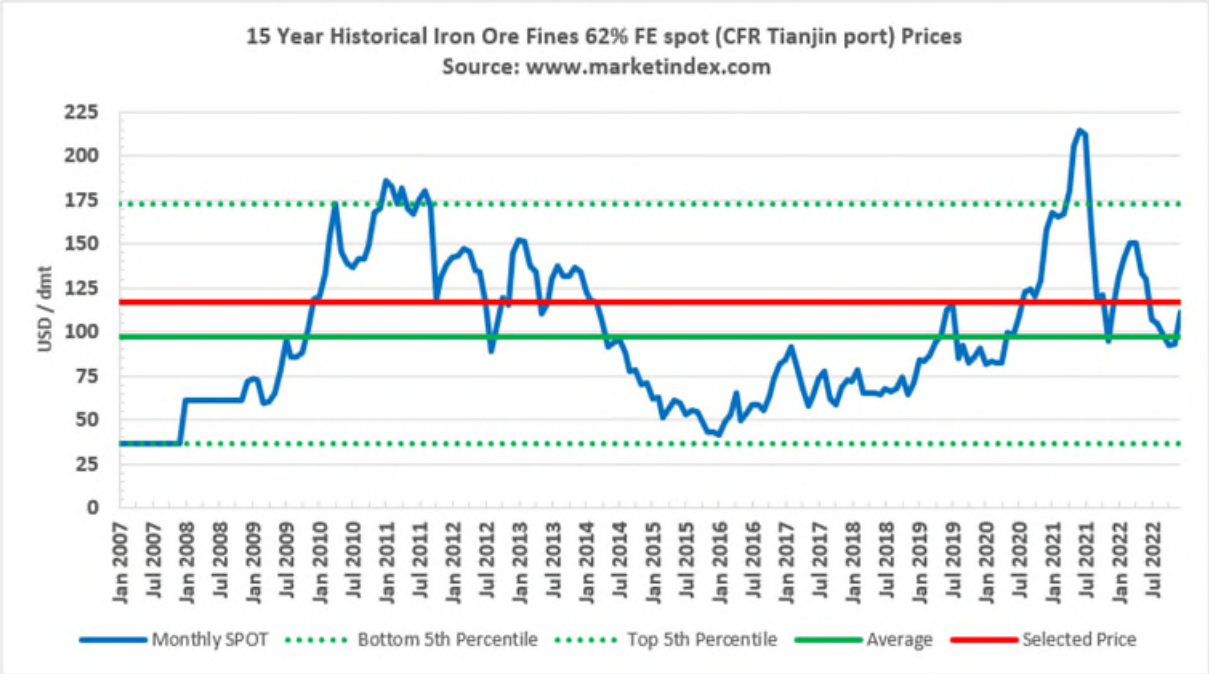


Figure 13.2 – Long-term 62% Fe price for RPEEE pit shell selection.

14 Mineral Resource Statement

14.1 Mineral Resource Classification

The mineral resource has been considered for classification into Measured, Indicated, and Inferred categories based on the criteria/metrics of:

- drill hole survey status quality.
- drill hole assay QAQC.
- drill hole spacing.
- nature and quality of bulk density estimates.
- confidence in geological continuity.
- estimation quality.
- expected variation and proposed mining rate.

The resource classification scheme is summarised in Table 14.1, and the criteria/ metrics discussed below.

Table 14.1 – Mineral resource classification scheme.

Category	Annual Expected Variation Range	Geological Confidence	Drill Spacing Low Continuity	Drill Spacing High Continuity	Density	Data Quality	Survey Status Quality	Estimation Quality
Measured	< ±5%	Very High	25x25	50x50	Local estimate	High	High	High
Indicated	±5 - 10%	High to Very High	50x50	100x75	Local estimate + Assigned	High	High to Moderate	High
Inferred	±10 - 20%	Moderate	100x75	150x100	Assigned	High to Moderate	Moderate to Low	Moderate to Low
Potential	±50%	Low	+250m	+250m	Assigned	Low	Not required	Not required

* Potential is a category not reported externally or publicly. Low Continuity domains: HEO, SCH, MSU, ESZ. High Continuity domains: HEC, MTC, MTS

* Annual variation is based on a notional 18-22mtpa mining rate

14.1.1 Assay Quality and Survey Status Quality

The QAQC for drill hole assays is comprehensive and the sample assays are of sufficiently high quality for consideration in classification as Measured, Indicated, or Inferred. A summary of the QAQC process has been described in Section 4.4, and the results summarised in Section 5. Detailed QAQC report are available in Appendix 1.

Drill hole survey quality was considered in preparing data for the mineral resource update (Section 6), and the filtering and exclusion at drill holes without adequate survey was assessed resulting in those drillholes being excluded prior to estimation, at the AcQuire database level.

14.1.2 Quality of Density Estimates

Density estimates are a key consideration in the mineral resource classification scheme as this metric is strongly positively correlated to Fe grade, and strongly negatively correlated to SiO_2 grade. For an Inferred resource, an average assigned density based on domain is deemed acceptable, whilst Indicated resources are required to be

supported by a mixture of locally estimated and assigned average density. In the case of a Measured resource, only local density estimates are considered acceptable.

14.1.3 Drill Spacing

The drill spacing is an objective measure of the density of drilling required to achieve confidence in geological continuity of the domains within the deposit. The greater the number of drill holes, the higher the confidence. By virtue of the volume variance effect, there is also a strong association between drill hole spacing and production rate. Large increases in the mining production rate smooths out variability. As this rate increases, the number of drill holes informing that tonnage, for a fixed drill spacing, also increases thereby leading to increasing confidence in the resource.

The close-spaced drill spacing for the less continuous, thinner units (e.g., MSU 48, SCH 46, ESZ 75) is based on the experience of people working in this province over the last 25+ years and has been confirmed using the conditional simulation work based on data as of May 2023 (Section 14.4).

The wide-spaced drill spacing of the more continuous MTS 40 domain is based on the uncertainty model developed from the conditional simulation work. This domain exhibits lower variability and does not require as close a drill spacing as the other less continuous domains.

14.1.4 Confidence in Geological Continuity

The MTS 40 domain (and historically the MTC 43) is the dominant mineralised domain and exhibits the greatest geological continuity and confidence. The domains of HEO 30, SCH 46, MSU 48 and ESZ 75, which are volumetrically smaller and characterised by “pinch and swell” and lens-like geometry, exhibit less continuity. This is accounted for in resource classification by consideration of a closer drilling spacing for these less continuous domains, and a wider drill spacing for the more continuous domains. Haematite resources (HEO 30) are classified on the same basis as the magnetite domains of lower continuity.

14.1.5 Expected Variation and Mining Rate

The expected variation (relevant confidence) of the magnetite resource tonnage and grade on an annual basis has been considered in the classification, assessed using an uncertainty model generated using conditional simulation techniques (Section 14.4).

The expected variation of each resource category has been quantified based on the post-processing of the uncertainty model at a 90% confidence interval. The measure is both a spatial one, 9 out of 10 annual production parcels, as well as a temporal one, 9 out of 10 years. For an Indicated resource, the annual variation for tonnes was calculated as ±2.1-5% for Indicated, ±8-10% for Inferred, based on an annual mining rate of 18 to 22 mtpa. These variations were used to define the tolerances for mineral resource classification criteria shown in Table 14.1.

The resource has been classified on a bulk open pit mining basis using a notional mining rate of 18 to 22 mtpa based on internal mine expansion studies. The mining rate does affect the expected variation, since it has been shown that as the volume mined increases, the variability decreases. Figure 14.1 shows that expected variation is relatively stable for mining rates between 10 to 40 mtpa, but that the expected variation increases dramatically at mining rates below 5 mtpa.

14.1.6 Estimation Quality

The quality of the estimates has been accounted for through consideration of the Kriging Neighbourhood Analysis described in Section 10.4.3 as well as the exhaustive visual and statistical validation discussed in Section 11.

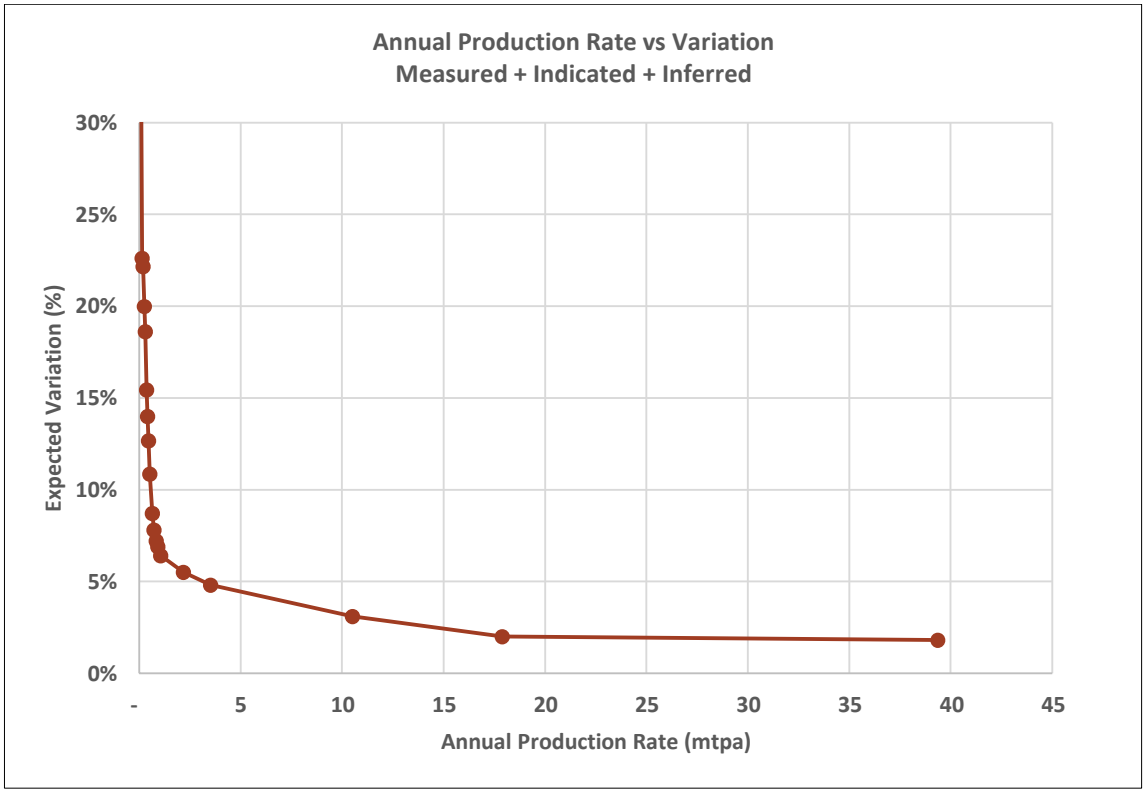


Figure 14.1 – Expected variation in tonnage for different annual production rates.

14.1.7 Applying the classification to the model

The number of drill holes used in estimating block grades was counted, then subject to a smoothing algorithm to remove artefacts by converting isolated blocks such that they matched the majority drill hole count of the surrounding blocks. The criteria for the drill hole count are shown in Table 14.2.

Table 14.2 – Criteria for counting drill holes in blocks depending on domain continuity.

Domain Continuity	Category	Search	Domain Criteria	Minimum Drillholes
Low	Measured	30 x 20 x 20m	HEO + SCH + MSU + ESZ	4
	Indicated	50 x 40 x 20m	HEO + SCH + MSU + ESZ	4
	Inferred	100 x 60 x 30m	HEO + SCH + MSU + ESZ	2
High	Measured	50 x 40 x 40m	MTC + MTS + HEC	4
	Indicated	100 x 80 x 80m	MTC + MTS + HEC	4
	Inferred	150 x 100 x 100m	MTC + MTS + HEC	1
Low + High	Potential	250 x 150 x 100m	HEO + HEC + SCH + MSU + ESZ + MTC + MTS	1

This smoothed model was then run through a categorical implicit modelling routine in Vulcan software to generate base wireframes of the average drill hole count. These base wireframes were verified by spatially examination against the drill holes and grade estimates, and further edited where required to remove spurious facets, triangles, and outliers to derive the final classification wireframes.

The final wireframes were used to flag the base resource category into the resource model as shown in Table 14.3. Mutually exclusive field HCLASS was used for haematite mineralisation (HEO 30) and MCLASS was used for magnetite mineralisation (HEC 32, MTS 40, MTC 43, SCH 46, MSU 48 and ESZ 75).

Table 14.3 – Final classification wireframes.

Wireframe	Category	HCLASS or MCLASS	Blocks Flagged
clean_class_4_o.00t	Potential	4	HEO + SCH + MSU + ESZ
clean_class_4_m.00t	Potential	4	HEC + MTC + MTS
clean_class_3_o.00t	Inferred	3	HEO + SCH + MSU + ESZ
clean_class_3_m.00t	Inferred	3	HEC + MTC + MTS
clean_class_2_o.00t	Indicated	2	HEO + SCH + MSU + ESZ
clean_class_2_m.00t	Indicated	2	HEC + MTC + MTS
clean_class_1_o.00t	Measured	1	HEO + SCH + MSU + ESZ
clean_class_1_m.00t	Measured	1	HEC + MTC + MTS

* HCLASS = haematite categorical classification field. MCLASS = magnetite categorical classification field.

The criteria/metrics discussed earlier were then used to further assess the appropriateness of base classification criteria with the following modifications made in finalising the mineral resource classification:

- Small and isolated HEC 32 domain located between the Iron Magnet Pit and Iron Duchess Pit was downgraded to Potential because of a complete absence of samples for estimation at this location.
- ESZ 75 blocks all set to Inferred due to very limited concentrate samples in this domain.

For mine planning purposes, an additional class field was derived using the following logic:

xclass = 1 if (mclass eq 1 or hclass eq 1)

xclass = 2 if (mclass eq 2 or hclass eq 2)

xclass = 3 if (mclass eq 3 or hclass eq 3)

xclass = 4 if (mclass eq 4 or hclass eq 4)

Figure 14.2, Figure 14.3, and Figure 14.4 show examples of the final classification at the block model level.

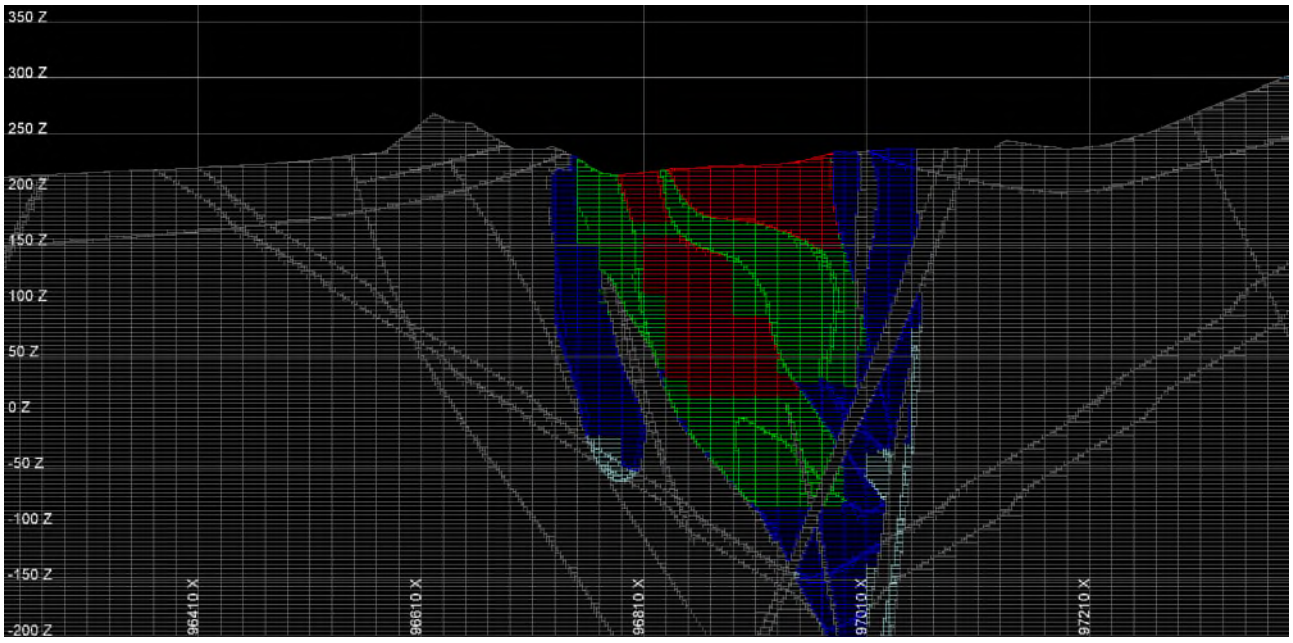


Figure 14.2 – Cross section through the Iron Magnet Pit at 17,227mN showing the final resource classification. Red = Measured, Green = Indicated, Dark Blue = Inferred, Light Blue = Potential, Grey = Not Classified.

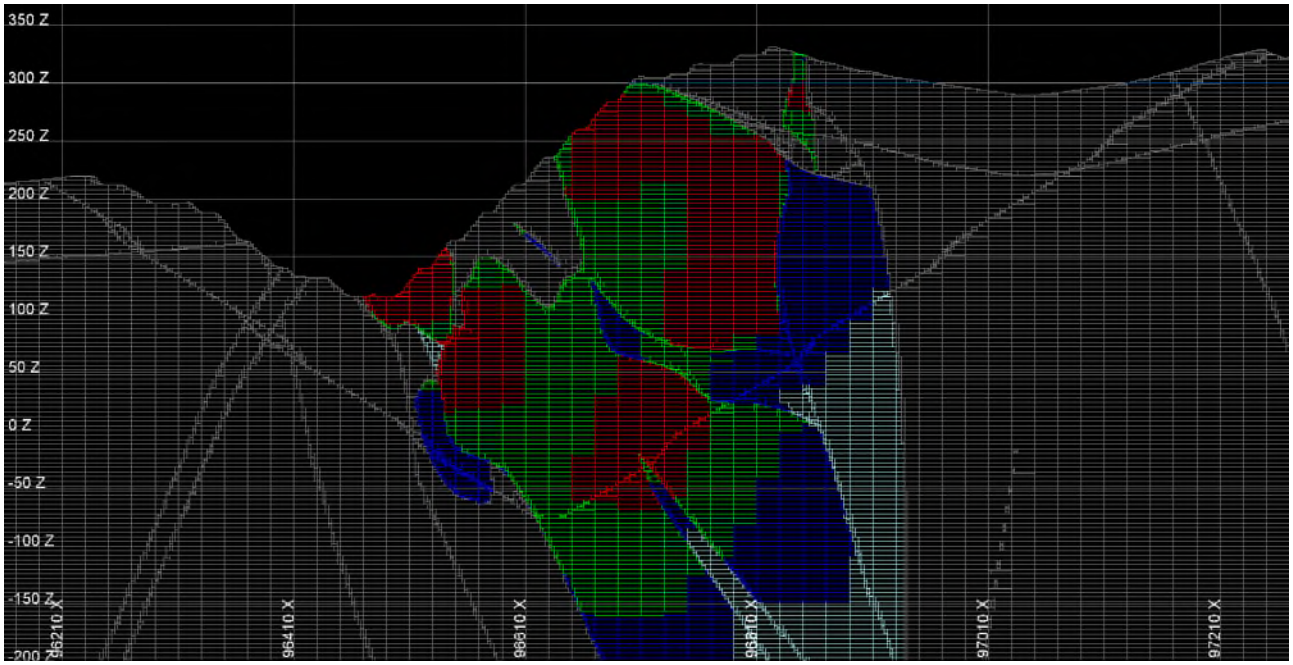


Figure 14.3 – Cross section through the Iron Magnet Pit at 18,709mN showing the final resource classification. Red = Measured, Green = Indicated, Dark Blue = Inferred, Light Blue = Potential, Grey = Not Classified.

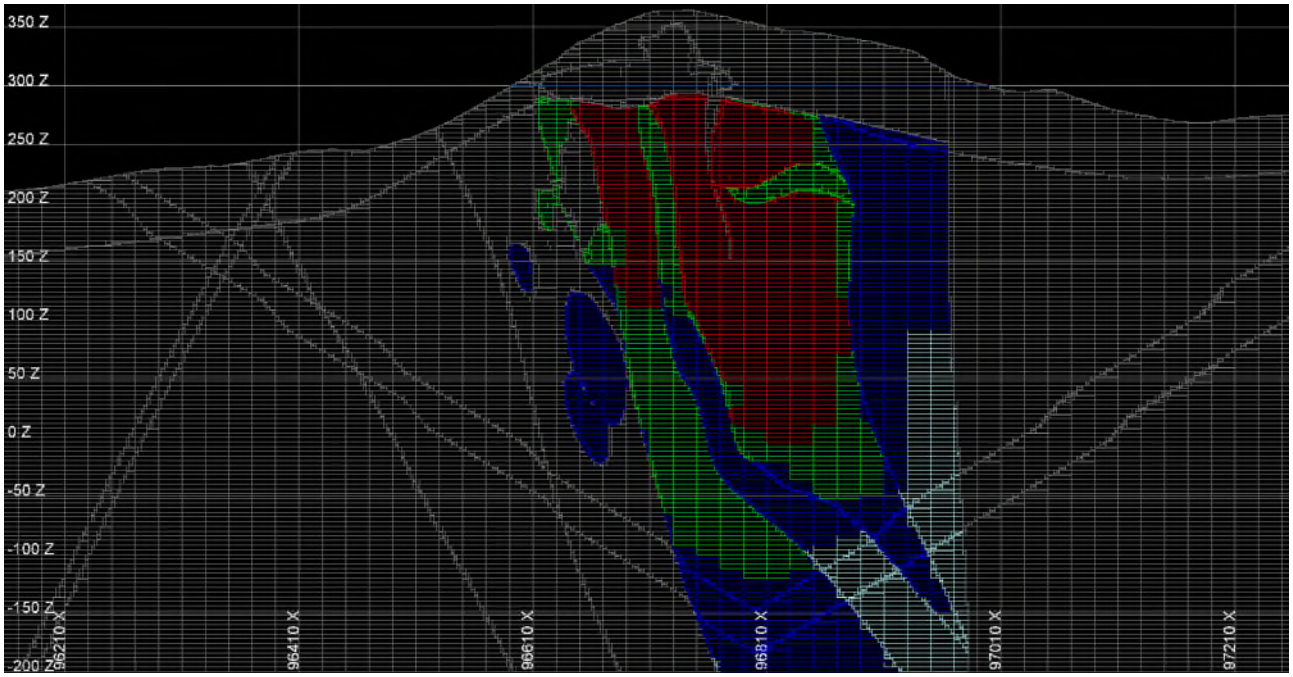


Figure 14.4 – Cross section through the Duchess South area at 18,183mN showing the final resource classification. Red = Measured, Green = Indicated, Dark Blue = Inferred, Light Blue = Potential, Grey = Not Classified.

14.2 Grade Control and Reconciliation

14.2.1 Grade Control Sampling

For grade control, the blast hole collar plot provided by the mining contractor and survey department is referenced and two samples are taken by vertically cutting through one side of the blast hole spoil cone (cone cut) at surface using a trenching tool.

The top 10% of the cone cut is assumed to be sub-drill material and is discarded, care being taken not to contaminate the remainder of the cone cut. The remaining top 50% of the cone cut is sampled as the 'B' sample, whilst the remainder of the cone cut to the bench surface is sampled as the 'A' sample.

Samples are bagged, checked, entered to an acQuire database using a scanned bar code, and submitted to the BV laboratory in Whyalla with accompanying assay requirements, including any GLIB compositing and assaying instructions. Upon receipt, BV checks the samples and verifies the compositing and assaying requirements, before physically compositing the samples. BV inserts coarse and pulp duplicates, and standards, at a rate of 1:20 samples.

Whilst the blast hole sampling is considered unreliable when compared to RC drill hole samples, and not used for resource estimation, the blast hole sampling practices are sufficiently refined to enable reasonable local definition for mining.

14.2.2 Reconciliation

SIMEC uses a detailed pit to port reconciliation system managed by a reconciliation specialist, using a system of spreadsheets and Power BI reporting front-end that monitors and reports on the performance of forecast versus actual production. Table 14.4 to Table 14.6 shows the reconciliation for production from the Iron Magnet Pit, between the mining production models (depicting the ore reserve which is based on the mineral resource) and the mining/grade control models for the same period. The MTS 40 domain is a small proportion of the production volume.

Table 14.4 – Comparison between mining production model 2111A and mining/grade control.

Period	Mining Production Model 2111A				Mining / Grade Control Model			
	Tonnes	MASSREC	SiO_2_H	SiO_2_C	Tonnes	MASSREC	SiO_2_H	SiO_2_C
FY20	4,953,193	37.79	23.63	3.85	4,813,537	38.75	26.78	2.58
FY21	4,733,119	38.62	21.17	2.65	4,757,138	37.92	22.62	1.84
FY22	4,804,194	39.16	24.21	2.98	4,991,125	39.21	25.82	1.76
*FY23	3,233,370	41.04	20.00	2.04	3,053,055	40.03	22.05	1.23

* Based on the 2020 resource model update. FY23 partially mined at this time

Table 14.5 – Comparison between mining production model 2303A and mining/grade control.

Period	Mining Production Model 2303A				Mining / Grade Control Model			
	Tonnes	MASSREC	SiO_2_H	SiO_2_C	Tonnes	MASSREC	SiO_2_H	SiO_2_C
FY20	4,863,214	38.33	23.73	3.91	4,813,537	38.75	26.78	2.58
FY21	4,601,017	40.73	21.28	2.64	4,757,138	37.92	22.62	1.84
FY22	4,871,144	41.40	23.90	2.87	4,991,125	39.21	25.82	1.76
*FY23	3,277,218	42.52	18.93	2.04	3,053,055	40.03	22.05	1.23

* Based on the May 2023 resource model update. FY23 partially mined at this time

Table 14.6 – Comparison between mining production model 2311A and mining/grade control.

Period	Mining Production Model 2311A				Mining / Grade Control Model			
	Tonnes	MASSREC	SiO_2_H	SiO_2_C	Tonnes	MASSREC	SiO_2_H	SiO_2_C
*FY20	-	-	-	-	-	-	-	-
FY21	4,647,257	40.67	21.55	2.67	4,757,138	37.92	22.62	1.84
FY22	4,782,967	41.36	23.94	2.94	4,991,125	39.21	25.82	1.76
FY23	5,983,398	41.90	22.60	2.43	5,757,115	40.81	23.88	1.17
*FY24	1,347,719	45.32	20.58	2.13	1,082,241	42.78	22.51	1.02

* Based on the October 2023 resource model update. Model depleted to mining surface post-dating FY20. FY24 partially mined at this time

The relative variances (actual mining / production forecast x 100) for the three resource models are shown in Table 14.7, Table 14.8, and Table 14.9.

Table 14.7 – Relative variances between mining production model 2111A and mining/grade control.

Period	Tonnes	MASSREC	SiO_2_H	SiO_2_C
FY20	97%	103%	113%	67%
FY21	101%	98%	107%	69%
FY22	104%	100%	107%	59%
FY23	94%	98%	110%	60%

* Based on the 2020 resource estimate. Actual / Forecast x 100.

Table 14.8 – Relative variances between mining production model 2303A and mining/grade control.

Period	Tonnes	MASSREC	SiO_2_H	SiO_2_C
FY20	99%	101%	113%	66%
FY21	103%	93%	106%	70%
FY22	102%	95%	108%	61%
FY23	93%	94%	116%	60%

* Based on the May 2023 resource estimate. Actual / Forecast x 100.

Table 14.9 – Relative variances between mining production model 2311A and mining/grade control.

Period	Tonnes	MASSREC	SiO_2_H	SiO_2_C
FY20	-	-	-	-
FY21	102%	93%	105%	69%
FY22	104%	95%	108%	60%
FY23	96%	97%	106%	48%
FY24	80%	94%	109%	56%

* Based on the October 2023 resource estimate. Actual / Forecast x 100. FY24 partially mined at this time

The tonnage and mass recovery generally reconcile very well. Both SiO_2_H and SiO_2_C grades reconcile less favourably. It is thought that one aspect that contributes to this is the historical difference in the sample preparation for the grade control samples (blast hole samples), and the samples used in the resource estimate (RC drill hole samples), over the footprint of the Iron Magnet pit only.

In the case of the SiO_2_H grade:

- 93% of the RC samples are prepared using a dry grind P90 75µm
- 7% of the RC samples are prepared using a dry grind of P80 38µm
- 100% of the blast hole samples are prepared using a wet grind of P80 38µm

The finer grind regime of P80 38µm for blast hole liberates more SiO_2 relative to the P90 75µm grind regime for RC samples, meaning the resulting XRF analysis reports more SiO_2 from blast hole samples.

In the case of the SiO_2_C grade:

- 90% of the RC samples are prepared using a dry grind of P80 45µm
- 10 % of the RC samples are prepared using a wet grind of P80 38µm
- 100% of blast hole samples are prepared using a wet grind of P80 38µm

The coarser grind regime of P80 45µm for RC samples liberates less SiO_2 relative to the P80 38µm grind regime for blast hole samples, meaning that more SiO_2 entrapped with magnetite reports to the magnetic fraction during DTR, resulting in a higher SiO_2_C grade in the concentrate assays of RC samples.

All RC drillhole samples north of the existing Iron Magnet pit north wall have been prepared at P80 38µm for concentrate grade analysis, bringing them in line with the existing preparation for grade control blast hole samples. The target production rate from an expanded magnetite production (MEP2) is approximately 4 times that of the existing annual production of ~5 mtpa from Iron Magnet, and in this scenario, the expected variation between actual production and forecast production is expected to minimise further on account of the volume-variance effect (refer to Figure 14.1).

14.3 Mineral Resource Reporting

The Duchess South mineral resource has been reported using the estimated variables described, below the 1 July 2023 mining surface, and within an optimised pit shell (Whittle Shell 57) described in Section 13.

For haematite resources, in-situ HEO 30 domain material, classified as Measured, Indicated, and Inferred, is reported where Fe_H > 47 and SiO_2_H < 50. The cut-off is the same as that used in previous estimates and is based on RPEEE aspects and existing mining cut-offs for haematite production from several haematite pits. The reported haematite mineral resource is shown in Table 14.10.

Table 14.10 – Duchess South Haematite Mineral Resource as of 1 July 2023.

Resource Classification	Tonnes mt	Fe %	SiO_2 %	Al_2O_3 %	LOI %	P %	Density tm^3
Measured	2.4	56.80	6.31	1.19	4.97	0.08	3.59
Indicated	6.9	56.12	7.72	1.47	4.21	0.09	3.55
Inferred	8.9	56.17	8.48	1.33	3.14	0.09	3.63
Total	**18.2**	**56.23**	**7.90**	**1.36**	**3.79**	**0.09**	**3.59**

* Cut-off: Fe > 47% and SiO_2 < 50%, inside optimised Whittle Shell 57, below 1 July 2023 mining surface, south of Y19,800N. Tonnages rounded to nearest hundred thousand.

For magnetite resources, in-situ material from the major magnetite domains MTC, MTS, and MSU, minor magnetite domains HEC, SCH and ESZ, classified as Measured, Indicated, and Inferred, is reported for the MEP2 processing configuration described in Section 12 where MASSREC > 15 and Fe_H > 15 and SiO_2_H < 70 and SiO_2_C < 30. The cut-off is the same as that used in previous estimates and is based on previous reviews of grade-tonnage curves, consideration of RPEEE aspects, and existing mining cut-offs for magnetite production from the Iron Magnet pit. The reported magnetite mineral resource is shown in Table 14.11.

Table 14.11 – Duchess South Magnetite Mineral Resource as of 1 July 2023.

Resource Classification	Tonnes mt	Mass Rec %	Fe_C %	Fe_H %	SiO_2_C %	SiO_2_H %	Density tm^3
Measured	253	36.86	64.33	32.92	8.84	41.33	3.49
Indicated	245	31.97	64.03	30.42	9.00	45.00	3.43
Inferred	175	25.89	64.84	28.49	7.99	48.23	3.40
Total	**673**	**32.23**	**64.35**	**30.86**	**8.68**	**44.46**	**3.44**

* Cut-off: Mass recovery > 15% and Fe_H > 15% and SiO_2_H < 70% and SiO_2_C < 30%, inside optimised Whittle Shell 57, below 1 July 2023 mining surface. Tonnages rounded to nearest million.

14.3.1 Alternate Consideration of the HEC Domain

The haematite carbonate (HEC) domain is transitional between haematite and magnetite and may be processed as either magnetite or haematite feed. For the purposes of mineral resource reporting, HEC is treated as a magnetite feed source due to mass recoveries greater than the cut-off and is consistent with previous reporting methodology. During reserving and mine planning, HEC may be treated as a haematite processing feed where the Fe grade is close to DSO (direct shipping ore) grades. This treatment as DSO represents a revenue opportunity during reserving since HEC has low SiO_2 content, effectively a 100% mass recovery, and no associated concentrator costs.

Table 14.12 shows an alternate version of the haematite mineral resource if the HEC domain is included in the reporting of the haematite mineral resource.

Table 14.12 – Duchess South Alternate Haematite Mineral Resource including the HEC domain as of 1 July 2023.

Resource Classification	Tonnes mt	Fe %	SiO_2 %	Al_2O_3 %	LOI %	P %	Density tm^3
Measured	14.1	54.68	5.25	2.24	6.47	0.06	3.70
Indicated	11.2	55.76	7.22	2.02	4.40	0.08	3.61
Inferred	10.1	55.99	8.17	1.49	3.37	0.08	3.63
Total	**35.4**	**55.39**	**6.71**	**1.96**	**4.93**	**0.07**	**3.65**

* Cut-off: Fe > 47% and SiO_2 < 50%, inside optimised Whittle Shell 57, below 1 July 2023 mining surface, south of Y19,800N. Tonnages rounded to nearest hundred thousand.

Table 14.13 shows an alternate version of the magnetite mineral resource if the HEC domain is excluded from the reporting of the magnetite mineral resource.

Table 14.13 – Duchess South Alternate Magnetite Mineral Resource excluding the HEC domain as of 1 July 2023.

Resource Classification	Tonnes mt	Mass Rec %	Fe_C %	Fe_H %	SiO_2_C %	SiO_2_H %	Density tm^3
Measured	241	37.62	64.08	32.13	9.27	43.12	3.48
Indicated	241	32.12	63.95	30.07	9.14	45.64	3.42
Inferred	173	25.92	64.79	28.27	8.07	48.66	3.39
Total	**655**	**32.50**	**64.22**	**30.35**	**8.90**	**45.51**	**3.44**

* Cut-off: Mass recovery > 15% and Fe_H > 15% and SiO_2_H < 70% and SiO_2_C < 30%, inside optimised Whittle Shell 57, below 1 July 2023 mining surface. Tonnages rounded to nearest million.

A detailed breakdown of the reported magnetite mineral resource by domain is shown in Table 14.14, and graphically illustrated in Figure 14.5.

Table 14.14 – Breakdown of reported magnetite mineral resource by domain. Tonnages round to nearest million.

		Tonnes	Concentrate Grade Estimate							Head Grade Estimate							Density
Domain	Category	Millions	MR%	Fe%	SiO_2%	Al_2O_3%	CaO%	MgO%	S%	Fe%	SiO_2%	Al_2O_3%	CaO%	MgO%	LOI	S%	tm^3
HEC 32	Measured	13	22.32	69.17	0.55	0.16	0.38	0.39	0.02	48.15	6.64	3.02	5.05	6.30	9.03	0.10	3.68
	Indicated	4	23.16	69.23	0.64	0.18	0.27	0.36	0.07	50.85	8.03	3.36	2.81	5.14	6.23	0.25	3.66
	Inferred	2	22.70	69.56	0.51	0.16	0.30	0.33	0.05	49.09	6.71	2.87	2.93	5.54	7.04	0.12	3.59
	Total	**19**	**22.55**	**69.22**	**0.57**	**0.16**	**0.35**	**0.38**	**0.03**	**48.85**	**6.96**	**3.08**	**4.34**	**5.96**	**8.20**	**0.14**	**3.67**
MTS 40	Measured	200	35.94	62.92	10.97	0.07	0.15	1.06	0.04	30.24	49.77	0.40	1.11	4.30	0.62	0.10	3.41
	Indicated	176	33.01	63.05	10.36	0.09	0.15	1.33	0.08	29.34	49.52	0.49	1.06	5.23	0.81	0.13	3.39
	Inferred	55	33.36	66.42	7.27	0.05	0.12	0.51	0.06	30.34	49.55	0.49	1.39	4.24	0.29	0.09	3.42
	Total	**431**	**34.41**	**63.42**	**10.25**	**0.08**	**0.15**	**1.10**	**0.06**	**29.88**	**49.64**	**0.45**	**1.12**	**4.67**	**0.66**	**0.11**	**3.40**
MTC 43	Measured	41	45.79	69.72	0.92	0.10	0.71	0.55	0.01	41.34	10.76	1.77	8.11	7.36	10.95	0.11	3.86
	Indicated	24	41.82	69.02	1.89	0.15	0.63	0.44	0.02	40.20	14.67	2.09	7.38	5.10	8.18	0.12	3.81
	Inferred	9	41.35	69.24	1.84	0.11	0.53	0.40	0.02	35.94	17.15	1.51	8.75	4.58	9.52	0.17	3.83
	Total	**74**	**43.98**	**69.44**	**1.34**	**0.12**	**0.66**	**0.50**	**0.01**	**40.34**	**12.78**	**1.84**	**7.95**	**6.30**	**9.88**	**0.12**	**3.84**
SCH 46	Measured	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Indicated	22	20.20	62.55	11.10	0.10	0.20	1.20	0.27	26.50	53.19	0.72	0.87	5.79	0.52	0.20	3.36
	Inferred	23	19.10	61.93	11.15	0.12	0.24	1.43	0.53	28.03	52.00	0.46	0.81	5.63	0.16	0.19	3.42
	Total	**45**	**19.63**	**62.23**	**11.13**	**0.11**	**0.22**	**1.32**	**0.40**	**27.29**	**52.58**	**0.59**	**0.84**	**5.71**	**0.33**	**0.19**	**3.39**
MSU 48	Measured	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Indicated	20	25.42	67.33	4.97	0.08	0.26	0.57	0.61	28.18	40.41	1.02	3.55	7.53	5.51	1.68	3.40
	Inferred	38	24.49	66.56	5.20	0.10	0.28	0.58	1.24	26.45	43.57	0.93	3.71	6.68	4.05	2.03	3.38
	Total	**58**	**24.81**	**66.82**	**5.12**	**0.09**	**0.27**	**0.58**	**1.02**	**27.04**	**42.49**	**0.96**	**3.66**	**6.97**	**4.55**	**1.91**	**3.39**
ESZ 75	Measured	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Indicated	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Inferred	49	19.20	62.16	10.84	0.15	0.18	1.10	0.45	26.15	55.56	0.84	0.65	4.23	0.77	0.22	3.29
	Total	**49**	**19.20**	**62.16**	**10.84**	**0.15**	**0.18**	**1.10**	**0.45**	**26.15**	**55.56**	**0.84**	**0.65**	**4.23**	**0.77**	**0.22**	**3.29**
Total Measured		**253**	**36.86**	**64.33**	**8.83**	**0.08**	**0.25**	**0.94**	**0.03**	**32.92**	**41.33**	**0.75**	**2.43**	**4.89**	**2.71**	**0.10**	**3.50**
Total Indicated		**245**	**31.97**	**64.04**	**9.00**	**0.10**	**0.21**	**1.15**	**0.13**	**30.42**	**45.00**	**0.76**	**1.89**	**5.45**	**1.97**	**0.26**	**3.43**
Total Inferred		**175**	**25.88**	**64.84**	**8.00**	**0.10**	**0.21**	**0.80**	**0.48**	**28.49**	**48.23**	**0.75**	**1.99**	**4.98**	**1.75**	**0.56**	**3.40**
Total Resource		**673**	**32.23**	**64.35**	**8.68**	**0.09**	**0.23**	**0.98**	**0.19**	**30.86**	**44.46**	**0.75**	**2.12**	**5.12**	**2.19**	**0.28**	**3.45**

* Note that minor discrepancies may occur in totals and averages due to rounding to appropriate significant figures

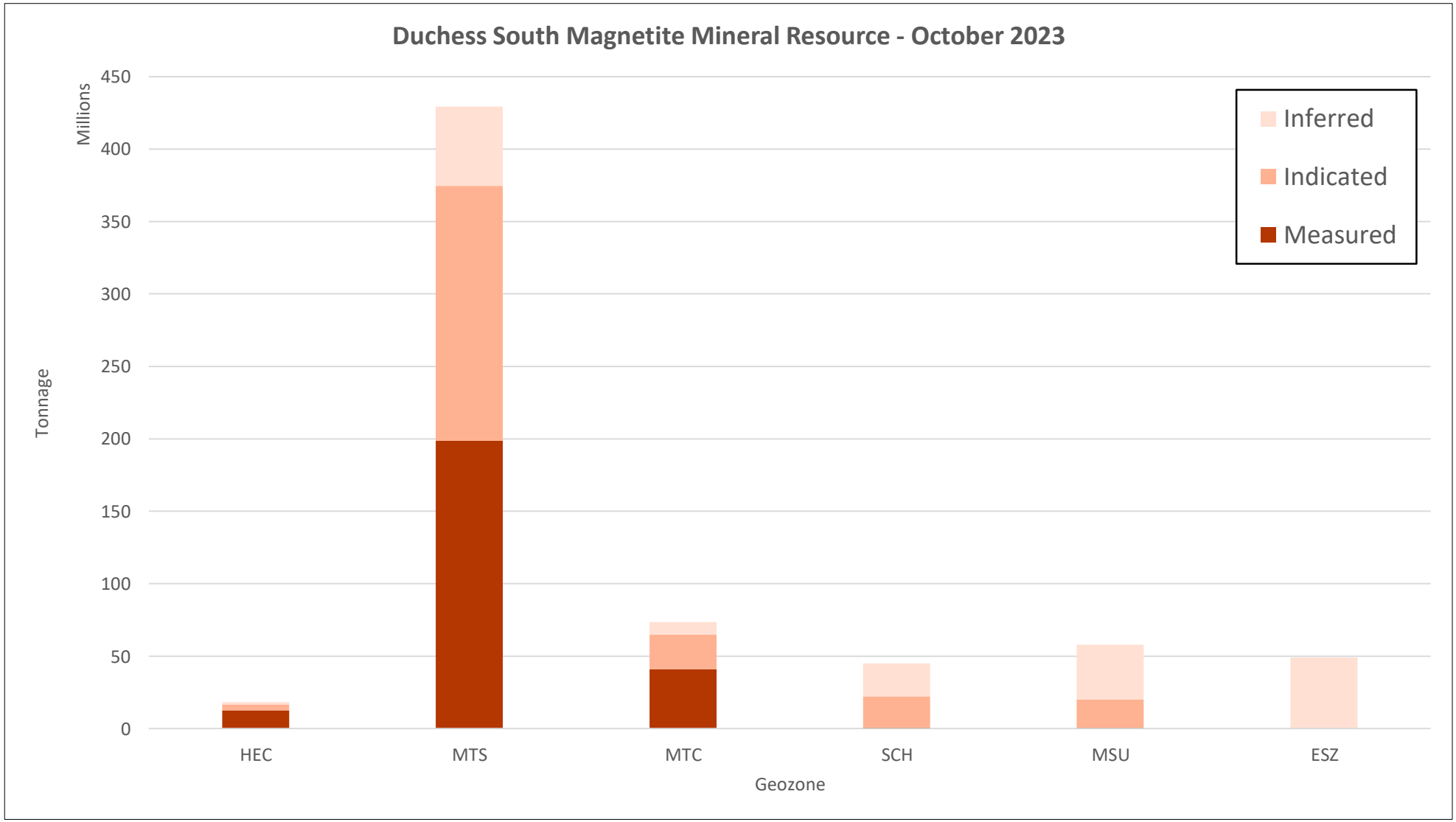


Figure 14.5 – Graphical representation of the breakdown of Measured, Indicated, and Inferred tonnage by domain, for the reported magnetite mineral resource.

14.4 Comparison with Previous Mineral Resource

A comparison to the previous magnetite mineral resource finalised in May 2023 was made based on the same cut-off and depletion surface of 1 July 2023 and summarised in Figure 14.6. The salient features of the change between the May 2023 and October 2023 mineral resource are:

- 5% Increase in total resource from 635mt to 673mt.
- Classification of 253mt of Measured resource.
- Decrease in Indicated resource from 428mt to 245mt due to conversion to Measured.
- Decrease in Inferred resource from 207mt to 175mt due to conversion to Measured and Indicated respectively.

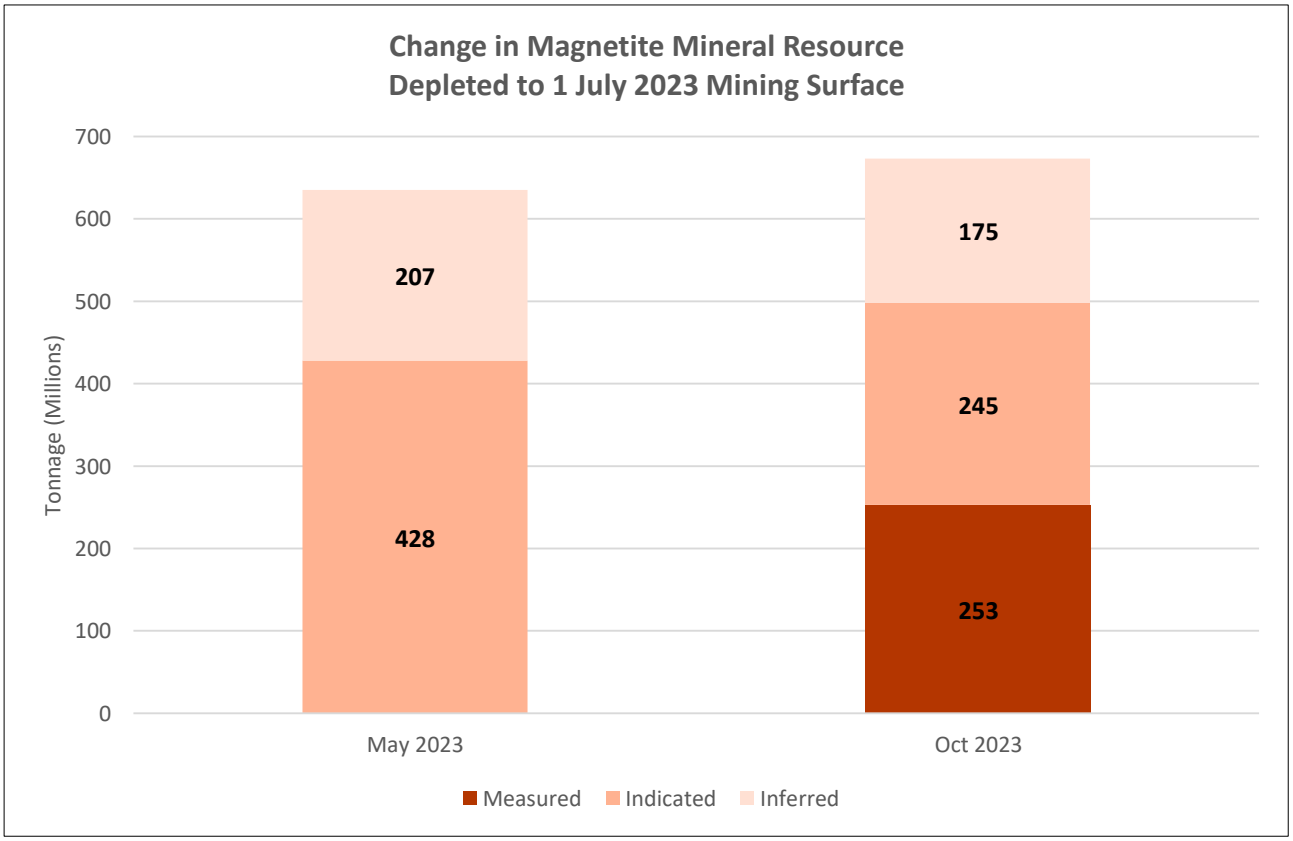


Figure 14.6 – Summary of magnetite mineral resource changes from May 2023 to October 2023, depleted to the 1 July 2023 mining surface.

The differences in the magnetite mineral resource are due to:

- 14.8km of additional infill drilling (55 drill holes).
- Re-interpretation of the underlying geology, and update to the resultant geological model.
- Modest increase in defined MTS, MSU and ESZ domain volumes.
- Update to estimation parameters to reflect additional data and updated geological model.
- Local estimation of density using close-spaced drilling.
- Revision to resource classification criteria based on updated density estimates.
- Revision to the RPEEE shell based on updated pit optimisation assumptions, costs, and revenue.

The net outcome is a slightly larger resource, with a decrease in Inferred and Indicated resource due to conversion to Measured resource, respectively.

The major differences between the May 2023 and October 2023 haematite mineral resource, within the Duchess South model area only, are:

- Increase in total resource from 14.0mt to 18.2mt.
- Classification of 2.4mt of Measured resource.
- Decrease in Indicated resource from 8.7mt to 6.9mt.
- Increase in Inferred resource from 5.3mt to 8.9mt.

These differences are due to:

- Minor thin HEO intersections from new drilling east of the Iron Duchess pit.
- Re-interpretation of the HEO domain using both RC drilling and verified production blast hole drilling.
- Update to estimation parameters to reflect the changes in the geological model.
- Local estimation of density using close-spaced drilling.
- Revision to resource classification criteria based on updated density estimates.
- Revision to the RPEEE shell based on updated pit optimisation assumptions, costs, and revenue.

The net outcome is a slightly larger haematite resource, with the gains occurring in Inferred resource below the existing Iron Duchess Pit floor.

The model governing the potentially acid forming (PAF) material has been revised as discussed in Section 10.4.7. A comparison to the previous model from May 2023 (Appendix 6) is shown in Figure 14.7. Overall, there is a 48% reduction in total PAF tonnage within the optimised Whittle reporting shell.

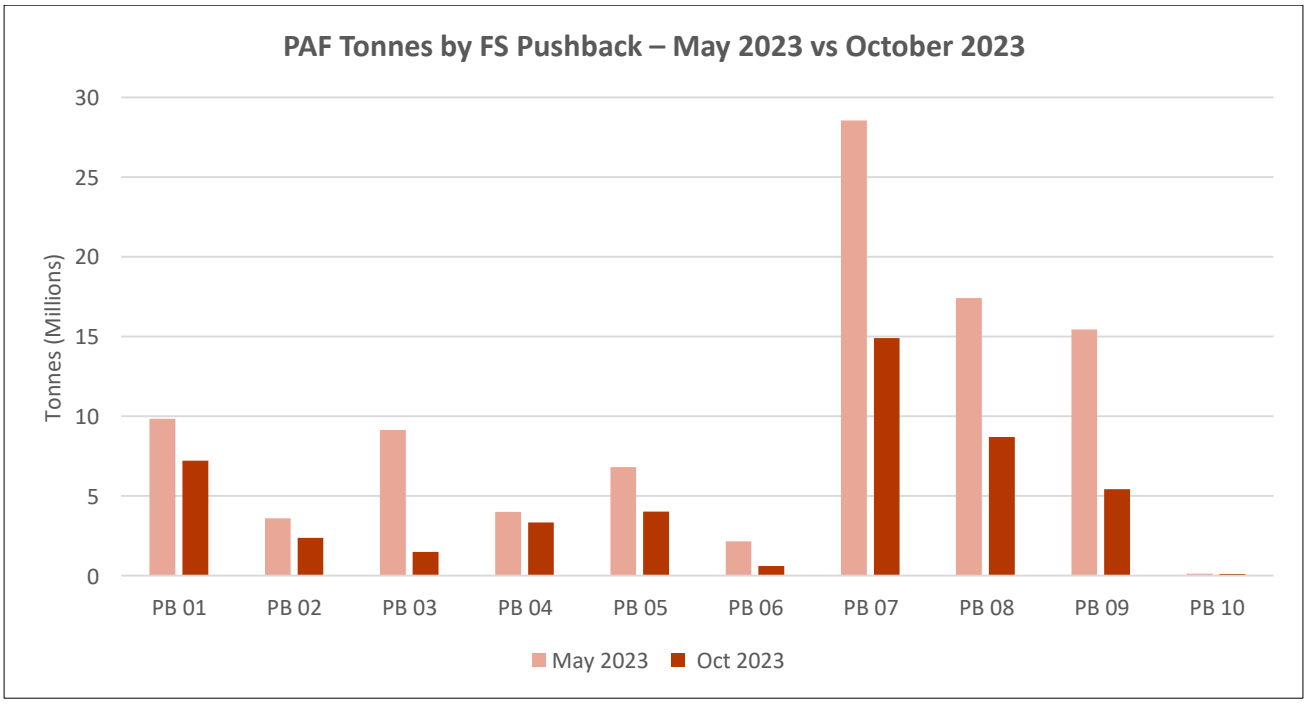


Figure 14.7 – Total PAF tonnage in the May 2023 and October 2023 models within 10 annual mining push-back designs.

The major contributor to this reduction is the modelling of the Katunga Dolomite (DOM 71) unit. In the previous update of May 2023 this unit wasn't distinguished as a separate domain with the result that it was treated as Basal Sequence (BSQ 70). This reinterpretation of DOM 71 effectively halves the proportion of sulphide rich BSQ 70 present (see Figure 7.6 to Figure 7.10), which in turn halves the proportion of PAF material designated.

14.5 Discussion on Relative Accuracy and Confidence

Conditional Simulation techniques were used to characterise the full space of uncertainty in the magnetite mineral resource, thereby providing a basis to quantify the accuracy in the mineral resource estimate. The work is based on data used in the May 2023 resource update. Only a summary of the work done is presented here, as a more complete description falls outside the scope of this mineral resource report.

14.5.1 Overview of Methodology

Thirty (30) unique realisations of the 14 geological model domains were developed using Sequential Indicator Simulation (SIS). Each of these unique geological realisations was then used as a basis for the simulation of mass recovery, Fe_H, Fe_C, SiO_2_H and SiO_2_C using Sequential Gaussian Simulation (SGS). Nodes were simulated at a 5 x 5 x 4m support and the relationships and correlations between the grade variables were accounted for through the application of the Stepwise Conditional Transform approach. The 30 resulting models were validated using statistical and visual techniques, regularised to a 20 x 25 x 4m support, and then post-processed to calculate confidence intervals for annual production volumes of 18 to 22 million tonnes, based on internal mine planning studies. The uncertainty model developed is thus a measure of local uncertainty for an annual mining volume of 18-22 million tonnes.

Figure 14.8 shows one realisation out of a total of 30 realisations of geology, Fe_H grade and mass recovery.

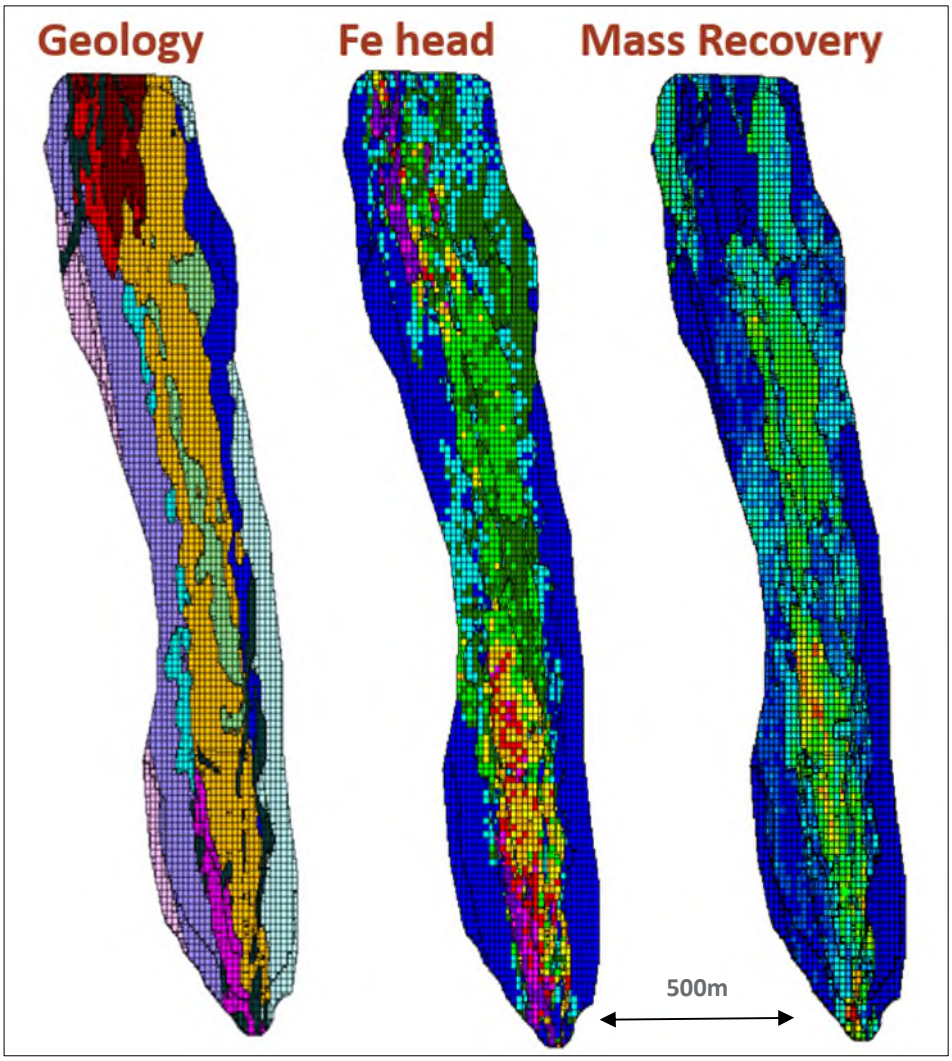


Figure 14.8 – Plan view showing one realisation of geology, Fe_H grade and mass recovery. A total of 30 realisations of each were developed to characterise the uncertainty in the reported magnetite mineral resource.

Figure 14.9 shows a plan view of 4 geological realisations over the Duchess South area, and Figure 14.10 shows three mass recovery realisations regularised to a 20 x 25 x 4m support.

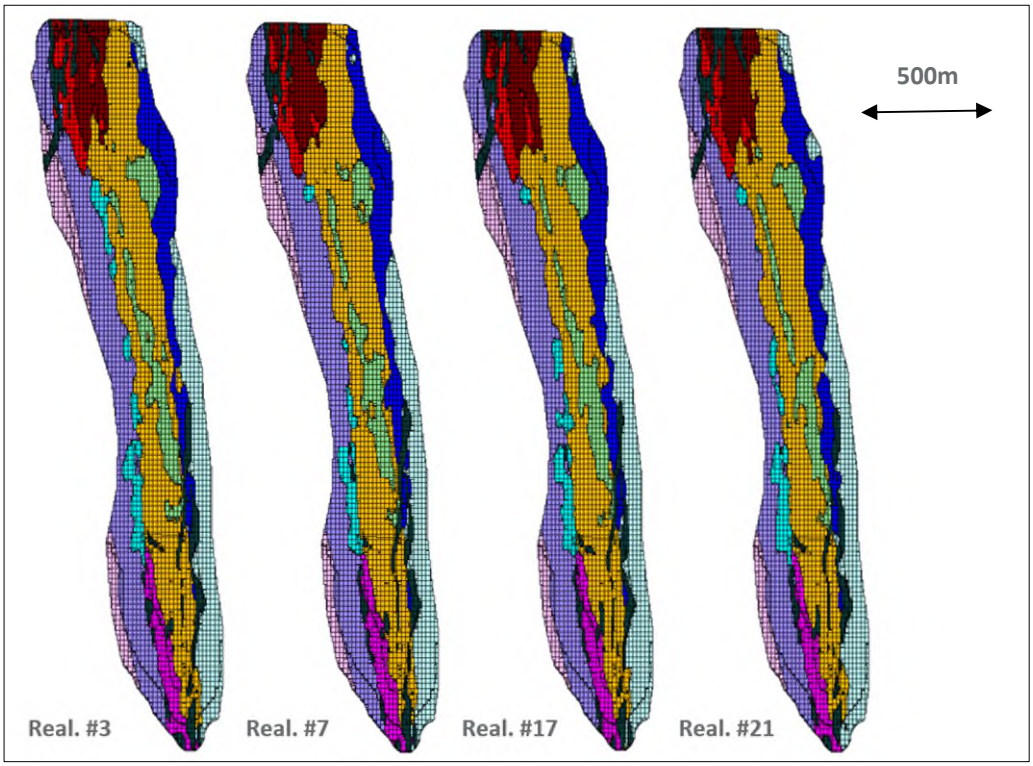


Figure 14.9 – Plan view over the Duchess South area showing four realisations of geological domain. Note the differences between realisations for thicker units such as MTS 40 (ORANGE) compared to thinner units such as SCH 46 (GREEN) and MSU 48 (LIGHT BLUE).

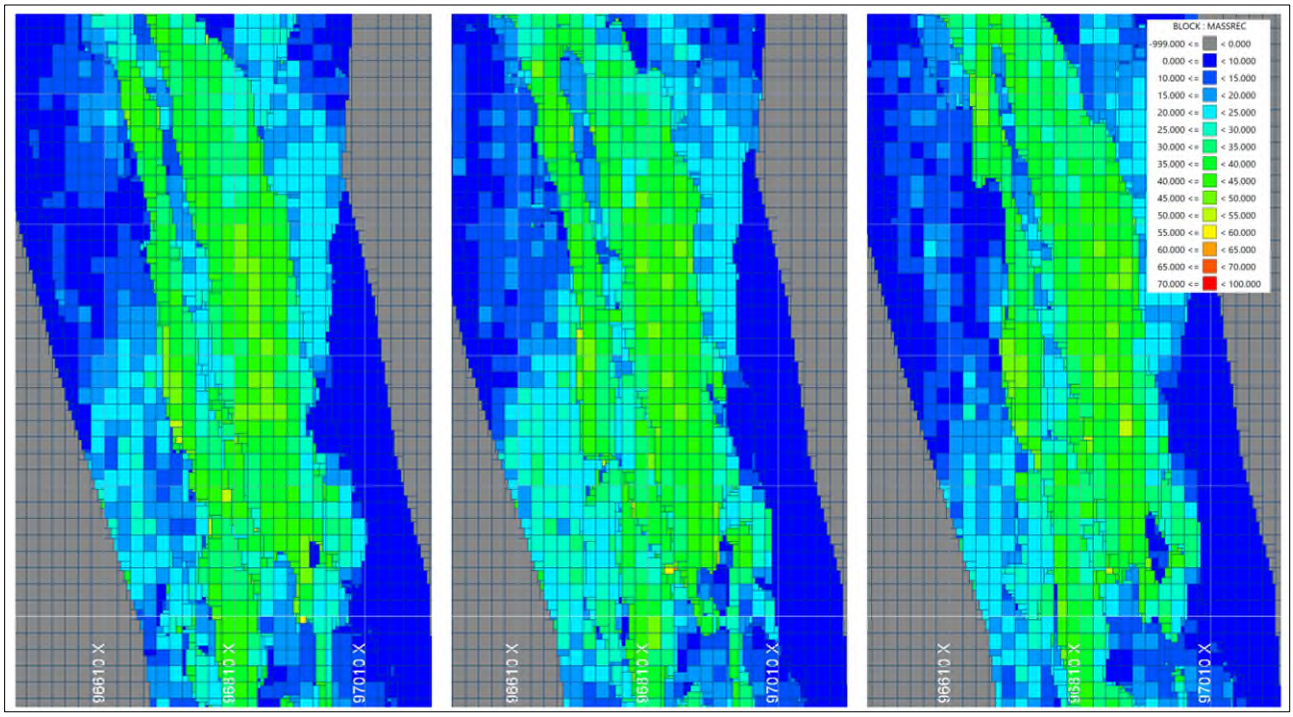


Figure 14.10 – Plan view over the Duchess South area showing realisations #1 (LEFT), #8 (CENTRE) and #14 (RIGHT) for mass recovery after regularisation to a 25 x 20 x 4m support.

14.5.2 Validation of Simulation Models

The SIS models of geology were validated visually against the drill hole data as well as the proportions of the geological model wireframes. SIS and M.A.P.S program parameters were iteratively adjusted until the average variation from the declustered drill hole proportions were within 5%.

The SGS realisations of grade have been exhaustively validated by statistical and visual means. Statistical validation consisted of comparisons of mean and standard deviation of declustered samples versus simulated values. An acceptable variation of within 5% was obtained for most domains. Scatter plots were used to assess the reproduction of the correlation and relationships between Fe and SiO_2, both after the Stepwise Conditional Transformation (SCT), and after the Stepwise Conditional Back-Transformation, with the key domains performing very well (Figure 14.11 and Figure 14.12).

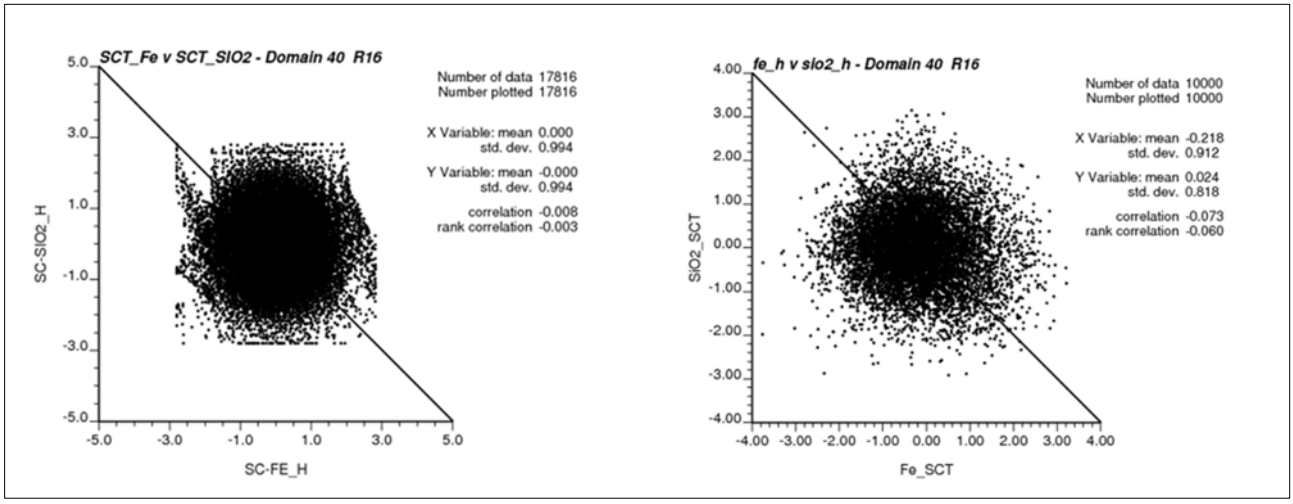


Figure 14.11 – Scatter plot showing Stepwise conditionally transformed samples (LEFT), and Stepwise conditionally transformed simulated nodes (RIGHT) of Fe_H versus SiO_2_H for domain MTS 40 realisation #16. The circular pattern demonstrates that the variables have been decorrelated prior to, and during, simulation – a necessary requirement.

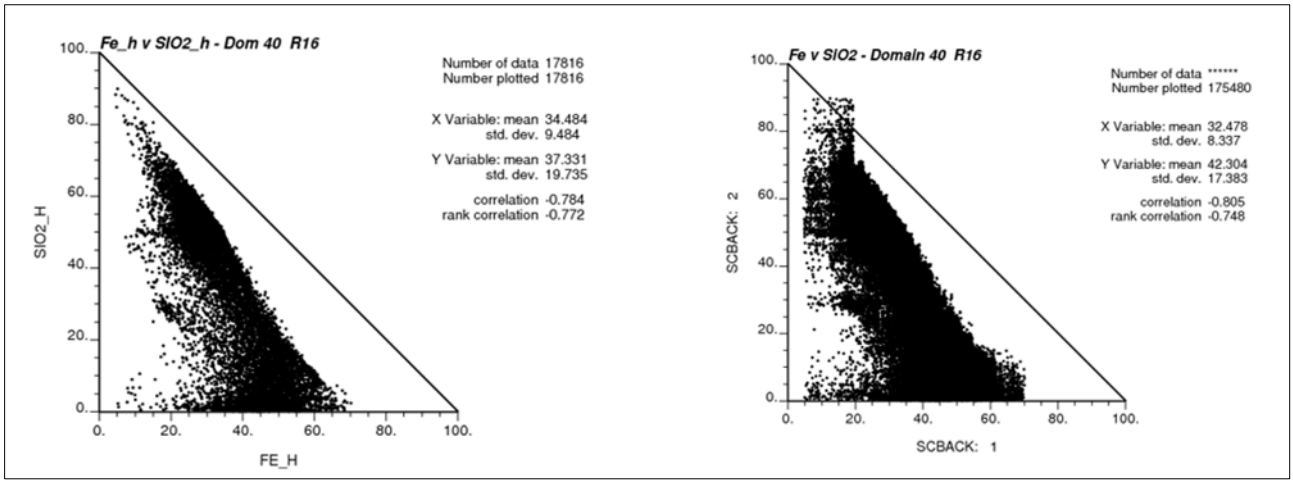


Figure 14.12 – Scatter plot showing naive samples (LEFT), and back-transformed simulated nodes (RIGHT) of Fe_H versus SiO_2_H for domain MTS 40 for realisation #16. The relationships observed in the samples have been successfully reproduced in the simulated nodes.

QQ plots were used to assess the reproduction of the histogram by comparing declustered samples to the simulated values. The larger domains such as MTS 40 performed very well with excellent reproduction (Figure 14.13 to Figure 14.17).

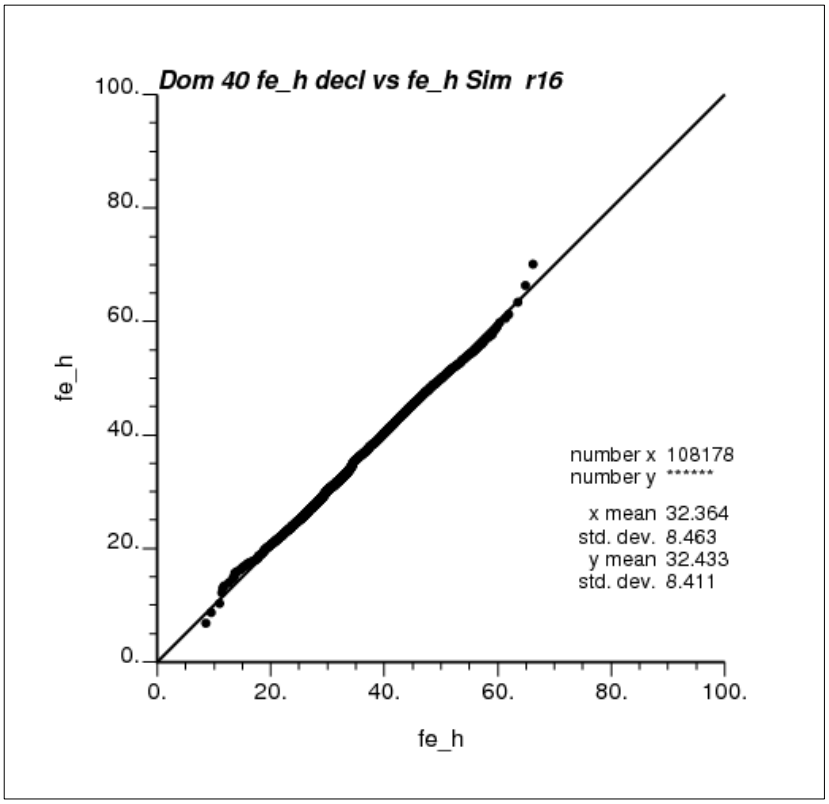


Figure 14.13 – QQ plot of Fe_H samples (horizontal axis) versus nodes (vertical axis) for realisation # 16 for domain MTS 40.

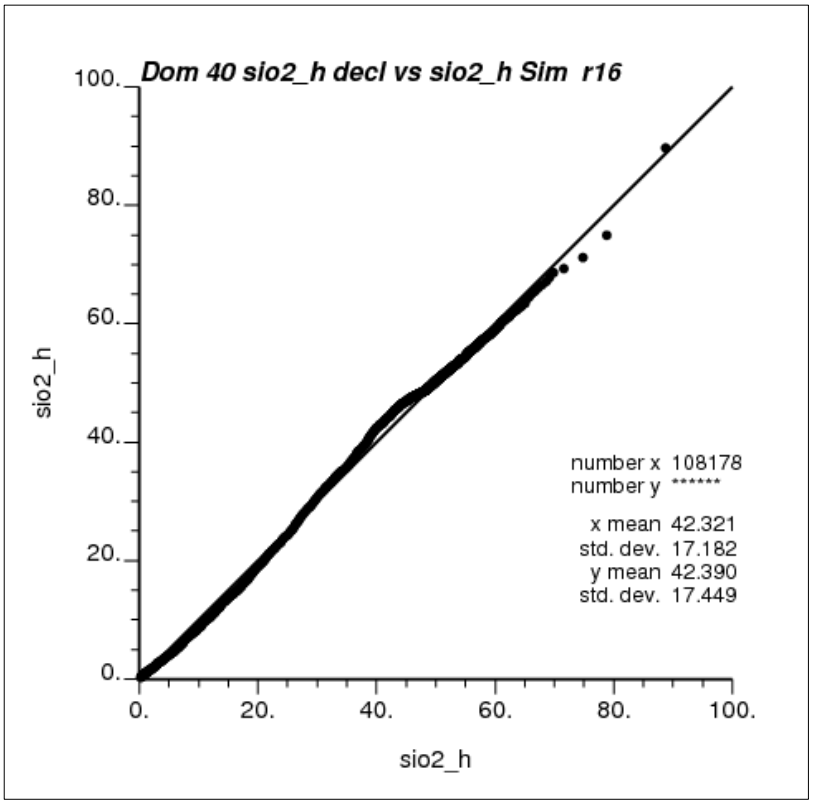


Figure 14.14 – QQ plot of SiO_2_H samples (horizontal axis) versus nodes (vertical axis) for realisation # 16 for domain MTS 40.

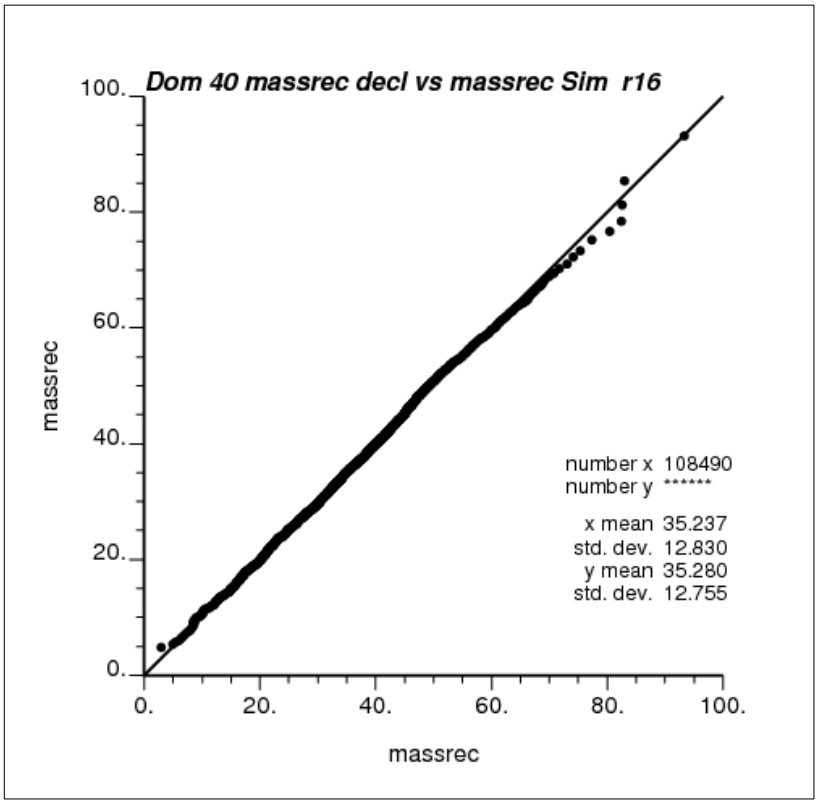


Figure 14.15 – QQ plot of mass recovery samples (horizontal axis) versus nodes (vertical axis) for realisation # 16 for domain MTS 40.

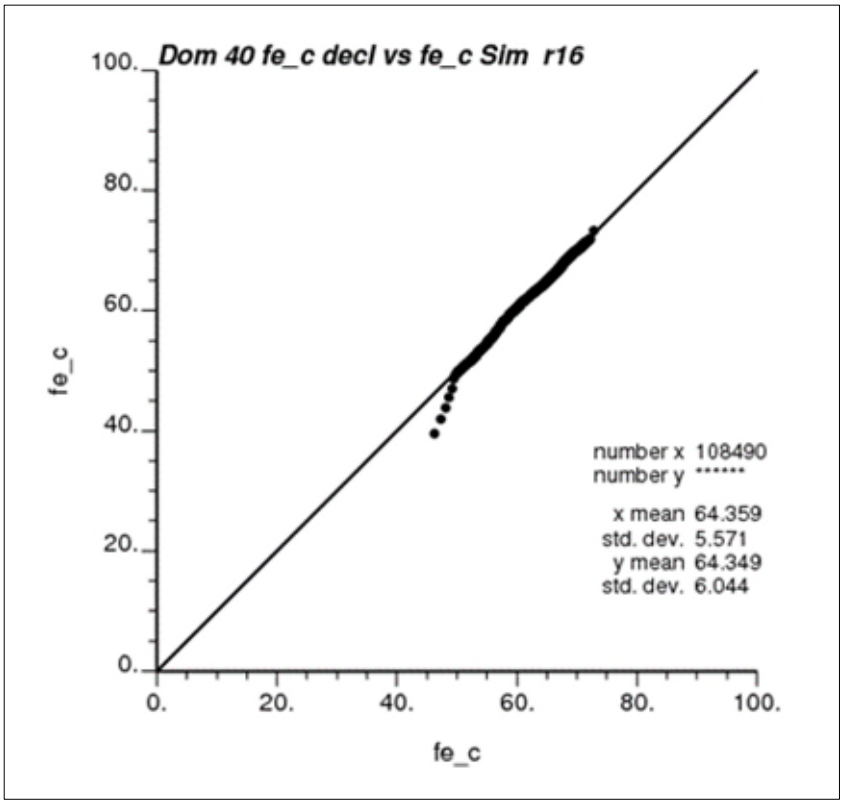


Figure 14.16 – QQ plot of Fe_C samples (horizontal axis) versus nodes (vertical axis) for realisation # 16 for domain MTS 40.

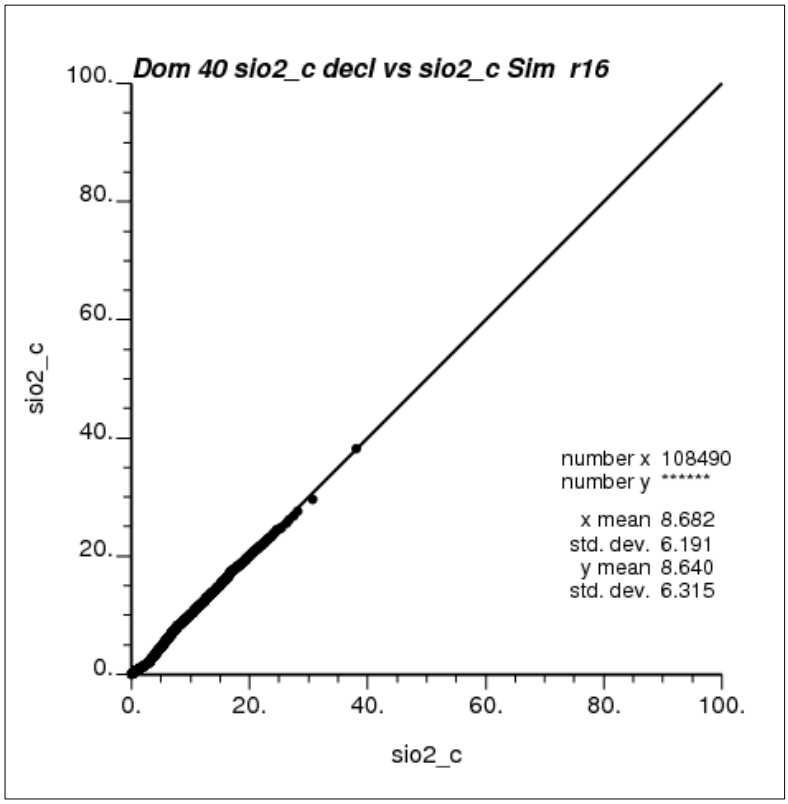


Figure 14.17 – QQ plot of SiO_2_C samples (horizontal axis) versus nodes (vertical axis) for realisation # 16 for domain MTS 40.

Figure 14.18 shows an example of the visual validation performed between the samples and regularised simulated nodes.

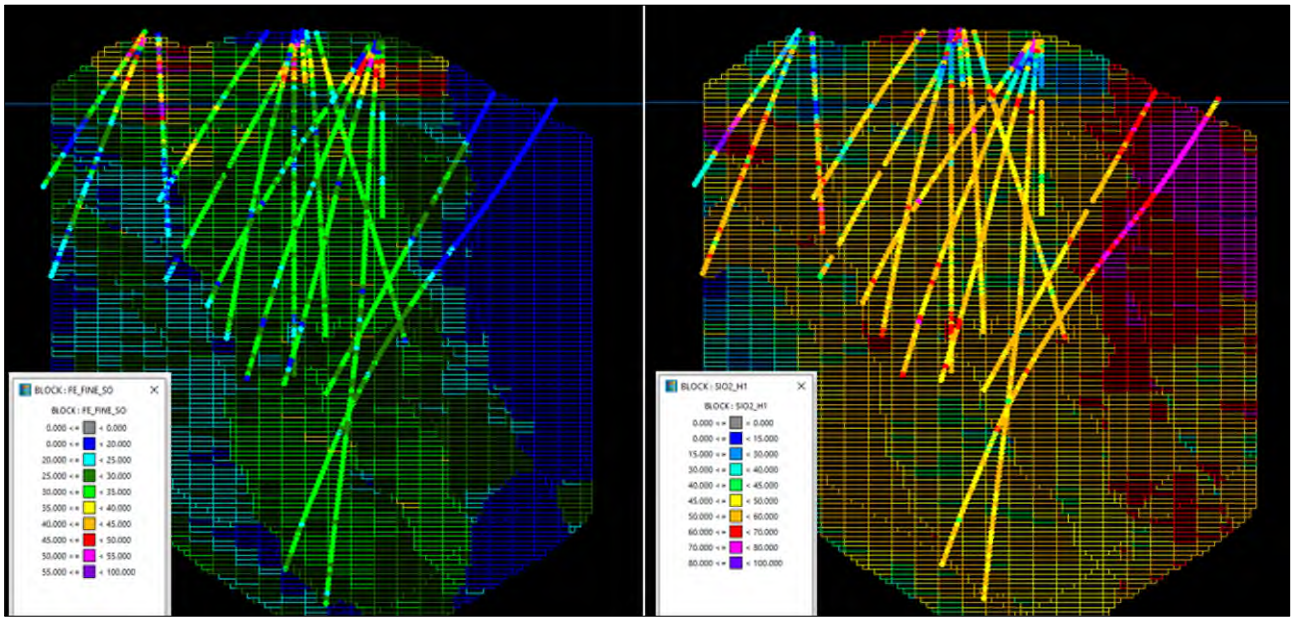


Figure 14.18 – Cross section through the Duchess South area showing the excellent match between samples grades and regularised nodes for Fe_H (LEFT) and SiO_2_H (RIGHT).

14.5.3 Uncertainty Outcomes

The expected variation at a 90% confidence interval in the volumes of the simulated geological domains, which reflect the nature of the contacts between domains, at a zero cut-off are shown in Table 14.15.

Table 14.15 – Expected variation in geological domain volume at a 90% confidence interval.

Domain	Variation in Volume (%)
AMP 10	± 0.9
BIF 20 and MBF 47	± 0.6
HEO 30	± 0.6
HEC 32	± 0.9
HBF 37	± 1.1
MTS 40	± 0.4
MTC 43	± 0.4
SCH 46	± 1.3
MSU 48	± 1.0
BSQ 70	± 0.9
DOM 71	Not assessed
ESZ 75	± 1.5
CGS 80	± 1.1
GRT 90	± 1.4

* Note the CGS 80 and GRT 90 domain variation is a consequence of relatively small volumes in the uncertainty model. DOM71 was not assessed in the May 2023 update as it only existed as a subset of the BSQ70 domain at the time. DOM71 is expected to yield the same uncertainty characteristics as BSQ70.

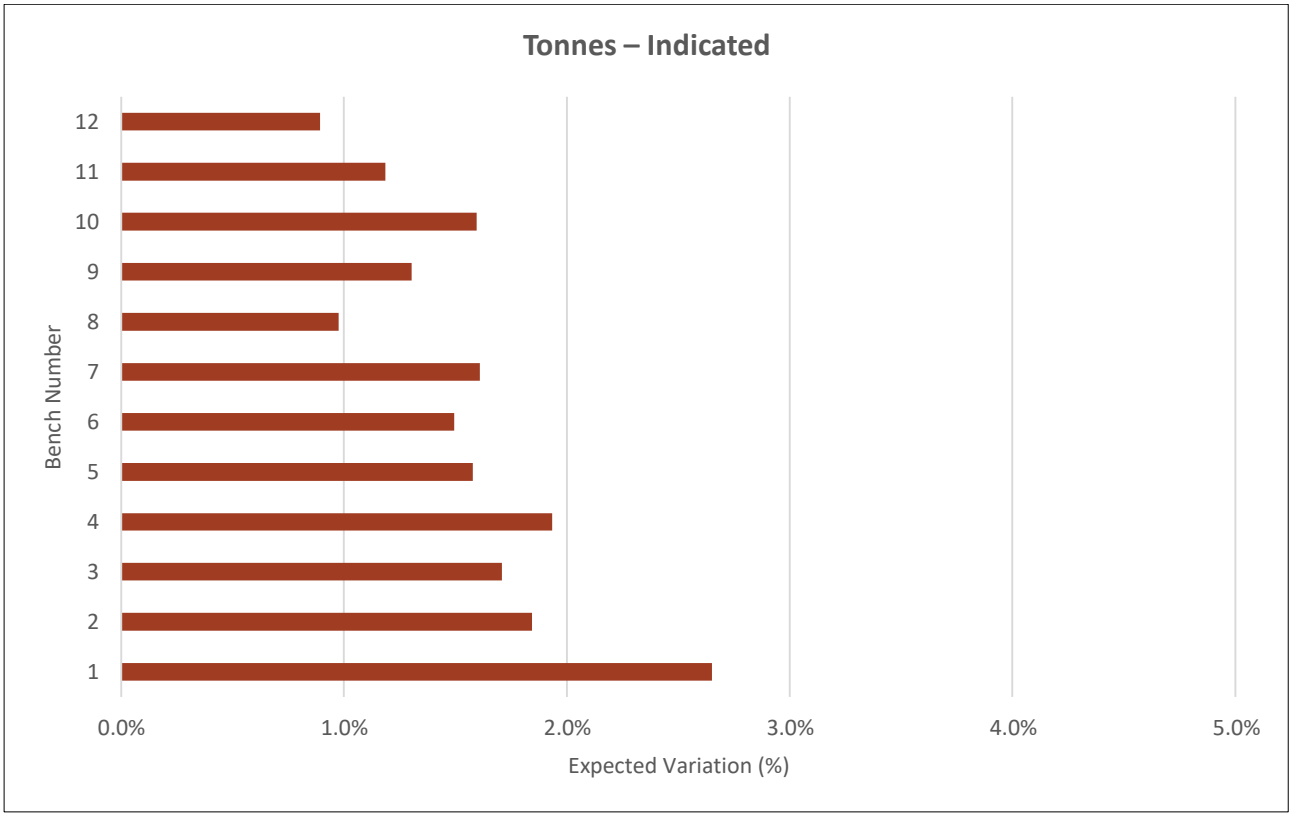
The expected variation in the tonnage and grade attributes of the magnetite mineral resource at a 90% confidence interval, for in-situ material below the 1 January 2023 mining surface. Inside Whittle Shell 57, and above a cut-off of MASSREC > 15 and FE_H > 15 and SiO_2_H < 70 and SiO_2_C < 30, is shown in table 14.16.

Table 14.16 – Expected annual variation in tonnes and grade attributes for the reported magnetite mineral resource at a 90% confidence interval.

Classification	Tonnes	Mass Rec	Fe_C	Fe_H	SiO_2_C	SiO_2_H
Measured	± 1.2 - 2.1%	± 2.0%	± 0.1%	± 0.5%	± 2.5%	± 1.3%
Indicated	± 2.1 – 5.1%	± 0.8%	± 0.2%	± 0.6%	± 1.6%	± 1.0%
Inferred	± 8 - 10%	± 2.6%	± 0.6%	± 1.3%	± 3.9%	± 1.4%

Annual variation in tonnes and grade is based on a proposed mining rate of 18-22mtpa.

Figure 14.19 to Figure 14.24 shows the differences in variation for Indicated and Inferred resource for mass recovery, Fe_H, SiO_2_H, Fe_C and SiO_2_C, on a bench basis within the reporting shell. Bench tonnages are notionally 18 to 22 mtpa. The expected variation in the Inferred resource is approximately four times that of the Indicated resource.



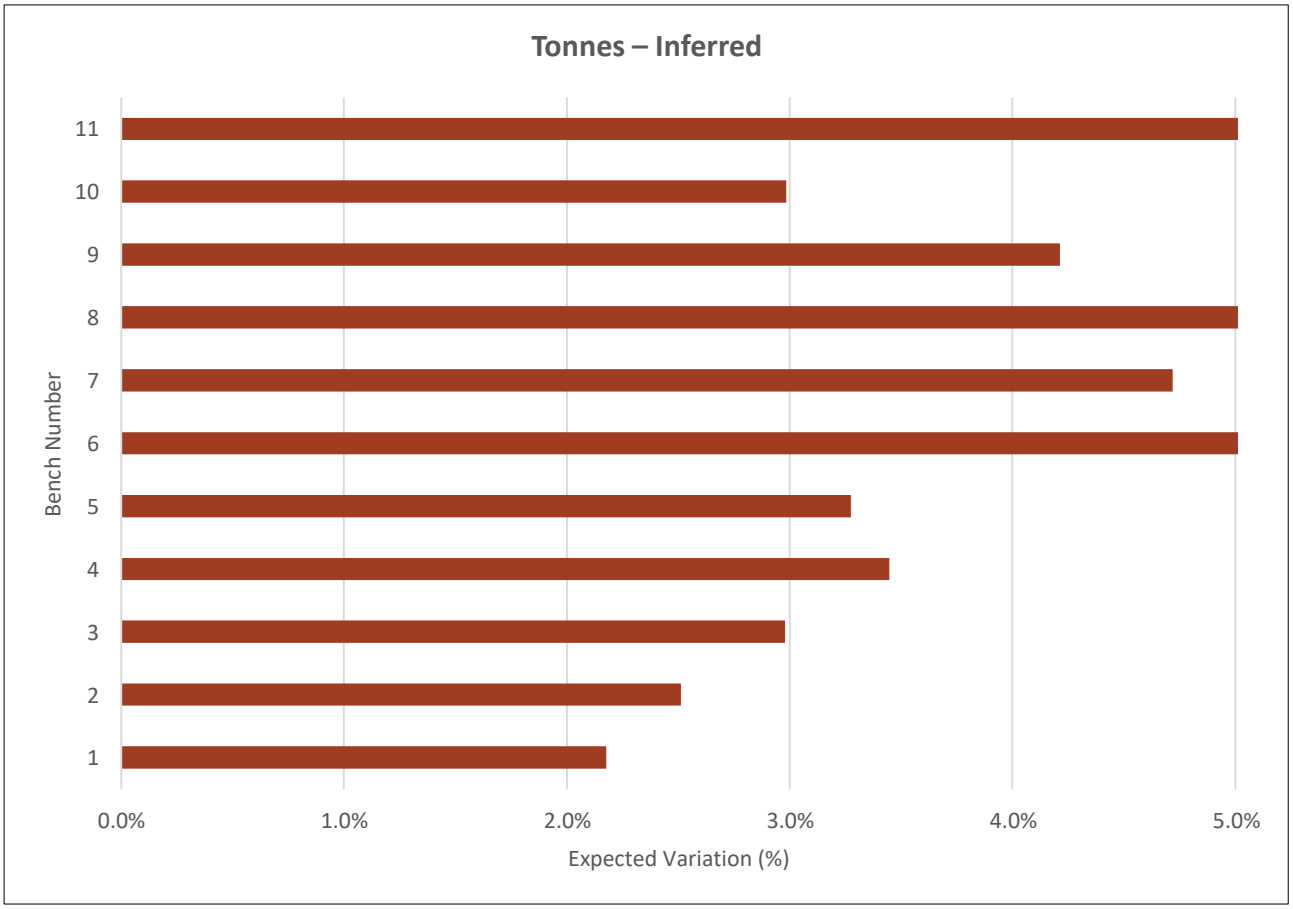
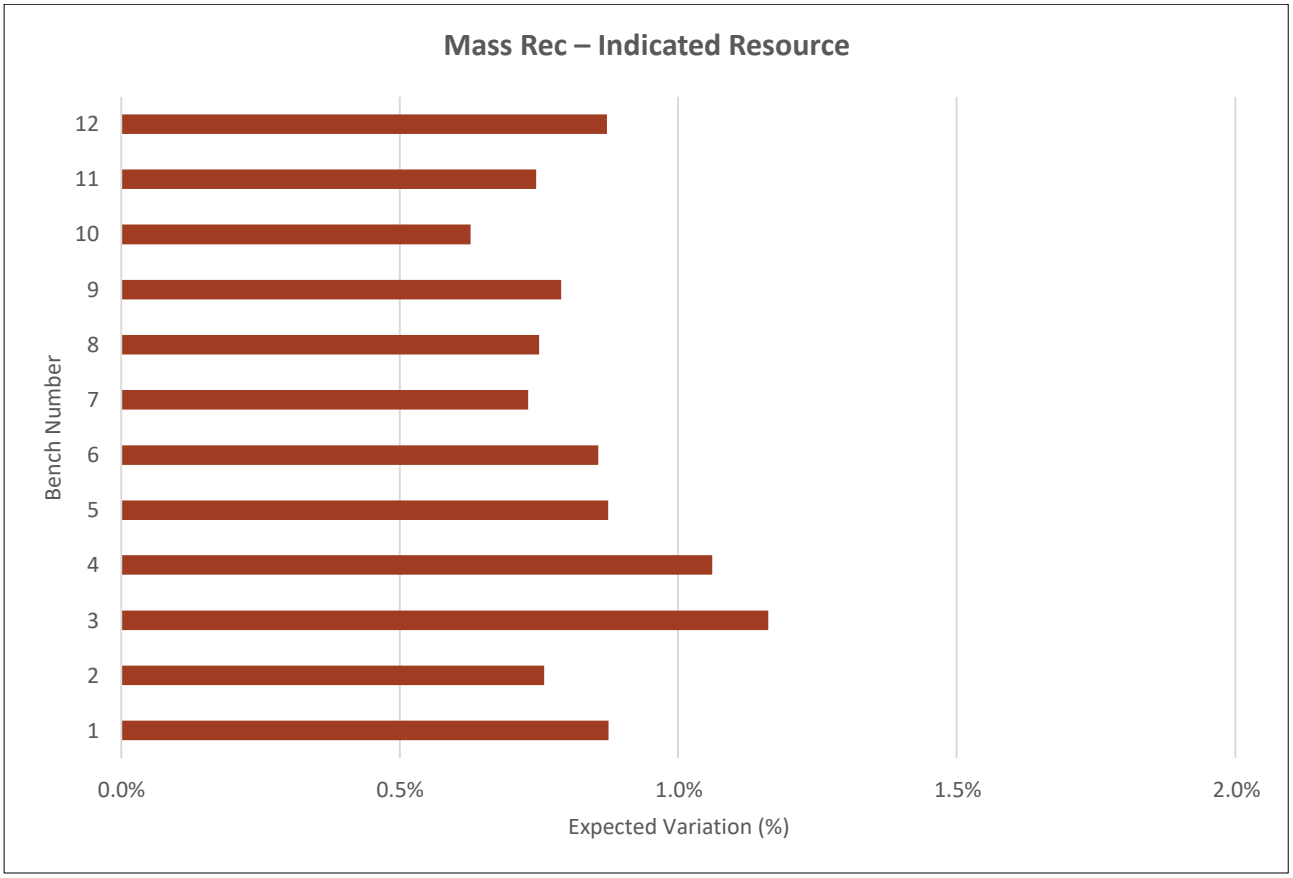


Figure 14.19 – Expected variation in tonnage for Indicated resource (TOP) and Inferred resource (BOTTOM) for the reported mineral resource. Benches are notionally 18 to 22mtpa.



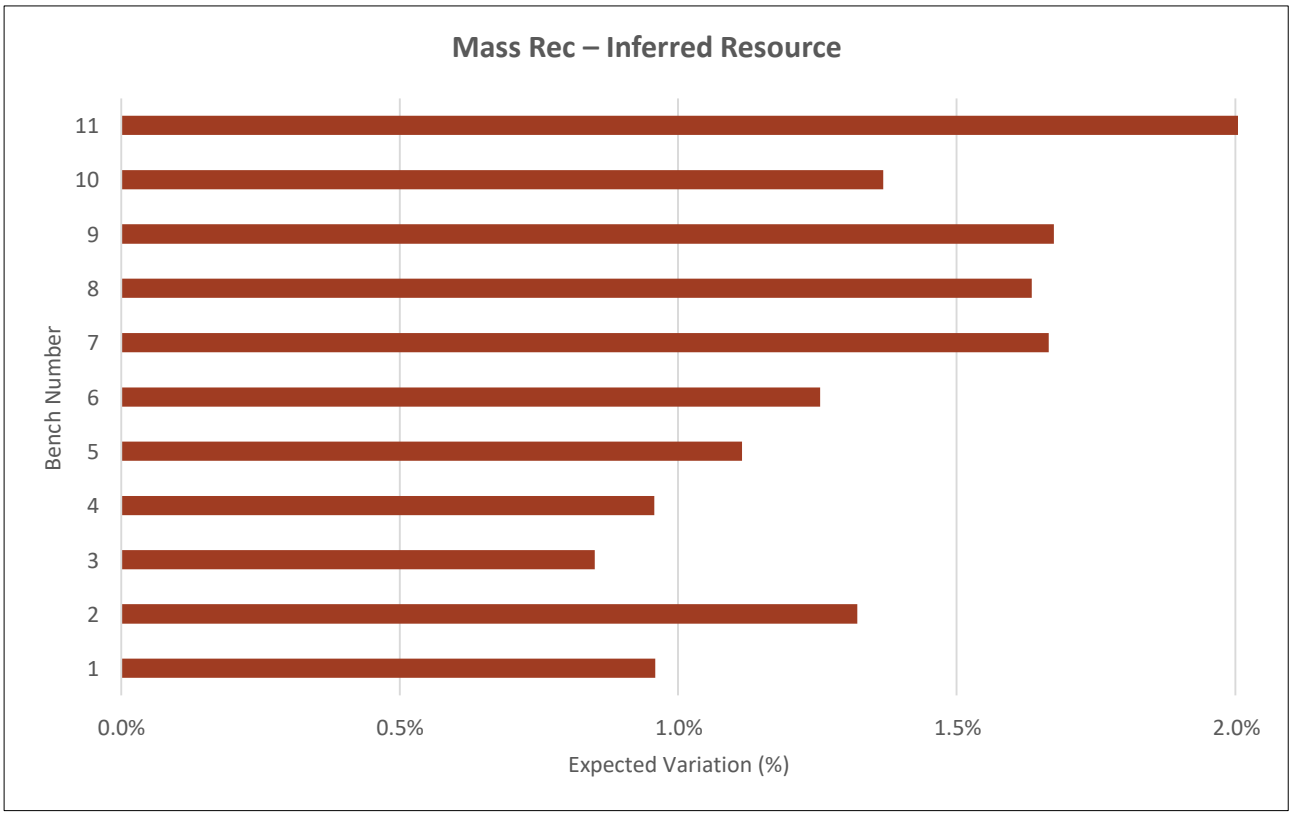


Figure 14.20 – Expected variation in mass recovery for Indicated resource (TOP) and Inferred resource (BOTTOM) for the reported mineral resource. Benches are notionally 18 to 22mtpa.

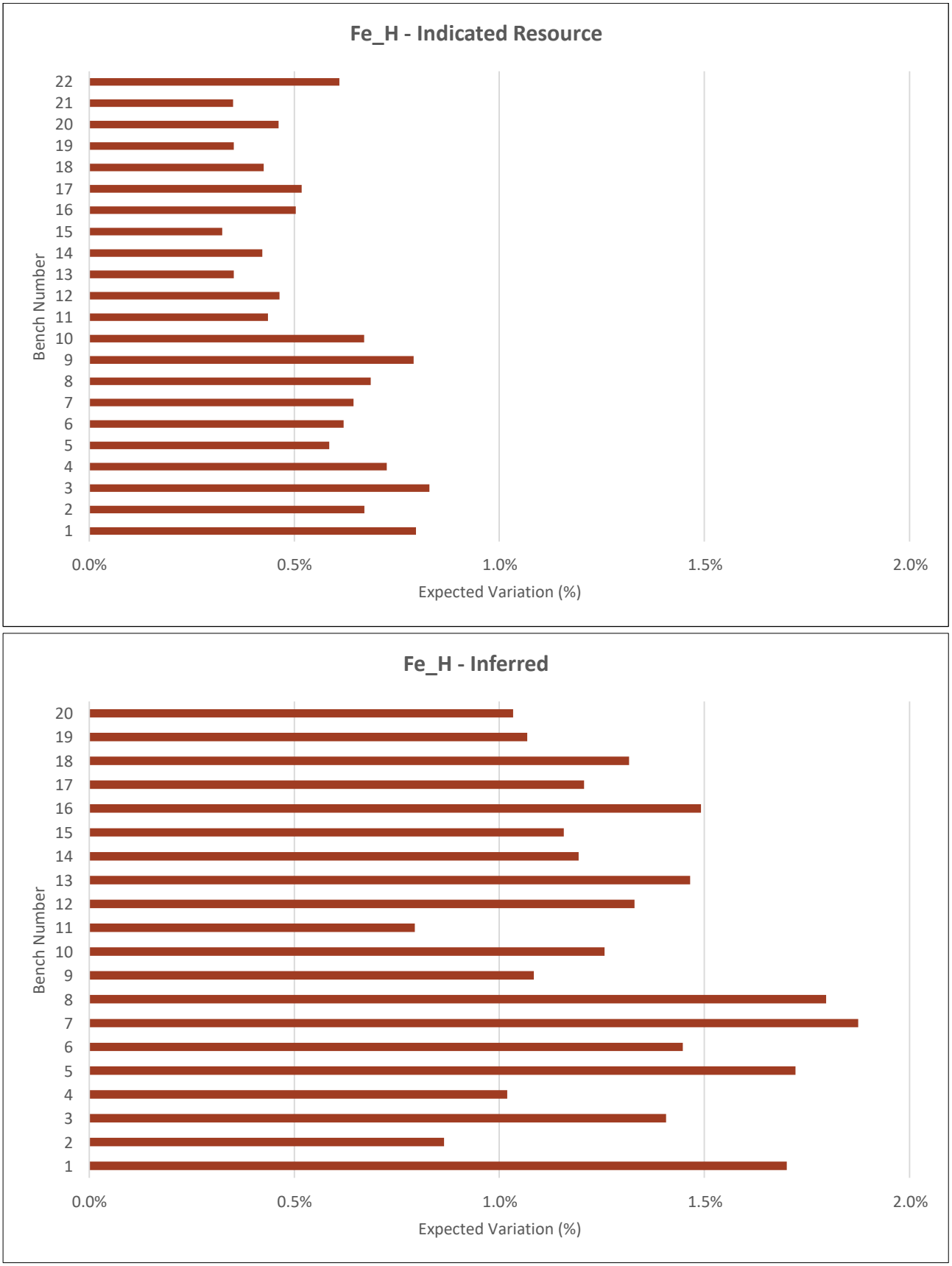
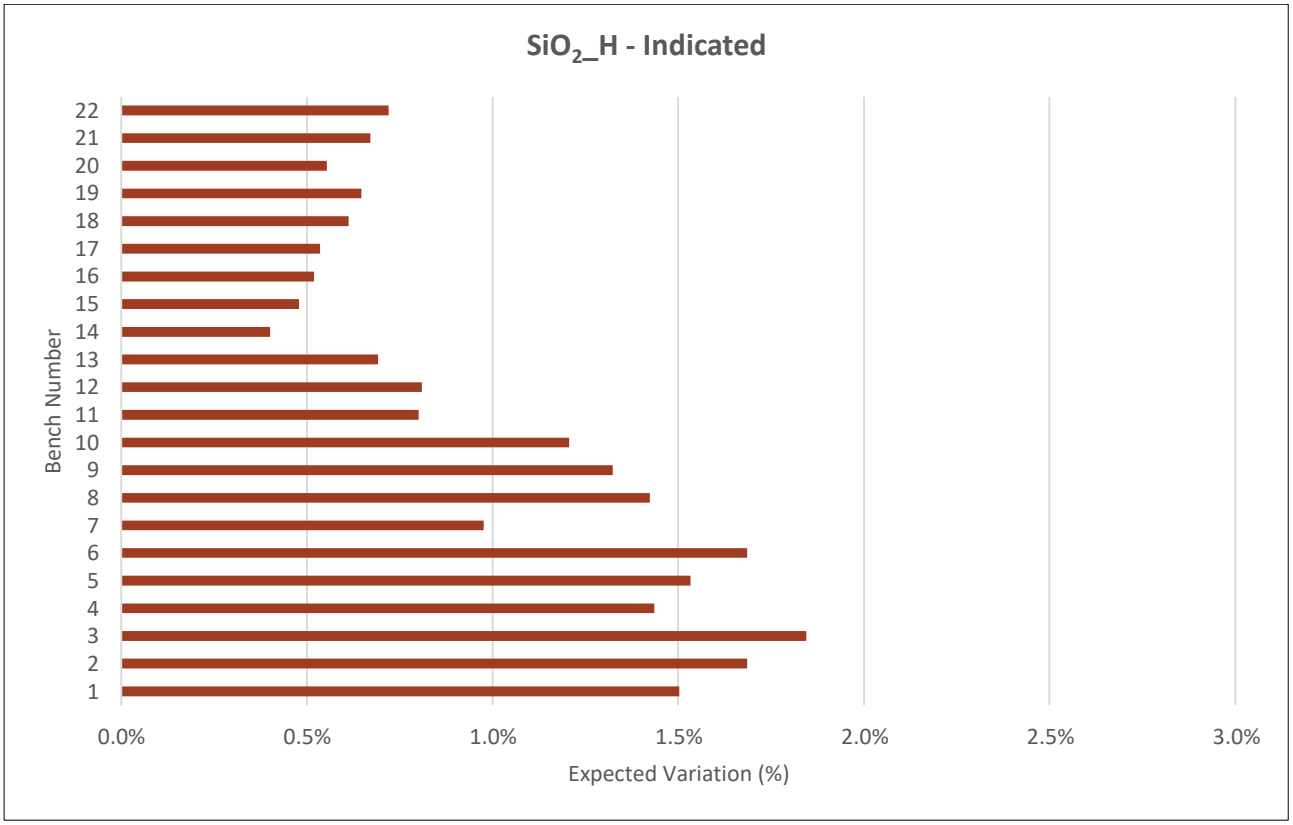


Figure 14.21 – Expected variation in Fe_H for Indicated resource (TOP) and Inferred resource (BOTTOM) for the reported mineral resource. Benches are notionally 18 to 22mtpa.



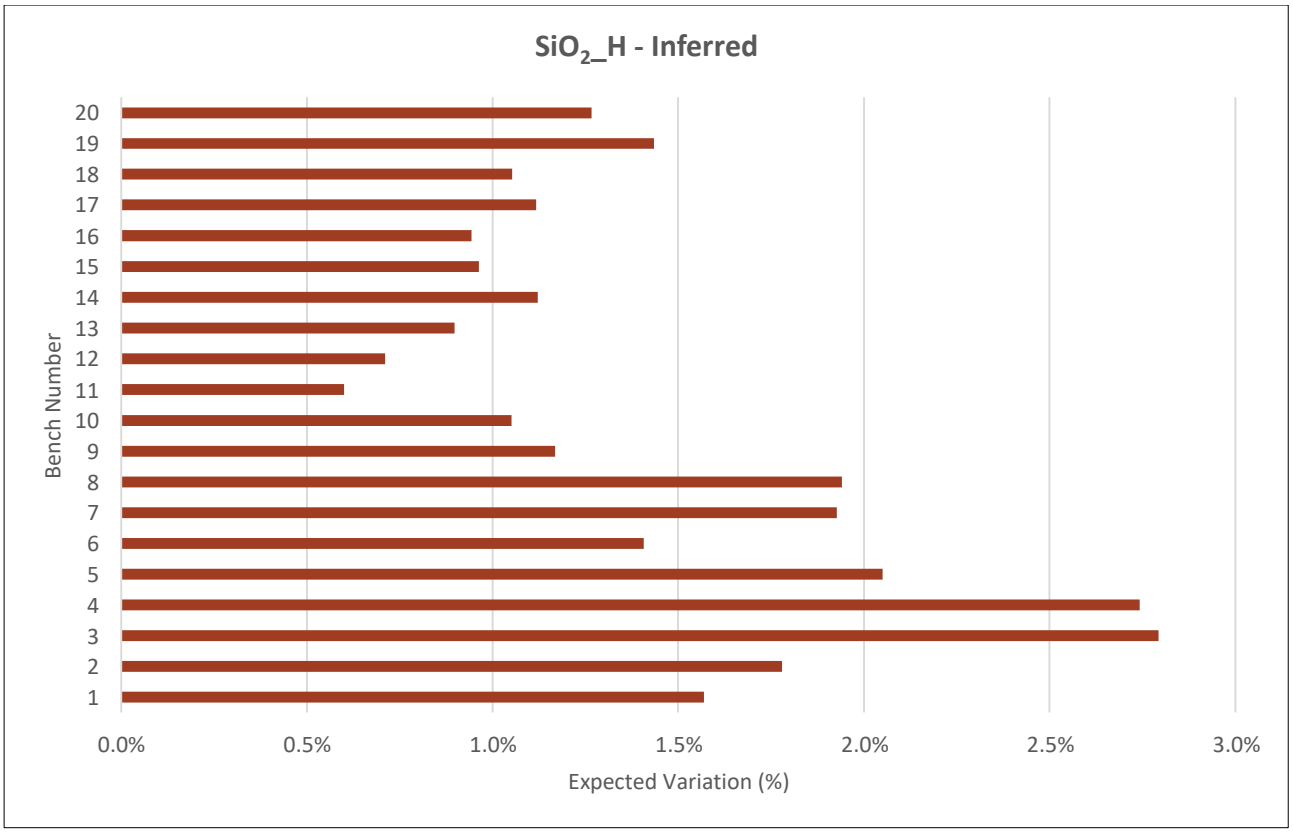


Figure 14.22 – Expected variation in SiO_2_H for Indicated resource (TOP) and Inferred resource (BOTTOM) for the reported mineral resource. Benches are notionally 18 to 22mtpa.

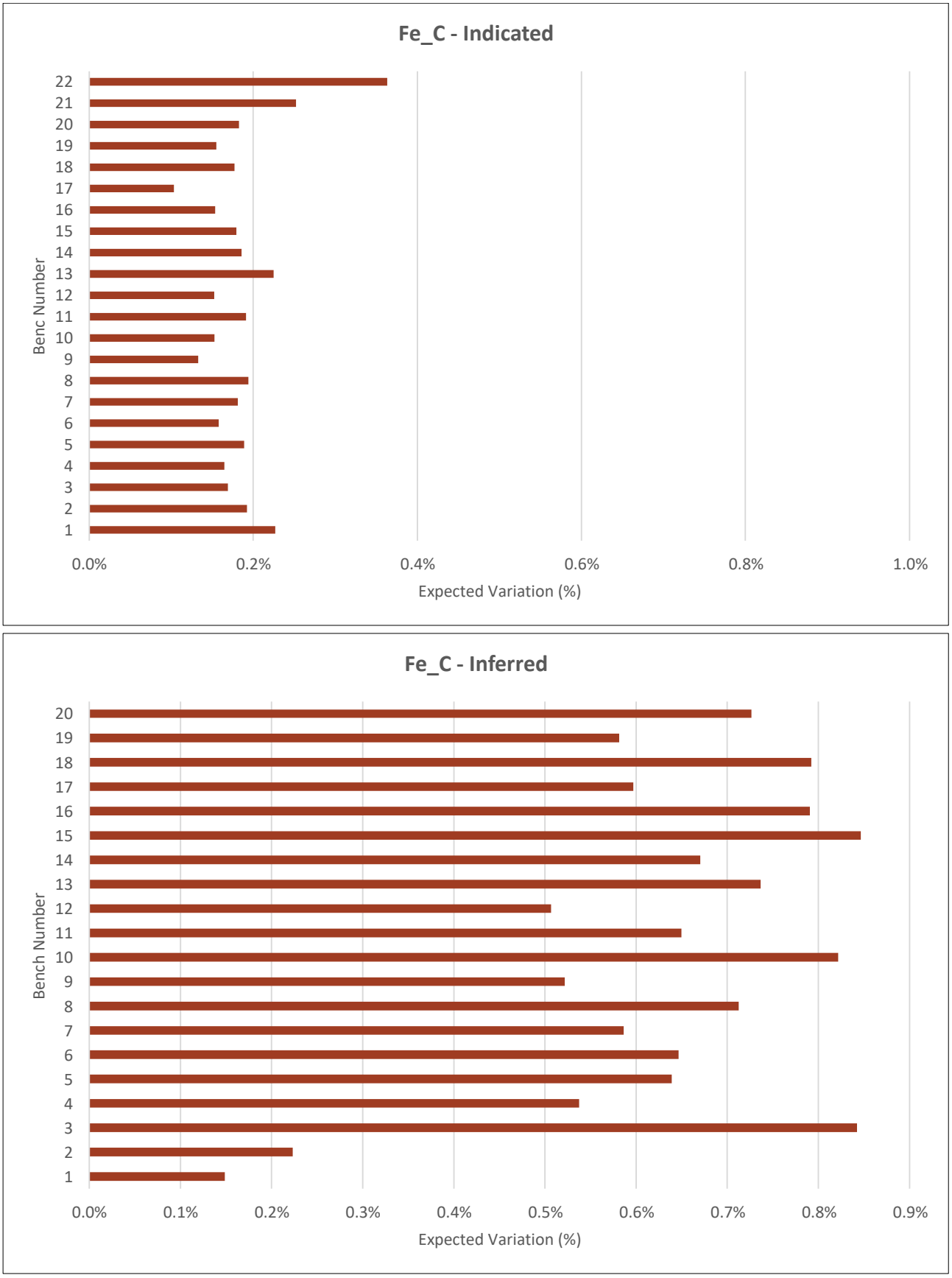


Figure 14.23 – Expected variation in Fe_C for Indicated resource (TOP) and Inferred resource (BOTTOM) for the reported mineral resource. Benches are notionally 18 to 22mtpa.

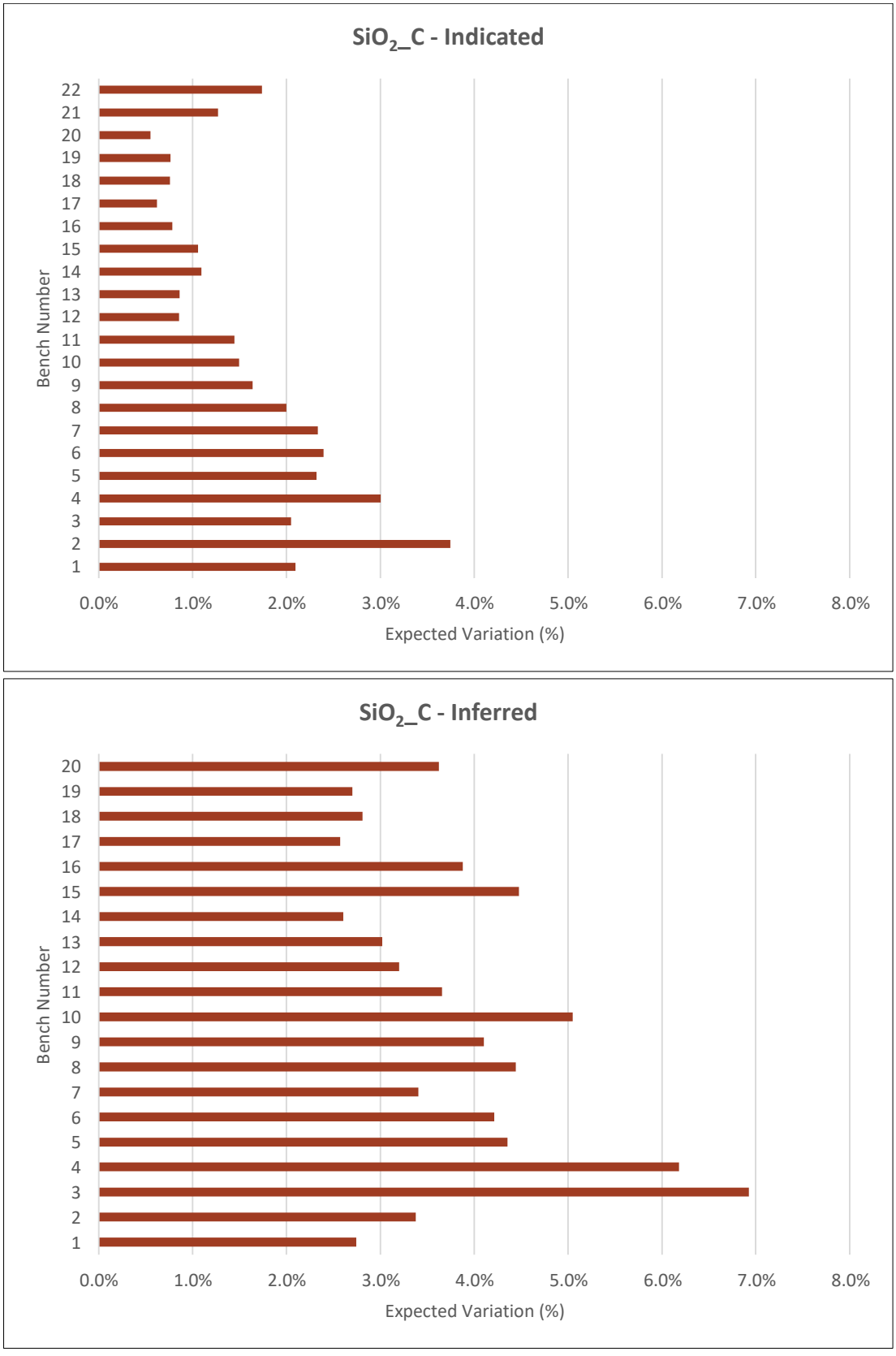


Figure 14.24 – Expected variation in SiO_2_C for Indicated resource (TOP) and Inferred resource (BOTTOM) for the reported mineral resource. Benches are notionally 18 to 22mtpa.

15 Conclusions

The Duchess South mineral resource update and statement has been prepared and reported in accordance with the JORC Code 2012 Edition. This update incorporates new drilling results across the Duchess South area, a revised geological model based on a robust litho-geochemical approach tested over many years of exploration and mining, and an updated approach to estimation of density.

The resource estimate has been extensively validated using traditional statistical approaches, exhaustive visual approaches, as well as an assessment of the expected smoothing using a robust change of support model. The mineral resource has been classified using the guidelines in the JORC 2012 Code, and the relative accuracy and confidence in the resource has been objectively defined on an expected annual mining basis using well-established conditional simulation techniques.

Seventeen (17) drill holes for specific geotechnical and metallurgical studies have not been included in this resource update. All of these are either diamond tails on existing RC pre-collar holes, or diamond core drilled from surface. At the time of writing, these are still undergoing consideration for metallurgical sampling, and it is unknown whether all the drill core will be destroyed for analysis. It is considered unlikely that any remaining core that is sampled will have a material effect on the resource estimate, and thus no further resource updates to the Duchess South area are warranted.

16 Acknowledgements

This report includes contributions from several persons, principally:

- Chiedza Nematadzira
- Matthew Peacock
- Shane O'Connell
- Rob Deceukelaire
- Scott Kneebone
- Shannon Nielsen

17 List of Appendices

Appendix 1 – QAQC Reports

Appendix 2 – Use of Service Variable in Estimation Memorandum

Appendix 3 – Head Grade Variography

Appendix 4 – Density Variography

Appendix 5 – Concentrate Grade Variography

Appendix 6 – NAPP and ANC Estimation Memorandum

Appendix 7 – Pit Shell Optimisation Memorandum

Appendix 8 – Mining Model Preparation Memorandum

JORC Code, 2012 Edition – Table 1

Section 1 Sampling Techniques and Data

(Criteria in this section apply to all succeeding sections.)

Criteria	JORC Code explanation	Commentary
Sampling techniques	• *Nature and quality of sampling (eg cut channels, random chips, or specific specialised industry standard measurement tools appropriate to the minerals under investigation, such as down hole gamma sondes, or handheld XRF instruments, etc). These examples should not be taken as limiting the broad meaning of sampling.* • *Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.* • *Aspects of the determination of mineralisation that are Material to the Public Report.* • *In cases where 'industry standard' work has been done this would be relatively simple (eg 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverised to produce a 30 g charge for fire assay'). In other cases more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralisation types (eg submarine nodules) may warrant disclosure of detailed information.*	All samples for assay are derived from chips from percussion drilling, and hard rock core samples derived from diamond drilling. Prior to 2003, samples were collected from open hole percussion (OHP), reverse circulation (RC) chips and diamond drill (DD) core samples. Between 2005 and 2023, samples were collected from RC chips and DD core only. RC samples are collected over 2m intervals. DD core is sampled over 1 to 2m intervals, depending on the position of observed geological contacts. Prior to 2011 most beneficiation samples were collected at 4m intervals, with some 2m sample intervals in use between 2011 and 2012. Between 2012 and 2018 there was no beneficiation sampling undertaken. From 2018 onwards, beneficiation samples were collected at 8m intervals, with some 4m intervals in the most recent drilling in the Iron Magnet Pit. Density data was collected from geophysical wireline logging, typically at 10cm intervals, from the bottom of the hole to the collar. The probe is calibrated to material of known density on a regular basis, and detailed calibration reports are submitted at the end of every logging campaign.
Drilling techniques	• *Drill type (eg core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc) and details (eg core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or other type, whether core is oriented and if so, by what method, etc).*	There have been several drilling campaigns over Duchess South from 1958 onwards. Historically, open hole percussion (OHP) drilling, and variants thereof, was the dominant percussion drilling technique but was phased out in favour of modern RC percussion drilling variants from 1988 onward. By 2005, RC using a 5¼ and/or 5½ inch face sampling hammer was the only percussion drilling technique in use. Sonic drilling was only ever used on waste rock dump investigation. HQ3 and NQ DD drilling are occasionally used for geotechnical and geometallurgical investigative purposes, or where select RC holes require diamond tails for geological investigation at depth (deepest is 753.6m below

<table>
<tr><th>Criteria</th><th>JORC Code explanation</th><th>Commentary</th></tr>
<tr><td></td><td></td><td>collar). All core is orientated using a REFLEX or CHAMPORI real-time in-barrel electronic orientation tool for every core run drilled. The total number of drill holes in the area is 2,185.
<table>
<tr><th>Method</th><th>Drilled Lengths (km)</th><th>%</th></tr>
<tr><td>Open Hole Percussion</td><td>32.9</td><td>11</td></tr>
<tr><td>Air Core</td><td>6.0</td><td>2</td></tr>
<tr><td>Sonic</td><td>1.2</td><td><1</td></tr>
<tr><td>Reverse Circulation</td><td>136.9</td><td>45</td></tr>
<tr><td>Reverse Circulation Cross-Over Sub</td><td>1.2</td><td><1</td></tr>
<tr><td>Reverse Circulation Hollow Hammer</td><td>76.6</td><td>25</td></tr>
<tr><td>Diamond Drill</td><td>48.0</td><td>16</td></tr>
<tr><td>Unknown</td><td>4.6</td><td><1</td></tr>
<tr><td>TOTAL</td><td>307.5</td><td>100</td></tr>
</table></td></tr>
<tr><td>Drill sample recovery</td><td>• Method of recording and assessing core and chip sample recoveries and results assessed.
• Measures taken to maximise sample recovery and ensure representative nature of the samples.
• Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.</td><td>DD core sample recovery is determined through traditional comparison of actual core length measured by the logging geologist versus drilled core length as recorded by the driller. Core recovery is typically 99% across holes, and within mineralised zones.

RC sample recovery is recorded for every hole at the time of logging using a subjective visual assessment of the expected volume and weight of the sample for a given lithology, drilling type, bit diameter and sample length. Fines material is also captured in the samples by means of a cyclonic dust extractor unit.

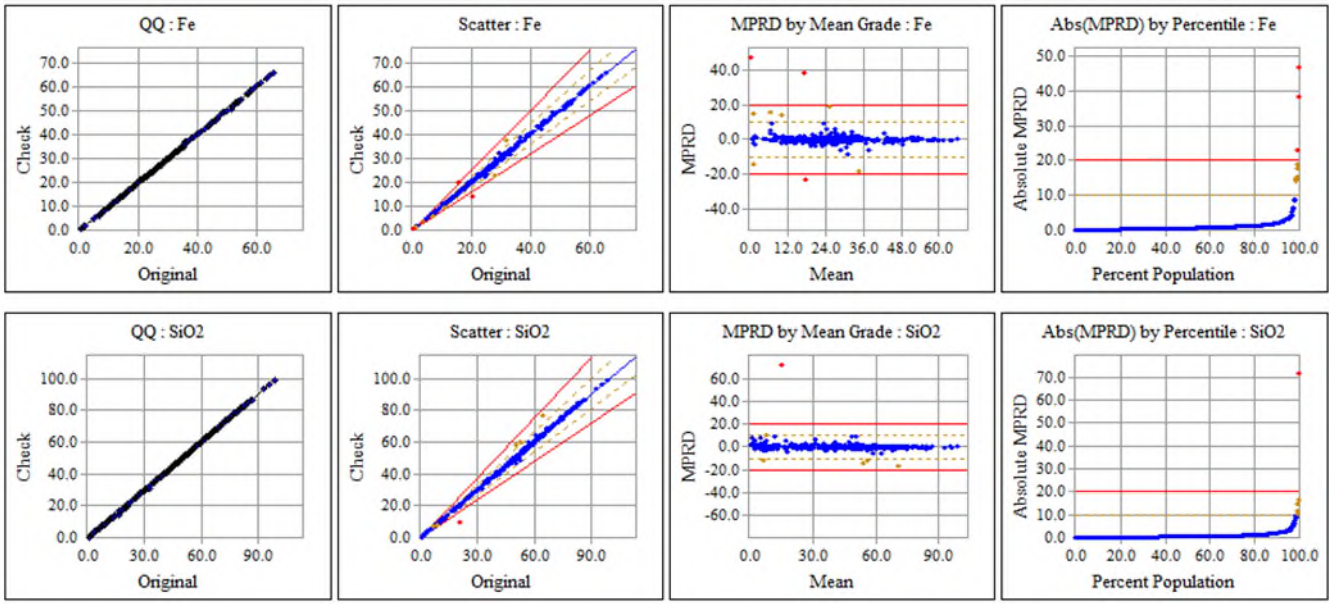
No relationships have been determined between sample recovery and grade.</td></tr>
<tr><td>Logging</td><td>• Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.
• Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc) photography.
• The total length and percentage of the relevant intersections logged.</td><td>Both RC chip and DD core samples are initially qualitatively logged and then cross-checked with resulting whole rock XRF analysis prior to assigning a final geological logging code. The level of detail in the logging is appropriate for all estimation, mining, and metallurgical studies.

97% of all 307.5km of drilling is geologically logged.</td></tr>
<tr><td>Sub-sampling techniques and sample preparation</td><td>• If core, whether cut or sawn and whether quarter, half or all core taken.
• If non-core, whether riffled, tube sampled, rotary split, etc and whether sampled wet or dry.
• For all sample types, the nature, quality and appropriateness of the sample preparation technique.</td><td>DD sample core is sawn, half being available for sampling, and the remaining half retained for future needs. In some cases, core is quartered if material is required for further environmental or geometallurgical testing purposes, and in some cases the entire core is submitted for test work. All core is photographed prior to sampling.

RC samples typically exceed 30kg and are reduced to between 2-5kg using a drill rig mounted cyclone and dust collector, and then split using a three-stage riffle splitter (pre-2014) or cone splitter (post-2014). Samples are</td></tr>
</table>

Criteria	JORC Code explanation	Commentary
	• *Quality control procedures adopted for all sub-sampling stages to maximise representivity of samples.* • *Measures taken to ensure that the sampling is representative of the in situ material collected, including for instance results for field duplicate/second-half sampling.* • *Whether sample sizes are appropriate to the grain size of the material being sampled.*	collected in calico bags directly from the drill rig mounted splitter. In-field duplicate samples, as well as blank samples, are inserted by the responsible rig geologist at a rate of 1 in 15 samples. Almost all sampling is dry sampling, with <1% of total samples recorded as occurring in moist or wet conditions. The rig geologists routinely monitor and audit drilling activities to ensure drilling and sampling standards are maintained. Sample sizes are appropriate for the grain size of the sampled material.
Quality of assay data and laboratory tests	• *The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.* • *For geophysical tools, spectrometers, handheld XRF instruments, etc, the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.* • *Nature of quality control procedures adopted (eg standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (ie lack of bias) and precision have been established.*	Sample preparation and assaying is done at Bureau Veritas Laboratory (BV) in Whyalla, which is NATA and ISO accredited. Samples are checked, sorted, and dried in a gas fired oven at 105° for a minimum of 4 hours, then weighed. Dried samples are crushed to P100 -3mm by a Boyd crusher and riffle split to obtain a 1.5kg sample for pulverisation. Reject material is typically stored for a minimum of 3 months. The crushed 1.5kg sample is robotically pulverised to P90 75µm, and a cone split performed to obtain a 200g homogenised sample for analysis. For head assay analysis, two sub-samples are taken from the 200g pulverised sample. The first sub-sample of 0.72g is fused with lithium borate flux to form a glass disc and analysed by XRF for Fe, SiO_2, Al_2O_3, P, CaO, Cu, Pb, Ba, V, MgO, Mn, S, TiO_2, Na_2O, Zn and K_2O. As, Co, Cr, Ni and Sn were added to the analysis suite from 2018 onwards. The second sub-sample of 1g is used to determine Loss of Ignition (LOI). The sample is dried in an oven at 105°, then weighed, placed in a temperature-controlled environment at 1,000° for an hour, cooled and re-weighed. The difference in weight is the LOI. Positive LOI values occur when mass is lost, whilst negative LOI values occur where mass is gained, typically when magnetite (Fe_3O_4) oxidises to haematite (Fe_2O_3). Reject sample material from the primary crusher split is physically composited to either 4m or 8m for magnetite (concentrate) analysis. Compositing is performed under instruction from exploration geology and based on logged geology, the XRF head assay result, and magnetic saturation (SATMAGAN) of the sample. Further sample preparation has varied over the years. Between1993-2013, samples were crushed to P100 850µm and riffle split to obtain a 1kg sub-sample, then iteratively dry ground in an LM2 pulveriser in 2-minute increments until the sample passes P80 45µm. From 2013 onwards the samples rotary/riffle split to obtain a 1kg sub-sample, then wet ground to P80 38µm in rod mills. Ground samples from both sample preparation variants are filter pressed and dried at 105° for 12 hours, after which a sub-sample of 20 to 100g is passed to Davis Tube Recovery (DTR) analysis. DTR is performed using a stroke frequency of 60 strokes / minute, a stroke length of 38mm, magnetic field strength of 3,000 Gauss, tube angle of 45°, tube diameter of 25mm, and water flow rate of 540ml / minute, for 15 minutes or until the wash water is clear. The mass recovery is the proportion of the sample reporting to the magnetic stream. For concentrate analysis, the total sample, the magnetic fraction, and the non-magnetic fraction are prepared for XRF using the fusion technique described earlier. Analysis is performed for Fe, SiO_2, Al_2O_3 , P, CaO, MgO, Mn,

Criteria	JORC Code explanation	Commentary
		S, TiO_2, Na_2O and K_2O. LOI is calculated on all three fractions using the same method as in the head assay analysis. Thorough QAQC procedures are employed to verify the accuracy and precision of assay results reported by the laboratory. Regular fortnightly meetings between the Principal Database Geologist and laboratory manager are held to discuss various issues related to laboratory performance. QAQC is monitored on a sample despatch basis and reported on in detail at the completion of drilling campaigns, or at a nominated data cut-off date. Field blanks from the Ardrossan dolomite quarry were introduced for use in monitoring for cross-contamination from 2011 and are inserted into sample despatches at a rate of 1 in 15. Field duplicate samples are inserted at a rate of 1 in 15 samples, whilst laboratory crusher duplicates are inserted at a rate of 1 in 25 samples to verify assay accuracy. The use of certified reference material (CRM) standards since 2003, inserted at a rate of 1 in 25, are used to verify assay precision. Prior to 2003, drill hole samples despatches included no QAQC samples, but this is not considered material as those same areas received additional coverage in more recent drilling which was subject to thorough QAQC procedures. For magnetite, there are 4 CRM standards used for head assay and 2 CRM standards for concentrate grade assay. For all other assays, there are 7 CRM standards used to monitor assay precision. Three older, poorly performing non-CRM standards were permanently retired in mid-2013. Intertek Genalysis in Perth are used for inter-laboratory umpire checks. Typically, this consists of the submission of approximately 200 BV pulp reject samples for XRF analysis, two to three times a year. Pulp rejects spanning a range of Fe grades are randomly selected by the Principal Database Geologist and include CRM standards inserted at a rate of 1 in 25, as well as dolomite blanks inserted at a rate of 1 in 15. BV performs their own internal QAQC, which is typically referenced in the fortnightly laboratory meetings, for example to discuss laboratory performance, but this is not relied on for sample selection for mineral resource estimation. Sample assays must meet SIMEC's QAQC performance criteria prior to being released for later use. The latest QAQC outcomes are deemed acceptable, and within the reasonable error limits expected, for use in mineral resource estimation. An example for laboratory duplicates QAQC outcomes for Fe and SiO_2 is shown below.

Criteria	JORC Code explanation	Commentary
		
Verification of sampling and assaying	• *The verification of significant intersections by either independent or alternative company personnel.* • *The use of twinned holes.* • *Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.* • *Discuss any adjustment to assay data.*	The Iron Magnet and Duchess Haematite deposits are currently in operation and the geometry and magnitude of mineralisation observed in grade control drilling broadly mirrors that modelled in the mineral resource estimate. No twin holes have been drilled over the deposits. Geological logging is captured in pre-defined spreadsheets on laptops, and together with sample submission and subsequent assay analysis, imported in electronic form in to an acQuire database. Several data validation routines are run during and after import to verify the data. The master acQuire database is backed up daily to a separate data server with restricted access. Reported assay values are not adjusted, except for the inter-laboratory assays for Ba, Mn and V which are reported as oxides, which are converted to an elemental state in additional data columns to enable comparison to the same elements reported by BV.
Location of data points	• *Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.* • *Specification of the grid system used.* • *Quality and adequacy of topographic control.*	Currently all drill hole collar coordinates are surveyed by differential global positioning systems (DGPS). 75% of all drilling is surveyed by DGPS, 10% of historical drilling by hand-held GPS, compass or topographic reckoning, whilst the method of survey for 16% of drill holes are no survey method recorded. SIMEC considers it reasonable to assume that historical collars were located with the best available method at the time, and the degree of correlation between lithologies logged in past and recent drill hole positions lends some confidence to this assumption.

Criteria	JORC Code explanation	Commentary
		31% of all drill holes have down-the-hole survey measurements using gyroscopic, Eastman camera or EZISHOT surveys. The remaining holes use the collar azimuth and dip, as determined from compass and clinometer, as the full survey trace. All drillhole positional data is recorded in the AMG66 Zone 53 grid system. Modelling and estimation is in local mine grid derived by subtracting 6,300,000 from AMG66 North, and 600,000 from AMG66 East. Digital terrain mapping (DTM) is provided by the mine survey department and incorporate mining and topographic surfaces. These surfaces are updated on a monthly schedule to reflect current mining activities including open pit excavation and rock dump generation. The topographic data is of sufficiently high quality for use in preparation of mineral resources.
Data spacing and distribution	• *Data spacing for reporting of Exploration Results.* • *Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied.* • *Whether sample compositing has been applied.*	Drill coverage is variable along strike and down-dip. In the southern area (15,600N to 17,200N) of the deposit the average drill spacing is 25 x 25m. From 17,200N to 19,000N the drill spacing averages 50 x 50m. Over the haematite deposit at Duchess (19,000N to 21,500N) the average drill spacing is also 25 x 25m, but in the magnetite mineralised area it is 50m x 75m. Details of drill spacing in support of mineral resource classification is provided in Section 3. Primary head assays are typically 2m in length and are not physically composited. Magnetite beneficiation samples are physically composited to either 4m or 8m lengths, with some lesser occurrences of longer 10m lengths on older drilling. Compositing boundaries are determined by geological boundary. For mineral resource estimation, the head assay data are composited to the modal naïve sample length of 2m, whilst for magnetite the concentrate assay data is composited to the modal physical composite length of 4m in the south, and 8m in the north.
Orientation of data in relation to geological structure	• *Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.* • *If the relationship between the drilling orientation and the orientation of key mineralised structures is considered to have introduced a sampling bias, this should be assessed and reported if material.*	Haematite and magnetite mineralisation occurs in a thick package of lithologies that strike NW and dip at 60° to 70° to the east, with a shallow plunge of 5° to 10° to the north. The orientation of sampling is broadly not material to the style of mineralisation, but in some local cases drilling is designed to intersect some narrower domains as close to perpendicular as possible, drill site location permitting. Orientation-based sampling bias is not considered material to the style of mineralisation and has not been investigated.
Sample security	• *The measures taken to ensure sample security.*	The sample chain of custody is managed by the SIMEC exploration team. Samples are stored in a dedicated core yard at the SIMEC steelworks in Whyalla, which is designated a secure site. Samples are transferred between the core yard and laboratory, or in some cases directly from the field to the laboratory, by the exploration team only. In some cases, BV Whyalla prepares samples for analysis at BV Adelaide, usually to cope with increased demand, and they are contractually obliged to securely transport the samples between these locations.

Criteria	JORC Code explanation	Commentary
Audits or reviews	• *The results of any audits or reviews of sampling techniques and data.*	SIMEC employs an experienced full-time database geologist who is dedicated to all aspects of sample and assay management, is responsible for implementing and documenting sampling and QAQC procedures and holding the laboratory to account for the assay results by means of fortnightly meetings with the laboratory as described earlier. The Competent Person for mineral resource estimation and reporting visited the site in May 2023, including the BV laboratory, and considers the operating standards to be acceptable. The data handling and storage procedures are regularly audited by an external party (Max Geoservices), with the last three audits conducted in 2009, 2014 and 2021. None of the audits identified any issues material to mineral resource estimation.

Section 3 Estimation and Reporting of Mineral Resources

(Criteria listed in section 1, and where relevant in section 2, also apply to this section.)

Criteria	JORC Code explanation	Commentary
Database integrity	• *Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes.* • *Data validation procedures used.*	SIMEC Mining uses acQuire software to manage the entry, storage and retrieval of exploration and resource drill hole data. The Principal Database Geologist manages the data capture, management, and storage procedures related to this data. Several automated validation processes are scripted in acQuire as internal checks on several aspects of the data entry into acQuire. These typically include missing/overlapping intervals, missing data, and extreme value checks. Once data for a drillhole has been validated, the database record is “locked” to avoid accidental or unintended changes. No material issues were noted for this update. Data for consideration in mineral resource estimation is exported from the acQuire database in CSV format. The CSV files were used to create a Vulcan database file which was subject to further validation checks including testing for duplicate drillholes, duplicate samples, and overlapping sample intervals. Manual crosschecks on the number of samples are made between the raw data in acQuire, the export to CSV format, and the resulting Vulcan database files.
Site visits	• *Comment on any site visits undertaken by the Competent Person and the outcome of those visits.* • *If no site visits have been undertaken indicate why this is the case.*	The Competent Person has routinely visited site every year since 2020. The most recent visit was in May 2023.

<table>
<tr><th>Criteria</th><th>JORC Code explanation</th><th>Commentary</th></tr>
<tr><td>Geological interpretation</td><td>Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit.
Nature of the data used and of any assumptions made.
The effect, if any, of alternative interpretations on Mineral Resource estimation.
The use of geology in guiding and controlling Mineral Resource estimation.
The factors affecting continuity both of grade and geology.</td><td>The geological interpretation has been shown to be robust, suitable for resource estimation and of low uncertainty as the broad controls on mineralisation are well understood. Magnetite mineralisation forms a relatively continuous strata bound zone with gradational contacts to surrounding lithologies. Haematite mineralisation (HEO) is observed to form a discontinuous zone along the western flanks of the topographic ridges, with a variable easterly dip from 30° to almost vertical. The major magnetite domain is magnetite silica (MTS) with lesser amounts of magnetite carbonate (MTC), with a high degree of spatial continuity. Secondary magnetite domains with lower spatial continuity are an internal schist (SCH) domain, magnetite sulphide (MSU) domain on the western contact with MTS, and an eastern shear zone (ESZ) domain on the eastern contact of the MTS. Volumetrically insignificant intrusive rocks are devoid of any mineralisation, and their position is well known at the time of mining.

Data used in the geological interpretation is comprised of all verified drill hole data that has been classified using a combination of lithological logging and objective geochemical classification using ioGas software. This enabled the simplification of decades of geological logging codes across the deposit in an objective and repeatable classification. Together with drilling undertaken since the 2021 resource update (102 drillholes for 29.1km), this allowed for the amalgamation and simplification of previous magnetite domains, and better characterisation of internal SCH, ESZ and overlying BIF units. The result is an objectively interpreted, well-constrained, continuous body of magnetite mineralisation trending north-northwest (NNW) from the Iron Magnet Pit in the south, to Iron Duchess Pit in the north.

In May 2023, an uncertainty model using Sequential Indicator Simulation (SIS) was used to develop 30 alternate variations of the geological interpretation across all the lithological domains. There is less than 2% variation in volumes of the domains at a 90% confidence interval, demonstrating that alternate interpretations would have a negligible impact on mineral resource estimation.

<table>
<tr><th colspan="2">Average Geological Uncertainty for Magnetite Domain Volumes</th></tr>
<tr><th>Domain</th><th>Uncertainty at 90% Confidence Limit</th></tr>
<tr><td>MTS</td><td>±0.5%</td></tr>
<tr><td>MSU</td><td>±1.2%</td></tr>
<tr><td>SCH</td><td>±1.1%</td></tr>
<tr><td>ESZ</td><td>±1.5%</td></tr>
</table>

The lithological interpretation is a key driver to resource estimation activities given the strong stratigraphic control on the mineralisation. Magnetite zones are variable intercalated with baron zones of non-magnetic high silica material, which increases in occurrence to the north-east of the deposit. The haematite deposit has been formed from supergene enrichment in carbonate-dominant lithologies at the base of the sedimentary sequence, whilst magnetite is both primary metamorphic and hydrothermal in origin. Igneous intrusive and local structural offsets have also played a role in localizing the mineralisation and the supergene enrichment, more specifically in the southern half of the deposit.</td></tr>
</table>

<table>
<tr><th>Criteria</th><th>JORC Code explanation</th><th>Commentary</th></tr>
<tr><td></td><td></td><td>Geological modelling is undertaken using Leapfrog software by using objectively defined litho-geochemical classification, as well as observations and understanding gained during exploration and mining activities. Geological control is enforced on the resulting model where appropriate, using various modelling approaches to guide the resultant 3D geological model. Geological interpretations represented in the resultant geological model are validated using geotechnical and metallurgical diamond drill holes, and geological exposures in the Iron Magnet Pit and peer-reviewed by several geologists before being released for use in estimation.</td></tr>
<tr><td>Dimensions</td><td>• The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.</td><td>The magnetite mineral resource extends over an approximate area of 355m E (across-strike) x 3,900m N (along strike) x 370m RL (vertically). The haematite mineral resource is considerably smaller, more discontinuous and enveloped by the magnetite resource in part, and typically located on its western margin.</td></tr>
<tr><td>Estimation and modelling techniques</td><td>• The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used.
• The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data.
• The assumptions made regarding recovery of by-products.</td><td>All estimation was performed using Maptek Vulcan software, using 2m length-weighted composite samples for head grades (_H) and density, and 4m or 8m length-weighted composite samples for concentrate grades (_C).

Each litho-geochemical domain was assigned a unique identifier GEOZONE identifier in both sample composites and blocks, used to constrain estimation to common domains.
<table>
<tr><th colspan="3">Geozone Estimation Identifiers</th></tr>
<tr><th>GEOZONE Code</th><th>LITHOLOGY Code</th><th>Litho-geochemical description</th></tr>
<tr><td>10</td><td>AMP</td><td>Amphibolite</td></tr>
<tr><td>20</td><td>BIF</td><td>Banded iron formation</td></tr>
<tr><td>30</td><td>HEO</td><td>Haematite</td></tr>
<tr><td>32</td><td>HEC</td><td>Haematite carbonate</td></tr>
<tr><td>37</td><td>HBF</td><td>Banded iron formation ± haematite</td></tr>
<tr><td>40</td><td>MTS</td><td>Magnetite silica</td></tr>
<tr><td>43</td><td>MTC</td><td>Magnetite carbonate</td></tr>
<tr><td>46</td><td>SCH</td><td>“Schist” (internal)</td></tr>
<tr><td>47</td><td>MBF</td><td>Banded iron formation ± magnetite</td></tr>
<tr><td>48</td><td>MSU</td><td>Magnetite sulphide</td></tr>
<tr><td>70</td><td>BSQ</td><td>Basal sequence</td></tr>
<tr><td>71</td><td>DOM</td><td>Katunga Dolomite</td></tr>
<tr><td>75</td><td>ESZ</td><td>Eastern Shear Zone</td></tr>
<tr><td>80</td><td>CGS</td><td>Cooks Gap Schist</td></tr>
<tr><td>90</td><td>GRT</td><td>Granite</td></tr>
</table>
</td></tr>
</table>

Criteria	JORC Code explanation	Commentary
	• *Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation).* • *In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed.* • *Any assumptions behind modelling of selective mining units.* • *Any assumptions about correlation between variables.* • *Description of how the geological interpretation was used to control the resource estimates.* • *Discussion of basis for using or not using grade cutting or capping.* • *The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.*	Exploratory data analysis and variography was completed for: • Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, P, S, SiO_2, TiO_2, Ba, Cu, Pb, V and Zn for _H assay grades for all 15 domains for the 2m composite length samples. • Mass Recovery, Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, P, S, SiO_2 and TiO_2 for _C assay grades, for the magnetite bearing domains of MTC, MTS, MSU, SCH, ESZ, HEC, and potentially mineralised AMP, BIF and MBF domains, for the 4m and 8m composite length samples Negative LOI values were adjusted by a factor of 10 in the samples prior to estimation, and the factor then subtracted for the final LOI estimate. There are no assumptions made about the recovery of any by-products. Potentially acid forming (PAF) material occurs primarily within the BSQ70 and MSU48 domains where elevated S drill hole assays and visible pyrite and pyrrhotite sulphides are encountered. An updated multiple regression model based on 978 drillhole samples analysed for net acid production potential (NAPP), acid neutralising capacity (ANC), and maximum potential acidity (MPA), was used to predict NAPP at non-analysed sample locations. The regression model typically used combinations of Fe, SiO_2, Al_2O_3, LOI, CaO, TiO_2, MgO, Mn, Na_2O, K_2O and S on a domain basis to derive the NAPP predictions. Models were validated, and variograms and search neighbourhoods constructed and the predicted NAPP values used to estimate to a block support of 20x25x4m using Ordinary Kriging (OK). All domain boundaries were treated as hard boundaries. Directional variogram models were defined across all the _H and _C samples, and typically consisted of two nested structures and a nugget defined by the down-the-hole variogram. Exponential with practical range models were used as they provided the best fit to the sample data. Final variogram anisotropies were supported by knowledge gained from the geological interpretation and model. _H grades Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, P, S, SiO_2, TiO_2, Ba, Cu, Pb, V, Zn on 2m composite lengths were estimated using Ordinary Kriging to a 20x25x4m block support. Sub-blocks of 2.5x2.5x1m used to model geological boundaries was estimated at the parent block support. _C grades Mass Recovery, Al_2O_3, CaO, Fe, K_2O, LOI, MgO, Mn, Na_2O, P, S, SiO_2 and TiO_2 on both 4m and 8m composite lengths were estimated using Ordinary Kriging to a 20x25x4m support in the south, and a 20x25x8m support in the north. Sub-blocks of 2.5x2.5x1m used to model geological boundaries was estimated at the parent block support. Multiple linear regression models of density on a domain basis were derived for all drill hole 2m composite sample locations that were not surveyed for density but assayed for Fe, SiO_2, Al_2O_3, LOI, CaO, TiO_2, MgO, Mn, Na_2O, K_2O, P and S, and then validated against known sample density measurements. The derived density using these 2m composites were used to estimate density to a support of 20x25x4m across the deposit using Ordinary Kriging (OK). Hard boundaries were adopted between each domain, except for a low volume domain of marginal grade MBF within the BIF domain that had insufficient samples for a robust stand-alone estimate.

Criteria	JORC Code explanation	Commentary

For _H grade estimates, a four-pass search strategy was employed with a search ellipsoid orientated to the major, semi-major and minor directions of the variogram models. Where possible, some domains used a dynamic anisotropic search guided by local changes in the domain geometry. The number of samples used in the estimate was optimised using Kriging Neighbourhood Analysis for various drill spacings using Fe and SiO_2 across all domains and showed that Kriging Efficiency plateaus at a maximum of 9/10 samples per estimate. Local declustering was achieved by limiting the maximum number of samples per drillhole such that an estimate required a minimum of 2 drillholes for an estimate. Search dimensions were empirically constructed and guided by available drill hole spacing to provide a local accurate estimate.

Head (_H) Grade Estimation Search Strategy			
Pass	**Search**	**Min / Max Samples**	**Max Samples per Drillhole**
1st	25x15x25m	Min = 5 Max = 9	3
2nd	50x25x50m	Min = 5 Max = 9	3
3rd	75x38x75m	Min = 5 Max = 9	3
4th	150x100x150m	Min = 3 Max = 9	2

For _C grade and mass recovery estimates, a three-pass search strategy was employed with a search ellipsoid orientated to the major, semi-major and minor directions of the variogram models. Where possible, some domains used a dynamic anisotropic search guided by local changes in the domain geometry. Local declustering was achieved by limiting the maximum number of samples per drillhole such that an estimate required a minimum of 2 drillholes for an estimate. Search dimensions were empirically constructed to provide a local accurate estimate.

Concentrate (_C) Grade Estimation Search Strategy			
Pass	**Search**	**Min / Max Samples**	**Max Samples per Drillhole**
1st	50x30x30m	Min = 5 Max = 9	3
2nd	100x60x100m	Min = 5 Max = 9	3
3rd	150x120x150m	Min = 5 Max = 9	3

All grade variables were subject to a local grade capping approach known as spatial high yield distance restriction, a sophisticated approach that limits the influence of very high-grade samples in the estimate. Properly implemented, it's use avoids the local smearing of extreme values into blocks during estimation and was iteratively tailored and empirically customised for each element and domain being estimated. The technique is applied in such a way that sample grade values above a nominated value were only used within a smaller than usual search neighbourhood. Typically, the nominal sample grade value is the 99th percentile of the grade distribution, but locally customised high yield distance restrictions were also employed and empirically derived during validation of estimates. The observations were that spatial high yield distance restrictions result in better local estimates and have no material impact on the global resource.

Criteria	JORC Code explanation	Commentary
		For density estimation, samples below 1.5 t/m^3 and samples greater than 5.0 t/m^3 were ignored and not used during estimation. Estimates were run using Vulcan CShell scripts that served as an audit trail for the estimation performed. There were no assumptions made about the correlation between estimated elements. Estimates were exhaustively validated using several techniques. Significant emphasis was placed on visual validation of the estimates. Typically, the approach was to iteratively validate an initial estimate, then adjust or fine-tune estimation parameters where required, and re-run the estimation, until such time the visual validation was judged to be satisfactory. Composite samples and block estimates were loaded into Vulcan using a common legend, and the data dynamically sliced to ensure that the block estimates were supported by the surrounding samples. Exhaustive visual validations were performed in every domain at several orientations and scales and using several legend ranges. Initially, validation proceeded with the key mass recovery, Fe_C, SiO_2_C, and density estimates. Finally, S_H, S_C, and all the remaining _H and _C grade estimates were assessed and validated. The amount of smoothing incurred during the estimation was checked. The performance of the current Kriging parameters using a minimum of 5 samples, maximum of 9 samples, and 3 samples per drillhole was assessed by comparing the theoretical change of support (using the Discrete Gaussian Change of Support Model) to the actual change of support incurred in the estimate. Grade-volume curves for Fe and SiO_2 in the major MTS magnetite domain were compared to an alternate Kriging plan using a minimum of 12 samples, maximum of 24 samples, and 8 samples per drillhole. The observation was that the volume and grade curves for both Fe and SiO_2 both plot closer to that predicted by the Discrete Gaussian Change of Support, meaning that these Kriging parameters result in an estimate with the most appropriate amount of smoothing. Traditional comparisons of declustered composite samples to block estimates using statistics and histograms were performed for all estimates. Swathe plots were used to compare the declustered sample averages to the block estimate averages for slices in the north, east and vertical directions across the deposit. Key variable relationships, such as Fe v SiO_2, were compared using scatterplots for both declustered samples and block estimates to ensure that the relationships observed in the samples, are honoured in the block estimates.
Moisture	• *Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.*	Tonnages are estimated with natural moisture without any corrections. Indicative global moisture content was determined to be between 0% based on recent magnetite drill core sampling, and 4%, based on in-pit haematite blast hole sampling. Samples were submitted to BV and then weighed before and after drying in an oven with the relative difference in mass being the percentage moisture.
Cut-off parameters	• *The basis of the adopted cut-off grade(s) or quality*	The basis of the mineral resource cut-off is the recovery of magnetite by magnetic separation from whole rock, with the subsequent concentration of Fe, with SiO_2 acting as a deleterious element above a particular

Criteria	JORC Code explanation	Commentary
	parameters applied.	concentration, as derived from metallurgical test work, existing concentrator production reconciliation, and orebody knowledge. The cut-off for the reporting of magnetite mineral resources is MassRec > 15% and Fe_H > 15% and SiO_2_H < 70 % and SiO_2_C < 30%. The cut-off for reporting of the haematite mineral resource is Fe_H > 47% and SiO_2_H < 50% and is based on historical production and selling contracts.
Mining factors or assumptions	• *Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.*	The Iron Magnet and Duchess Haematite resource is currently mined through conventional drill and blast open pit methods. A minimum mining width of 5m was considered when interpreting the mineralisation boundaries, however not explicitly applied as mining methods are open to re-optimization. This minimum mining width is consistent with the equipment and grade control block out methods currently in use at the operation. The Z (vertical) block dimension and origin was selected to align with planned open pit benches. No internal or external dilution was modelled. Selective mining units were not defined or corrected for in the mineral resource estimate. Whittle optimisation was run on the updated mineral resource using mining costs, processing costs, geotechnical parameters, and long-term prices for consideration to assess Reasonable Prospects for Eventual Economic Extraction (RPEEE).
Metallurgical factors or assumptions	• *The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral*	The metallurgical amenability of the magnetite resource utilises Fe_H, SiO_2_C and mass recovery results from grind liberation and Davis Tube Recovery (DTR) test work undertaken on several drill hole sample bulk composites targeting the MTS, MTC, SCH, and MSU magnetite domains. This method of has been utilised at the existing magnetite concentrator to target a fixed SiO_2 specification and mass recovery to a captive downstream pellet plant for over 10 years. The MTS domain north of the Iron Magnet Pit is known to have a high SiO_2 content that is historically considered waste/low grade ore within the capacity of the current processing circuit. Typically, MTS ore does not obtain adequate liberation of Fe from SiO_2 at the current concentrators grind size capacity of P80 38µm and thus does not obtain satisfactory grade through a conventional magnetic separation circuit. This is due to tiny inclusions of magnetite within the quartz that causes the magnetite to be recovered to magnetics. It is uneconomic to grind the magnetite to sufficient liberation size to achieve acceptable grade through magnetic separation exclusively. Introduction of reverse flotation for removal of SiO_2 is proposed to facilitate beneficiation of MTS ore. Reverse

Criteria	JORC Code explanation	Commentary
	Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.	flotation is a well-established technique in use in several magnetite iron ore operations, principally in South America. It is widely adopted in facilities that produce a direct reduction grade concentrate due to its ability to remove silica that would otherwise be recovered through magnetic separation. Reagents known as collectors are added that make the quartz hydrophobic, based on surface area, with depressant added to make magnetite hydrophilic. The quartz is then floated to the surface as a froth, facilitating removal of quartz with tiny magnetite inclusions from more liberated magnetite. Metallurgical test-work was conducted on samples representing the magnetite lithologies including the MTS, MTC, MSU and SCH domain. The results of the test work showed that all samples tested could achieve direct reduction grade, with Fe recovery through flotation ranging from 92.2 to 97.1%. Grades exceeding 70% Fe are expected to be achieved for all MTS similar in composition to that tested given the binary nature of Fe and SiO_2 present. The flotation test work program has shown that ores requiring liberation below 20µm can be readily beneficiated. It is noted that no other deleterious elements were considered to have any material significance to the processing stream. A proposed high-level flowsheet/block diagram showing mass flow, typical grades, existing concentrator and upgraded mills and flotation circuits has been included in the detailed report along with high level capital costs.
Environmental factors or assumptions	• *Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the*	Iron Magnet and Duchess Haematite is an operating mine. Waste is disposed of on designated stockpiles for rehabilitation under the Mine and Rehabilitation Plan approved for the site. It has been assumed for the purpose of the mineral resource update that legislation in this regard will remain unchanged such that continued mining of the resource will operate in the same way.

<table>
<tr><th>Criteria</th><th>JORC Code explanation</th><th>Commentary</th></tr>
<tr><td></td><td>environmental assumptions made.</td><td></td></tr>
<tr><td>Bulk density</td><td>• Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples.
• The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit.
• Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.</td><td>The host sequence comprises high grade metamorphic rocks with generally low porosity. Some goethitic lithologies are slightly porous, which is accounted for during geophysical wireline logging. Bulk Density is estimated on a wet basis and considers the weathering profile modelled across the deposit.

Density data from geophysical wireline logging was composted to 2m intervals, and robust multiple linear regression models using Fe, SiO_2, Al_2O_3, LOI, CaO, TiO_2, MgO, Mn, Na_2O, K_2O, P and S used to predict density at closely spaced sample locations without density measurements. Once validated, these predicted density values were estimated into the block model on a domain and weathering basis using Ordinary Kriging (OK). All domains apart from granite (GRT90) have density estimated.

The following average density assumptions were applied where estimates were not possible due to a lack of data.
<table>
<tr><th>Geozone Domain</th><th>Lithology Domain</th><th>Litho-geochemical Description</th><th>Weathered Density t/m^3</th><th>Un-Weathered Density t/m^3</th></tr>
<tr><td>10</td><td>AMP</td><td>Amphibolite</td><td>2.45</td><td>3.13</td></tr>
<tr><td>20</td><td>BIF</td><td>Banded iron formation</td><td>2.59</td><td>2.77</td></tr>
<tr><td>30</td><td>HEO</td><td>Haematite</td><td>3.22</td><td>3.57</td></tr>
<tr><td>32</td><td>HEC</td><td>Haematite carbonate</td><td>3.02</td><td>3.65</td></tr>
<tr><td>37</td><td>HBIF</td><td>Banded iron formation ± haematite</td><td>3.50</td><td>3.89</td></tr>
<tr><td>40</td><td>MTS</td><td>Magnetite silica</td><td>3.17</td><td>3.38</td></tr>
<tr><td>43</td><td>MTC</td><td>Magnetite carbonate</td><td>3.08</td><td>3.75</td></tr>
<tr><td>46</td><td>SCH</td><td>“Schist” (internal)</td><td>2.71</td><td>3.37</td></tr>
<tr><td>47</td><td>MBF</td><td>Banded iron formation ± magnetite</td><td>2.59</td><td>3.19</td></tr>
<tr><td>48</td><td>MSU</td><td>Magnetite sulphide</td><td>2.92</td><td>3.39</td></tr>
<tr><td>70</td><td>BSQ</td><td>Basal sequence</td><td>2.58</td><td>3.04</td></tr>
<tr><td>71</td><td>DOM</td><td>Katunga Dolomite</td><td>2.57</td><td>3.06</td></tr>
<tr><td>75</td><td>ESZ</td><td>Eastern Shear Zone</td><td>2.37</td><td>3.20</td></tr>
<tr><td>80</td><td>CGS</td><td>Cooks Gap Schist</td><td>2.13</td><td>2.60</td></tr>
<tr><td>90</td><td>GRT</td><td>Granite</td><td>2.23</td><td>2.70</td></tr>
</table></td></tr>
<tr><td>Classification</td><td>• The basis for the classification of the Mineral Resources into varying confidence categories.
• Whether appropriate account has been taken of all relevant factors (ie relative confidence</td><td>The mineral resource was considered for classification into Measured, Indicated, and Inferred resource categories based on the metrics of drill hole assay QAQC, drillhole survey status quality, confidence in geological continuity, drillhole spacing, nature and quality of bulk density estimates, estimation quality, and expected variation and proposed mining rate.

Within the magnetite resource, the MTS (and historically the MTC) is the dominant domain, with lesser occurrences of HEC, and exhibits greater geological continuity and confidence than the less continuous domains of HEO, SCH, MSU and ESZ, which typically exhibits a less continuous pinch and swell, and lens-like geometry.</td></tr>
</table>

<table>
<tr><th>Criteria</th><th>JORC Code explanation</th><th>Commentary</th></tr>
<tr><td></td><td>in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).
• Whether the result appropriately reflects the Competent Person's view of the deposit.</td><td>This is accounted for in resource classification by consideration of a closer drilling spacing requirement for these less continuous domains, and a wider drill spacing requirement for the more continuous domains. Haematite resources are classified on the same basis as the magnetite resource.

The QAQC for drill hole assays is comprehensive and the sample assays are of sufficiently high quality for consideration across all three resource classification categories.

Density estimates are a key consideration in the classification scheme as it is strongly correlated to both Fe and SiO_2 grade. For an Inferred resource, an average assigned density based on domain is deemed acceptable, whilst Indicated resources are required to be supported by a mixture of locally estimated and assigned average density. In the case of a Measured resource, only local density estimates are considered acceptable.

The quality of the estimates as determined from the Kriging neighbourhood analysis, as well as exhaustive validation of the model and checks on smoothing, have also played a key part in informing the classification of the resource.

The expected variation (relevant confidence) of the magnetite resource tonnage and grade on an annual basis has been considered in the classification, assessed using an uncertainty model from early 2023, generated using Conditional Simulation techniques and discussed in the Relative Accuracy and Confidence section of this table.

The resource has been classified on a bulk open pit mining basis using a notional mining rate of 18 to 22 mtpa based on internal mine expansion studies.

The mineral resource classification scheme is summarised below.

<table>
<tr><th>Category</th><th>Geological Confidence</th><th>Drill Spacing Lower Continuity</th><th>Drill Spacing Higher Continuity</th><th>Data Quality</th><th>Density</th></tr>
<tr><td>Measured</td><td>Very High</td><td>25x25m</td><td>50x50m</td><td>High</td><td>Local estimate</td></tr>
<tr><td>Indicated</td><td>High to Very High</td><td>50x50m</td><td>100x75m</td><td>High</td><td>Local estimate + assigned</td></tr>
<tr><td>Inferred</td><td>Moderate</td><td>100x75m</td><td>150x100m</td><td>High to Moderate</td><td>Assigned</td></tr>
</table>
• Low Continuity domains: HEO, SCH, MSU, ESZ
• High Continuity domains: HEC, MTC, MTS

The Competent Person has been satisfied that appropriate account has been taken of all relevant criteria including data integrity, data quantity, geological continuity, and grade continuity in the classification of the mineral resource, and that result reflects the Competent Person's view of the deposit.</td></tr>
<tr><td>Audits or reviews</td><td>• The results of any audits or reviews of Mineral Resource</td><td>All mineral resource estimates are subject to internal per review by qualified technical SIMEC personnel.</td></tr>
</table>

<table>
<tr><th>Criteria</th><th>JORC Code explanation</th><th>Commentary</th></tr>
<tr><td></td><td>estimates.</td><td></td></tr>
<tr><td>Discussion of relative accuracy/ confidence</td><td>• Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate.
• The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.
• These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.</td><td>The key areas that affect the relative confidence and accuracy of tonnage and grade are the geological variability and grade variability of the deposit.

Conditional Simulation techniques were used to characterise the full space of uncertainty by employing Sequential Indicator Simulation (SIS) for geological uncertainty, and Sequential Gaussian Simulation (SGS) for grade uncertainty in early 2023. Thirty (30) unique geological models of 14 estimation domains were generated using SIS, which in turn was used as a basis for grade simulation using SGS. Grade simulation focused on the economic variables of mass recovery, Fe_H, Fe_C, SiO_2_H and SiO_2_C for the magnetite resource. The stepwise conditional transformation technique was used to account for the relationships and correlations between the grade variables.

The uncertainty model developed using conditional simulation is a measure of local uncertainty for a mining volume of 18 to 22 mtpa at a block support of 20x25x4m.

The expected variation at a 90% confidence interval in the volumes of the simulated geological domains are tabulated below.

<table>
<tr><th>Geozone Domain</th><th>Lithology Domain</th><th>Variation in Domain (%)</th></tr>
<tr><td>10</td><td>AMP</td><td>± 0.9</td></tr>
<tr><td>20 / 47</td><td>BIF / MBF</td><td>± 0.6</td></tr>
<tr><td>30</td><td>HEO</td><td>± 0.6</td></tr>
<tr><td>32</td><td>HEC</td><td>± 0.9</td></tr>
<tr><td>37</td><td>HBIF</td><td>± 1.1</td></tr>
<tr><td>40</td><td>MTS</td><td>± 0.4</td></tr>
<tr><td>43</td><td>MTC</td><td>± 0.4</td></tr>
<tr><td>46</td><td>SCH</td><td>± 1.3</td></tr>
<tr><td>48</td><td>MSU</td><td>± 1.0</td></tr>
<tr><td>70</td><td>BSQ</td><td>± 0.9</td></tr>
<tr><td>71</td><td>DOM</td><td>Not assessed</td></tr>
<tr><td>75</td><td>ESZ</td><td>± 1.5</td></tr>
<tr><td>80</td><td>CGS</td><td>± 1.1</td></tr>
<tr><td>90</td><td>GRT</td><td>± 1.4</td></tr>
</table>
• DOM71 was not assessed in the May 2023 update as it only existed as a subset of the BSQ70 domain at the time. DOM71 is expected to yield the same uncertainty characteristics as BSQ70.</td></tr>
</table>

Criteria	JORC Code explanation	Commentary

The expected average variation for magnetite resources at a 90% confidence interval in the tonnage and grade estimates above a cut-off of MassRec > 15 and Fe_H > 15 and SiO_2_H < 70 and SiO_2_C < 30, within the defined resource classification volumes, for a mining rate of 18 to 22 mtpa is tabulated below.

Resource Category	Tonnes	Mass Recovery	Fe_C	Fe_H	SiO_2_C	SiO_2_H
Measured	± 1.2 - 2.1%	± 2.0%	± 0.1%	± 0.5%	± 2.5%	± 1.3%
Indicated	± 2.1 - 5.1%	± 0.8%	± 0.2%	± 0.6%	± 1.6%	± 1.0%
Inferred	± 8 - 10%	± 2.6%	± 0.6%	± 1.3%	± 3.9%	± 1.4%

The mineral resource tonnage and grade relevant to technical and economic evaluation are detailed in the mineral resource tabulations below.

Duchess South Haematite Mineral Resource							
Category	**Tonnes Mt**	**Fe_H %**	**SiO_2_H %**	**Al_2O_3_H %**	**LOI %**	**P_H %**	**Density t/m³**
Measured	2.4	56.80	6.31	1.19	4.97	0.08	3.59
Indicated	6.9	56.12	7.72	1.47	4.21	0.09	3.55
Inferred	8.9	56.17	8.48	1.33	3.14	0.09	3.63
Total	**18.2**	**56.23**	**7.90**	**1.36**	**3.79**	**0.09**	**3.59**

- Cut-off : Fe_H > 47% and SiO2_H < 50% ; below the 1 July 2023 mining depletion surface and inside optimised Whittle Shell 57 Oct 2023. Tonnages rounded to nearest hundred thousand.

Duchess South Magnetite Mineral Resource							
Category	**Tonnes Mt**	**Mass Rec %**	**Fe_C %**	**Fe_H %**	**SiO_2_C %**	**SiO_2_H %**	**Density t/m³**
Measured	253	36.86	64.33	32.92	8.84	41.33	3.49
Indicated	245	31.97	64.03	30.42	9.00	45.00	3.43
Inferred	175	25.89	64.84	28.49	7.99	48.23	3.40
Total	**673**	**32.23**	**64.35**	**30.86**	**8.68**	**44.46**	**3.44**

- Cut-off : MassRec > 15% and Fe_H > 15% and SiO2_H < 70% and SiO2_C < 30% ; below the 1 July 2023 mining depletion surface and inside optimised Whittle Shell 57 Oct 2023. Tonnages rounded to nearest million.

The use of robust multiple linear regression models for density has allowed sufficient information, at the required drill spacing, to classify Measured resource.

Global reconciliation systems are in place that monitor the performance of forecast and actual production based on the scheduling of the resource and reserve models. For the Iron Magnet Pit magnetite operation, reconciliation based on mining between 3 to 4.9mtpa using data based on the October 2023 resource update is tabulated below. The MTS domain is a small proportion of the production volume.

Criteria	JORC Code explanation	Commentary

Iron Magnet Pit - Magnetite Reconciliation Summary				
Mining Period	**Tonnes**	**Mass Recovery**	**SiO_2_C**	**SiO_2_H**
FY21	102%	93%	69%	105%
FY22	104%	95%	60%	108%
FY23	96%	97%	48%	106%
FY24	80%	94%	56%	109%

- Actual from Grade Control Model / 2023 Production Model x 100/ FY24 partially mined only.

The lower factor for SiO_2_C grades is due to the difference in sample preparation of the blasthole samples (grade control model) and that used for the RC drilling samples (resource/reserve model) at that time. Blastholes are prepared using a wet grind of P80 38µm, whilst the RC samples were prepared using a dry grind of P80 45µm. The dry grind for RC samples was coarser liberating less silica, with the net effect that more SiO_2 reported to DTR with a corresponding higher SiO_2 grade.

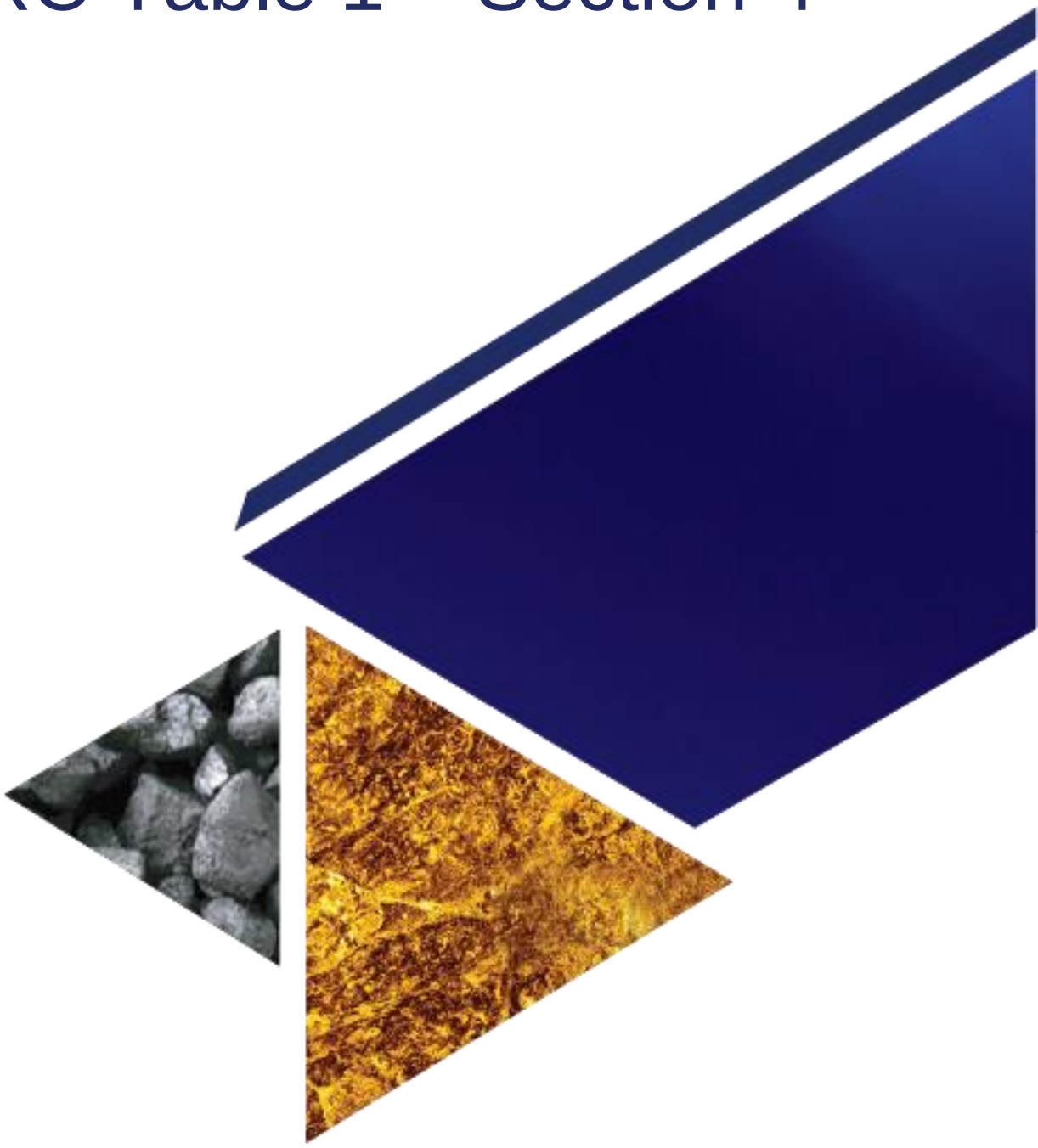
The higher factor for SiO_2_H grades is due to the difference in sample preparation of the blasthole samples (grade control model) and the RC drilling samples (resource/reserve model). Blastholes are prepared using a wet grind of P80 38µm, whilst the RC samples are prepared using a dry grind of P90 75µm. The wet grind for blasthole samples is finer liberating more silica, with the net effect that the SiO_2 grade is higher than the RC samples.

For the Duchess Pit haematite operation reconciliation based on mining between 1 to 2.4mtpa using the 2021 resource/reserve update is tabulated below. At the time of writing, the operation is close to depleting the existing mining schedule. The remaining haematite material represented in the 2023 resource update is forecast to be mined as part of a future expansion of the Iron Magnet operation.

Duchess Pit - Haematite Reconciliation Summary				
Mining Period	**Tonnes**	**Fe_H**	**SiO_2_H**	**Al_2O_3_H**
FY21	101%	99%	105%	80%
FY22	99%	98%	112%	115%
FY23	107%	99%	106%	102%

- Factors: Actual from Grade Control Model / Forecast from 2021 Production Model x 100

Appendix C.
JORC Table 1 – Section 4



Section 4 Estimation and Reporting of Mineral Reserves

Criteria	JORC Code explanation	Commentary
Mineral Resource estimate for conversion to Ore Reserves	• *Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve.* • *Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.*	• The Mineral Resources has been compiled by Mr Colin Badenhorst. Mr Colin Badenhorst is a current Member of the Australian Institute of Mining and Metallurgy (MAusIMM No. 225506) and a full-time employee of SIMEC. Mr. Badenhorst has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity that he has undertaken to qualify as a Competent Person as defined in the JORC Code. • The Mineral Resources are inclusive of these Ore Reserves.
Site visits	• *Comment on any site visits undertaken by the Competent Person and the outcome of those visits.* • *If no site visits have been undertaken indicate why this is the case.*	• Mr Igor Bojanic, is the nominated Competent Person (CP). He is a Fellow of the Australasian Institute of Mining and Metallurgy (FMAusIMM, No 111767), and is a full-time employee of RPM. Mr Igor Bojanic has sufficient experience, which is relevant to the style of mineralisation and type of deposit under consideration and to the activity, which he has undertaken to qualify as a Competent Person, as defined in the 2012 Edition of the Australasian Code for the Reporting of Mineral Resources and Ore Reserves. • A site visit was undertaken by the Competent Person for MEP1 Ore Reserves, Mr Igor Bojanic, on 13 February 2024. The purpose of the visit was to assess the current state of the site and the implications for the MEP 1 Project.
Study status	• *The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves.* • *The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.*	• The Mineral Resources have been converted to Ore Reserves by means of a life of mine plan completed to Feasibility Study (FS) level which targets an accuracy equivalent of Class 3 as defined by the Association for the Advancement of Cost Engineering (AACE) has been completed on the Project • The FS mine plan demonstrates that the Project outcomes are technically achievable, and the Project is economically viable.
Cut-off parameters	• *The basis of the cut-off grade(s) or quality parameters applied.*	• The cut-off grade estimates are an outcome of the final detailed scheduling and economic evaluation from the FS. • As the magnetite ore feed is constrained by processing and product blend constraints, the actual application of cut-off parameters and the resulting processable quantities can only be definitively known

Criteria	JORC Code explanation	Commentary
		following detailed production scheduling." • The estimation of the magnetite cut-off is a combination of net value per processing bottleneck unit and sulphur cut-offs.
Mining factors or assumptions	• *The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimisation or by preliminary or detailed design).* • *The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc.* • *The assumptions made regarding geotechnical parameters (egg pit slopes, stope sizes, etc.), grade control and pre-production drilling.* • *The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate).* • *The mining dilution factors used.* • *The mining recovery factors used.* • *Any minimum mining widths used.* • *The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion.* • *The infrastructure requirements of the selected mining methods.*	• The FS included technical analyses to determine the most appropriate mining method and estimate ore loss and dilution • The mining method for the extraction of ore is to be conventional open cut mining. It requires no specialist infrastructure requirements. • The in-situ Resource model was converted to a run-of-mine mining model by spatially modelling ore selectivity and mineable quantities using a specialist program developed by dC Mining Engineering and Technology Pty Ltd (dC-MET). RPM reviewed the process and considers it reasonable. • The ore selectivity modelling was based on a minimum selective mining unit (SMU) of 10 m east-west, 10 m north-south and 12 m vertical. An additional 0.6m edge transfer was also assumed for block edge mining dilution. • As the magnetite is a large zone of mineralisation, the conversion of overall magnetite (MAG) resource in the base geological model to mineable quantities increases the total MAG mass by 2% with only minor changes to overall head grades and mass recovery. • The geotechnical criteria for the design of the open cut were developed by Peter O'Bryan and Associates Pty Ltd for the purposes of the FS. The mining region was sub-divided into a number of geotechnical sectors with parameters assigned based on sector properties and rock characteristics. In general, the inter-ramp slope was approximately 40 degrees. • Minimum mining width for "good-bye" cut is approximately 25 m. • Minimum cutback mining width targeted 75 m. • The economic mining limit was defined using proprietary dC-OreFlow software developed by dC-MET. The pit limit optimisation software uses the Pseudoflow algorithm to define a three-dimensional shape for the open cut pit, which is considered the "optimal" economic shell for mining. The process incorporates all pit shell drivers such as geotechnical parameters, ore loss and dilution, metallurgical recovery, mining costs, processing and product costs, and revenue. A scenario with only Measured and Indicated Resources was used to confirm the economic mining limit. • As this is a long-life project with high up-front capital, the mining study

Criteria	JORC Code explanation	Commentary
		was inclusive of Inferred Resources. Inferred Resources were approximately 4% of the total mineable quantity processed. • Conventional open cut mining is a very common mining method used through the mining industry and requires no specialist infrastructure. • The required supporting infrastructure like equipment workshops has been included in the FS. As this is an expansion of an existing operation, much of the infrastructure and services are already present.
	• *The metallurgical process proposed and the appropriateness of that process to the style of mineralisation.* • *Whether the metallurgical process is well-tested technology or novel in nature.* • *The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied.* • *Any assumptions or allowances made for deleterious elements.* • *The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole.* • *For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?*	• Though the site currently processes magnetite ore, additional metallurgical test work has been completed to confirm the new flow sheet and approach which includes reverse flotation supports the wide range of rock types present at Duchess South. • Test work includes some pilot testing. • The test work sampling is considered reasonably representative. • The metallurgical recoveries for the magnetite ore is a function of the magnetite grade. In general, the recovery is approximately 30% • The target throughput is 8.2 Mtpa of magnetite ore to produce approximately 2.5 Mtpa of concentrate product. The quantity of concentrate varies depending on the quality of the feed. • No major presence of deleterious material has been identified in the product. The marketing study considered the product to be a high grade low impurity (alumina, silica, phosphorus, etc.) product. • In RPM's opinion, the minerals that are defined and the ore reserve mine planning has been based on the appropriate mineralogy to meet the specifications.
Environmental	• *The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterisation and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.*	• SIMEC Mining as an existing operator has established management plans and procedures to meet its environmental obligations under relevant legislation as well the terms and conditions of its existing tenements and development approvals. Systems, processes and management plans are reviewed and updated to support the project and in accordance with an ISO14001-certified environmental management system (EMS). • An internal review of environment management requirements found no regulatory or stakeholder fatal flaws due to SIMEC Mining's solid history of diligent environmental and social licence management. • The project will be subject to a range of regulatory approvals under various South Australian and Commonwealth. • Environmental studies to support the regulatory approvals applications are at an advanced stage including flora/fauna assessments,

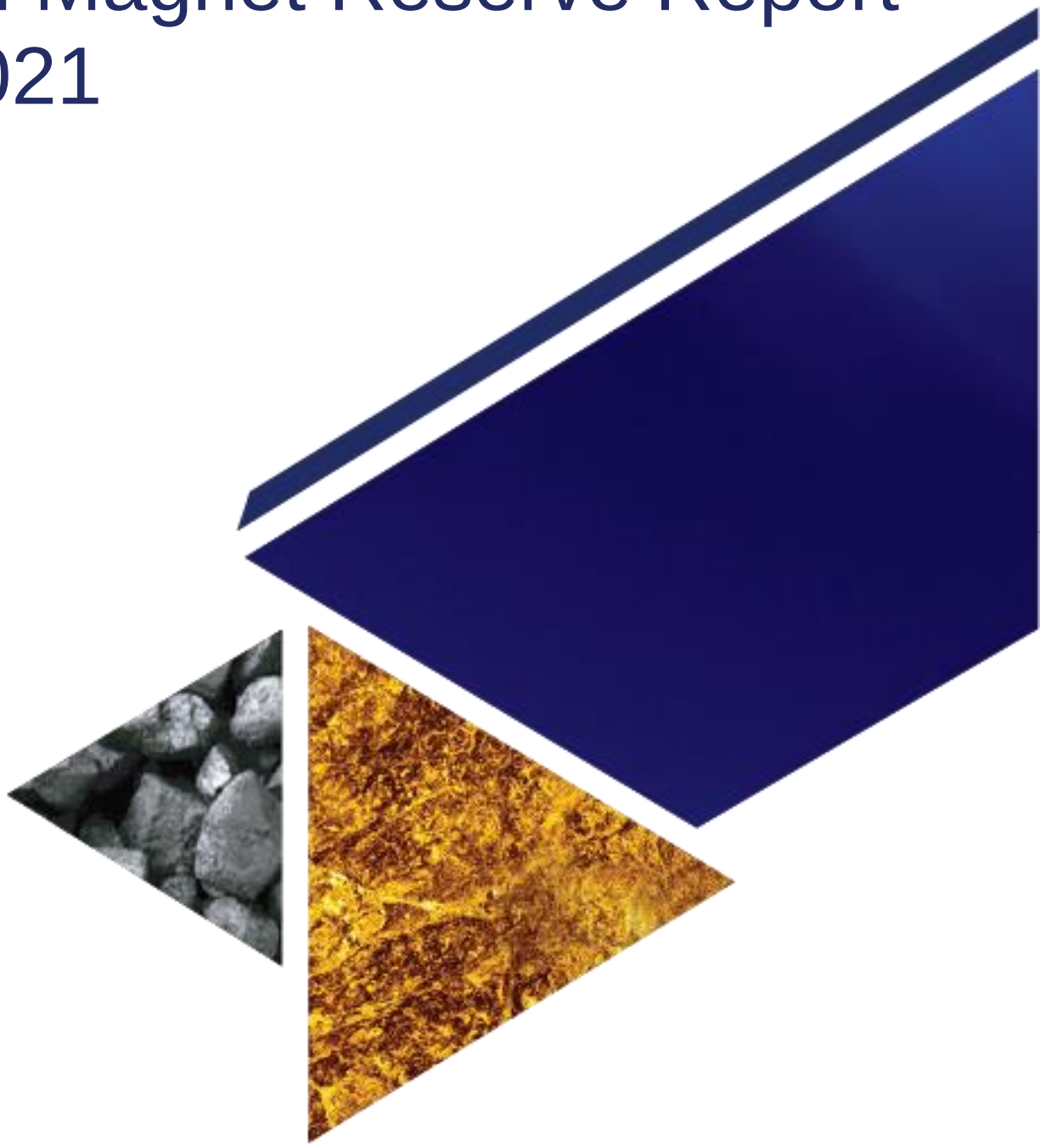
Criteria	JORC Code explanation	Commentary
		groundwater impact and baseline studies in the areas of noise, air quality, and visual amenity. • Cultural heritage surveys with the Traditional Owners of the land, the Barngarla People, have been undertaken over the project footprint and further survey works will likely be required prior to development together with ongoing engagement. • Though gaining all necessary approvals is identified as a risk, SIMEC consider it as a manageable risk as it has the systems and processes in place to support the applications.
Infrastructure	• *The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.*	• As an operating mine, much of the infrastructure and connection to services are in place. • However, due to the increased scale of this Project upgrades will be required to all areas such as power, water and off-site transport. • The proposed MEP1 Process Plant and associated facilities including the tailings storage facility are the major capital construction requirement. • As the area is an established mining area and is near the main regional town of Whyalla, South Australia, professional staff and labour should be able to be both sourced and accommodated locally.
Costs	• *The derivation of, or assumptions made, regarding projected capital costs in the study.* • *The methodology used to estimate operating costs.* • *Allowances made for the content of deleterious elements.* • *The derivation of assumptions made of metal or commodity price(s), for the principal minerals and co- products.* • *The source of exchange rates used in the study.* • *Derivation of transportation charges.* • *The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc.* • *The allowances made for royalties payable, both Government and private.*	• Cost modelling was undertaken in Australian Dollars for the feasibility study to an accuracy equivalent of Class 3 as defined by the Association for the Advancement of Cost Engineering (AACE). • Mining costs were sourced from quotes received by mining equipment hire companies as well as OEMs. • Processing plant costs, G&A and other overheads are estimated from first principles as part of the FS. • The estimation of iron ore prices and other revenue factors were derived by SIMEC based on a combination of dedicated marketing studies, price forecasts such as from CRU and in-house experience as a producer of iron ore products. • The exchange rate was estimated by SIMEC from a range of sources including Bloomberg and CRU. The AUD:USD forecast generally ranged from 0.6 to 0.8. SIMEC selected 0.70. • Government royalty at 5% of revenue. • SIMEC estimated transport charges assuming delivery of the product to China based on existing operational data. • Allowances for deleterious materials or premiums for improved product qualities are included in the product pricing.

Criteria	JORC Code explanation	Commentary
Revenue factors	• *The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc.* • *The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.*	• The estimation of iron ore prices and other revenue factors were derived by SIMEC based on a combination of dedicated marketing studies, price forecasts such as from FastMarkets consultants and in-house experience as a producer of iron ore products. • The product price assumes a high quality direct reduction magnetite concentrate of 70.45% Fe and favourable levels of contaminants. That is, the price assumes high value in use price premiums. • The average product selling price is USD154/dmt over the Project life. The price forecast is initially USD146 /dmt, increasing to a high of USD173 /dmt by 2035 before falling back to ~USD160 /dmt by 2039.
Market assessment	• *The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future.* • *A customer and competitor analysis along with the identification of likely market windows for the product.* • *Price and volume forecasts and the basis for these forecasts.* • *For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.*	• MEP1 is considered to produce only a Magnetite concentrate as a traditional blast furnace grade concentrate or as a direct reduction (DR) pellet feed. • SIMEC engaged FastMarkets to complete a marketing study on the proposed concentrate product and selling price. No issues were identified with market acceptance or sales.
Economic	• *The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc.* • *NPV ranges and sensitivity to variations in the significant assumptions and inputs.*	• An economic model has been prepared by SIMEC from the outcomes of the detailed engineering and costing associated with the life of mine plan. The economic modelling demonstrates that the Project is cash flow positive. • The base case results in a positive economic outcome as assessed by an NPV calculation (@7.3% DCF). • The NPV is most sensitive to the iron ore price. An analysis on the financial model indicated that the iron ore forecast prices would need to fall by 25% to generate a zero NPV@7.3%.
Social	• *The status of agreements with key stakeholders and matters leading to social licence to operate.*	• SIMEC advises that it enjoys a good relationship with the local community.
Other	• *To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves:* • *Any identified material naturally occurring risks.* • *The status of material legal agreements and marketing arrangements.* • *The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be*	• All property permissions, permitting, legal and marketing arrangements are understood to be in good standing. • The estimate of Ore Reserves for the MEP1 Project is not, to RPM's knowledge, materially affected by any other known environmental, permitting, legal, title, taxation, socio-economic, marketing, political or other relevant factors other than that described in the preceding text. It is believed that the classification of Ore Reserves as set out in this report is reasonable. • The FS report notes that the high risk items for the project are:

Criteria	JORC Code explanation	Commentary
	received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.	• Delays in the construction of Tailings Storage Facilities (TSF) will impact the ability for the concentrator to operate at its maximum capacity • Delays in the delivery of regulatory approvals will affect the ability for MEP1 to operate as planned • Delays in delivery of critical items for the proess plant upgrade • Failure to deliver planned process debottlenecking upgrades will impact SIMEC's ability to deliver the volumes of magnetite concentrate predicted in the mine plan • Non-acceptance of geochemistry work by regulators will cause delays in approval to expand mine pit outside of existing approvals and to construct waste rock dumps with PAF cells
Classification	• *The basis for the classification of the Ore Reserves into varying confidence categories.* • *Whether the result appropriately reflects the Competent Person's view of the deposit.* • *The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).*	• The Ore Reserve is classified as Proved and Probable in accordance with the JORC Code, corresponding to the resource classifications of Measured and Indicated Resources. • Measured Resources have been converted to Proved Reserves. • Indicated Resources have been converted to Probable Reserves. • No Inferred Mineral Resources were included in the Ore Reserve estimate.
Audits or reviews	• *The results of any audits or reviews of Ore Reserve estimates.*	• The JORC Code provides guidelines which set out minimum standards, recommendations and guidelines for the Public Reporting of exploration results, Mineral Resources and Ore Reserves. Within the JORC Code is a "Checklist of Assessment and Reporting Criteria" (Table 1 – JORC Code). This checklist has been used as a systematic method to undertake a review of the underlying Study used to report in accordance with the JORC Code. • RPM has completed an internal review of the Ore Reserve estimate, deriving results using separate methods, and believes the estimate accurate.
Discussion of relative accuracy/ confidence	• *Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate.* • *The statement should specify whether it relates to global or local*	• The proposed MEP 1 Project will employ conventional mining and tested ore processing techniques, which will deliver confidence that technical outcomes will be achieved. • The life of mine plan has been supported by engineering and costing to an accuracy equivalent of Class 3 as defined by the Association for the Advancement of Cost Engineering (AACE). • Detailed pit design was undertaken based on the preferred pit shell. • Ore Reserve quantities and grades were derived based on the mining model, the cut-off grade and the detailed ultimate pit shell.

Criteria	JORC Code explanation	Commentary
	estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • *Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage.* • *It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.*	• An internal audit checked the estimation of quantities. • Sensitivity analyses were undertaken on the economic model. • The base case FS assumptions indicate that the economic outcomes demonstrate a positive NPV Project. • The accuracy of the underlying Mineral Resources is defined by the Resource Category that the Mineral Resources are assigned to. Only Measured and Indicated Resources have been used for estimating Ore Reserves.

Appendix D.
Iron Magnet Reserve Report - 2021



2021 Ore Reserve Report

Effective Date of 1st January 2021

Paul Leevers (B.AppSc (Geol), M Min Eng, MAusIMM)

26th July 2021



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Acronyms Used

MBR	Middleback Ranges
SMR	Southern Middleback Ranges
IKMA	Iron Knob Mining Area
IBMA	Iron Baron Mining Area
DSO	Direct Shipping Ore
m^3x10^6	Million Cubic Meters
M'dmt	Million Dry Metric Tonnes
M'wmt	Million Wet Metric Tonnes
k'dmt	Thousand Dry Metric Tonnes
Mtpa	Million Tonnes Per Annum
ROM	Run of Mine
IPF	Integrated Processing Facility
LGO	Low Grade Ore (Cut off <55% Fe and >47% Fe)
H2O%	Moisture %
Fe%	Iron %
SiO2%	Silicon Dioxide %
Al2O3%	Alumina
P%	Phosphorous
LOI	Loss on Ignition
BD	Bulk Density
Scree	Detrital Ores used in beneficiation
Mass_Rec	Recovered tonnages from Beneficiation (Product Tonnes (dry)/Feed Tonnes (dry)%
Concentrate	Magnetite Concentrate
Bene Product	Product from beneficiation process
DSD	Department State Development South Australia
SG	Specific Gravity
PEPR	Program for Environment Protection and Rehabilitation
Project Prime	Current MBR Magnetite Project to Extend Reserve Base

Executive Summary

SIMEC has used the 1st of January 2021 JORC Code Mineral Resource estimate as a key input into the Ore Reserve estimation. As the operations are operating mining projects that are not supported by a feasibility study, to support the Ore Reserves, SIMEC has supported the Ore Reserve estimate with the Life of Mine Plans for the operations. This approach is supported by the following excerpt from guidance notes published by the Australian Securities Exchange (ASX):

'Where an entity has an operating mine for an Ore Reserve, its Life of Mine Plan would generally be expected to contain information at better than Pre-Feasibility or Feasibility level for the whole range of inputs normally required for a Pre-Feasibility or Feasibility study and this would meet the requirement in Clause 29 for the Ore Reserve to continue that classification. Where, however, its Life of Mine Plan does not contain information at Pre-Feasibility or Feasibility level, it will have to upgrade its Life of Mine Plan to Pre-Feasibility or Feasibility level before 1 December 2014 or else downgrade the Ore Reserve to a Mineral Resource.'

The MBR DSO Hematite, MBR Beneficiated Hematite and MBR Magnetite Ore Reserves have been reported as at the 1st of January 2021 and are summarised in the Table's below.

MBR DSO HEMATITE ORE RESERVE					
	M'dmt	Fe%	SiO2%	Al2O3%	P%
PROVED	3.6	59.3	7.3	1.5	0.10
PROBABLE	11.7	58.2	6.0	2.4	0.06
TOTAL	15.2	58.4	6.3	2.2	0.07

*Simec Interest 100%

*Competent Person: P. Leevers

The Simec Middleback Ranges (MBR) DSO Hematite Ore Reserve has been derived at a cut-off grade of 55% Fe and SiO2 <20% for all material deposits, except Iron Cavalier which has been declared at a cut off of 50% Fe and SiO2 <20%.

`	MBR BENEFICIATED HEMATITE ORE RESERVE				
Category	M'dmt	Fe%	SiO2%	Al2O3%	P%
PROVED	0.5	60.73	6.06	2.79	0.05
PROBABLE	5.7	60.66	6.27	2.88	0.05
TOTAL	6.2	60.67	6.26	2.88	0.05

*Simec Interest 100%

*Competent Person: P. Leevers

The Middleback Range Beneficiated Hematite Reserves have been declared from feed stocks at a Fe cut-off Grade of 35% for the Iron Baroness/Empress Scree and the Monarch Scree Ore Projects. Stockpiles have been reported with an estimated grade ranging between 40- 45% Fe.

	MBR MAGNETITE ORE RESERVE					
	M'dmt	Fe%	SiO2%	Al2O3%	P%	Mass_Rec%
PROVED	30.4	37.6	24.2	1.8	0.1	37.0
PROBABLE	26.0	36.7	21.2	2.4	0.1	41.3
TOTAL	56.4	37.2	22.8	2.1	0.1	39.0

*Simec Interest 100%

*Competent Person: P. Leevers

The Middleback Magnetite Reserves have been reported at a Mass Recovery of >20% and SiO2 of <50%.

1 Introduction

This technical report provides a Reserve Estimate for the Middleback Ranges (MBR) Hematite and Magnetite Mines located in Whyalla South Australia.

The MBR Hematite Ore Reserve is the combination of the MBR DSO Hematite Project and The MBR Beneficiated Hematite Project and has been derived from 5 resources from the MBR DSO Hematite Project and 3 resources from the MBR Beneficiated Hematite Project.

The MBR Magnetite Ore Reserve has been derived from the MBR Magnetite Resource Project.

The Middleback Ranges Hematite and Magnetite Mines are operating Mines that have been in commercial production since 1896 (Hematite) and 2007 (Magnetite) and are owned operated by Simec Mining which is a private company that forms part of the Gupta Family Group (GFG) Alliance

This report provides Mineral Reserve Estimates and a classification of resources and reserves prepared in in accordance to the standards as per the JORC Code (JORC, 2012) and has been prepared for Simec Mining Ltd by Mr Paul Leevers who is a full-time employee of Simec Mining.

2 Program objectives and work program

2.1 Purpose

The following document outlines the methodologies and processes employed to derive the 1st of January 2021 Ore Reserve Estimates for Simec Mining.

2.2 Reporting standard

This report provides Mineral Reserve Estimates and a classification of resources and reserves prepared in in accordance to the standards as per the JORC Code (JORC, 2012)

2.3 Project team

Estimation of the Ore Reserve has been completed by Paul Leevers (B.AppSc (Geol), M Min Eng, MAusIMM) with additional inputs from:

- Simec Mining Marketing (Market Assessment)
- SRK Consulting (Resource and Reserve Estimate Review)
- Peter O'Bryan and Associates (Geotechnical)
- R. Deceukelaire - Dc Met Consulting (Pit Optimisation and Design Review)

2. Project and Operational Descriptions

The Simec Reserve has been declared in accordance with the JORC Code as 3 distinct projects:

1. The Middleback Ranges Hematite Project - consists of all Reserves and Resources associated with Direct Shipping Ores (DSO) derived from the Middleback Ranges
2. The Middleback Range Beneficiated Hematite Project - inclusive of all reserves of Low-Grade Ores (LGO) to be upgraded to meet current and forward export specifications through beneficiation processes within the Middleback Ranges

3. **MBR Magnetite** - inclusive of all Magnetite Reserves and Resources within the Middleback Ranges including the Iron Magnet deposit

JORC 2012 Table 1, Section 4, summaries of each project are contained in **APPENDICES 1,2 and 3**.

2.3.1 Operational Description

All hematite DSO ores are mined to ROM and crushed and screened to lump (+6.3mm, -31.5mm) and fines product (-6.3mm). Low grade ores (inclusive of Scree) at the IKMA and IBMA are mined to the ROM pad where they are blended with low grade ores sourced from long term stockpiles and crushed to -31.5mm at the IBMA and -8mm at the IKMA and then fed through the Integrated Processing facilities (IPF) to produce high grade Lump and Fines product utilising density separation techniques (jigs and spirals).

Lump and fines ores are railed to Whyalla via contract rail operator OneRail Australia Pty Lid, on a Simec owned rail network, where the product is blended in the export sheds at the Whyalla Port prior to transhipping via barges operated by CSL to Cape sized vessels.

Magnetite ores mined at SMR are mined to ROM and blended with ores of poorer quality, reclaimed from long term stockpiles. Magnetite ores are crushed to -32mm all in at the Southern SMR crusher and fed through the Magnetite concentrator to produce c. 2.2Mtpa of magnetite concentrate, which as a slurry is pumped through a 60km pipeline to Whyalla where the slurry is filtered, with the recovered water returned through a water pipeline adjacent to the slurry pipeline to the concentrator. The filtered concentrate takes a variety of paths from this point. The majority is mixed with fluxes (limestone and dolomite) and processed into pellets for the Whyalla Blast Furnace, with the balance remaining unfluxed and blended with DSO and beneficiated ores from the Middleback Ranges to improve export grade, or available to market as a concentrate product, or pellet.

3 Estimation and reporting of Ore Reserves

3.1 Resource development

The resources used for the estimation of the Middleback Ranges (MBR) Hematite and Magnetite Ore Reserves are:

1. The Middleback Ranges DSO Hematite Project consisting of:
   a. Sheoak, Bark Hills, Adder Hills
   b. Cooks North
   c. Iron Duchess
   d. Iron Cavalier
   e. Crushed Low Grade Stockpiles

2. The Middleback Ranges Beneficiated Hematite Project
   a. Iron Monarch Scree
   b. Iron Baroness Scree
   c. Iron Empress Scree
   d. Low Grade Stockpiles at Iron Baron and Iron Knob scheduled for beneficiation

3. The Middleback Ranges Magnetite Project
   a. Iron Magnet Resource

Resource models used for the estimate of the Middleback Ranges DSO Hematite and Beneficiated Hematite Project have been developed by Simec Mining Technical Services in conjunction with Simec Mining Exploration with resource estimates prepared by Paul Leevers to JORC 2012 standard, with audits by SRK Consulting.

Resource models have been prepared utilising DATAMINE Software with Geological domain envelopes provided by Simec Exploration and further guidance provided from in pit mapping and reconciliation processes. Block estimation has been by Ordinary Kriging utilising hard boundary envelopes. Estimation parameters for each resource have been adjusted based on local geological conditions.

The resource model used for the estimate of the Middleback Ranges Magnetite Project has been developed by SRK Consulting. Resource models have been prepared utilising VULCAN Software with Geological domain envelopes provided by Simec Exploration and further guidance provided from in pit mapping and reconciliation processes. Block estimation has been by Ordinary Kriging utilising hard boundary envelopes.

Bulk densities used for all 3 projects have been derived from a combination of downhole insitu densities, diamond core measurements and production history.

Mineral resource classification and estimation has been in accordance to the JORC 2012 guidelines.

3.1 Public Reporting

SIMEC has used the Mineral Resource estimate dated 1st of January 2021 and estimated to JORC 2012 standards Code as a key input into the Ore Reserve estimation. As the operations are operating mining projects that are not supported by a feasibility study, to support the Ore Reserves, SIMEC has supported the Ore Reserve estimate with the Life of Mine Plans for the operations. This approach is supported by the following excerpt from guidance notes published by the Australian Securities Exchange (ASX):

'Where an entity has an operating mine for an Ore Reserve, its Life of Mine Plan would generally be expected to contain information at better than Pre-Feasibility or Feasibility level for the whole range of inputs normally required for a Pre-Feasibility or Feasibility study and this would meet the requirement in Clause 29 for the Ore Reserve to continue that classification. Where, however, its Life of Mine Plan does not contain information at Pre-Feasibility or Feasibility level, it will have to upgrade its Life of Mine Plan to Pre-Feasibility or Feasibility level before 1 December 2014 or else downgrade the Ore Reserve to a Mineral Resource.'

The MBR DSO Hematite, MBR Beneficiated Hematite and MBR Magnetite Ore Reserves have been reported as at the 1st of January 2021 and are summarised in Table's 1 and 2.

These estimates represent the first public reporting of ore reserves completed for the MBR DSO Hematite, MBR Beneficiated Hematite and MBR Magnetite Projects since 2016, under the previous owner Arrium Mining Pty Ltd (Administrators Appointed).

There have been no changes to project definitions since previous public reporting.

MBR DSO HEMATITE ORE RESERVE					
	M'dmt	Fe%	SiO2%	Al2O3%	P%
PROVED	3.6	59.3	7.3	1.5	0.10
PROBABLE	11.7	58.2	6.0	2.4	0.06
TOTAL	15.2	58.4	6.3	2.2	0.07
MBR BENEFICIATED HEMATITE ORE RESERVE					
Category	M'dmt	Fe%	SiO2%	Al2O3%	P%
PROVED	0.5	60.7	6.1	2.8	0.05
PROBABLE	5.7	60.7	6.3	2.9	0.05
TOTAL	6.2	60.7	6.3	2.9	0.05
MBR DSO HEMATITE + MBR BENEFICIATED HEMATITE					
	M'dmt	Fe%	SiO2%	Al2O3%	P%
PROVED	4.0	59.5	7.2	1.7	0.10
PROBABLE	17.5	59.0	6.1	2.6	0.05
TOTAL	21.4	59.1	6.3	2.4	0.06

Table 1: MBR DSO Hematite and MBR Beneficiated Hematite Ore Reserves

Cut off Grades used:

- MBR DSO Hematite >55% Fe SiO2 <20% for all deposits except Iron Cavalier >50% Fe <20% SiO2 and historic crushed LGO Stockpiles scheduled in DSO Blend >50% Fe
- MBR Beneficiated Hematite - application of metallurgical factors and recoveries to insitu LGO resources and historic stockpiles to provide product grades >55% Fe.

MBR MAGNETITE ORE RESERVE						
	M'dmt	Fe%	SiO2%	Al2O3%	P%	Mass_Rec%
PROVED	30.4	37.6	24.2	1.8	0.07	37.0
PROBABLE	26.0	36.7	21.2	2.4	0.07	41.3
TOTAL	56.4	37.2	22.8	2.1	0.07	39.0

Table 2: MBR Magnetite Project Ore Reserve

Cut off Grades used:

- Magnetite Reserves have been reported at a Mass Recovery of >20%

The public reporting statement for the competent person is contained in **APPENDIX 2**

3.3 Mineral Resource estimates for conversion to Ore Reserves

The resource estimates used for the derivation of the Simec Mining MBR DSO Hematite, Beneficiated Hematite and Magnetite Ore Reserves are summarised in Tables 3, 4 and 5.

	Volume m3x10^6	M'wmt	M'dmt	H2O%	FE%	SIO2%	AL2O3%	P%	DENSITY
MEASURED	0.8	2.5	2.5	4%	57.64	8.38	2.78	0.09	3.31
INDICATED	25.7	84.5	82.7	4%	56.72	6.52	2.69	0.07	3.29
Inferred	10.7	38.9	38.0	4%	57.46	7.77	2.04	0.09	3.63
TOTAL	37.2	126.0	123.2	4%	56.95	6.91	2.51	0.07	3.39

Table 3: Total MBR DSO Hematite Resource

MBR DSO Hematite Resource has been reported as at the 1st of January 2021.

- Cut off grade >47% Fe and SiO2%<50

	Volume m3x10^6	M'wmt	M'dmt	H2O%	FE%	SIO2%	AL2O3%	P%	DENSITY
MEASURED	-	-	-						
INDICATED	5.6	17.1	16.9	4%	41.7	26.0	7.2	0.02	3.01
INFERRED	1.7	5.0	4.9	4%	40.7	26.9	7.9	0.03	2.92
TOTAL.	7.3	22.1	21.9	4%	41.4	26.2	7.3	0.02	3.00

Table 4: Total MBR Beneficiated Hematite Resource

The MBR Beneficiated Hematite Resource has been reported as at the 1st of January 2021. Cut off grades are outlined below:

- >35% Fe for the Baroness/Empress and Monarch Scree Ore Projects
- >40% Fe for LGO Stockpiles

IM_2020_11	Category	Volume (m^3 x 10^5)	Tonnage (mt)	Mass Rec %	SiO2_C %	Fe_H %	SiO2_H %	S_C %	Al2O3_H %	LOI_H %	DENSITY t/m^3
Within MAG pit (current processing route) MassRec > 20% and SiO2_H < 50% (INCLUSIVE RESOURCE USED TO DERIVE ORE RESERVE)	Measured	7	25	44.92	1.87	39.57	18.85	0.02	1.94	8.02	3.76
	Indicated	8	30	39.53	2.49	37.05	23.14	0.04	1.97	7.66	3.68
	Inferred	1	3	28.67	4.36	32.97	32.16	0.22	2.23	5.48	3.41
		Volume (m^3 x 10^5)	Tonnage (mt)	Mass Rec %	SiO2_C %	Fe_H %	SiO2_H %	S_C %	Al2O3_H %	LOI_H %	DENSITY t/m^3
Within MAG pit (proposed Prime processing) MassRec >15% and Fe_H >20% and SiO2_H< 60% and SiO2_C < 20% (INCLUSIVE RESOURCE)	Measured	-	-	-	-	-	-	-			-
	Indicated	4	12	33.63	7.47	29.2	48.41	0.03	1.11	1.61	3.26
	Inferred	2	7	23.5	9.52	26.37	53.07	0.09	0.64	0.99	3.15
		Volume (m3 x 10^5)	Tonnage (mt)	Mass Rec %	SiO2_C %	Fe_H %	SiO2_H %	S_C %	Al2O3_H %	LOI_H %	DENSITY t/m3
Outside MAG pit (proposed Prime processing) MassRec > 15% and Fe_H > 20% and SiO2_H < 60% and SiO2_C < 20% within Prime pit shell	Measured	-	-	-	-	-	-	-			-
	Indicated	38	133	37.8	7.24	33.16	41.2	0.02	1.14	2.38	3.5
	Inferred	70	235	27.77	10.93	28.84	48.75	0.18	0.75	1.44	3.34
		Volume (m3 x 10^5)	Tonnage (mt)	Mass Rec %	SiO2_C %	Fe_H %	SiO2_H %	S_C %	Al2O3_H %	LOI_H %	DENSITY t/m3
Total All Categories	Total Measured	7	25	44.92	1.87	39.57	18.85	0.02	1.94	8.02	3.76
	Total Indicated	50	175	37.81	6.44	33.56	38.6	0.02	1.28	3.23	3.52
	Total Inferred	73	245	27.66	10.81	28.82	48.67	0.18	0.76	1.48	3.34
	Total	130	445	32.66	8.55	31.34	42.9	0.11	1.04	2.56	3.43

Table 5: Total MBR Magnetite Project Resource

The MBR Magnetite Project Resource has been reported as at the 1st of January 2021. Cut off grade used is outlined below:

- Mass Recovery > 15% and Fe_H > 20% and SiO2_H < 60% and SiO2_C < 20%

Resources exclusive of ore Reserves are contained in Tables 6 and 7 for the MBR DSO Hematite Project and MBR Beneficiated Hematite Project and Table 5 for the MBR Magnetite Project.

	Volume $m3x10^6$	M'wmt	M'dmt	H2O%	FE%	SIO2%	AL2O3%	P%	DENSITY
MEASURED	0.8	2.6	2.5	4%	57.64	8.38	2.78	0.09	3.31
INDICATED	19.8	66.0	64.8	4%	56.46	6.72	2.83	0.07	3.29
INFERRED	10.4	38.2	37.9	4%	57.16	7.96	2.17	0.09	3.63
TOTAL	31.0	106.3	105.3	4%	56.72	7.18	2.61	0.08	3.39

Table 6: MBR DSO Hematite Resource Exclusive of Ore Reserves

CATEGORY	Volume $m3x10^6$	M'wmt	M'dmt	H2O%	FE%	SIO2%	AL2O3%	P%	DENSITY
MEASURED									
INDICATED	1.5	5.4	5.2	4%	32.31	43.07	7.82	0.01	2.95
INFERRED	1.6	4.7	4.6	4%	40.63	26.89	7.96	0.03	2.95
TOTAL	3.0	10.1	9.7	4%	36.20	35.50	7.89	0.02	2.95

Table 7: MBR Beneficiated Hematite Resource Exclusive of Ore Reserves

3.4 Site visits

The competent person visits the Sites on a regular basis with no material issues identified.

3.5 Study status

The Iron Magnet which makes up the MBR Magnetite Reserve is an operating Mine with all infrastructure and approvals in place to support ongoing operations.

For the MBR DSO Hematite Reserve, The Iron Duchess, Bark Sheoak, Adder and Iron Cavalier deposits are operating Mines with all infrastructure and approvals in place to support ongoing operations. Cooks North is an extension of an existing mining operation and currently is in the process of heritage and PEPR approvals to commence mining in H1 FY2023.

The Iron Empress, Iron Baroness and Monarch Scree make up the MBR Beneficiated Hematite Reserve and all infrastructure and approvals are in place to support ongoing operations.

3.6 Mining factors or assumptions

All Mining across the MBR Magnetite and Hematite Operations is by convention open cut drill and blast methods with equipment shared between operations.

Since 1998 mining has been undertaken by a mining contractor, with the current incumbent Golding Pty Ltd (Formerly BGC) being in place since 2012.

Mining is carried out on 6 or 8m benches with consideration given to ore body access and pit geometry.

Typical fleet size is 200t excavators matched to 125t dump trucks. Dig rates are calculated based on dry SG and with dig rates and fleet configuration derived from current mining operations. Reductions are applied for minimum mining width, pit geometry and local conditions.

Geotechnical studies have been completed for all operating mines and future operating mines. The studies have been completed externally by Peter O'Bryan and Associates in conjunction with Simec Mine Technical Services Teams.

Geotechnical parameters have been based either on actual pit specific geotechnical investigations or, in the absence of any specific pit geotechnical information, it has been assumed that geotechnical parameters will be similar to historical geotechnical investigations of current mining operations located nearby and/or slope stability observations over time in areas that have been previously mined.

3.6.1 Basis of assessment

The Simec Mining Ore Reserve Estimates have been derived from the Simec Mining Life of Mine Plan which is a combination of the MBR DSO Hematite, MBR Beneficiated Hematite and MBR Magnetite Ore Reserves.

Life of Mine Planning is conducted annually at the beginning of each Calendar year. The Life of Mine used for this Ore Reserve Estimate was completed in November 2020 as part of the 2021 Life of Mine Update. Key considerations for Life of Mine Development were:

- Maximises DSO export rate based on resource availability for the remaining life of the reserve base
- Achieves 2.2Mt annualised Magnetite concentrate.
- Pit development timing aligned with delivery of optimal pit value based on forward pricing assumptions
- Optimal utilisation of available mining fleet resources
- Provision of a consistent ore flow without excessive stockpiling
- Develops new pits based on a low to high risk and capital profile
- New pits not developed prior to the regulatory approval's timeline

Appropriate consideration and validation of all inputs used in the plan has been completed through reconciliation of past performance and operational history within the Middleback Ranges since operations commenced.

3.6.2 Defining mineralisation considered in Ore Reserve estimation

As part of due diligence and ongoing review of mine economics, pit re optimisation and updating of the mine plans is under taken on a regular basis for the MBR hematite and Magnetite resources.

Pit re-optimisation was completed in conjunction with by R. Deceukelaire of Dc Met consulting utilising standard pit optimisation software.

The optimisation process utilized a regularized and diluted resource model with consideration of geotechnical parameters, local conditions, costs derived from current operations and revenue derived from consensus long term price forecasting.

Pit shell selection was based on the following key criteria:

- Optimisation of NPV and Cashflow
- Practicality of development
- Mine Plan fit relative to price forecast
- Overall Mine Plan benefit
- Regulatory criteria and timelines

- Matching to Life of Whyalla Steelworks (MBR Magnetite Only)

Final designs were then completed on selected pit shells by Simec Mining and. All designs have been based on the Simec Mining Mine Design standards and take into account the following criteria:

- Minimum Mining Width for Cutbacks
- Local Geotechnical Conditions
- Practicality of access and sustainability
- Environmental and Regulatory Considerations
- Current operating conditions and budget
- Final Geotechnical review by external consultants (Peter O'Bryan and Associates)

3.6.3 Mine planning processes

Simec Mine Planning utilises the Runge Pincock Minarco (RPM) suite of Open Pit Mining Tools (OPMS) for Mine Planning Purposes.

4 phases of Mine Planning occur within the Simec Mine Planning Process which forms the basis of ore reserve estimate.

- Life of Mine Planning
    - Completed By Simec Mining Technical Services
    - Occurs Annually or where there are material changes to resources or external factors
    - Inputs derived from both internal and external stakeholders
- 36 Month Plan
    - Completed by Simec Mining Technical Services
    - Developed from the Life of Mine Plan
    - Completed Quarterly
    - Inputs derived from both internal and external stakeholders
    - Defines budget and 3 year forecasts
- 13 Week Plan
    - Completed by Simec Mining Technical Services
    - Developed from the 36-month plan
    - Completed Monthly
    - Inputs derived from both internal and external stakeholders
    - Defines monthly cashflow and marketing updates
- Monthly Plan
    - Completed by Mining Contractor (Golding Pty Ltd)
    - Derived from the 13 week Mine plan
    - Completed weekly

All inputs are signed off by the relevant stakeholder and process owner. Key inputs considered in the planning process but not limited to are:

- Mining Productivity Factors and Assumptions
- Dilution, Ore Loss and local orebody risk
- Metallurgical Factors
- Logistics (Rail, Port) considerations
- Fixed plant (Crushers, Beneficiation Plants)
- Internal Customer (Whyalla Steelworks Long Products) Considerations
- External Stakeholder Considerations
- Shipping and Marketing Requirements

3.6.4 Dilution and ore loss

Dilution and ore loss are applied on a local and global basis.

A 3-dimensional dilution modelling process has been applied to the resource model to develop the reserve models used in scheduling. The process accounts for a minimum mining width of 6m, bench height of 2m and ore body geometry. Where the resource model does not meet this criterion, ore is re blocked to account for the additional width and grades diluted accordingly

Further application of loss and dilution factors are applied to the mine planning process in local areas based on historical performance or consideration for local conditions such as geotechnical conditions or further ore geometry complexities.

Average conversion losses from resource to reserve is approximately a 11% loss in resource tonnes and 0.5% reduction in Fe grade for the Middleback Ranges DSO Project.

For the Middle Back Ranges Magnetite Project this represents a resource conversion loss of 2.5% of tonnages 2% in Mass Recovery and 1% in Fe grades.

For the MBR Beneficiated Hematite Project dilution factors have been applied to the feed stocks prior to beneficiation with an overall reduction in Mass Recovery to plant of 3%.

3.6.5 2021 Life of Mine Plan Used to Define Ore Reserves

The 2021 Life of Mine Plan used to define ore reserves is inclusive of beneficiated products and feed sources with rates and recoveries derived from current operations and future forecasts from feasibility studies and test work. Lump / Fines splits and internal transfer of product has also been factored into the plan. The MBR DSO and Beneficiated Hematite Life of Mine is contained in Figure 1 and the MBR Magnetite Life of Mine plan is contained in Figure 2.

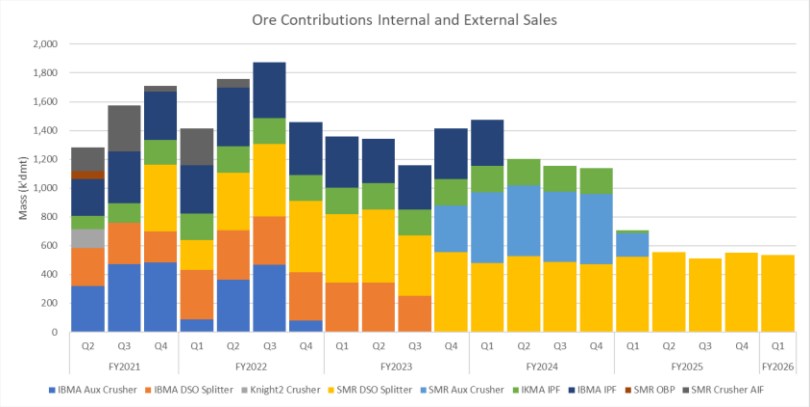


Figure 1: MBR DSO and Beneficiated Hematite Life of Mine plan – Ore Contribution

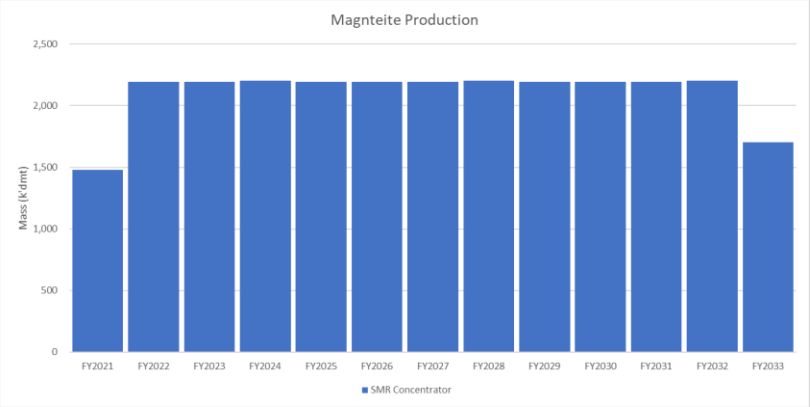


Figure 2: MBR Magnetite Life of Mine plan – Concentrate Production @ 65.8% Fe, 4.5% SiO2

Mine plan sequence and ore contribution are summarised in (Table 8), this is inclusive of inferred resources. Mining volume and tonnages by pit is summarised in APPENDIX 3.

Key points are:

- Completion of the MBR DSO and MBR Beneficiated Projects at the end of FY2025
- Completion of the MBR Magnetite Project FY2032

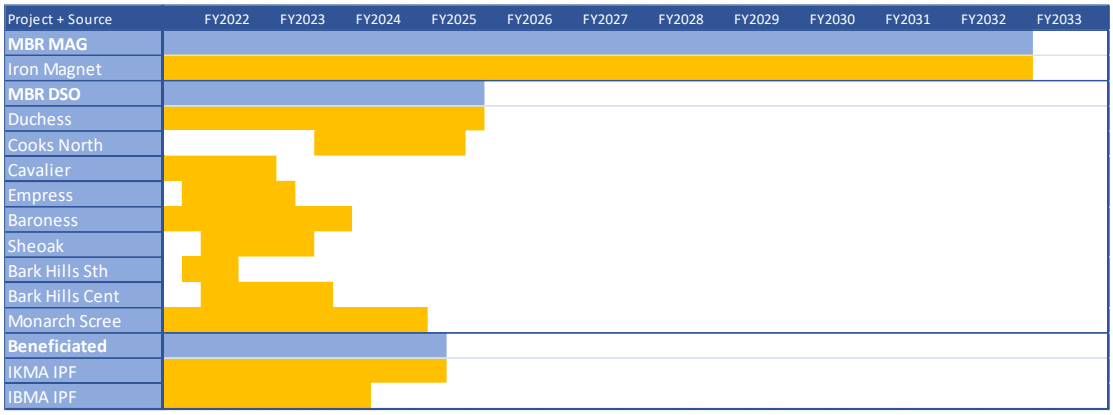


Table 8: 2021 LOM PLAN: Where Blue = Project Life, Orange Project Contribution Life

Mining of Inferred Mineral Resources is scheduled through the Mine Plan and comprises approximately 6% of DSO mined, 3% of LGO / Scree Ore and 6% of magnetite ores.

The inclusion of Inferred in the Mine Plan is not considered material and has not been included in the economic assessment.

Potential exists within all Projects for further extensions to the reserve base. However, all are currently below pre-feasibility study level. The key Ore Reserve extension projects are:

- Increase to the MBR Beneficiated Hematite Project through review and extension to Monarch and Baroness Empress Scree Deposits by further pit optimisation and process review – Studies scheduled for H1 FY2022
- Increase to the MBR DSO Hematite Project through review of previous mothballed operations with focus on the Iron Monarch Mine – Studies currently underway
- Increase to the MBR Magnetite Project (Project Prime) focussing on tripling of the reserve base by re optimisation of the Iron Magnet Resource and review of processing options – studies currently underway.

3.6.6 Cut-off parameters

The cut off grades have been derived from financial analysis based on detailed mine planning, including mine production schedules that indicated that a saleable product could be produced, taking into account market considerations for current iron ore price term contracts and spot shipments.

The Simec Middleback Ranges (MBR) DSO Hematite has been scheduled at a cut-off grade of >55% Fe and <20% SiO2 for all deposits except Iron Cavalier which has been derived at a cut-off grade of 50% Fe.

Low-grade (50 to 55% Fe < 20% SiO2) has been scheduled for crushing and blending with MBR Hematite DSO and MBR Beneficiated Ore through FY2022.

The Middleback Range Beneficiated Hematite Reserves have been declared through the application of metallurgical recoveries derived from current operations and ore characterisation test work derived from bulk samples, test parcels through current operations, and drill samples from within the MBR Beneficiated Hematite Resource with the application of metallurgical factors and recoveries to insitu LGO resources and historic stockpiles to provide a beneficiated product grade >55% Fe.

Cut off grades used for life of Mine Planning for the MBR Magnetite is a Mass Recovery of >20% and SiO2 <50%. This has been derived from detailed financial analysis, taking into account, mine planning, concentrator capability and market considerations for the quality of concentrate produced.

3.6.7 Reconciliation

Reconciliation is performed throughout the supply chain for the MBR DSO, MBR Beneficiated and MBR Magnetite Projects on a monthly, quarterly and annual basis.

Reconciliation of The Middleback Ranges DSO Hematite Project from the 1st of July 2016 (Last Declared Reserve) to the 1st of January 2021 is outlined in Table 9.

	Recovered					Reserves				
Mining Area	M'wmt	FE%	SIO2%	AL2O3%	P%	M'wmt	FE%	SIO2%	AL2O3%	P%
SMR	2.2	58.47	6.05	1.83	0.06	1.6	58.93	7.14	1.97	0.06
KNIGHT	3.5	55.29	6.96	2.84	0.02	4.3	54.25	6.76	2.66	0.01
BARON	8.7	59.67	6.54	2.49	3.96	10.1	59.38	6.58	2.39	0.04
KNOB	4.9	59.42	5.66	2.2	4.05	4.7	58.48	5.68	2.14	0.06
TOTALS	19.3	58.7	6.3	2.4	0.1	20.7	58.1	6.5	2.4	0.0

Table 9: Reconciliation of MBR DSO Ore Reserve 1st July 2016 to 1st January 2021

Overall reconciliation is within 93% inclusive of removals outside of depletions.

Key Variations are:

- SMR – Recovery of additional Inferred resources from Iron Magnet (Hematite DSO) and Duchess North
- Iron Knight – Removal of 0.8Mt of Iron Chieftain due to re optimisation and reassessment of recovery factors
- Iron Baron – Removal of Camel Hills deposit due reassessment of Market Value within the Whyalla Steelworks

Reconciliation of The Middleback Ranges Beneficiated Hematite from the 1st of July 2016 (Last Declared Reserve) to the 1st of January 2021 is outlined in Table 10.

	RECOVERED						ORE RESERVES					
CATEGORY	Product M'wmt	Mass_Rec	Fe	Sio2	Al2O3	P	Product M'wmt	Mass_Rec	Fe	Sio2	Al2O3	P
FY17	1.9	54%	60.5	6.0	1.8	0.04	2.2	49%	59.7	6.6	2.3	0.04
FY18	2.2	45%	60.7	6.6	1.8	0.05	4.0	53%	60.8	6.1	2.4	0.06
FY19	2.8	43%	60.3	5.6	2.1	0.06	3.9	50%	60.4	6.2	2.5	0.06
FY20	2.9	48%	60.4	5.9	2.4	0.05	2.8	40%	60.0	6.2	2.6	0.05
FY21 (H1)	1.3	49%	60.5	6.0	2.7	0.03	1.4	43%	60.9	5.5	2.8	0.07
TOTAL	**11.0**	**47%**	**60.5**	**6.0**	**2.2**	**0.05**	**14.2**	**47%**	**60.4**	**6.2**	**2.5**	**0.06**

Table 10: Reconciliation of MBR Beneficiated Ore Reserve 1st July 2017 to 1st January 2021

Key variations:

- Period of poor performance from FY2017 to FY2019 due to reliability issues with the IBMA and IKMA IPF plants

- Rectification of reliability issues and further understanding and optimisation of beneficiation feed leading to stabilisation of production and product grades

Reconciliation of The Middleback Ranges Magnetite Ore Reserve is outlined in Table 11.

CATEGORY	Recovered Feed Tonnes M'dmt	MASS_REC%	Concentrate M'dmt	Ore Reserve Feed Tonnes M'dmt	MASS_REC%	Concentrate M'dmt
MBR MAG	23.8	37.6	8.9	22.1	37.5	8.3

Table 11: Reconciliation of MBR Magnetite Ore Reserve 1st July 2017 to 1st January 2021

For the MBR Magnetite Project overall reconciliation is positive and 6% above depletions.

3.6.8 Mine Approvals

The Iron Magnet, Iron Duchess, Iron Cavalier, Bark Sheoak, Baroness, Empress and Monarch Scree are operating mines and have all required approvals in place. Cooks North is an extension of an existing mining operation and currently is in the process of heritage and PEPR approvals to commence mining in H1 FY2023, no issues that would prevent the approvals in the timeframe required have been identified.

Outline of leases and Tenure is contained in Figure 1.

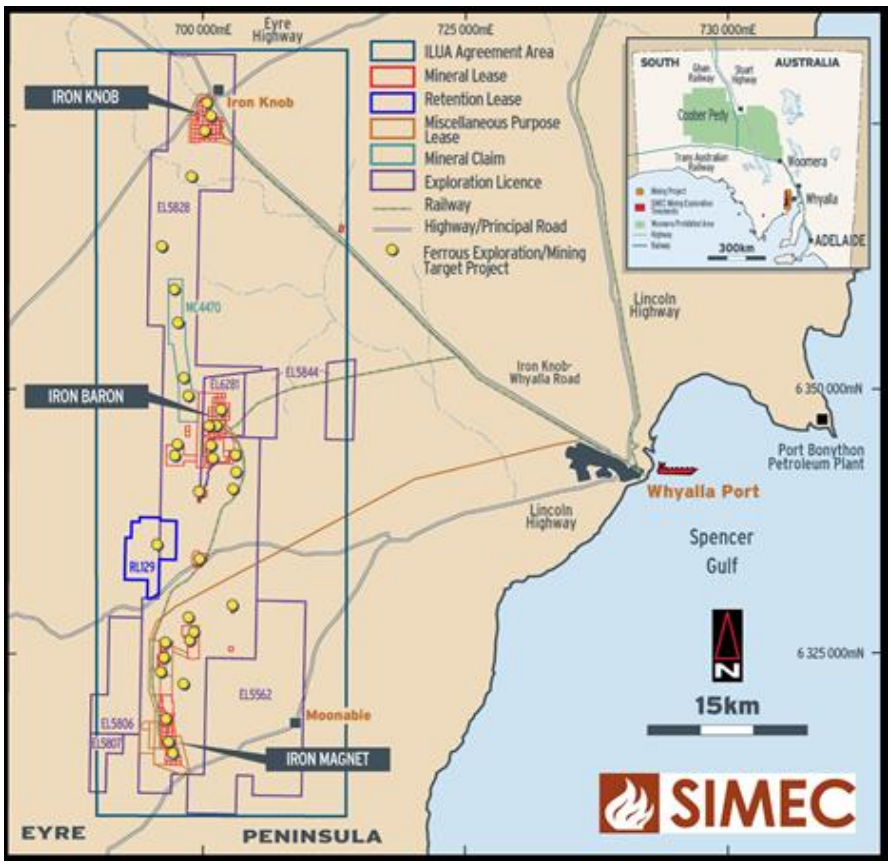


Figure 1: Tenement Location and Infrastructure MBR

All tenements are wholly owned OneSteel Manufacturing Pty Ltd (Simec Mining) and consists of 85 Mineral Leases (MLs) and 17 Miscellaneous Purpose Licences (MPLs) in the SMR which cover all current and future mining operations.

3.6.9 Mining methods

All Mining across the MBR Magnetite and Hematite Operations is by convention open cut drill and blast methods with equipment shared between operations.

Mining is carried out on 6 or 8m benches with consideration given to ore body access and pit geometry.

Typical fleet size is 200t excavators matched to 125t and 75t dump trucks. Dig rates are calculated based on dry SG and with dig rates and fleet configuration derived from current mining operations. Reductions are applied for minimum mining width, pit geometry and local conditions.

Typical digger / truck configurations assumed in the pit optimisation and derived from LOM 18.1 are outlined in (Table 12).

ID	EX1	EX2	EX3	EX4	EX5	EX6
EXCAVATOR	PC4000	EX2600	EX2600	PC2000	PC2000	PC1250
TRUCK	785	785	777	785	777	777

Table 12: Truck and Excavator Matching MBR

3.7 Metallurgical factors or assumptions

All Direct Saleable Ore (DSO) is crushed and screened to deliver a “Fines Product” (-6.3mm) and a “Lump Product” (=6.3mm to -31.5mm). Minor quantities are used as feedstock for the Whyalla Blast Furnace and Pellet plant. The metallurgical process of crushing and screening iron ore to produce either Lump or Fines product is industry standard.

Metallurgical test work and assumptions have been derived from samples taken from diamond core, in-pit samples and production data from nearby operations of similar mineralogy, they have been used to derive Lump / Fines splits and processing characteristics. Typically, production data from nearby operations forms the majority of test sampling and is used for existing operations. Typical lump yields are 30% of total crushed tonnages and no metallurgical recovery factors are applied to DSO ores.

Due to the long history of mining of MBR DSO ores, operational history is considered an adequate model for new deposits (Cooks North) as they have the same mineralogy and stratigraphy.

The lump / fines splits derived have then been used as inputs into LOM plan 18.1 for derivation of product blends.

For the MBR Beneficiated Hematite Reserves ores are beneficiated through the Iron Baron and Iron Knob Integrated Processing Facilities (IPF) utilising density separation (jigs and spirals) (Figures 2 and 3) . At the Iron Baron ore is crushed to -32mm to produce a high-grade Lump (-32mm, +6.3mm) and Fines (-6.3mm) product. For the Iron Monarch Beneficiation Project material

is crushed to -8mm utilising the current crushing plant and then beneficiated to produce a high-grade Fines (-8mm) product.

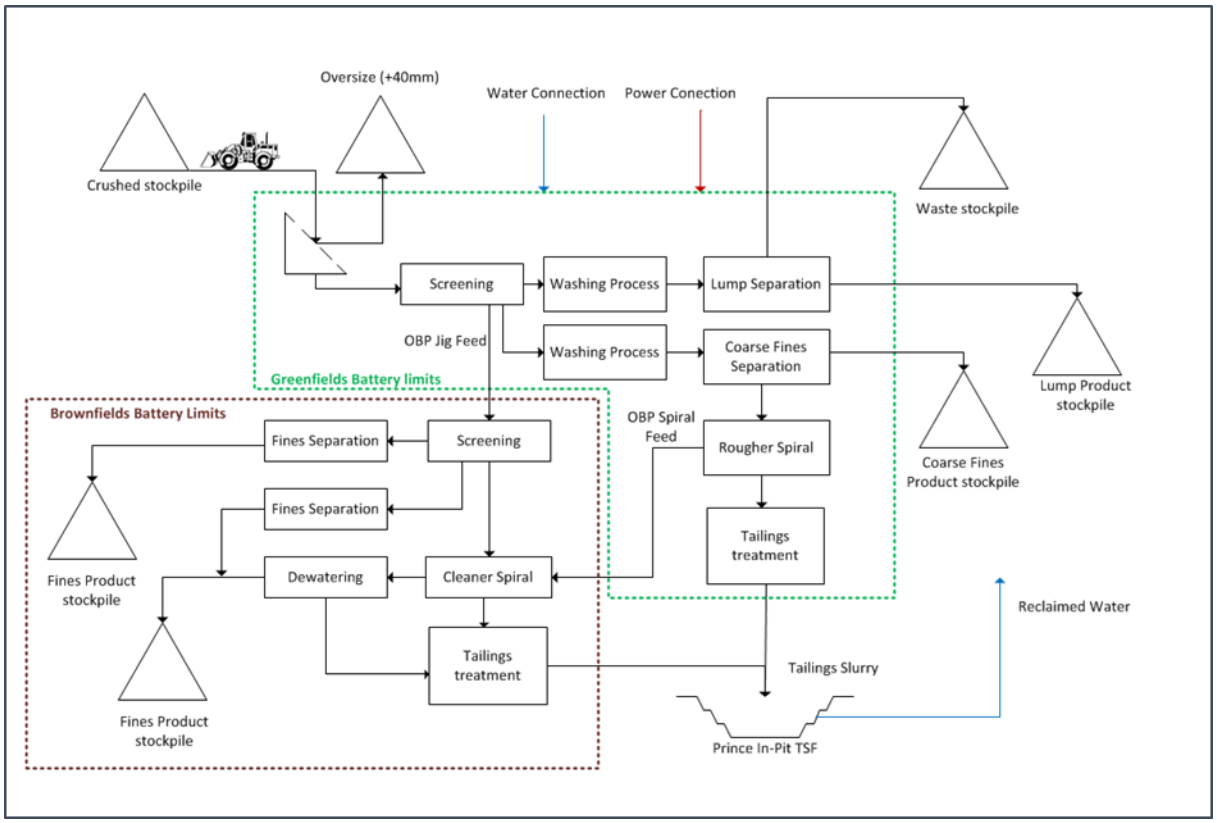


Figure 2: IBMA IPF Flow Chart

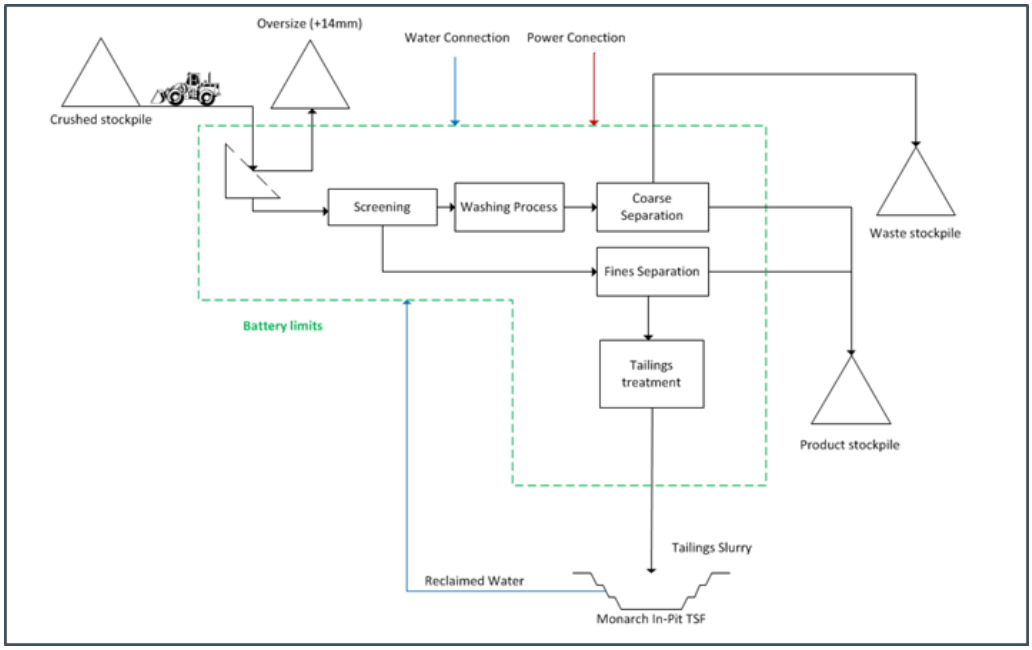


Figure 3: IKMA IPF Flow Chart

Recovery factors and product grades applied to the MBR Beneficiated Ore Reserve are based on ongoing reconciliation operational history and metallurgical test work from bulk samples taken from trenches, auger drilling and sonic drilling. Metallurgical test work completed is inclusive of

Heavy Liquid Separation, Mini Jig Tests and bulk samples through the current IPF plants. Metallurgical test work reflects the operational process described. Samples used for metallurgical test work have been sourced from sonic drilling, auger drilling, trenching and bulk in pit samples.

Recovery factors and product grades derived have been applied to stockpiles and estimated into the Baroness / Empress and Monarch Scree Models and applied to the LOM 18.1 scheduling model.

The MBR DSO Hematite and MBR Beneficiated Hematite product forms part of an overall "Whyalla" blend and is sourced from a number of operations. The impact of deleterious elements is taken into account during the scheduling of the "Whyalla" Blend and the economic assessment as part of the Simec overall business model.

For the MBR Magnetite Deposit ore is processed through the magnetite concentrator at rate of between 4.6 and 5.9 Mtpa using a process of magnetic separation to produce a concentrate that is slurried to Whyalla (Figure 4).

The existing concentrator has been in operation, for 15 years with metallurgical parameters derived from initial test work and updated and refined as a result of concentrator production reconciliation and forward test work based on bulk samples from forward portions of the orebody that is completed on a regular basis.

Recovery factors have been applied to the MBR Magnet Mining model and have been scheduled through the Life of Mine.

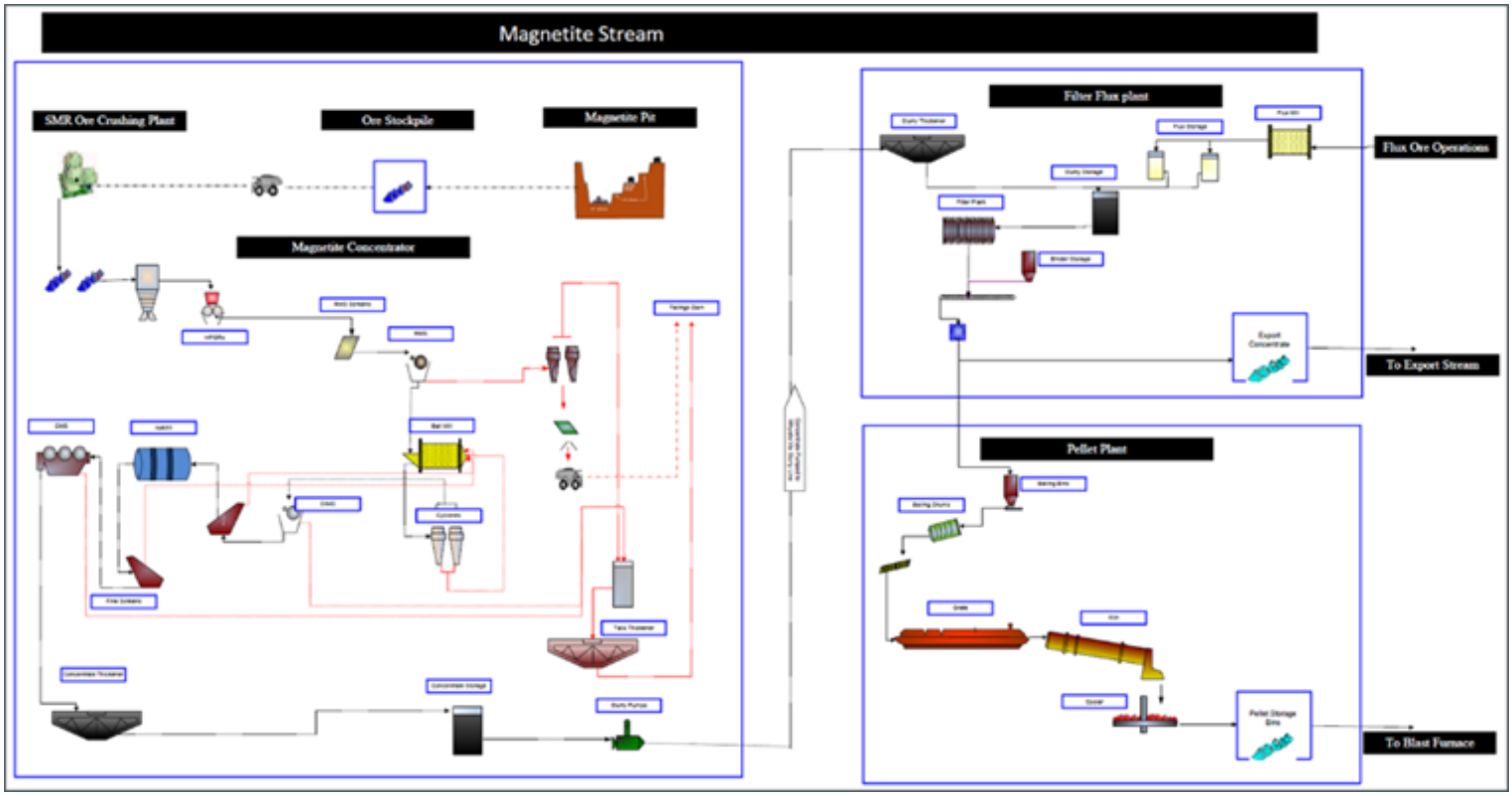


Figure 4: Magnetite Stream Flow Chart

Concentrate produced is processed into iron ore pellets for use as feedstock to the Whyalla Integrated Steelworks and excess concentrate is blended with Hematite production as part of the overall blended product. The impact of deleterious elements is taken into account in the overall blend.

3.8 Environmental and Rehabilitation

The Iron Magnet, Iron Duchess, Iron Cavalier, Bark Sheoak, Baroness, Empress and Monarch Scree are operating mines and have all required approvals in place. Cooks North is at feasibility status.

The Middleback Ranges site works is inclusive of all remediation required for rehabilitation at the operating Middleback Ranges Mine sites AND future mine sites declared in the reserve statement.

The rehabilitation estimates have been based on the designs and outcomes expressed in the approved mining program (PEPR) for each operating or mothballed mining area.

Where Mining Lease Approvals (PEPR) are still in negotiation (Cook North, Duchess Stage D) rehabilitation estimates are based on rehabilitation designs and initial outcomes defined during the feasibility and pre-feasibility phase of the project.

Estimates are inclusive of but not limited to:

- Dozing and reshaping waste rock dumps to agreed landforms
- Top soiling of waste rock dumps and open areas
- Scarifying and seeding of all roads and ROM pads
- Removal of all infrastructure
- Capping and top soiling of tailings dams

Rehabilitation costs are scheduled and modelled through the life of each reserve contribution with final rehabilitation of all infrastructure occurring at the end of the Reserve Life of Mine Plan

3.9 Infrastructure

The Middleback Ranges can be broken broadly into 3 main sites, with four operational hubs and infrastructure in place for ongoing operations (Figure 1). All infrastructure is owned by Simec Mining.

The 3 sites are described below:

- Iron Baron Mining Area which the Beneficiated Scree Ore Reserves of the Baroness and Empress and the adjacent DSO Reserves of Bark / Sheoak.
- South Middleback Range (S-SMR and N-SMR), incorporating Iron Magnet, Iron Duchess and Cooks North pits.
- Iron Knob Mining Area (IKMA), incorporating the Monarch Scree Deposit.

The four operational hubs at MBR are described below:

Hub 1: South - Southern Middleback Ranges ('S-SMR')

- Infrastructure including three stage crushing facilities, magnetite concentrator with forecast concentrate capacity of 2.2Mtpa, slurry and return water pipeline, and rail loading facilities.
- Ore sourced from the "Magnet" pit containing mostly magnetite with c. 10% hematite ore and Primary ore source for hematite crushing from existing low-grade stockpiles and the Iron Duchess pit.

Hub 2: North - Southern Middleback Ranges ('N-SMR')

- Infrastructure includes 1 x mobile crusher at the Iron Knight ROM location adjacent to rail loading facilities.
- Ore sources are from current LGO feeds sourced from Iron Duchess and future direct shipping ore (DSO) sources from Cooks North.

Hub 3: Iron Baron Mining Area ('IBMA')

- Crushing facilities with 1,500tph capacity, rail loading siding adjacent to crushing infrastructure.
- Beneficiation or Integrated Processing Facility (IPF) plant with production capacity of ~1.4Mtpa
- Ore sources are Scree Ore for feed to the IPF from Empress and Baroness and DSO from Bark and Sheoak.

Hub 4: Iron Knob Mining Area ('IKMA')

- Crushing and stacking infrastructure adjacent to rail loading area.
- Sourcing Scree Ores from Monarch Scree.
- The low-grade material from the Monarch Scree and low-grade stockpiles is processed through a wash and beneficiation plant (IPF) with a production capacity of ~0.6Mtpa.
- A Quartz Quarry is located approx. 10km from IKMA. This pit is campaign mined, crushed and screened. The Quartz is used as a flux in the Iron Making process at the Whyalla Steelworks.

3.10 Costs

Projected mining costs are derived from current service contracts in place with current contract providers, adjusted to take into account projected changes in activity (due to pit depths, haulage distances, etc.) over the life of mine.

Capital costs include sustaining capital expenditure and development (expansion) capital expenditure.

Sustaining capital (including initial waste pre-strip) are derived from costs of existing operations and are consistent with the SIMEC's business plan, projected over the life of mine. Development capital, the capital required for new projects and expansion are input as per the SIMEC's indicated studies and capital program.

Input assumptions are in Real FY20 terms and adjusted for inflation in the economic evaluation.

3.11 Revenue factors

Short-term price estimates are based on market data in the near-term and third party macroeconomic informed data in the long-term.

Realised prices for revenue approximations are estimated on a dry metric tonne unit basis. Revenue factors are calculated by individual product types (lump, pellets, fines, concentrate). The benchmark 62% Index fines price is applied, with premia relating to grades, impurities, realised premium or other characteristics based on individual product specifications (value-in-use) expected under current life of mine planning.

Where products are matched to the Life of Steelworks Asset (MBR Magnetite Project) downstream value add is also taken into account when defining revenue factors.

3.12 Market assessment

Sales volume forecasts and target product grades been based on current and future planned infrastructure capacity defined by the Life of Mine Plan and assessment of internal (Whyalla Steelworks which is a captive market) and external market demand, supply and stock situation by Simec's marketing and planning teams.

This is completed annually with target product grades and sales volumes adjusted accordingly which is used to further review and refine the annual Life of Mine Planning Process.

3.13 Economic Evaluation

SIMEC's primary approach to the valuation of the mineral assets involves the application of the Discounted Cashflow ("DCF") methodology. The discounted cashflow methodology involves the calculation of net present values by discounting expected future cashflows. Projected cashflows are discounted to a present value using discount rates that take into account the time value of money and risks associated with the cashflows. The discounted cashflows methodology is particularly appropriate for assets such as mineral assets, where reserves are depleted over time and where significant capital expenditure is required. It is the primary method of valuation in the mining industry.

A detailed financial model has been constructed for the project using capital and operating costs developed by SIMEC and revenue factors stated above.

The principal case assessed, assumes that the majority of product is exported to China on CFR (Cost and Freight) basis and internal consumption for the MBR DSO Hematite and MBR Beneficiated Hematite Projects.

For the MBR Magnetite Project assessment takes into account Life of Asset planning for the Whyalla Steelworks and downstream value add processes. The current end of Life for the Steelworks asset is scheduled at 2032.

Financial analysis shows over the next ~3-4yrs a strong cash surplus being generated from the high price cycle in Iron Ore however once the Hematite is depleted lower margins and volumes in Magnetite result in the narrowing cashflows at the Long-Term Price US$72/dmt (2020 real).

3.14 Risks and Sensitivities

Sensitivity analyses have been conducted for the project to assess the effects of changes in key parameters to the nominal NPV. The NPV is most sensitive to Iron Ore price which is assumed to average US$107/dmt over the life of the project (Table 24 and Figure 8).

Mining and processing risk due to resource confidence are considered minimal due to current operational status and performance history.t

3.13 Social

A comprehensive Agreement and Indigenous Land Use Agreement (ILUA) has been negotiated with the Barngala People for the Iron Magnet Iron Duchess, Iron Cavalier, Bark Sheoak, Baroness, Empress and Monarch Scree Mining Areas.

Negotiations are continuing for Cooks North.

The agreements include social, economic and non-financial benefits from Simec Mining in exchange for their consent for Simec Mining operations in their country.

Where culturally sensitive areas exist at the Bark Sheoak Mining Area Barngala supervisors are employed to ensure operations are carried as per heritage agreements.

3.14 Other

3.14.1 Naturally occurring risks

No material naturally occurring risks have been identified within the Projects

3.14.2 Status of material legal agreements and marketing arrangements

Simec Mining is a private company that forms part of the Gupta Family Group (GFG) Alliance.

The Middleback Ranges Hematite and Magnetite Projects are existing operations and sales will continue through existing marketing arrangements, including a mix of term and spot contracts.

Major contracts are in place with the following contractors:

- Golding Pty Ltd for mining operations at the Southern Middleback and Iron Baron sites
- Walga Mining Pty Ltd for mining operations at the Iron Knob Mine Site
- OneRail Australia Pty Ltd for rail haulage
- BIS Pty Ltd for port loading
- CSL Pty Ltd for transhipping services

3.15 Classification

The classification of the Ore Reserves into varying confidence categories was based on operating history and is commensurate with the Ore Reserve classification as defined in JORC 2012.

No probable reserves have been derived from measured resources.

3.16 Audits or reviews

SRK Consulting have reviewed the Ore Reserve estimate derivation.

3.17 Discussion of relative accuracy/confidence

The relative accuracy and confidence level in the Ore Reserve estimate is in line with that of the Ore Reserve classification and has been validated through reconciliation of current mining operations.

3.17.1 Comparison to Previous Declared Estimates

The MBR DSO Hematite, MBR Beneficiated Hematite and MBR Magnetite Projects Ore Reserve represents the first Hematite Ore Reserve declared since end of Financial Year FY2016 (YEJ2016) under the previous owner Arrium Mining.

Comparison and description of changes for each of the Projects compared to the YEJ2016 estimates is summarised in Table 13. Comparisons are in M'wmt.

Project	YEJ2016		2021		Change	
	Ore (M'wmt)	% Fe grade	Ore (M'wmt)	% Fe grade	Ore (M'wmt)	% Fe grade
MBR DSO Hematite	32.2	57.5	15.9	58.4	-16.3	0.9
MBR Beneficiated Hematite	25.9	59.6	6.6	60.6	-19.3	1.1
MBR Magnetite	56.0	38.5	58.7	37.2	2.7	-1.3

Table 13: 2021 MBR DSO Hematite Project Comparison to YEJ16 and Explanation of Changes

For the MBR DSO Project a reduction of 16.3Mt and subsequent increase of 0.9% Fe has been the result of the depletion of 19.1 Mt through Mining, additions of 16.8Mt through exploration and pit re optimization and further removal of 13.9Mt through further pit optimisation and changes to value in use assumptions.

For the MBR Beneficiated Hematite Reserve of note is the removal of 7.5Mt above depletions.

This has primarily been due to further understanding of the metallurgical characteristics of the feed sources to the IKMA and IBMA IPF plants as mining and processing since commencement of the IBMA IPF and IKMA IPF in 2016.

Recognition of these changes in the for the 1st of January 2021 estimate has been through reconciliation of beneficiation performance and adjustment of metallurgy recovery factors and product grades accordingly (Table 10).

The MBR Magnetite Project has seen positive reconciliation since declaration of the YEJ2016 estimate.

Positive reconciliation can be attributed to recovery of inferred mineralisation and positive reconciliation within the Northern Areas of the Mine.

4 Conclusions and Recommendations

The 2021 Life of Mine Plan represents the base case Life of Mine for Simec Mining's Middleback Ranges Operations.

Key points from the Life of mine plan are:

- Cessation of Hematite Export Operations at the end of 2025 and a reduction in Hematite Export Rate to 4 Mtpa at the beginning of FY2025

- Magnetite Operations continue to FY2032 with the majority of feed being drawn from long term stockpiles from FY2029

- NPV flattens from FY2026. This correlates to the cessation of Hematite Export activities and acceleration of the Stage F cutback to sustain Magnetite feed for Steelworks consumption until end of asset life inFY2032.

Further work and recommendations are:

- Continue with LOM plan scenarios and options to further extend hematite export life and volume. (Project Martha – Introduction of the Iron Monarch Cutback)

- Revalidate the value of Iron Magnet Stage F to overall value contribution to the LOM plan.

- Continue Project Prime (Magnet Expansion) for future expansion and to further improve economics of Stage F.

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APPENDIX 1 – JORC TABLE 1 DOCUMENTATION – MBR DSO HEMATITE

Section 4 Estimation and Reporting of Ore Reserves

Criteria	JORC Code explanation	Commentary
Mineral Resource estimate for conversion to Ore Reserves	*Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve.*	The modifying factors generated for this Ore Reserve estimate have been derived from the MBR DSO Hematite Resource Estimate determined as of 1 January 2021.
	Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.	The Mineral Resources are inclusive of the Ore Reserves.
Site visits	*Comment on any site visits undertaken by the Competent Person and the outcome of those visits.*	The Competent person visits the sites on a regular basis, with no material issues identified to date.
	If no site visits have been undertaken indicate why this is the case.	Not applicable.
Study status	*The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves*	Deposits are located in operational mining areas, with all of the mine infrastructure, plant and equipment in place.
	The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.	The Iron Cavalier, Iron Duchess, Bark – Sheoak, Empress, Baroness and Monarch Scree are operating mines. Cooks North is an extension of an existing mining operation and currently is in the process of heritage and PEPR approvals to commence mining in H1 FY2023.
Cut-off parameters	*The basis of the cut-off grade(s) or quality parameters applied.*	Reserve cut-off grades are based on a Fe value greater or equal to 55% for Iron Duchess, Bark Sheoak and Cooks North. Iron Cavalier has been declared at a cut off of greater than or equal to 50% Fe. Low grade crushed stockpiles that are blended with direct shipping ores and depleted through FY2022 have been declared at a cut off of 50%. The cut off grades have been derived from financial analysis based on detailed mine planning, including mine production schedules that indicated that a saleable product could be produced, taking into account market considerations for current iron ore price term contracts and spot shipments.
Mining factors or assumptions	*The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimisation or by preliminary or detailed design)*	Conversion of Mineral Resources to Ore Reserves has been by the application of appropriate mining factors and assumptions based on current mining practices, operating and capital costs based on Simec's existing mining operations, as well as mine specific factors such as local geotechnical investigations. Pit optimization utilizing the Lerch Grossman Algorithm using industry standard software were undertaken. Estimation utilized a regularized and diluted resource model with consideration of geotechnical parameters, costs derived from current operations and revenue derived from consensus long term price forecasting Pit shells and designs were derived from selected optimization shells and used for Life of Mine Scheduling
	The choice, nature and appropriateness of the selected mining method(s) and other	Simec currently mines iron ore across the MBR using a conventional open cut, drill and blast, followed by truck and

Criteria	JORC Code explanation	Commentary
	mining parameters including associated design issues such as pre-strip, access, etc	shovel operation. The mining method described is considered appropriate for the deposits in question.
	The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling.	Geotechnical parameters have been based either on actual pit specific geotechnical investigations or, in the absence of any specific pit geotechnical information, it has been assumed that geotechnical parameters will be similar to historical geotechnical investigations of current mining operations located nearby and/or slope stability observations over time in areas that have been previously mined.
	The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate).	The mineral resources used to derive the DSO reserve estimates have been derived in accordance with JORC 2012 Guidelines. Separate resource models and estimates have been derived for Iron Duchess, Iron Cavalier, Bark Sheoak and Cooks North
	The mining dilution factors used.	For the Iron Duchess, Cooks North, Bark Sheoak and Cooks North a dilution modelling process has been applied to the resource model to develop the reserve model that accounts for minimum mining widths and grades based on a minimum width of 6m and minimum bench height of 2m. Further dilution factors have applied to the Resource prior to reporting of the Reserve estimate based on reconciliation data. A reduction in Fe grade and an increase in the deleterious elements of SiO2 and Al2O3 has been applied with specific reference to mining methodology and local conditions employed. In general, a 1% reduction in Fe grade and an increase of up to 1% in SiO2 and 0.5% in Al2O3 grade has been applied.
	The mining recovery factors used.	Mining recovery factors are derived from reconciliation data and, on average, equate to approximately 95% of the mineral resource contained within the relevant pit.
	Any minimum mining widths used.	With respect to mining selectivity, a 6m minimum mining width is applied in line with current mining practices. With respect to the minimum cutback width, 30m has been applied.
	The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion.	Mining of Inferred Mineral Resources is scheduled through the Mine plan and comprises approximately 5% of the total schedule or 0.9Mt of sales tonnages. The inclusion of Inferred in the mine plan is not considered material to the outcome of the economic assessment.
	The infrastructure requirements of the selected mining methods	All infrastructure is in place to support the current mining method.
Metallurgical factors or assumptions	*The metallurgical process proposed and the appropriateness of that process to the style of mineralisation.*	All Direct Saleable Ore (DSO) is crushed and screened to deliver a "Fines Product" (-6.3mm) and a "Lump Product" (=6.3mm to -31.5mm). Minor quantities are used as feedstock for the Whyalla Blast Furnace and Pellet plant.
	Whether the metallurgical process is well-tested technology or novel in nature.	The metallurgical process of crushing and screening iron ore to produce either Lump or Fines product is industry standard.
Metallurgical factors or assumptions cont.	*The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied.*	Metallurgical test work and assumptions are derived from samples taken from diamond core, in-pit samples and production data from nearby operations of similar mineralogy, they have been used to derive Lump / Fines splits and processing characteristics. Production data from nearby operations forms the majority of test sampling and is used for existing operations. Typical lump yields are 30% of total crushed tonnages No metallurgical recovery factors are applied to DSO ores.
	Any assumptions or allowances made for deleterious elements.	All DSO and beneficiated product produced at MBR will form part of an overall Simec blended product. The impact of deleterious elements is taken into account during the economic assessment as part of the Simec overall business model.
	The existence of any bulk sample or pilot scale test work	Bulk samples are generally not used as most of the deposits have an operating history.

Criteria	JORC Code explanation	Commentary
	and the degree to which such samples are considered representative of the orebody as a whole.	
	For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?	Operational history is considered an adequate model for new deposits in the same area as they have the same mineralogy and stratigraphy.
Environmental	*The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterisation and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.*	The Iron Duchess, Iron Cavalier, Bark Sheoak, Baroness, Empress and Monarch Scree are operating mines and have all required approvals in place. Cooks North is at feasibility status and applications for the various environmental and mining approvals are being prepared. Based on preliminary discussions with the Department for State Development (DSD), no issues that would prevent issuing the approvals in the timeframe required have been identified.
Infrastructure	*The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.*	All infrastructure for the current mining and beneficiation operations at MBR is in place and is operating as part of existing MBR operations.
Costs	*The derivation of, or assumptions made, regarding projected capital costs in the study.*	Capital costs include sustaining capital expenditure and development (expansion) capital expenditure. Sustaining capital (including initial waste pre strip) are derived from costs of existing operations and are consistent with the SIMEC's business plan, projected over the life of mine. Development capital, the capital required for new projects and expansion are input as per the SIMEC's indicated studies and capital program. Projected mining costs are derived from current service contracts in place with current contract providers, adjusted to take into account projected changes in activity (due to pit depths, haulage distances, etc.) over the life of mine. All costs assumptions are calculated to include inflation and discount rates used are consistent with those used in the Simec business plan, projected over the life of mine.
	The methodology used to estimate operating costs.	Mine plans and operational schedules are used to derive forecasts for operating costs. Operating cost estimates are based on existing operations.
	Allowances made for the content of deleterious elements.	Reduction of revenue due to the presence of deleterious elements in the Simec blended product have been factored into the revenue assumptions (see further below).
	The derivation of assumptions made of metal or commodity price(s), for the principal minerals and co- products.	All price estimates for revenue approximations are estimated on a dry metric tonne unit basis. Revenue factors are calculated by individual product types (lump, pellets, fines, concentrate) taking into account individual product premiums or discounts based on individual product specifications (value-in-use).
	The source of exchange rates used in the study.	Foreign exchange projections are based on independent external forecasts and reflect the assumptions made in the Simec business plan.

Criteria	JORC Code explanation	Commentary
	Derivation of transportation charges.	Shipping and freight charge projections are based on available independent external forecasts, adjusted to reflect shipping from Whyalla to our primary markets in North Asia and to take into account existing contracts of affreightment and reflect the assumptions made in the Simec business plan.
	The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc.	Treatment and refining charges are based on the cost of existing operations and reflect the assumptions made in the Simec business plan. The impact of specifications of ore shipped is dealt with in the revenue assumptions as reflected in the Simec business plan (see further below).
	The allowances made for royalties payable, both Government and private.	Allowances for royalties are based on current legislation and reflect the assumptions made in the Simec business plan.
Revenue factors	*The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc.*	Short-term price estimates are based on market data in the near-term and on third party macroeconomic informed data in the long-term using a benchmark 62% fines price, with premia relating to grades, impurities, realised premium or other characteristics, adjusted for expected realised prices derived from current contracts and Simec blended product specifications (including grade and the presences of any deleterious elements) expected under current life of mine planning.
	The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	See above description of revenue factors.
Market assessment ***Market assessment cont.***	*The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future.*	An assessment of the demand, supply and stock situation is made by Simec based on its internal market research and internal market sensitivity analysis, which includes market intelligence by its staff based in Asia.
	A customer and competitor analysis along with the identification of likely market windows for the product.	Analysis of customers and competitors is carried out by Simec's internal analysts based on internal market research and forecasts and internal market sensitivity analysis, which includes market intelligence by its staff based in Asia.
	Price and volume forecasts and the basis for these forecasts.	Volume forecasts have been based on current and future planned infrastructure capacity and current mine plans. Pricing forecasts are derived in the manner described above under the criterion Revenue factors.
	For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract	Not applicable as iron ore is not considered an industrial material.
Economic	*The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc.*	The inputs to the economic analysis are based on existing operations as described in the previous criteria. The details of this process are commercially sensitive and are not disclosed as they are derived from confidential cost and revenue data and key contracts in place with service providers and customers.
	NPV ranges and sensitivity to variations in the significant assumptions and inputs.	As above.
Social	*The status of agreements with key stakeholders and matters leading to social licence to operate.*	A comprehensive Agreement and Indigenous Land Use Agreement (ILUA) has been negotiated with the Barngala People for the Iron Duchess, Iron Cavalier and Bark Sheoak Mining Areas. Negotiations are continuing for Cooks North

Criteria	JORC Code explanation	Commentary
		The agreements include social, economic and non-financial benefits from Simec Mining in exchange for their consent for Simec Mining operations in their country. Where culturally sensitive areas exist at the Bark Sheoak Mining Area Barngala supervisors are employed to ensure operations are carried as per heritage agreements.
Other	*To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves:*	
	Any identified material naturally occurring risks.	No material natural occurring risks, e.g. geological risks, were identified.
	The status of material legal agreements and marketing arrangements.	Simec Mining is a private company that forms part of the Gupta Family Group (GFG) Alliance. MBR is an existing operation and sales will continue through existing marketing arrangements, including a mix of term and spot contracts. Contracts are in place with BGC Contracting Pty Ltd, Walga Mining Pty Ltd for mining operations, CSL Pty Ltd for transhipping services and OneRail (formerly Genesee & Wyoming Australia) for rail haulage. Negotiations are continuing for landowner agreements for the Cooks North.
	The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent	Iron Duchess, Iron Cavalier, Bark Sheoak, Empress, Baroness and Monarch Scree are operating mines and have all necessary approvals in place for operations. Cooks North is at feasibility status and applications for mining leases are currently being prepared.
Classification	*The basis for the classification of the Ore Reserves into varying confidence categories.*	The classification of the Ore Reserves into varying confidence categories based on operating history and is commensurate with the Ore Reserve classification as defined in JORC 2012.
	Whether the result appropriately reflects the Competent Person's view of the deposit.	The Ore Reserve classification reflects the views of the Competent Person.
	The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	No Probable Ore Reserves have been derived measured resources
Audits or reviews	*The results of any audits or reviews of Ore Reserve estimates.*	Ore Reserve is currently being reviewed by SRK
Discussion of relative accuracy/ confidence	*Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an*	The relative accuracy and confidence level in the Ore Reserve estimate is in line with that of the Ore Reserve classification and has been validated through reconciliation of current mining operations.

Criteria	JORC Code explanation	Commentary
	approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate.	
Discussion of relative accuracy/ confidence cont.	*The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.*	Statement relates to global estimates within the MBR Hematite project.
	Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. *It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.*	The modifying factors are based on existing operational parameters that include reconciliation of actual production data.

APPENDIX 2 – JORC TABLE 1 DOCUMENTATION – MBR BENEFICIATED HEMATITE

Section 4 Estimation and Reporting of Ore Reserves

Criteria	JORC Code explanation	Commentary
Mineral Resource estimate for conversion to Ore Reserves	*Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve.*	The modifying factors generated for this Ore Reserve estimate have been derived from the MBR Beneficiated Hematite Resource Estimate determined as of 1 January 2021.
	Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.	The Mineral Resources are inclusive of the Ore Reserves.
Site visits	*Comment on any site visits undertaken by the Competent Person and the outcome of those visits.*	The Competent Person visits the sites on a regular basis, with no material issues identified to date.
	If no site visits have been undertaken indicate why this is the case.	Not applicable.
Study status	*The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves*	The beneficiated low-grade ores (LGO) that form part of the Ore Reserves described under the following criteria comprise 1) Stockpiles that are located within active mining areas and 2) Insitu LGO deposits from Baroness, Empress and Monarch Scree Deposits.
	The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.	Iron Empress, Iron Baroness and Monarch Scree are all operating mines.
Cut-off parameters	*The basis of the cut-off grade(s) or quality parameters applied.*	The cut-off grades adopted for the low grade stockpiles varied between 40% Fe and 47% Fe, dependant on the test results derived from bulk metallurgical samples. The cut-off used for the LGO deposits of Baroness and Empress Scree Project was 35% Fe, based on target Fe product grade from metallurgical test work and pit optimisation. The cut-off grade used for the Monarch Scree deposit was 35% Fe based on Metallurgical test work and pit optimisation.
Mining factors or assumptions	*The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimisation or by preliminary or detailed design*	Conversion of Mineral Resources to Ore Reserves has been by the application of appropriate mining factors and assumptions based on current mining practices, operating and capital costs based on Simec's existing mining operations, as well as mine specific factors such as local geotechnical investigations. Pit optimization utilizing the Lerch Grossman Algorithm using industry standard software were undertaken. Estimation utilized a regularized and diluted resource model with consideration of geotechnical parameters, costs derived from current operations and revenue derived from consensus long term price forecasting Pit shells and designs were derived from selected optimization shells and used for Life of Mine Scheduling Simec currently mines iron ore across the MBR using a conventional open cut, drill and blast, followed by truck and

Criteria	JORC Code explanation	Commentary
		shovel operation. The mining method described is considered appropriate for the deposits in question.
	The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc	Stockpile recovery in 4m flitches using front-end loaders and haul trucks in line with current mining methods. The Baroness, Empress and Monarch Scree deposits are reclaimed using conventional truck and shovel methods
	The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling.	Existing stockpile slopes are in line with the natural angle of repose for the tip-head of these stockpiles. The Baroness and Empress deposits are shallow and at this stage conservative slopes have been adopted based on geotechnical investigations. Monarch Scree deposit is shallow (<10m) and conservative slopes have been adopted based on current Mining Exposures and geotechnical investigations.
	The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate).	The mineral resources used to derive the MBR Beneficiated Ore reserve estimates have been derived in accordance with JORC 2012 Guidelines. Separate resource models and estimates have been derived for Baroness, Empress and Monarch Scree.
	The mining dilution factors used.	For stockpiles no dilution has been applied for the purpose of the Ore Reserve estimate due to the assumption that the entire stockpile will be reclaimed and no selective mining will be applied. Baroness, Empress and Monarch Scree a dilution modelling process has been applied to the resource model to develop the reserve model that accounts for minimum mining widths and grades based on a minimum width of 6m and minimum bench height of 2m. Further dilution factors have applied to the Resource prior to reporting of the Reserve estimate based on reconciliation data. A reduction in Fe grade, Mass Recovery and an increase in the deleterious elements of SiO_2 and Al_2O_3 has been applied with specific reference to mining methodology and local conditions employed. In general, a 1% reduction in Fe grade and 5% in Mass recovery and an increase of up to 1% in SiO_2 and 0.5% in Al_2O_3 grade has been applied.
	The mining recovery factors used.	For stockpiles a mining recovery of 100% is assumed. For insitu LGO and Empress and Baroness mining recovery factors of 100% are assumed after application of dilution models. They are derived from reconciliation data and ore selectivity modelling.
	Any minimum mining widths used.	For stockpiles this is not applicable as all of the stockpiles will be reclaimed in their entirety. The Scree deposits have a minimum thickness of 2m applied.
	The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion.	Inferred LGO Mineral Resources form 5% of the current total LGO stockpile resource. After variable processing recoveries are applied, they contribute to approximately 1% of the total DSO tons as contained within the Arrium Business Plan. Whilst the Inferred Resources associated with the LGO resources have been included in the Business Plan during at the end of the mine life, they are not included in the estimate of Ore Reserves. The inclusion of Inferred in the mine plan is not considered material to the economic assessment.
	The infrastructure requirements of the selected mining methods	Beneficiation plants and all other supporting infrastructure are in operation at the Iron Baron and Iron Knob Mining areas.
Metallurgical factors or assumptions	*The metallurgical process proposed and the appropriateness of that process to the style of mineralisation.*	All material reclaimed is crushed to -32mm through crusher infrastructure located at the Iron Baron and Iron Knob mine sites. Ore is then beneficiated through the Iron Baron Integrated Processing Facility (IPF) utilising density separation (jigs and

Criteria	JORC Code explanation	Commentary
Metallurgical factors or assumptions cont.		spirals) to produce a high grade Lump (-32mm, +6.3mm) and Fines (-6.3mm) product. The Baron IPF plant is located adjacent to the crushing facilities at the Iron Baron mine site. For the Iron Monarch Beneficiation Project material is crushed to -8mm utilising the current crushing plant and then beneficiated through an integrated Processing facility (IPF) utilising density separation (jigs and spirals) to produce a high grade Fines (-8mm) product.
	Whether the metallurgical process is well-tested technology or novel in nature.	The metallurgical processes described above are used industry wide and have been operating in the Middleback Ranges for over 18 years.
	The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied.	Recovery factors and product grades applied to the Ore Reserve are based on operational history and metallurgical test work from bulk samples taken from trenches, auger drilling and sonic drilling. Metallurgical test work completed is inclusive of Heavy Liquid Separation, Mini Jig Tests and bulk samples through the current IPF plants. Metallurgical testwork reflects the operational process described. Recovery factors applied are dependent upon the test work results of each individual LGO stockpile and range between 33% and 63%.
	Any assumptions or allowances made for deleterious elements.	All DSO and beneficiated product forms part of an overall "Whyalla" blend that is derived from a number of operations. The impact of deleterious elements is taken into account during the scheduling of the "Whyalla" Blend and the economic assessment as part of the Simec overall business model.
	The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole.	Samples have been sourced from sonic drilling, trenching and as bulk samples. They are considered representative of the LGO stockpiles. For Monarch Scree, Empress and Baroness samples have been derived from a detailed auger drilling programs or bulk samples obtained during mining operations.
	For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?	Samples are considered representative of the stockpile and insitu mineralisation based on the mineralogy, stockpile build and recovery data, where available.
Environmental	*The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterization and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste Stockpiles should be reported.*	The Iron Duchess, Iron Cavalier, Bark Sheoak, Baroness, Empress and Monarch Scree are operating mines and have all required approvals in place. Cooks North is at feasibility status and applications for the various environmental and mining approvals are being prepared. Based on discussions with the Department for Energy and Mining (DEM), no issues that would prevent issuing the mining leases and approvals in the timeframe required have been identified.
Infrastructure	*The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.*	All infrastructure for the current mining and beneficiation operations at MBR is in place and is operating as part of existing MBR operations.
Costs	*The derivation of, or assumptions made, regarding*	Current beneficiation plant capacity underpins the LGO Ore Reserve estimate.

Criteria	JORC Code explanation	Commentary
	projected capital costs in the study.	Costs associated with processing and transport are derived from existing operations. Capital costs include sustaining capital expenditure and development (expansion) capital expenditure. Sustaining capital (including initial waste pre strip) are derived from costs of existing operations and are consistent with the SIMEC's business plan, projected over the life of mine. Development capital, the capital required for new projects and expansion are input as per the SIMEC's indicated studies and capital program. Projected mining costs are derived from current service contracts in place with current contract providers, adjusted to take into account projected changes in activity (due to pit depths, haulage distances, etc.) over the life of mine. All costs assumptions are calculated to include inflation and discount rates used are consistent with those used in the Simec business plan, projected over the life of mine.
	The methodology used to estimate operating costs.	Mine plans and operational schedules used to derive forecasts for operating costs, are based on existing operations.
	Allowances made for the content of deleterious elements.	Reduction of revenue due to the presence of deleterious elements in the Simec blend products has been factored into revenue assumptions (see further below).
	The derivation of assumptions made of metal or commodity price(s), for the principal minerals and co- products.	All price estimates for revenue approximations are estimated on a dry metric tonne unit basis. Revenue factors are calculated by individual product types (lump, pellets, fines, concentrate) taking into account individual product premiums or discounts based on individual product specifications (value-in-use).
	The source of exchange rates used in the study.	Foreign exchange projections are based on independent external forecasts and reflect the assumptions made in the Simec business plan.
	Derivation of transportation charges.	Shipping and freight charge projections are based on available independent external forecasts, adjusted to reflect shipping from Whyalla to our primary markets in North Asia and to take into account existing contracts of affreightment and reflect the assumptions made in the Simec business plan.
	The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc.	Treatment and refining charges are based on the cost of existing operations and reflect the assumptions made in the Simec business plan. The impact of specifications of ore shipped is dealt with in the revenue assumptions as reflected in the Simec business plan (see further below).
	The allowances made for royalties payable, both Government and private.	Allowances for royalties are based on current legislation and reflect the assumptions made in the Simec business plan.
Revenue factors ***Revenue factors cont.***	*The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc.*	Short-term price estimates are based on market data in the near-term and on third party macroeconomic informed data in the long-term using a benchmark 62% fines price, with premia relating to grades, impurities, realised premium or other characteristics, adjusted for expected realised prices derived from current contracts and Simec blended product specifications (including grade and the presences of any deleterious elements) expected under current life of mine planning.
	The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	See above description of revenue factors.
Market assessment	*The demand, supply and stock situation for the particular*	An assessment of the demand, supply and stock situation is made by Simec based on its internal market research and

Criteria	JORC Code explanation	Commentary
	commodity, consumption trends and factors likely to affect supply and demand into the future.	internal market sensitivity analysis, including by its staff based in Asia.
	A customer and competitor analysis along with the identification of likely market windows for the product.	Analysis of customers and competitors is carried out by Simec's internal analysts based on internal market research and forecasts and internal market sensitivity analysis, which includes market intelligence by its staff based in Asia.
	Price and volume forecasts and the basis for these forecasts.	Volume forecasts have been based on current and future planned infrastructure capacity and reclamation schedules. Pricing forecasts are derived in the manner described above under the criterion Revenue factors.
	For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract	Not applicable as iron ore is not considered industrial materials.
Economic	*The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc.*	The inputs to the economic analysis are based on existing operations as described in the previous criteria. The details of this process are commercially sensitive and are not disclosed as they are derived from confidential cost and revenue data and key contracts in place with service providers and customers.
	NPV ranges and sensitivity to variations in the significant assumptions and inputs.	As above
Social	*The status of agreements with key stakeholders and matters leading to social licence to operate.*	A comprehensive Agreement and Indigenous Land Use Agreement (ILUA) has been negotiated with the Barngarla People for the Iron Baroness, Iron Empress and Iron Monarch Scree Mines, with on-ground heritage clearance surveys undertaken. The agreements include social, economic and non-financial benefits from SIMEC Mining in exchange for their consent for SIMEC Mining operations in their country.
Other	*To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves:*	
	Any identified material naturally occurring risks.	No material naturally occurring risks e.g. geological risks, were identified.
	The status of material legal agreements and marketing arrangements.	SIMEC Mining is a private company that forms part of the Gupta Family Group (GFG) Alliance. MBR is an existing operation and sales will continue through existing marketing arrangements, including a mix of term and spot contracts. Contracts are in place with BGC Contracting Pty Ltd, Walga Mining Pty Ltd for mining operations, CSL Pty Ltd for transhipping services and OneRail (formerly Genesee & Wyoming Australia) for rail haulage. Negotiations are continuing for landowner agreements for the Cooks North.
	The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect	Iron Empress, Iron Baroness and Monarch Scree are operating mines and have all necessary mining leases and approvals in place for operations. Based on discussions with the Department for Energy and Mining (DEM), no issues that would prevent issuing the mining leases and approvals for Cooks North in the timeframe required have been identified.

Criteria	JORC Code explanation	Commentary
	that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent	
Classification	*The basis for the classification of the Ore Reserves into varying confidence categories.*	The classification of the Ore Reserves into varying confidence categories was based on operating history and commensurate with the Ore Reserve classification as defined in JORC 2012.
	Whether the result appropriately reflects the Competent Person's view of the deposit.	The Ore Reserve classification appropriately reflects the views of the Competent Person.
	The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	No Probable Ore Reserves have been derived from Measured Mineral Resources.
Audits or reviews	*The results of any audits or reviews of Ore Reserve estimates.*	Ore Reserve is currently being reviewed by SRK
Discussion of relative accuracy/ confidence	*Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate.*	Accuracy is in line with that of the Ore Reserve classification and has been validated through reconciliation.
Discussion of relative accuracy/ confidence cont.	*The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.*	The statement relates to global estimates.
	Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. *It is recognised that this may*	The modifying factors are based on existing operational parameters that include reconciliation of actual production data from a long operational history.

Criteria	JORC Code explanation	Commentary
	not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	

APPENDIX 3 JORC TABLE 1 DOCUMENTATION - MBR MAGNETITE

Section 4 Estimation and Reporting of Ore Reserves

Criteria	JORC Code explanation	Commentary
Mineral Resource estimate for conversion to Ore Reserves	*Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve.*	The modifying factors generated for this Ore Reserve estimate have been derived from the MBR Magnetite Resource Estimate determined as of 1 January 2021.
	Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.	The Mineral Resources are inclusive of the Ore Reserves.
Site visits	*Comment on any site visits undertaken by the Competent Person and the outcome of those visits.*	The Competent Person visits site on a regular basis, with no material issues identified to date.
	If no site visits have been undertaken indicate why this is the case.	Not applicable.
Study status	*The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves*	Iron Magnet is an operational mine site with necessary mine infrastructure, plant and equipment in place.
	The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.	Iron Magnet is an operating mine.
Cut-off parameters	*The basis of the cut-off grade(s) or quality parameters applied.*	Reserve cut-off grades are based on a Mass Recovery of greater than 20% and Silica less than 50%. This has been derived from detailed financial analysis, taking into account, mine planning, concentrator capability and market considerations for the quality of concentrate produced.
Mining factors or assumptions	*The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimisation or by preliminary or detailed design*	Conversion of Mineral Resources to Ore Reserves has been by the application of appropriate mining factors and assumptions based on current mining practices, operating and capital costs based on Simec's existing mining operations, as well as mine specific factors such as local geotechnical investigations. Pit optimization utilizing the Lerch Grossman Algorithm using industry standard software were undertaken. Estimation utilized a regularized and diluted resource model with consideration of geotechnical parameters, costs derived from current operations and revenue derived from consensus long term price forecasting Pit shells and designs were derived from selected optimization shells and used for Life of Mine Scheduling Simec currently mines iron ore across the MBR using a conventional open cut, drill and blast, followed by truck and shovel operation. The mining method described is considered appropriate for the deposits in question.
	The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including	Simec currently mines Iron Magnet using a conventional open cut, drill and blast, followed by truck and shovel operation. The mining method described is considered appropriate for Iron Magnet.

Criteria	JORC Code explanation	Commentary
	associated design issues such as pre-strip, access, etc	
	The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling.	Geotechnical parameters have been based either on actual pit specific geotechnical investigations or, in the absence of any specific pit geotechnical information, it has been assumed that geotechnical parameters will be similar to historical geotechnical investigations and monitoring of slope stability over time in areas that have been previously mined.
	The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate).	The mineral resource used to derive the MBR Magnetite Ore reserve estimates have been derived in accordance with JORC 2012 Guidelines.
	The mining dilution factors used.	Dilution was incorporated in the resource modelling and grade estimation process and no additional dilution is applied based on current concentrator reconciliation.
	The mining recovery factors used.	Recoveries have been applied to the Iron Magnet in the dilution / ore loss process described above – no further recovery factors have been applied
	Any minimum mining widths used.	With respect to mining selectivity a 5m minimum mining width is applied, in line with current mining practices. With respect to the minimum cutback width, 30m has been applied.
	The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion.	Mining of Inferred Mineral Resources occurs through the mine life and contribute to 10% of the Total Schedule. The inclusion of Inferred in the mine plan is not considered material to the outcome of the economic assessment.
	The infrastructure requirements of the selected mining methods	Iron Magnet's current infrastructure meets on-going requirements for the selected mining method.
Metallurgical factors or assumptions	*The metallurgical process proposed and the appropriateness of that process to the style of mineralisation.*	The Iron Magnet ore is processed through the magnetite concentrator using a process of magnetic separation to produce a concentrate that is slurried to Whyalla.
	Whether the metallurgical process is well-tested technology or novel in nature.	The existing concentrator has been operating for 15 years at a feed rate of between 4.6Mtpa and 5.9Mtpa, utilising industry standard technology
	The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied.	Metallurgical parameters were derived from initial metallurgical test work and updated as a result of concentrator production reconciliation.
Metallurgical factors or assumptions cont.	*Any assumptions or allowances made for deleterious elements.*	Concentrate produced is processed into iron ore pellets for use as feedstock to the Whyalla Integrated Steelworks and excess concentrate is blended with Hematite production as part of the overall blended product. The impact of deleterious elements is taken into account in the overall blend.
	The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole.	Bulk samples are used to derive concentrator performance for portions of the ore body on a regular basis.
	For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?	Ore Reserves have been based on the current concentrate specification derived from metallurgical test work and meet the integrated steelworks demand and quality requirements.
Environmental	*The status of studies of potential environmental impacts of the mining and processing operation.*	All Mining Leases and operational approvals via a Program for Environmental Protection and Rehabilitation are in place for on-going operations.

Criteria	JORC Code explanation	Commentary
	Details of waste rock characterisation and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.	
Infrastructure	*The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.*	All infrastructure for crushing, concentration, and transport to the Whyalla dewatering filter plant is in place and operating as part of the current Southern Middleback Magnetite operations. Infrastructure is also in place to allow for export of Magnetite concentrates or blending with Whyalla DSO shipments.
Costs	*The derivation of, or assumptions made, regarding projected capital costs in the study.*	Capital costs include sustaining capital expenditure and development (expansion) capital expenditure. Sustaining capital (including initial waste pre strip) are derived from costs of existing operations and are consistent with the SIMEC's business plan, projected over the life of mine. Development capital, the capital required for new projects and expansion are input as per the SIMEC's indicated studies and capital program. Projected mining costs are derived from current service contracts in place with current contract providers, adjusted to take into account projected changes in activity (due to pit depths, haulage distances, etc.) over the life of mine. All costs assumptions are calculated to include inflation and discount rates used are consistent with those used in the Simec business plan, projected over the life of mine.
	The methodology used to estimate operating costs.	Mine plans and operational schedules are used to derive forecasts for operating costs. Operating costs are based on existing operations.
	Allowances made for the content of deleterious elements.	Reduction of revenue due to the presence of deleterious elements in the product have been factored into revenue assumptions (see further below).
	The derivation of assumptions made of metal or commodity price(s), for the principal minerals and co- products.	All price estimates for revenue approximations are estimated on a dry metric tonne unit basis. Revenue factors are calculated by individual product types (lump, pellets, fines, concentrate) taking into account individual product premiums or discounts based on individual product specifications (value-in-use).
	The source of exchange rates used in the study.	Foreign exchange projections are based on independent external forecasts and reflect the assumptions made in the Simec business plan.
	Derivation of transportation charges.	Cost of transport of concentrate is based on operating costs for the magnetite slurry pipeline. Pellet sales on the spot iron ore market, shipping and freight charge projections are based on available independent external forecasts, adjusted to reflect shipping from Whyalla to our primary markets in North Asia and to take into account existing contracts of affreightment and reflect the assumptions made in the Simec business plan.
	The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc.	Treatment and refining charges are based on the cost of existing operations and reflect the assumptions made in the Simec business plan. The impact of specifications of ore shipped is dealt with in revenue assumptions (see further below).

Criteria	JORC Code explanation	Commentary
	The allowances made for royalties payable, both Government and private.	Allowances for royalties are based on current legislation and reflect the assumptions made in the Simec business plan.
Revenue factors	*The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc.*	Short-term price estimates are based on market data in the near-term and on third party macroeconomic informed data in the long-term using a benchmark 62% fines price, with premia relating to grades, impurities, realised premium or other characteristics, adjusted for expected realised prices derived from current contracts and Simec blended product specifications (including grade and the presences of any deleterious elements) expected under current life of mine planning.
	The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	See above description of revenue factors.
Market assessment	*The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future.*	An assessment of the demand, supply and stock situation is made by Simec based on the Whyalla Integrated Steelworks demand forecast and overall export blend requirements.
	A customer and competitor analysis along with the identification of likely market windows for the product.	The current magnetite life of mine is matched to the life of the Whyalla Steelworks assumptions and the additional concentrator capacity that exists in the magnetite concentrator facilities.
	Price and volume forecasts and the basis for these forecasts.	Volume forecasts have been based on current and future magnetite concentrator capability. Pricing forecasts are derived in the manner described above under the criterion revenue factors.
	For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract	Not applicable as iron ore concentrate is not considered an industrial material.
Economic	*The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc.*	The inputs to the economic analysis are based on existing operations as described in the previous criteria. The details of this process are commercially sensitive and are not disclosed as they are derived from confidential cost and revenue data and key contracts in place with service providers and customers.
	NPV ranges and sensitivity to variations in the significant assumptions and inputs.	As above.
Social	*The status of agreements with key stakeholders and matters leading to social licence to operate.*	A comprehensive Agreement and Indigenous Land Use Agreement (ILUA) has been negotiated with the Barngarla People for the Iron Magnet Mining Area which defines the MBR Magnetite Reserve, with on-ground heritage clearance surveys undertaken. The agreements include social, economic and non-financial benefits from SIMEC Mining in exchange for their consent for SIMEC Mining operations in their country.
Other	*To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves:*	
	Any identified material naturally occurring risks.	No material naturally occurring risks e.g. geological risks, were identified.
	The status of material legal agreements and marketing arrangements.	Simec Mining is a private company that forms part of the Gupta Family Group (GFG) Alliance.

Criteria	JORC Code explanation	Commentary
		MBR is an existing operation and sales will continue through existing marketing arrangements, including a mix of term and spot contracts. Contracts are in place with BGC Contracting Pty Ltd, Walga Mining Pty Ltd for mining operations, CSL Pty Ltd for transhipping services and Genesee & Wyoming Australia Pty for rail haulage. Negotiations are continuing for landowner agreements for the Cooks North.
	The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent	Full Mining and Tenement approvals are in place.
Classification	*The basis for the classification of the Ore Reserves into varying confidence categories.*	The classification of the Ore Reserves into varying confidence categories was based on operating history and is commensurate with the Ore Reserve classification as defined in JORC 2012.
	Whether the result appropriately reflects the Competent Person's view of the deposit.	The Ore Reserve classification appropriately reflects the views of the Competent Person.
	The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	No Probable Ore Reserves have been derived from Measured Mineral Resources.
Audits or reviews	*The results of any audits or reviews of Ore Reserve estimates.*	Ore Reserve is currently being reviewed by SRK
Discussion of relative accuracy/ confidence	*Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate.*	The relative accuracy and confidence level in the Ore Reserve estimate is in line with that of the Ore Reserve classification and has been validated through reconciliation of current mining operations.
Discussion of relative accuracy/ confidence cont.	*The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include*	Statement relates to global estimates within the MBR Magnetite project.

Criteria	JORC Code explanation	Commentary
	assumptions made and the procedures used.	
	Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. *It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.*	The modifying factors are based on existing operational parameters that include reconciliation of actual production data.

APPENDIX 4 – COMPETENT PERSONS STATEMENT

The information in the report to which this statement is attached relates to Ore Reserves is based on information compiled by Paul Leevers who is a member of The Australian Institute of Mining and Metallurgy

Mr Leevers is a full-time employee of Simec Mining and has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity being undertaken to qualify as a Competent Person as defined in the 2012 Edition of the "Australian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves".

Mr Leevers consents to the inclusion in the report of the matters based on his information in the form and context in which is appears.

Middleback Ranges DSO Hematite

The Simec Middleback Ranges (MBR) DSO Hematite Ore Reserve has been derived at a cut-off grade of 55% Fe and SiO2 <20% for all material deposits, except Iron Cavalier which has been declared at a cut off of 50% Fe and SiO2 <20%.

Low grade crushed stockpiles that are blended with direct shipping ores and depleted through FY2022 have been declared at a cut off of 50% Fe (Table 2).

The MBR DSO Hematite Project consists of all Reserves and Resources associated with direct shipping (DSO) ores derived from the MBR. Material deposits that contribute to the Middleback Ranges DSO Hematite Ore Reserve are the operating mines Iron Duchess, Cooks North, Iron Cavalier and Bark - Sheoak.

All Reserve Figures represent estimates at the 1st of January 2021, unless otherwise stated. Rounding of tonnes and grade information may result in small differences presented in the totals. Moisture is estimated at 4% and grades are reported uncalcined.

MBR DSO HEMATITE ORE RESERVE									
CATEGORY	Volume m^3x10^6	M'dmt	H2O%	FE%	SIO2%	AL2O3%	P%	Simec Interest	Competent Person
Proved	1.2	3.6	4%	59.3	7.3	1.5	0.07	100%	P. Leevers
Probable	3.5	11.7	4%	58.2	6.0	2.4	0.06		
TOTAL	4.7	15.2	4%	58.4	6.3	2.2	0.07		

Middleback Ranges Beneficiated Hematite

The MBR Beneficiated Hematite Project is inclusive of all resources of Low Grade Ores to be upgraded to meet current and forward export specifications through beneficiation processes within the MBR, and reports the product of beneficiation as the reserve tonnage and grade.

Material deposits that define the MBR Beneficiated Ore Reserve are the products from beneficiation of Low-Grade Stockpiles at the Iron Baron, the Baroness / Empress Scree deposits and Monarch Scree deposits which are all operating mines.

Ore Beneficiation operations commenced at the Iron Baron in FY2012 and at the Iron Monarch at the end of 2017.

The Middleback Range Beneficiated Hematite Reserves have been declared through the application of metallurgical recoveries derived from current operations and ore characterisation test work derived from bulk samples, test parcels through current operations, and drill samples from within the MBR Beneficiated Hematite Resources.

The Middleback Range Beneficiated Hematite Reserves have been declared from feed stocks at a Fe cut-off Grade of 35% for the Iron Baroness/Empress Scree and the Monarch Scree Ore Projects. Stockpiles have been reported with an estimated grade ranging between 40- 45% Fe. The Ore Reserve that can be beneficiated from these feed stocks to meet current and future export grade specifications are summarised in the table below. The estimates are valid as at the 1st of January 2021.

MBR BENEFICIATED HEMATITE ORE RESERVE										
CATEGORY	Volume m^3x10^6	M'dmt	H2O%	FE%	RECOVERY %	SIO2%	AL2O3%	P%	Simec Interest	Competent Person
Proved	0.2	0.5	5%	60.7	49.0	6.1	2.8	0.05	100%	P. Leevers
Probable	2.4	5.7	6%	60.7	45.0	6.3	2.9	0.05		
TOTAL	2.6	6.2	6%	60.7	46.0	6.3	2.9	0.05		

Middleback Ranges Magnetite

Magnetite Beneficiation operations commenced in the Middleback Ranges in 2007.

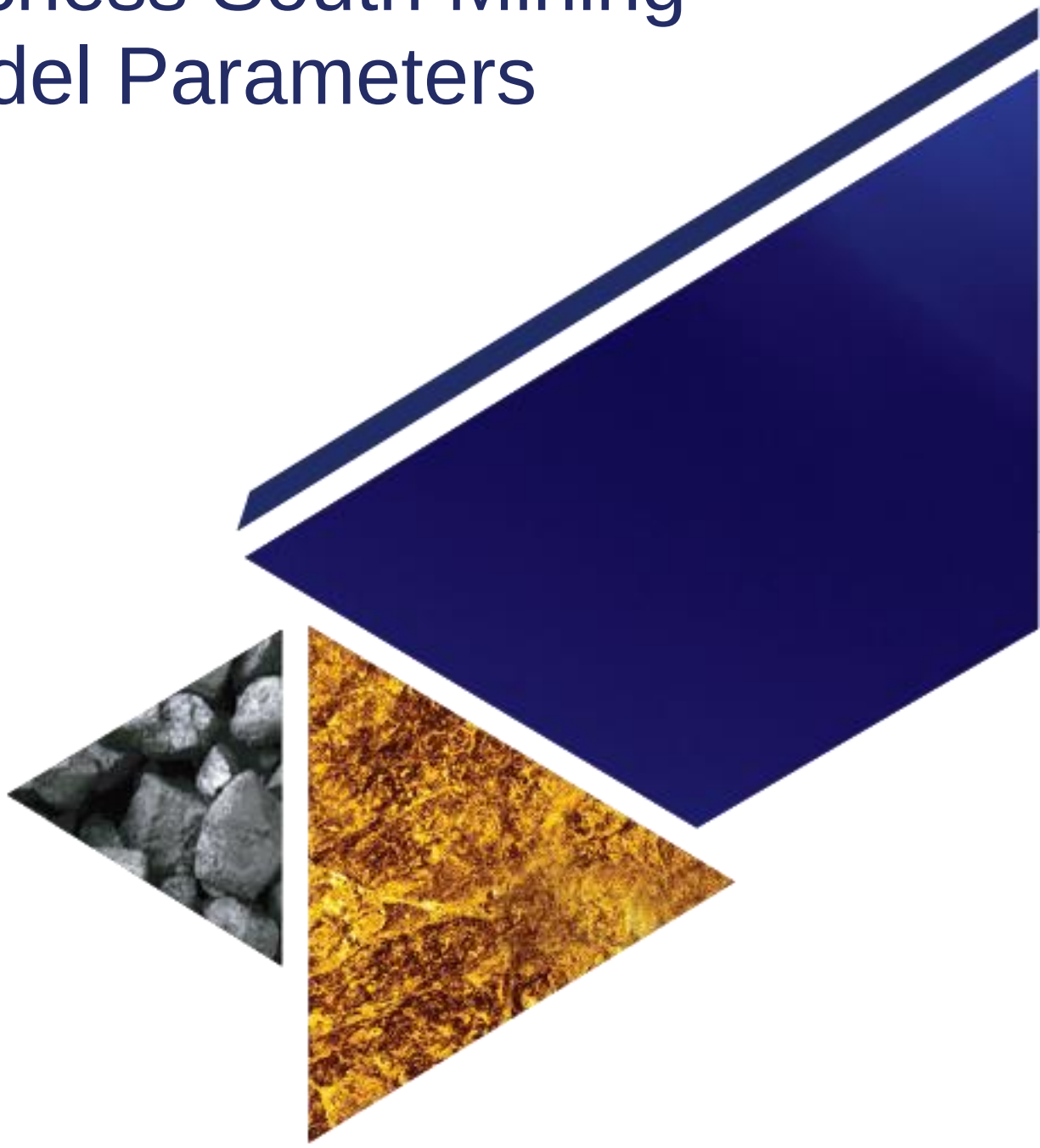
The MBR Magnetite Ore Reserve has been declared as at the 1st of January 2021.

Magnetite Reserves have been reported at a Mass Recovery of >20% and SiO2 of <50%.

All Reserve Figures represent estimates at the 1st of January 2021, unless otherwise stated. Rounding of tonnes and grade information may result in small differences presented in the totals.

MBR MAGNETITE ORE RESERVE								
CATEGORY	Volume m^3x10^6	M'dmt	H2O%	DTR%	FE%	SIO2%	Simec Interest	Competent Person
Proved	8.9	30.4	4%	37.0	37.6	24.2	100%	P. Leevers
Probable	6.9	26.0	4%	41.3	36.7	21.2		
TOTAL	15.8	56.4	4%	39.0	37.2	22.8		

Appendix E.
Duchess South Mining Model Parameters



SIMEC

MEMBER OF GFG ALLIANCE

DUCHESS SOUTH MINING MODEL: DM_2310B1

Magnetite Expansion and Growth

simec.com



Document Control

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1 Introduction

This document provides a description of the Duchess South mining model ***dm_2310b1_mm.dm*** developed for the SIMEC Magnetite Expansion Project Stage 1 (MEP1) and Stage 2 (MEP2).

SIMEC Mining uses an established process to prepare geological models for mine planning requirements. This process is managed through a script-set executed from Datamine that provides a standard and guided process to convert a geological model into the mining model format. The mining model process runs the following procedures on the input geological model:

1. Validation of the block model framework, field definitions, block value types and value ranges
2. Model depletion and the addition of waste rock filled areas based on mine topography surfaces
3. Modelling of mineable product types which incorporates base mining loss and dilution
4. Adjustments to processed product mass recovery and/or product grades (e.g., low-grade beneficiation)

A post-processing stage is required for the Duchess South mining model to apply additional field adjustments, set NAF/PAF variables and calculate block economics for mine planning and downstream model usage. These post-processing modifications are also outlined within this document.

2 Resource Model

The Duchess South mining model was generated from an updated resource model developed by SIMEC Mining and released as the October 2023 model update. The base resource model is named ***dsm_geo_2023_hc_mm3.bmf*** and was provided in a compressed 7-Zip file dated 26/10/2023 2:22PM.

The base resource model is a Vulcan format block model defined with a parent block framework of 20 x 25 x 12m with sub-blocking down to 2.5 x 2.5 x 1m to provide domain and structural edge resolution for the mining model process. Table 1 contains a summary of the resource model block framework. The extent of the Duchess South resource model as shown in Figure 1 covers the areas of Iron Magnet, Duchess South and Duchess North deposits.

Table 1: Resource Model Framework

	X-Dimension	Y-Dimension	Z-Dimension
Model Minimum (m)	95,810.00	15,600.00	-196.00
Model Maximum (m)	97,610.00	21,500.00	392.00
Model Length (m)	1,800.00	5,900.00	588.00
Parent Block Size (m)	20.00	25.00	12.00
Parent Block Count	90	236	49
Minimum Sub-Block (m)	2.50	2.50	1.00
Total Block Count	8,250,739		



Figure 1: Duchess South Resource Model Extent

The base resource model was exported to a CSV file which was then converted into the Datamine block model format using a model conversion script. No modifications were made to the block model extent or framework in the model conversion process.

The converted block model was processed to align the field names and adjust block values where required to be compatible with the mining model process. The following points summarise the resource model modifications made:

- XCLASS (combination of HCLASS and MCLASS) renamed to CLASS
- Head grade fields modified to remove '_H' suffix
- Product grade fields modified to remove '_C' suffix, and replace with 'P_' prefix
- MASSREC renamed to MASS_REC

- GEOZONE set to default of 10 where GEOZONE was undefined or zero
- CFZONE set to 1 (exists in some site resource models and required for mining model process)
- Head grades set to default waste values where less than zero, or less than -2% for LOI
- Head grades set to trace values where equal to zero
- Mass recovery of less than 0.01 set to zero
- Mass recovery set to zero where product P_FE or P_SIO2 are not estimated or zero
- P_H2O set to 8%
- Product grades set to zero where mass recovery is zero
- Product grades set to zero where less than zero, or less than -5% for product P_LOI
- P_ZN set to zero (was not defined in resource model)
- BENCH value calculated accordingly for 12m bench elevation aligned with MAG bench levels
- Processing recoveries, P2 bottleneck and P2 net value calculated as per ***VCO business model v1.12***

The resource model after conversion to Datamine format and with the above modifications applied is named ***dsm_geo_2023_hc_mm3_fixed.dm***. This forms the input block model for the mining model process.

Table 2 contains a summary of modelled lithology LITH codes and GEOZONE field values. The updated 2023 mineral resource model contains the new Katunga Dolomite lithology DOM which is set to GEOZONE 71. Katunga Dolomite was previously modelled as part of the Basal Sequence but has been separated out to improve the estimation of PAF/NAF physicals. GEOZONE 10 has been used as the default value for any undefined GEOZONE values and for may modelled fill zones such as waste dumps or in-pit back-fill.

Table 2: Prepared Resource Model Lithology and GEOZONE Coding

LITH	GEOZONE	DESCRIPTION
AMP	10	Amphibolite (and filled regions)
BIF	20	Banded Iron Formation
HEO	30	Haematite
HEC	32	Haematite Carbonate
HBF	37	Haematite Banded Iron Formation
MTS	40	Magnetite Silica
MTC	43	Magnetite Carbonate
SCH	46	Schist / Altered Magnetite Silica
MBF	47	Magnetite Banded Iron Formation
MSU	48	Magnetite Sulphide
ESZ	49	Eastern Shear Zone
BSQ	70	Basal Sequence
DOM *	71	Katunga Dolomite
CGS	80	Cooks Gap Schist
GRT	90	Granite

* New lithology added for Duchess South 2023 model

3 Model Validation

The mining model script performs an initial validation of the input resource model to check for structural issues and ensure a valid block model format prior to commencing model manipulation. The model validation performs 6 checks:

- All required model fields are defined and of the correct type
- Field values are within an expected numerical range
- At least 95% of grade totals are within 3 standard deviations
- The model contains no overlapping cells
- Small blocks less than 5% of parent block size do not exist
- Model proto is no greater than 50m larger than blocking extent

The input Duchess South resource model passed all model validation checks.

4 Model Depletion

The Duchess South mining model has been cut to the SMR mine topography as of ***1st July 2023***. The primary model depletion surface ***topo_smr_20230701_tr.dm*** was developed from SMR mine survey datasets combined into a single surface covering the complete Duchess South model extent. Blocks above this surface are removed from the resource model and gaps representing areas of waste rock dumps or pit back-fill are set as default waste rock fill.

The resource model is depleted using several surface triangulations which are flagged sequentially against the block model to set areas of in-situ rock or waste fill. Table 3 lists the triangulations applied for the Duchess South mining model depletion and waste-fill process with the corresponding projection direction and model adjustment applied.

Table 3: Model Clipping and Waste Fill Modelling Surfaces

Run	Surface Triangulation	Projection Direction	Flag Type
1	**topo_smr_20230701_[tr|pt].dm**	**Below**	**In Situ**
2	20200106_nat_surface_[tr|pt].dm	Above	Waste Fill
3	20200106_nat_surface_[tr|pt].dm	Above	Free Dig
4	iron_duke_30sep2015_[tr|pt].dm	Above	Waste Fill
5	iron_duke_30sep2015_[tr|pt].dm	Above	Free Dig
6	202005_topo_[tr|pt].dm	Above	Waste Fill
7	202005_topo_[tr|pt].dm	Above	Free Dig
8	dcs_stg1_20150126_[tr|pt].dm	Above	Waste Fill
9	dcs_stg1_20150126_[tr|pt].dm	Above	Free Dig
10	topo_mag_20230301_[tr|pt].dm	Above	Waste Fill
11	topo_mag_20230301_[tr|pt].dm	Above	Free Dig

Several surface triangulations are applied to the mining model to ensure all existing waste dumps or historical fill areas are correctly modelled as waste fill and flagged as free dig. Five surfaces were applied representing the following datasets:

1. SMR natural surface: upper starting surface
2. Mine topography as of 30th September 2015: mined out Iron Duke pit
3. Mine topography as of May 2020: intermediate mine topography
4. Original DCS Stg1 pit design: original DCS-A pit design
5. Mine topography as of 1st March 2023: in-pit geotechnical buttress fill material

5 Product Modelling

The modelling of mineable products uses the *dC-OreSum* ore selectivity software developed by *dC Mining Engineering and Technology*. The OreSum software delineates selectively mineable regions of waste rock and product to generate mineable product boundaries that satisfy a range of grade and material type constraints while maintaining minimum extractable block sizes. The ore selectivity modelling may cause areas of thin mineralisation to be excluded as product loss and thin sections of internal waste rock to be included as dilution where appropriate to do so. Multiple product definitions are executed sequentially in order of priority to define incremental product codes for the mining model. Additional edge dilution is applied to the final modelled product boundaries to incorporate block dilution expected from blasting and mining extraction activities.

5.1 Hematite Products

The Duchess South mining model has hematite modelled as two products: OHG high grade direct shipping ore (DSO) ≥ 55% Fe, and OLG low grade ore beneficiation plant (OBP) feed ≥ 47% Fe. Hematite products are modelled with a minimum mining block selectivity of 10 x 10 x 12m to align with the large-scale mining fleet planned for Duchess South.

The following ore selectivity parameters are applied for the DSO modelling:

- Selectivity sub-block resolution: 2.5 x 2.5 x 12m
- SMU sub-block constraints
    - Any sub-block: SUMCODE = 1
        - FILLTYPE = 2: in-situ rock, and
        - GEOZONE ≥ 30 and GEOZONE ≤ 39: hematite mineralisation, and
        - MASS_REC < 20: low magnetite mass recovery
    - Any sub-block: CLASS ≥ 1 and CLASS ≤ 3
        - Measured, indicated or inferred resource
- Ore selection objective
    - Minimum SMU size: 10 x 10m
    - Maximise Fe ≥ 55% (OHG), ≥ 47% Fe (OLG)
- Additional block edge dilution
    - X-dimension: 0.6m edge transfer
    - Y-dimension: 0.6m edge transfer

Table 4 shows the conversion of hematite resource in the base geological model to mineable OHG product. The resource model to mining model conversion is shown which includes the impact of product loss and waste dilution incorporated by the ore selection process. The displayed material physicals are spatially unconstrained and relate to the overall block model. The mining model process reduces the quantity of OHG product by 22% with an overall reduction of 0.8% Fe (abs) and increase of 0.2% SiO2 (abs). The modelled OHG product physicals are set to the head grade values as this is a direct shipped product.

Table 4: Mining Model OHG Product Transformation

OHG	Tonnes (M'dmt)	Fe (%)	SiO2 (%)	Al2O3 (%)	P (%)	S (%)	LOI (%)	Mass Rec (%)
Resource	**25.6**	**59.3**	**5.9**	**1.7**	**0.07**	**0.04**	**3.4**	-
- Loss	7.8	58.3	7.3	1.9	0.07	0.05	3.3	-
+ Dilution	2.3	48.6	12.4	3.3	0.07	0.06	5.0	-
Mining Model	**20.1**	**58.5**	**6.1**	**1.7**	**0.07**	**0.04**	**3.6**	**100.0**
Change (abs)	-5.5	-0.8	0.2	0.1	-0.00	-0.00	0.2	-
Change (%)	-22%	-1%	4%	5%	0%	-3%	6%	-

Table 5 shows the conversion of hematite in the base geological model to mineable OLG product. The mining model process increases the modelled mass of OLG by 8% with an overall reduction of 1.1% Fe (abs) and an increase of 1.1% SiO2 (abs). The increased mass of OLG results from the loss when modelling DSO, with thin areas of higher grade able to be mined above the lower OLG cut-off grade. The modelled OLG is expected to be beneficiated using the existing SMR ore beneficiation plant (OBP). Table 6 contains the product mass recovery and fixed product physicals applied to the OLG which is based on actual OBP performance data from FY2019.

Table 5: Mining Model OLG Product Transformation

OLG	Tonnes (M'dmt)	Fe (%)	SiO2 (%)	Al2O3 (%)	P (%)	S (%)	LOI (%)	Mass Rec (%)
Resource	**18.8**	**51.8**	**8.8**	**2.4**	**0.07**	**0.06**	**5.6**	-
- Loss	5.9	51.8	10.2	2.7	0.08	0.05	4.7	-
+ Dilution	7.4	48.9	12.9	3.1	0.07	0.09	5.6	-
Mining Model	**20.3**	**50.7**	**9.9**	**2.6**	**0.07**	**0.07**	**5.8**	**53.5**
Change (abs)	1.5	-1.1	1.1	0.2	-0.00	0.01	0.2	-
Change (%)	8%	-2%	12%	6%	-4%	27%	4%	-

Table 6: Mining Model OLG Product Physicals

P_MR	P_H2O	P_FE	P_SIO2	P_AL2O3	P_P	P_S	P_LOI
0.535	8	59.58	6.54	1.43	0.05	0.07	3.7

P_CAO	P_MGO	P_MN	P_TIO2	P_ZN	P_NA2O	P_K2O	-
0.44	0.88	0.47	0.18	0.01	0.18	0.05	-

5.2 Magnetite Products

Magnetite is modelled as multiple products in the Duchess South mining model to provide adequate grade selectivity for the mining schedule to prioritise high value feed and satisfy processing capacity and blend constraints. MAG is modelled with a minimum mining block selectivity of 10 x 10 x 12m to align with the large-scale mining fleet planned for Duchess South.

The following ore selectivity parameters are applied for the MAG modelling:

- Selectivity sub-block resolution: 2.5 x 2.5 x 12m
- SMU sub-block constraints
    - All sub-blocks: SUMCODE = 4 or GEOZONE = 10
        - FILLTYPE = 2: in-situ rock, and
        - GEOZONE ≥ 40 and GEOZONE ≤ 49: magnetite mineralisation, and
        - MASS_REC ≥ 10: minimum magnetite mass recovery, or
        - GEOZONE = 10: amphibolite (i.e. internal dykes)
    - Any sub-block: CLASS ≥ 1 and CLASS ≤ 3
        - Measured, indicated or inferred resource
- Ore selection objective
    - Minimum SMU size: 10 x 10m
    - Maximise NV/P2 ≥ product cut-off (all except MHW)
    - Maximise MR ≥ 10% (MHW only)
- Additional block edge dilution
    - X-dimension: 0.6m edge transfer
    - Y-dimension: 0.6m edge transfer

The product specific selection criteria are listed in Table 7. The primary ore selection objective is to maximise total value above the Net Value per P2 Bottleneck Unit value (NV/P2) cut-off. Secondary selection criteria are applied to head silica grade and product sulphur grade as listed.

Table 7: Mining Model Magnetite Product Selection Criteria

MAG Product	≤ SiO2 (%)	≤ P_S (%)	≥ NV/P2 (AU$/t)	≥ MR (%)	Description
M32	70	0.08	32		MAG ≥ $32/NV.P2
M27	70	0.08	27		MAG ≥ $27/NV.P2
MLM	70	0.03	14		MAG Low Sulphur Medium Value
M22	70	0.08	22		MAG ≥ $22/NV.P2
M17	70	0.08	17		MAG ≥ $17/NV.P2
M11	70	0.08	11		MAG ≥ $11/NV.P2
MHH	70	0.25	27		MAG High Sulphur High Value
MHL	70	0.25	18		MAG High Sulphur Low Value
MHW				10	Subgrade magnetite

Table 8 shows the overall conversion of magnetite resource in the base geological model to mining model MAG product excluding MHW. The resource model to mining model conversion shown includes the impact of product loss and waste dilution incorporated by the ore selection process. The displayed material physicals are reported on the overall resource model. The mining model process increases the quantity of MAG feed mass by 3% with generally minor changes to overall head grades and mass recovery. The mining modelling process incorporates some higher alumina material into the MAG material classification as a result of mining dilution.

Table 8: Mining Model MAG Product Transformation (excluding MHW)

MAG	Tonnes (M'dmt)	Fe (%)	SiO2 (%)	Al2O3 (%)	P (%)	S (%)	LOI (%)	Mass Rec (%)
Resource	**652.3**	**30.6**	**44.6**	**0.7**	**0.05**	**0.18**	**2.3**	**33.4**
- Loss	23.8	29.5	46.3	0.7	0.05	0.34	2.3	28.0
+ Dilution	43.0	25.7	44.2	3.9	0.07	0.30	3.9	20.0
Mining Model	**671.5**	**30.3**	**44.5**	**0.9**	**0.06**	**0.18**	**2.4**	**32.7**
Change (abs)	19.2	-0.3	-0.1	0.2	0.00	0.00	0.1	-0.7
Change (%)	3%	-1%	0%	29%	2%	1%	5%	-2%

MHW is included as a magnetite product code but is handled as mineralised waste in the mine scheduling. Total modelled MHW in the mining model is shown in Table 9 for reference.

Table 9: Mining Model MHW Physicals

MAG	Tonnes (M'dmt)	Fe (%)	SiO2 (%)	Al2O3 (%)	P (%)	S (%)	LOI (%)	Mass Rec (%)
Mining Model	**162.9**	**26.4**	**52.1**	**0.7**	**0.04**	**0.63**	**1.2**	**19.2**

6 Model Post-Processing

The Duchess South mining model requires several post-processing steps to finalise the model for mine planning processes. The following post-processing stages are applied.

6.1 Resource Re-Classification

Loss and dilution are typically incorporated into ore reserves by directly adjusting reported resource physicals with mass and grade factors. In this case, mining dilution assigned to measured, indicated or inferred resource is essentially reported as the same classification as the associated ore zones. However, when modelling ore selectivity spatially, the defined product blocks may include parts of the underlying resource model with unassigned or other resource classifications. This is an artefact specific to the spatial modelling approach where only mineralisation has been assigned a valid resource classification with adjacent waste or low-grade rock left unassigned.

To align the Duchess South reserve reporting with industry standards and resolve the unclassified material, the mining model resource classification has been adjusted so that material associated with measured or indicated resource extraction is upgraded to indicated, and remaining material associated with inferred resource extraction is upgraded to inferred. To select associated mineralisation, an ore selectivity model was run on the Duchess South mining model product blocks to create an envelope to upgrade material to indicated resource, with the remaining unclassified resource associated with inferred resource extraction upgraded to inferred.

The following ore selectivity parameters were applied to generate the measured and indicated resource envelope:

- Selectivity sub-block resolution: 2.5 x 2.5 x 12m
- SMU sub-block constraints
    - Any sub-block: CLASS = 1 or CLASS = 2
        - SMU must span measured or indicated resource
- Ore selection objective
    - Minimum SMU size: 10 x 10m
    - Maximise:
        - CLASS = 1 or CLASS = 2: 1 x Volume
        - CLASS = 3: -1 * Volume
        - NIR; -0.01 x Volume
        - Objective targets M+I with a maximum of 50% inferred dilution and minimal associated NIR

The resource was then reclassified in the mining model based on the following calculations:

```
' Calculate new resource classification values
If (([CLASS] = 0 Or [CLASS] = 3 Or [CLASS] = 4) And [ORESUM] = 1) Then
    ' Upgrade measured or indicated associated to indicated resource
    [CLASS] = 2
Else If ([CLASS] = 0 Or [CLASS] = 4) Then
    ' Upgrade remaining inferred associated to inferred resource
    [CLASS] = 3

End If
```

Figure 2 shows an oblique view of the Duchess South mining model coloured by resource classification for the base and reclassified resource classifications. The base model shows areas of internal or edge dilution with amphibolite dykes which would typically be included as internal dilution during mining activities. The reclassified model shows these areas either reassigned indicated or inferred resource classifications based on the associated product coding.

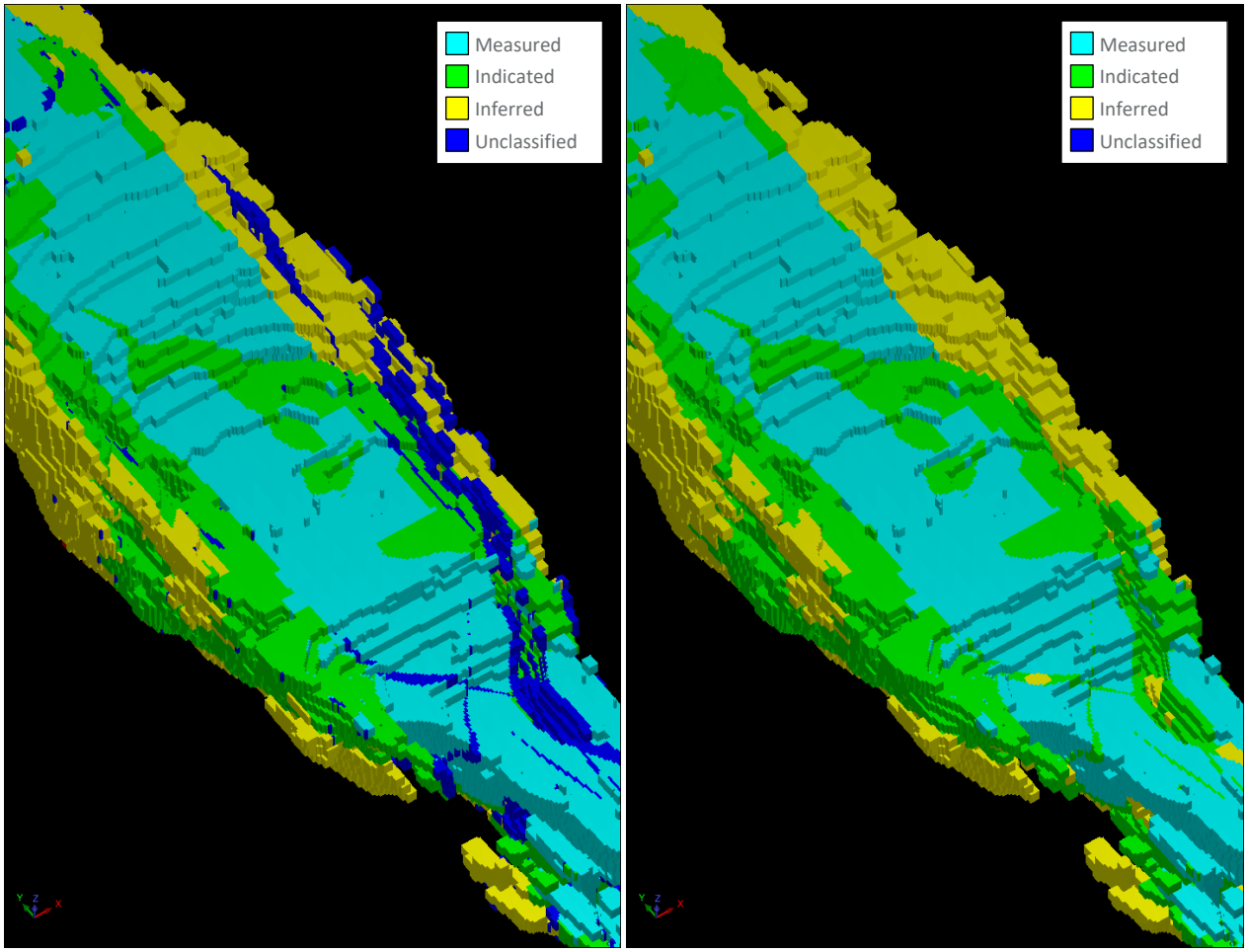


Figure 2: Original Resource Classification vs Reclassified Model

Table 10 and Table 11 show a breakdown of pre and post-resource reclassification mining model physicals for OHG and MAG product types. Mining model physicals that have not been reclassified are highlighted in each table showing the reclassified quantities make up a small proportion of the overall product quantities.

Table 10: Mining Model OHG Resource Reclassification

New Class	Old Class	Tonnes (M'dmt)	Fe (%)	SiO2 (%)	Al2O3 (%)	P (%)	S (%)	LOI (%)
1	0	0.0	57.6	6.3	2.6	0.06	0.07	3.7
	1	**5.1**	**58.3**	**4.7**	**1.9**	**0.06**	**0.06**	**4.6**
	2	0.2	57.6	7.0	2.3	0.05	0.07	3.7
	3	0.0	62.6	3.6	1.5	0.08	0.02	2.7
2	0	0.2	57.5	8.2	2.5	0.06	0.04	3.6
	1	0.2	57.8	5.9	2.3	0.06	0.05	4.0
	2	**7.4**	**59.1**	**5.9**	**1.9**	**0.08**	**0.04**	**3.6**
	3	0.1	58.6	6.4	2.1	0.06	0.03	3.3
	4	0.0	55.6	9.0	0.4	0.09	0.02	4.4
3	0	0.2	56.5	9.5	2.0	0.07	0.04	3.0
	1	0.0	58.9	4.9	1.8	0.05	0.04	3.5
	2	0.1	58.2	6.1	1.4	0.07	0.03	3.9
	3	**6.4**	**58.1**	**7.2**	**1.4**	**0.08**	**0.03**	**2.9**
	4	0.2	57.0	8.2	1.7	0.08	0.02	2.9
TOTAL		**20.1**	**58.5**	**6.1**	**1.7**	**0.07**	**0.04**	**3.6**

Table 11: Mining Model MAG Resource Reclassification (excluding MHW)

New Class	Old Class	Tonnes (M'dmt)	Fe (%)	SiO2 (%)	Al2O3 (%)	P (%)	S (%)	LOI (%)
1	0	1.2	33.7	31.3	2.3	0.07	0.08	6.7
	1	**226.1**	**32.1**	**43.0**	**0.7**	**0.06**	**0.10**	**2.4**
	2	4.6	30.4	45.9	0.6	0.05	0.14	1.9
	3	0.3	29.3	48.2	0.4	0.05	0.15	1.3
	4	0.0	40.1	27.7	0.3	0.05	0.67	7.2
2	0	7.5	29.6	29.5	6.0	0.10	0.14	6.8
	1	4.9	30.7	42.0	1.2	0.06	0.16	3.2
	2	**228.7**	**30.3**	**44.9**	**0.8**	**0.05**	**0.20**	**2.0**
	3	4.5	29.3	45.1	0.9	0.05	0.23	2.2
	4	0.4	27.2	48.6	0.8	0.06	0.17	2.0
3	0	9.4	24.9	34.3	7.6	0.10	0.18	6.1
	1	0.3	29.2	35.7	3.5	0.09	0.15	5.6
	2	3.3	30.0	42.3	1.2	0.06	0.27	2.7
	3	**170.9**	**28.4**	**47.0**	**0.8**	**0.05**	**0.25**	**2.4**
	4	9.3	28.2	49.6	0.5	0.05	0.15	3.0
TOTAL		**671.5**	**30.3**	**44.5**	**0.9**	**0.06**	**0.18**	**2.4**

6.2 Add NAF/PAF Variables

The Duchess South deposit contains areas of potentially acid forming rock. The mineral resource model includes estimated PAF modelling variables with the following data retained and applied in the mining model post-processing:

- MPA – Maximum potential acidity
- ANC – Acid neutralising capacity
- NAPP – Net acid producing potential
- ANC_MPA – ANC/MPA ratio

The **MPA** is the maximum amount of acid that could be generated by the contained sulphur. The MPA is calculated from the total sulphur content as follows: MPA (kg H2SO4/t) = Total %S x 30.6.

The **NAPP** is the amount of acid that potentially can be produced by a sample after allowing for ANC. The NAPP value is calculated based on linear regressions developed by SIMEC Mining. If the NAPP is negative then it is likely that the material has sufficient inherent buffer capacity to prevent acid generation. Conversely, if the NAPP is positive then the material may be acid generating.

The **ANC** is the acid neutralising capacity which is calculated by subtracting the NAPP value from MPA.

The **ANC/MPA** ratio is essentially another way of looking at the balance between ANC and MPA and provides an indication of the relative margin of safety with respect to the acid forming potential of a sample. A ratio less than 1 corresponds to a positive NAPP and indicates a material may be acid generating. Conversely, an ANC/MPA ratio of 2 or more generally signifies that there is a high probability that the material will remain circum-neutral in pH (i.e. the material should not be problematic with respect to ARD).

The **WST_TYPE** variable is added to the mining model to classify NAF/PAF material types based on the following coding:

- PAF – Potentially acid forming where ANC/MPA < 1
- UC – Uncertain or low capacity where 1 ≤ ANC/MPA < 2
- NAF – Not acid forming where 2 ≤ ANC/MPA < 3
- AC – Acid consuming where ANC/MPA ≥ 3

6.3 Finalise Model Fields

Not all fields required for downstream MEP mine planning activities are carried through the mining model process into the final prepared model. After the mining modelling process is complete the business model value drivers are added to the mining model and calculated via a scripted process. The fields added include the following:

- P1 DLIMS [P1_DLIMS] and P2 Cobbing [P2_DLIMS] reject percentages
- Flotation stage mass recovery [FLOT_MR]
- P2 VRM feed mass (i.e. P2 primary bottleneck) [C_P2SH_F]
- P1 [P1_NV] and P2 [P2_NV] net processing values
- P2 value per P2 primary bottleneck unit [NVP2_CON]

7 Scheduling Reserve Summary

Table 12 to Table 14 contain physicals for OHG, OLG and MAG (excluding MHW) material types reported using the completed Duchess South ***dm_2310b1_mm.dm*** mining model and based on the MEP2 'no-north dump' pit design phase solids.

Table 12: Mining Model PFS Pit Design OHG Physicals

Values	MAG-E	DCS-A	DCS-B	DCS-C	DCS-D	DCS-E	DCS-F	DCS-G	DCS-H	DCS-I	Total
Volume (M'bcm)	0.0	0.0	0.0	1.3	0.0	0.0	0.9	0.0	0.1	0.6	**2.9**
Dry Mass (M'dmt)	**0.0**	**0.0**	**0.0**	**4.6**	**0.0**	**0.0**	**3.3**	**0.0**	**0.5**	**2.1**	**10.5**
Fe (%)	-	55.6	55.3	58.7	56.1	-	57.5	55.0	57.8	58.2	**58.2**
SiO2 (%)	-	5.1	7.9	5.3	12.1	-	4.6	7.9	9.3	8.0	**5.9**
Al2O3 (%)	-	1.1	3.2	1.2	2.1	-	2.3	3.3	1.5	1.0	**1.5**
P (%)	-	0.06	0.11	0.10	0.08	-	0.05	0.11	0.06	0.08	**0.08**
S (%)	-	0.02	0.09	0.03	0.11	-	0.08	0.10	0.12	0.03	**0.05**
LOI (%)	-	6.2	9.1	4.1	4.7	-	4.9	9.8	3.8	2.4	**4.0**
CaO (%)	-	3.2	0.0	1.9	0.4	-	2.4	0.0	0.7	1.0	**1.8**
MgO (%)	-	4.4	0.1	3.0	1.5	-	3.9	0.1	1.9	3.6	**3.3**
P_MR (%)	-	100.0	100.0	100.0	100.0	-	100.0	100.0	100.0	100.0	**100.0**
P Dry Mass (M'dmt)	**0.0**	**0.0**	**0.0**	**4.6**	**0.0**	**0.0**	**3.3**	**0.0**	**0.5**	**2.1**	**10.5**
P_Fe (%)	-	55.6	55.3	58.7	56.1	-	57.5	55.0	57.8	58.2	**58.2**
P_SiO2 (%)	-	5.1	7.9	5.3	12.1	-	4.6	7.9	9.3	8.0	**5.9**
P_Al2O3 (%)	-	1.1	3.2	1.2	2.1	-	2.3	3.3	1.5	1.0	**1.5**
P_P (%)	-	0.06	0.11	0.10	0.08	-	0.05	0.11	0.06	0.08	**0.08**
P_S (%)	-	0.02	0.09	0.03	0.11	-	0.08	0.10	0.12	0.03	**0.05**
P_LOI (%)	-	6.2	9.1	4.1	4.7	-	4.9	9.8	3.8	2.4	**4.0**
P_CaO (%)	-	3.2	0.0	1.9	0.4	-	2.4	0.0	0.7	1.0	**1.8**
P_MgO (%)	-	4.4	0.1	3.0	1.5	-	3.9	0.1	1.9	3.6	**3.3**

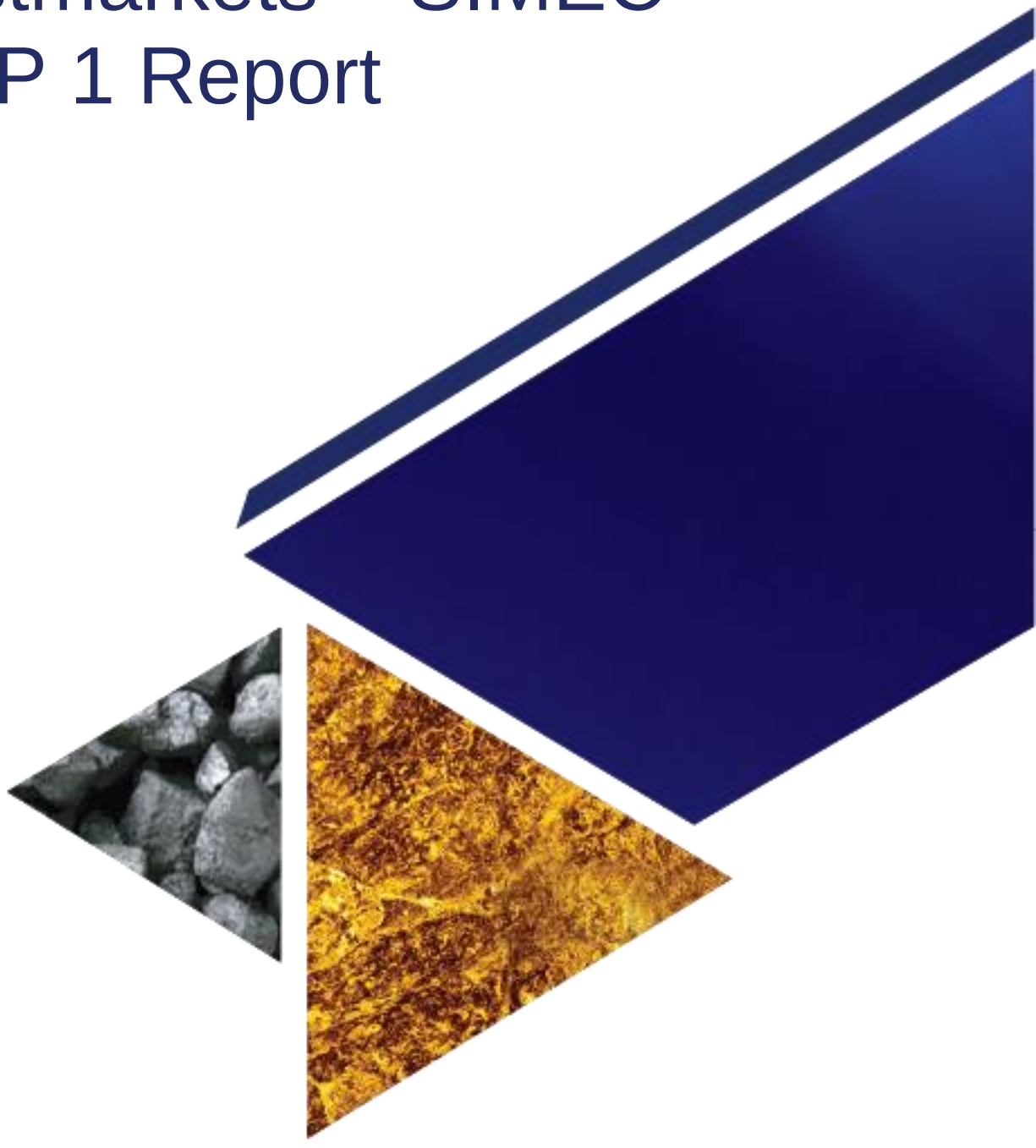
Table 13: Mining Model PFS Pit Design OLG Physicals

Values	MAG-E	DCS-A	DCS-B	DCS-C	DCS-D	DCS-E	DCS-F	DCS-G	DCS-H	DCS-I	Total
Volume (M'bcm)	0.0	0.0	0.0	0.9	0.0	0.0	1.5	0.1	0.2	0.7	3.4
Dry Mass (M'dmt)	**0.0**	**0.1**	**0.1**	**3.1**	**0.1**	**0.0**	**5.7**	**0.2**	**0.8**	**2.4**	**12.5**
Fe (%)	45.1	49.7	51.1	51.4	50.2	49.9	50.5	51.5	50.4	50.9	50.8
SiO2 (%)	8.1	9.0	10.7	9.9	15.2	8.9	5.6	9.5	14.4	13.6	9.0
Al2O3 (%)	2.7	1.3	5.4	1.7	1.1	5.1	2.7	5.2	1.1	1.4	2.1
P (%)	0.06	0.04	0.11	0.09	0.07	0.04	0.05	0.11	0.07	0.08	0.07
S (%)	0.06	0.10	0.10	0.04	0.13	0.15	0.10	0.11	0.26	0.03	0.08
LOI (%)	11.5	8.8	9.0	5.1	5.0	11.4	8.4	10.2	5.1	3.2	6.4
CaO (%)	6.3	4.2	0.0	2.3	1.5	0.1	4.6	0.1	2.0	1.2	3.1
MgO (%)	7.4	4.5	0.1	5.1	4.9	0.2	5.7	0.2	4.3	6.0	5.4
P_MR (%)	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5
P Dry Mass (M'dmt)	**0.0**	**0.1**	**0.0**	**1.7**	**0.1**	**0.0**	**3.1**	**0.1**	**0.4**	**1.3**	**6.7**
P_Fe (%)	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6
P_SiO2 (%)	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
P_Al2O3 (%)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
P_P (%)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
P_S (%)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
P_LOI (%)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
P_CaO (%)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
P_MgO (%)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

Table 14: Mining Model PFS Pit Design MAG Physicals (excluding MHW)

Values	MAG-E	DCS-A	DCS-B	DCS-C	DCS-D	DCS-E	DCS-F	DCS-G	DCS-H	DCS-I	Total
Volume (M'bcm)	3.0	17.6	11.4	6.5	11.1	7.5	5.0	17.9	20.8	21.7	122.4
Dry Mass (M'dmt)	**11.3**	**60.8**	**39.0**	**21.2**	**37.6**	**26.2**	**18.6**	**61.5**	**70.8**	**72.1**	**419.1**
Fe (%)	40.1	31.8	30.5	26.2	29.5	31.5	38.8	29.9	29.9	28.1	30.5
SiO2 (%)	11.2	42.4	49.5	53.6	51.2	35.3	12.3	50.9	49.2	48.6	45.3
Al2O3 (%)	2.6	1.1	0.6	0.5	0.6	2.0	2.7	0.6	0.5	0.4	0.8
P (%)	0.08	0.05	0.05	0.05	0.05	0.06	0.09	0.05	0.05	0.05	0.06
S (%)	0.10	0.22	0.08	0.16	0.10	0.47	0.29	0.10	0.13	0.23	0.18
LOI (%)	11.6	2.7	0.5	2.0	0.5	5.0	11.1	-0.1	0.7	1.9	2.1
CaO (%)	6.9	2.3	1.4	0.3	1.2	4.6	8.4	1.5	1.2	0.5	1.9
MgO (%)	8.8	4.9	3.7	5.1	3.6	5.5	6.9	3.5	4.7	7.6	5.2
P_MR (%)	43.0	34.9	35.6	32.6	33.3	34.7	38.7	34.8	33.1	30.6	34.0
P Dry Mass (M'dmt)	**4.9**	**21.2**	**13.9**	**6.9**	**12.5**	**9.1**	**7.2**	**21.4**	**23.5**	**22.1**	**142.6**
P_Fe (%)	69.9	67.1	65.1	56.3	63.9	68.3	68.9	65.4	62.1	60.4	64.3
P_SiO2 (%)	0.8	6.1	9.3	16.9	10.3	4.1	1.1	8.9	11.7	12.3	9.0
P_Al2O3 (%)	0.1	0.1	0.0	0.2	0.1	0.1	0.2	0.0	0.1	0.1	0.1
P_P (%)	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01
P_S (%)	0.01	0.03	0.02	0.06	0.03	0.04	0.02	0.04	0.06	0.06	0.04
P_LOI (%)	-2.0	-2.7	-2.9	-0.8	-2.7	-2.8	-1.5	-3.1	-2.3	-1.6	-2.4
P_CaO (%)	0.6	0.2	0.1	0.2	0.1	0.4	0.9	0.1	0.2	0.1	0.2
P_MgO (%)	0.6	0.4	0.3	2.8	0.6	0.4	0.6	0.3	1.3	2.4	1.0

Appendix F. Fastmarkets – SIMEC MEP 1 Report





Fastmarkets

Confidential for SIMEC – April 18th 2024 – MEP1 – Final Report

Brian Levich, Consultancy Director – Blevich@fastmarkets.com

Contents

- **Executive Summary**
- Global steel production and iron ore market review
- DRI/HBI Market characterisation
- DR pellet market and forecasts
- DR pellet feed market and forecasts
- Pricing and VIU analysis
- Green steel market developments
- SIMEC Market positioning
- Conclusions

The purpose of this report is to characterise global pellet and pellet feed markets to provide specific insights on opportunities for high grade ore products and pricing dynamics

- The purpose of this report is to provide an independent view of the global market for DR and BF pellet feed with specific focus on DR products. The market assessment will analyse the DRI/HBI market and its evolution and impact on associated raw materials across key regions
- Key elements of the report include:
- Overview of global steel industry and key trends and developments and outlook on steel production including BOF vs EAF in various regions. Review of global iron ore market across key product groups such as sinter, pellet and pellet feed across various regions
- Review of DRI/ HBI market with specific focus on DR pellet and pellet feed analysing supply and demand across key regions and identifying key players in the market and market outlook across product categories
- Overview of pellet plants and their characteristics including technology and ownership aspects
- A detailed analysis of pellet and pellet feed market with specific insights on BF and DR grade products. It also includes pellet plants and pelletisation capacity development over the forecast period and evolution of pellet feed supply over the forecast period
- Pricing analysis of iron ore products addressing the pricing dynamics of reference iron ore products and the development of newer indices to better capture the value associated with higher grade products. The analysis also presents the relative VIU of various high grade iron ore products and comparison against SIMEC's products
- SIMEC market positioning and comparison against peers and a list of potential customers for its products
- Conclusion summarising key messages and findings

SIMEC aims to produce 2.5mtpa of DR pellet feed in the first phase with a high Fe content and a low gangue content that aligns with DR pellet feed requirement

- SIMEC plans to produce 2.5mtpa of DR pellet feed in the first phase of its project - MEP1 and subsequently scale up to 7.5mtpa - MEP2. The focus of this analysis is MEP1
- Under MEP1, the company aims to produce DR pellet feed conforming to Spec 1 , as provided by the company, aggregating to 2.5mtpa
- Spec 1 is characterised by high Fe content of 70.45% with a relatively lower gangue content of 1.89%
- The gangue(SiO2 + Al2O3) content of the company's products align with a typical DR pellet feed, which require it to be <3%

SIMEC DR PELLET FEED PRODUCT SPECIFICATION

Item	Unit	Spec 1
Fe (total)	%	70.45
SiO2	%	1.8
Al2O3	%	0.09
CaO	%	0.1
MgO	%	0.28
S	%	0.04
P	%	0.01
Moisture	%	8.7
Na2O	%	0.02
K2O	%	0
Mn	%	0.07
TiO2	%	0.03
LOI	%	-2.88
>0.15mm	%	70.45

Source: SIMEC and Fastmarkets

SIMEC’s products has a higher Fe content content relative to some of the leading players in the market

SIMEC DR AND BF PELLET FEED CHEMISTRY VS COMPETITORS

		DR	DR	DR	DR	DR	DR	DR	BF	BF	BF
		SIMEC Spec 1	Champion	CMP-HUASCO	Vale Tubarao	CSN	Shougang	Kaunis	Minas Rio	Vale	IOC
Element	Unit	Australia	Canada	Chile	Brazil	Brazil	Peru	Sweden	Brazil	Brazil	Canada
Fe (total)	%	70.45	68.5	68	68	67	68	69	67.2	66.5	65.7
SiO2	%	1.8	1	2.35	0.95	1.9	2	1.1	2.7	2.5	4.5
Al2O3	%	0.09	0.2	0.8	0.5	0.7	0.5	0.2	0.5	0.7	0.2
CaO	%	0.1	0.1					0.05	0.04		0.05
MgO	%	0.28	0.02					2.2	0.04		0.05
S	%	0.04	0.02	0.03			0.22	0.04	<0.01	0.003	0.005
P	%	0.01	0.04	0.03	0.032	0.045	0.02	0.02	0.043	0.045	0.01
Moisture	%	8.7		8.75			8.5	9	8-9		4
Na2O	%	0.02	0.005						0.005		
K2O	%	0	0.005						0.02		
Mn	%	0.07			0.05	0.4	0.02	0.05	0.06	0.15	0.05
TiO2	%	0.03	0.005					0.05	0.09	0.5	0.05
LOI	%	-2.88					0.6	-2.9	0.5		0.2

Note:
- The specifications outlined above are not comprehensive and is only for comparison purposes at a high level
- The items have been presented to the extent information is available and hence the information may not be homogeneous across all the producers

Source: SIMEC and Fastmarkets

SIMEC potential customers

- SIMEC’s product has a high Fe content and low gangue elements that is valuable to the DR pellet producers.
- Bahrain Steel is one of the leading DR pellet producers and is reliant entirely on external feed supply.
- SIMEC is geographically better positioned to serve Asian pellet producers especially those in China and Japan
- Asian pellet feed customers are mainly BF pellet producers and may not be able to attribute similar value to SIMEC product the way a typical DR pellet producer may do
- However, Asian pellet producers are far more fragmented as opposed to highly concentrated DR pellet producers. Thus, the risk is somewhat reduced at the expense of potentially lower price realisation

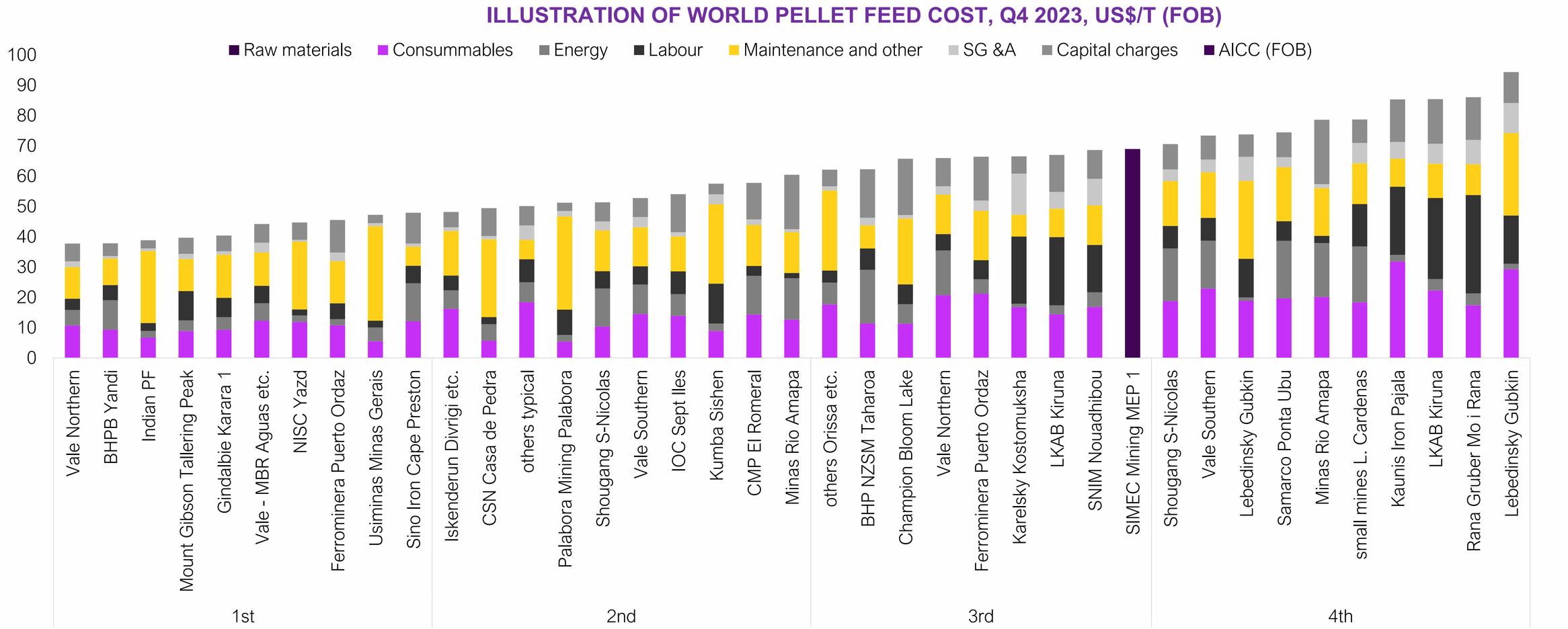
SIMEC POTENTIAL CUSTOMER OFFTAKE , MTPA

Company	Country	Pellet production capacity, mtpa	Pellet type	Estimated pellet feed demand	Potential SIMEC share	Potential SIMEC shipments
Bahrain steel	Bahrain	12.2	DR	12.6	6%	0.8
Kobe Steel	Japan	4	BF	4.1	4%	0.2
BaoWu	China	10	BF	10.3	4%	0.4
Anshan	China	10	BF	10.3	4%	0.4
AM/NS	India	14	BF/DR	14.4	3%	0.4
Trade/ other			BF/DR			0.3
Total						2.5

SIMEC key customer profile

Company	Country	Pellet feed type	SIMEC's proposed shipments, Mtpa	Strengths	Challenges
Bahrain steel	Bahrain	DR	0.8	• Product quality well aligned with DR pellet production • More flexible in terms of product quality since the company already employs several suppliers • It has the potential to displace other competitors due to its strong product attributes, particularly that of Spec 1	• Strong existing competition • New suppliers such as Champion (Canada) are developing DR pellet feed products with low impurity levels
Kobe Steel	Japan	BF	0.2	• Good product quality relative to competition	• Potential competition from Australian peers • Difficult to ascertain the same value as DR pellet feed since Kobe produces BF grade pellet
BaoWu	China	BF	0.4	• Good product quality relative to competition • Geographical proximity	• Stiff competition from established suppliers
Anshan	China	BF	0.4	• Good product quality relative to competition • Geographical proximity	• Stiff competition from established suppliers
AM/NS	India	BF/DR	0.4	• Fast growing market in Asia • Domestic supply not keeping up with the requirement	• Has access to own ore via its captive mines • Domestic suppliers such as NMDC may pose stiff competition
Trade/ other		BF/DR	0.3	• regular offtake • Reduced SG&A expenses	• Limited scope to strengthen end user market knowledge • Limited scope to build direct presence in the market
Total			2.5		

Vale Northern and BHPB Yandi are amongst the most cost competitive pellet feed producers in the world



Note:
- The pellet feed costs have been assessed on total cost basis which includes capital charges
- The costs are on FOB respective port basis

Source: Fastmarkets Cost data

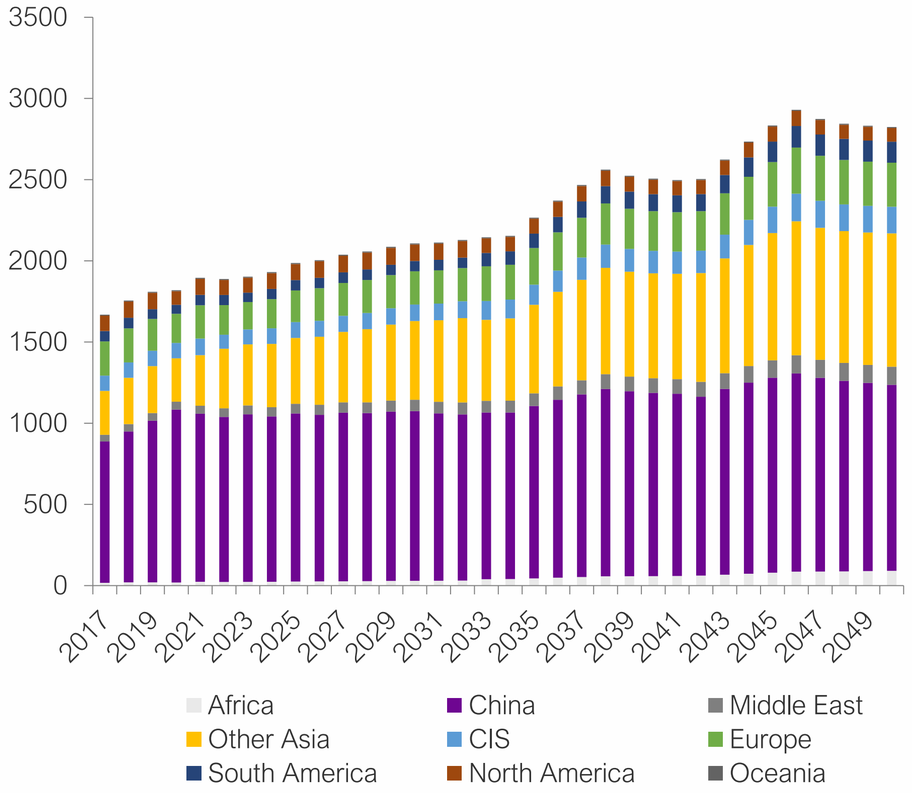
World crude steel production is forecast to grow to 2.5bnt by 2040 with the growth being driven by other Asian countries

- World crude steel production is forecast to grow to 2.5billion tonnes by 2040. Asia remains a key contributor to the global steel production accounting for a share of 70% of the world's steel production in 2040
- While China remains the world's largest crude steel producer for the foreseeable future, the growth will be mainly driven by other Asian countries
- Middle east is forecast to grow by 70% during 2022-40

REGIONAL CRUDE STEEL PRODUCTION FORECAST, MTPA

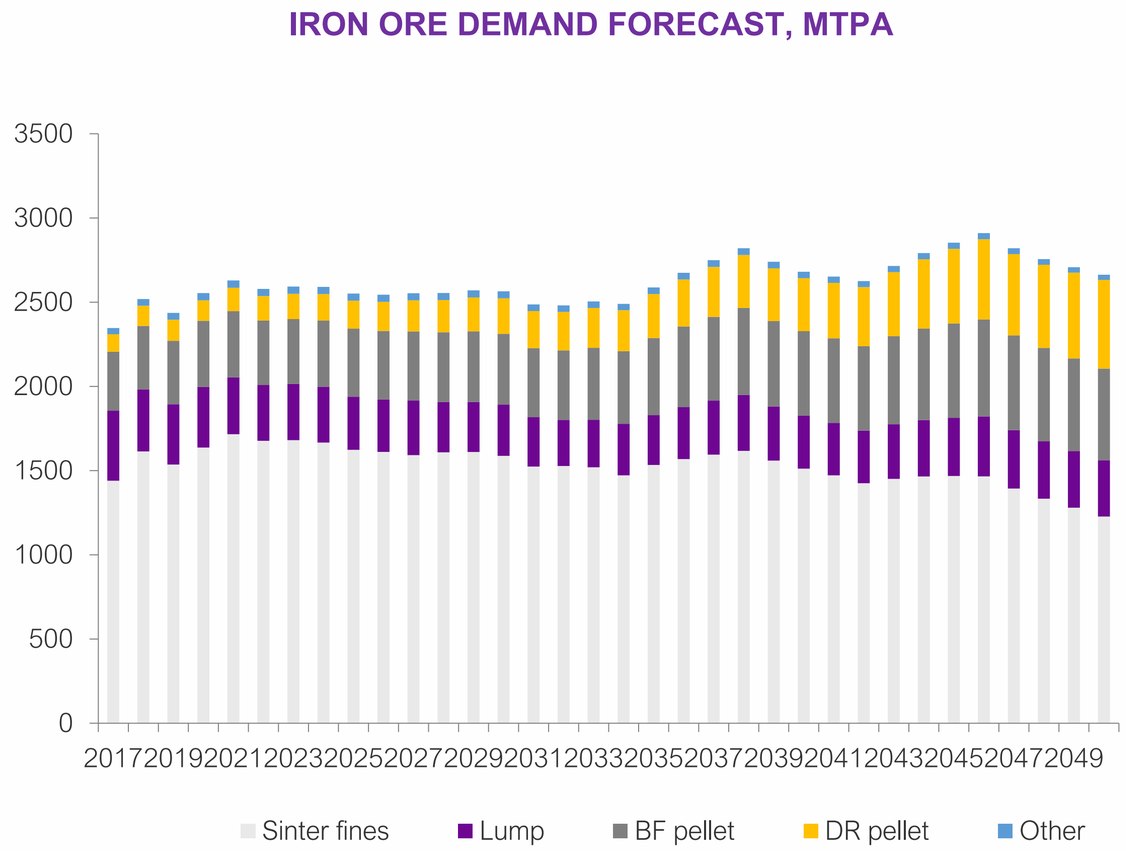
Region	2022	2040	2050
Afica	22	58	91
China	1016	1129	1146
Middle East	53	90	112
Other Asia	367	646	821
CIS	86	138	164
Europe	182	244	271
Latin America	62	105	130
North America	93	89	84
Oceania	6	6	6
Grand Total	1888	2506	2824

CRUDE STEEL PRODUCTION FORECAST, MTPA



The share of pellet in global iron ore consumption is forecast to increase while sinter is expected to decline in the long term since pellet has superior environmental credentials

- The share of pellet in the overall iron ore product is anticipated to grow due to its superior environmental credentials and large consumers of iron ore led by China are increasing the use of pellet in blast furnace
- China predominantly uses sinter as the main iron ore input into the blast furnace and accounts for about 70% of the total iron ore input into the furnace. The share of pellet is about 13%. It is anticipated that the share of pellet in the burden is likely to increase in the future
- The share of pellet in Europe has been traditionally on the higher side driven by stricter environment regulations particularly on sinter pollution norms.
- Blast furnace burdens vary across countries and across furnaces within the country itself based on the established practices and availability of input materials
- Pellet accounts for 20-40% in the EU, similar levels in Japan and 10-20% in China. The share of pellet in blast furnace is anticipated to further strengthen in China to comply with stricter environmental regulations in the country



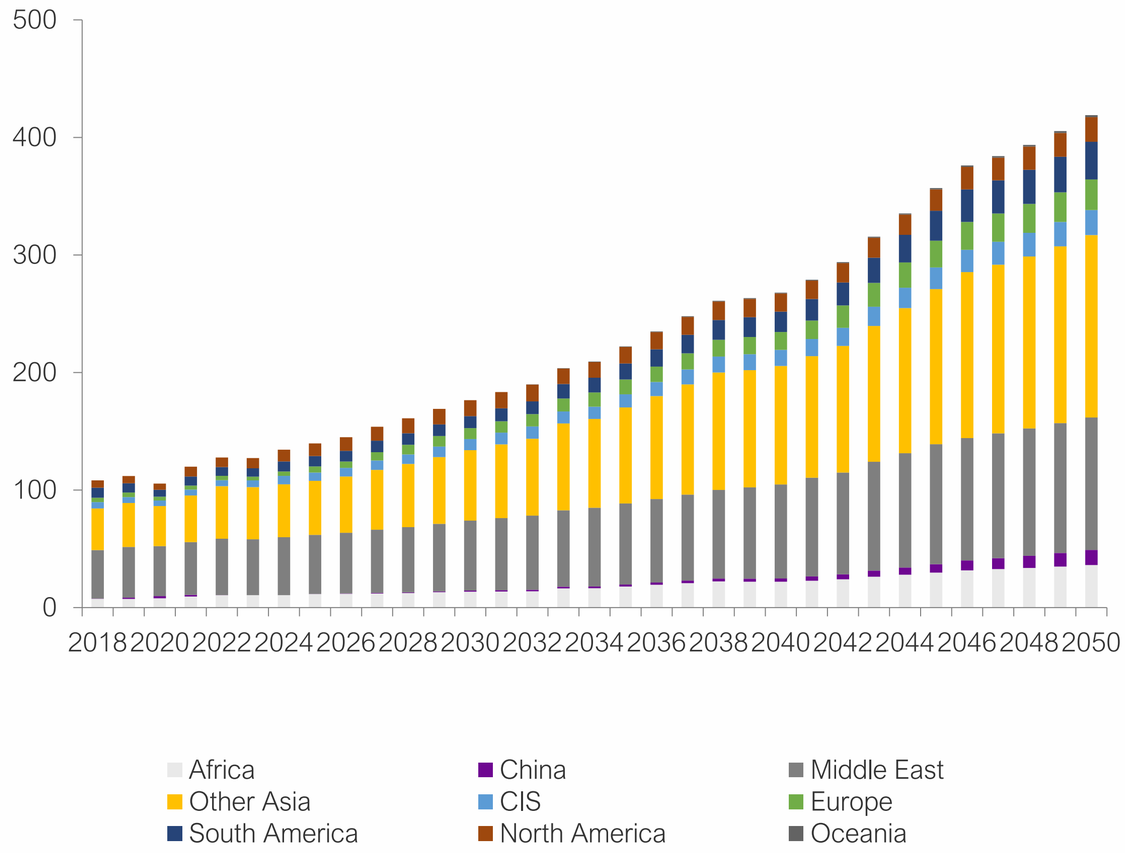
The global DRI/ HBI demand will continue to be led by Middle East and India. Other key players include the EU where EAF-HDRI is being pursued as a solution for decarbonisation

- The global DRI/ HBI production was 128mtpa in 2022 and Middle East accounted for a share of 38%. India is the world's largest DRI producer with a share of 34% of the world's production.
- India and Middle east will continue to be the key drivers of the overall DRI/HBI demand in the future. They continue to account for more than 65% of the world DRI demand
- However, with DRI being the key technology to enable decarbonisation, several asset transformations in the EU are based on phasing out some of the BF-BOF in favour of EAF-hydrogen DRI
- EU has been at the forefront of steel decarbonisation and several projects are being pursued by the leading steel companies in the region including ArcelorMittal, TKS, Salzgitter and others

DRI/HBI DEMAND, MTPA

Region	2022	2040	2050
Africa	11	22	36
China	0	3	13
Middle East	48	80	113
Other Asia	45	101	155
CIS	5	14	21
Europe	4	15	26
South America	7	17	32
North America	8	15	21
Oceania	0	1	2
Grand Total	128	268	419

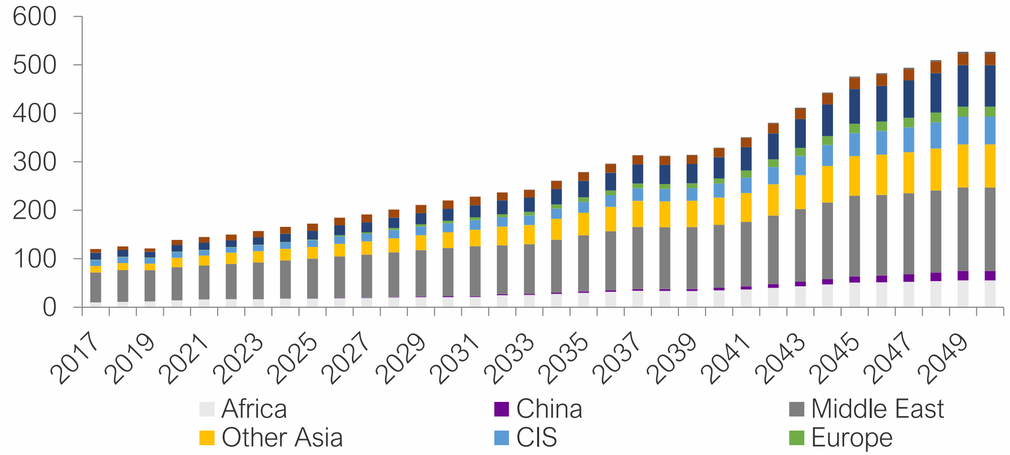
WORLD DRI/HBI* DEMAND FORECAST, MTPA



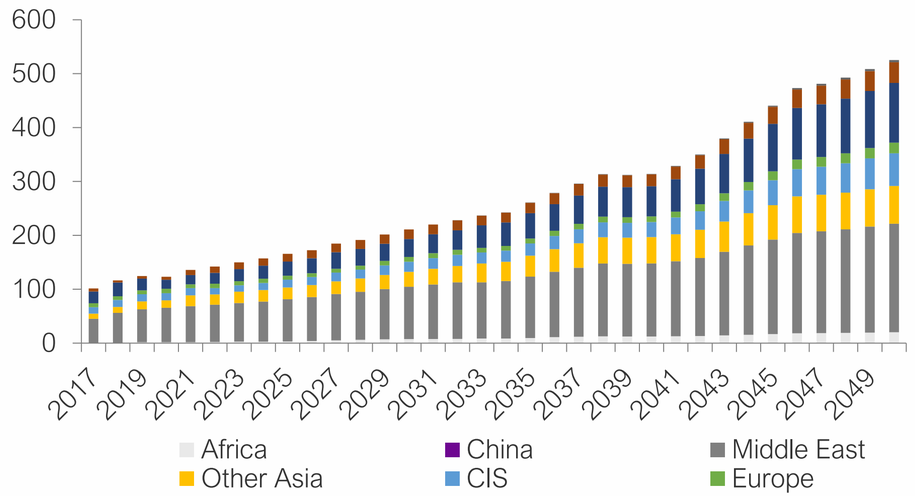
* The report treats all the DRI products as one entity and does not distinguish between DRI or HBI or other similar such products.

The demand for DR pellet is forecast to grow to 314mtpa in 2040 driven by growth in Middle east and South America

DR PELLET DEMAND FORECAST, MTPA



DR PELLET SUPPLY FORECAST, MTPA



DR PELLET DEMAND, MTPA

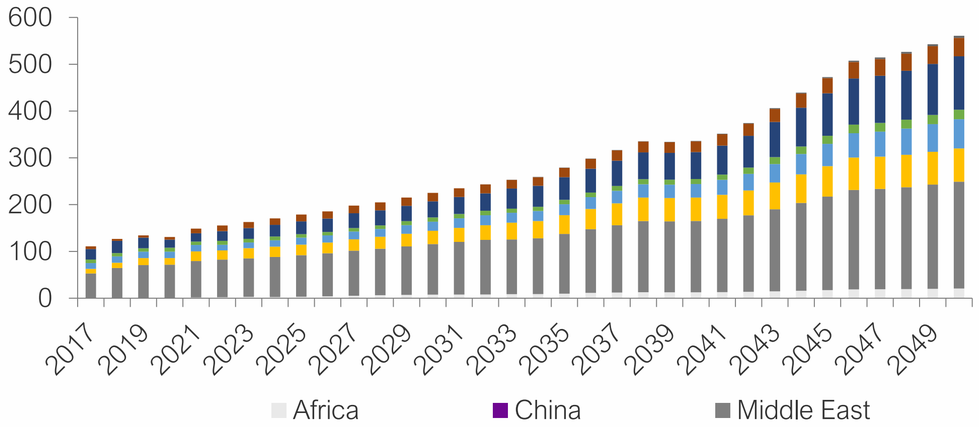
Region	2022	2040	2050
Africa	16	33	55
China	0	4	20
Middle East	70	128	172
Other Asia	21	54	89
CIS	11	26	57
Europe	1	10	21
South America	15	40	86
North America	11	18	24
Oceania	0	1	3
Grand Total	145	314	527

DR PELLET SUPPLY, MTPA

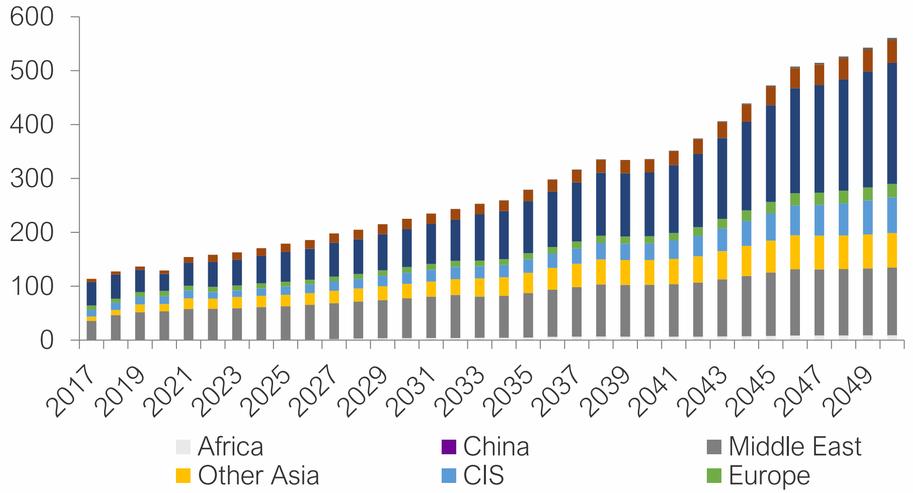
Region	2022	2040	2050
Africa	2	12	20
China	0	0	0
Middle East	69	136	201
Other Asia	19	49	70
CIS	12	28	61
Europe	8	10	20
South America	20	56	111
North America	12	22	38
Oceania	0	1	4
Grand Total	142	314	525

The demand for DR pellet feed is forecast to grow to 336mtpa in 2040 driven by growth in Middle east

DR PELLET FEED DEMAND FORECAST, MTPA



DR PELLET FEED SUPPLY FORECAST, MTPA



DR PELLET FEED DEMAND, MTPA

Region	2022	2040	2050
Africa	2	13	21
China	0	0	0
Middle East	80	152	228
Other Asia	20	50	71
CIS	12	29	62
Europe	8	11	20
South America	21	58	114
North America	12	23	40
Oceania	0	1	4
Grand Total	155	336	561

DR PELLET FEED SUPPLY, MTPA

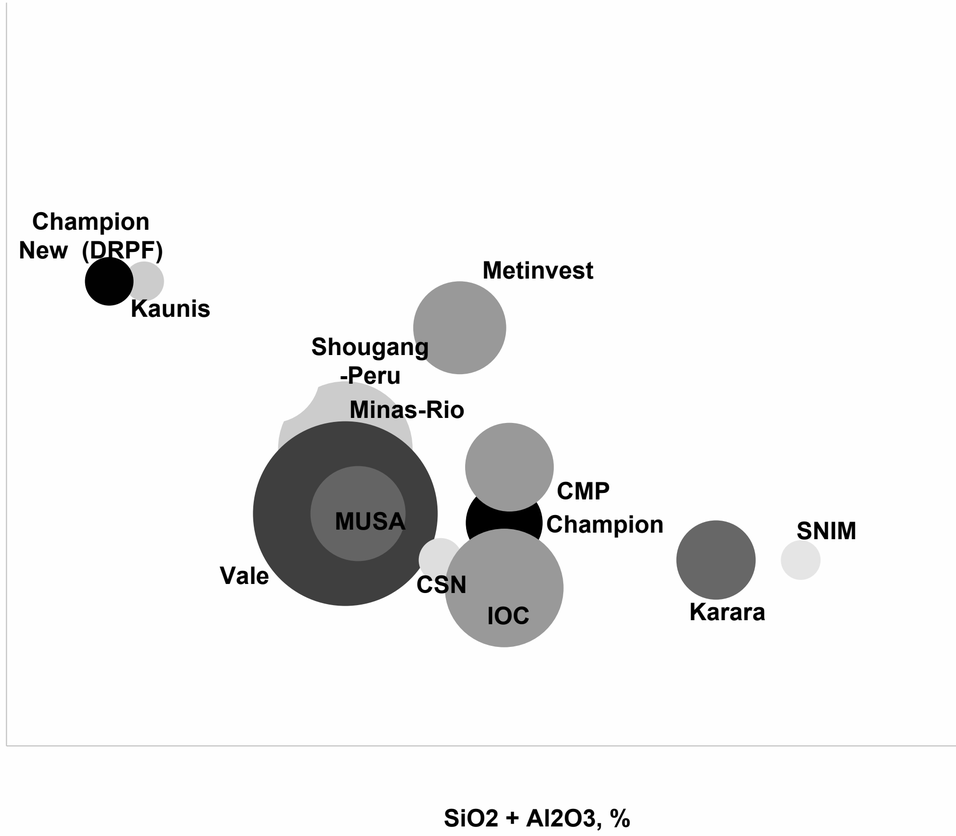
Region	2022	2040	2050
Africa	0	6	9
China	0	0	0
Middle East	58	96	126
Other Asia	19	46	64
CIS	12	31	66
Europe	10	13	25
South America	46	118	225
North America	13	24	42
Oceania	0	1	4
Grand Total	158	336	561

Vale and Minas Rio are amongst the leading pellet feed producers with lower gangue and higher Fe content

Supplier	Location	Indicative volume, Mtpa	Fe, %	SiO2+Al2O3, %
Minas-Rio	Brazil	23	67.2	3.2
Vale	Brazil	43	66.5	3.2
CSN	Brazil	2.5	66	4.1
Champion	Canada	7.5	66.2	4.5
Champion New (DRPF)	Canada	8	68.5	1.2
CMP	Chile	10	67	4.75
Karara	Australia	8	66	6.7
Fortescue Iron bridge	Australia	22	67	5.8
Metinvest	Ukraine	11	68.5	4.28
IOC	Canada	18	65.7	4.7
Shougang Peru	Peru	12	68	2.5
Kaunis	Sweden	2	69	1.3
MUSA	Brazil	11.5	66.5	3.32
SNIM	Mauritania	2	66	7.5

- The volumes shown above are indicative of the overall pellet feed output of these companies and not just seaborne or internal consumption. Vale's pellet feed is mainly internal and not any external sales. However, this may change in the future
- The purpose of the table is to illustrate relative product qualities and volumes to provide a perspective on the competition
- The volumes indicated do not necessarily correspond with 100% of the indicated product grade. There may be significant volume that may deviate from the grades

ILLUSTRATION OF PELLET FEED (BF & DR) PRODUCTS



Source: Fastmarkets

The prices for higher grade iron ore products are forecast to stay resilient driven by decarbonisation efforts leading to greater use of pellet

PRICE FORECASTS (2023$)

Category	Product	Price basis	2023	2030F	2035F	2040F	2045F	2050F
Iron ore products	Iron ore sinter fines, Fe-62%	$/tonne, CFR China	118	97	110	98	81	65
	Iron ore fines Fe-65%	$/tonne, CFR China	131	116	133	125	112	102
	Iron ore fines Fe-67.5%	$/tonne, CFR China	139	130	151	143	134	130
	BF pellet	$/tonne, CFR China	129	145	167	152	142	131
	DR pellet	$/t CFR Middle east	179	176	204	195	186	182
VIU	1% SiO2	$/t CFR China	-3.1	-4.1	-5	-5.3	-5.5	-5.6
	1% Al2O3	$/t CFR China	-4.7	-6.2	-7.4	-7.5	-7.7	-7.8
	1% Fe	$/t CFR China	1.9	2.5	3.7	3.3	3.9	4
Metallics	HBI	$/t CFR Italy	372	399	451	429	414	394
	DRI	$/t CFR Italy	367	394	446	424	409	389

Category	Route	Price basis	2023	2030F	2035F	2040F	2045F	2050F
Freight (Capesize vessel)	Whyalla - Qingdao	$/tonne	11.3	10.8	12.3	13.1	14.0	14.9
	Whyalla - Abu Dhabi	$/tonne	20.0	19.5	22.0	24.0	25.0	26.0
	Whyalla - JPN ports	$/tonne	12.4	11.9	13.5	14.4	15.4	16.4

Source: Fastmarkets

With steel decarbonisation progressing at a rapid pace, there is a strong demand for DR pellet and pellet feed as the industry migrates from BF-BOF to EAF-HDRI during the next few decades

- The demand for DR pellet feed is forecast to grow to ~560 mtpa by 2050 driven by continued growth in DRI production in Middle east and Asian markets, supported steel decarbonisation efforts in the EU. The steel industry is forecast to undergo a significant transformation in the medium to long term with slowing down of demand and production in China and decarbonisation around the world impacting the demand for iron ore
- The demand for sinter fines (Fe 62%) is forecast to slow down in the period to 2030, driven by slow down in China's steel production, increased use of pellet in BF and greater use of scrap in BF-BOF in the medium to long term. As a result, the demand for pellet and thus pellet feed is forecast to grow at a faster rate relative to sinter fines
- The steel industry is under pressure to decarbonise and the EU has been at the forefront on green steel transformation efforts. One of the key strategies being migration from BF-BOF to H2-DRI-EAF process. Leading EU steel mills such as ArcelorMittal, TKS and others are investing in EAF-HDRI process as part of their carbon mitigation and ultimately net zero goals by 2050
- With limited high quality scrap in the world, the demand for DRI and input raw materials such as DR pellet is likely to grow stronger
- With the proposed reduction of free carbon allowances and developing carbon price, the EU mills are under pressure to produce green steel at the earliest. However, this calls for significant scale of investments and above all access to green hydrogen. For sustained availability of green hydrogen, appropriate investments and engagement with other consuming sectors and correspondingly renewable electricity may be required

There is a need to enhance the DR pellet feed supply sources especially if the traditional sources of supply were to embark on own DRI production

- Although, majority of the DRI requirements will largely met by own DRI production in most of the markets, there is a likelihood of some imports resulting from misaligned schedules such as EAF being installed ahead of DRI. With some of the traditional seaborne DRI such as that from Russia coming under pressure, new sources may emerge in the future
- South America could become a a key supplier of DRI in the future, Brazil with DR pellet feed resources and renewable power to support production of green HBI in the long run. For example, Ternium and Vale exploring DRI production and export opportunities. This may constrain the supply of seaborne DR pellet and pellet feed originating from Brazil, driving the need to explore alternative sources of supply
- However, the supply of DR pellet feed that meets higher Fe and lower gangue content (<=3%) specifications are quite limited
- The tightening of pellet feed supply will impact the long term pricing of DR pellet feed and thus pellet. Although, new suppliers are forecast to enter the market, the supply may not be adequate resulting in higher pricing potential for DR pellet feed

However, new DRI installations face challenges due to high CAPEX requirements and the availability of renewable energy, especially in case of EU decarbonisation projects

DECARBONISATION IMPACT ON DR PELLET AND DR PELLET FEED MARKET

Item	Comments
Regional markets	▪ EU - The development of new DRI projects driven by migration from BF-BOF to EAF-DRI will drive additional demand for DR pellet in the future. ▪ Middle East and North Africa – Limited impact of decarbonisation in traditional seaborne markets such as Middle East and North Africa as the countries are yet to adopt any significant policies. Demand for DRI largely driven by domestic growth in steel production ▪ India –largely self-sufficient market with hardly any import/ export of DR pellet. Continue to rely on domestic iron ore resources ▪ Asia – The demand for pellet feed is led by China and Japan. The pellet plants produce BF pellet to meet the demands of their domestic BF-BOF mill. Pellet feed consumption is mainly limited to BF grade pellet feed and is entirely imported
Prices	▪ The prices will be driven by the tightness in DR pellet supply further driven by limited availability of DR pellet feed ▪ The uplift in prices may get further support should the decarbonisation efforts in the EU accelerate in the medium term leading to faster increase in DRI production capacity and thus driving the demand for DR pellet
DRI projects	▪ The successful commissioning of new DRI projects particularly in the EU will be driven by financial investments ▪ With weak domestic market prospects in the EU, the investment returns for such projects may be challenging and potentially risking the smooth progress of such projects ▪ Challenges associated with availability of renewable energy and green hydrogen in the EU
DR pellet/ pellet feed projects	▪ There are several challenges associated with commissioning new DR pellet feed projects such as geopolitical issues ▪ With H2 DRI being the preferred route for decarbonisation in the future and the rest of the world likely progress along the lines of EU's, the challenges to source the appropriate feed material will likely be more adverse

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The global crude steel production was 1.9 billion tonnes in 2022 and declined by about 4% relative to 2021 impacted by China's zero COVID policies

- World crude steel production was ca. 1.9billion tonnes in 2022. After growing continuously over the last 5 years, the production declined in 2022. The global crude steel production declined by about 4% in 2022 relative to 2021, mainly driven by strict COVID-19 policies in China. Although India's crude steel production increased in 2022, the increase was marginal to register any significant impact on a global scale

- China continues to be the main driver of global crude steel production accounting for 53% of the world's steel production 2022. China's crude steel production declined by about 2% in 2022 compared to 2021

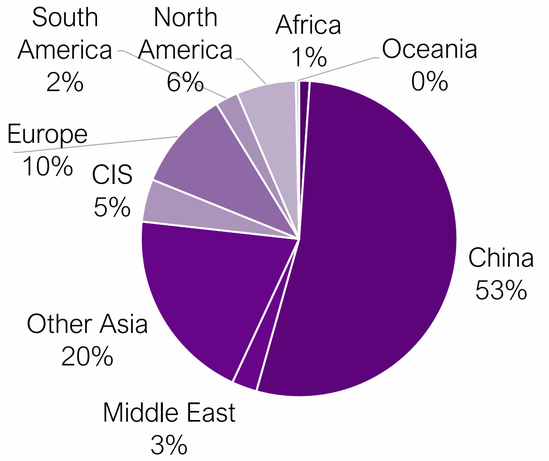
- Other Asia accounts for 20% of the world's production and is amongst the fastest growing regions in the world. Key players in the region being India, Indonesia and Vietnam

- Mature markets such as Europe and North America accounts for 16% of the global crude steel production. However, the growth story appears to be a bit divergent with North America growing faster than Europe during the period 2018-21

WORLD CRUDE STEEL PRODUCTION BY REGION, MTPA



WORLD CRUDE STEEL PRODUCTION BY REGION 1.9BILLION TONNES (2022)



Source: Fastmarkets

World crude steel production is forecast to grow to 2.5bnt by 2040 with the growth being driven by other Asian countries

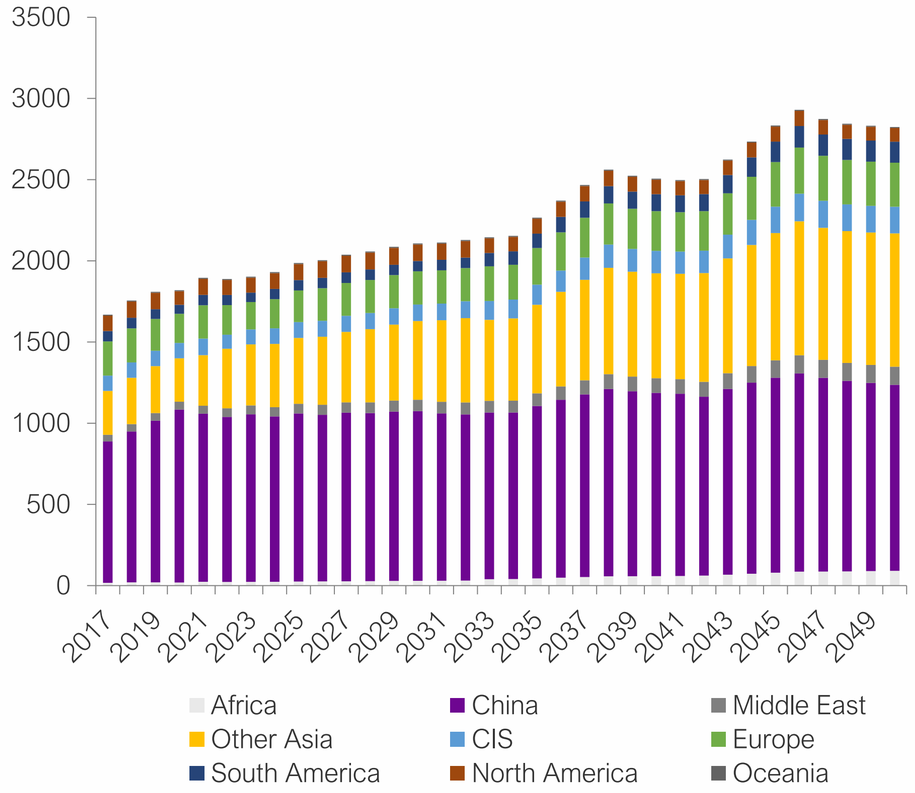
- World crude steel production is forecast to grow to 2.5billion tonnes by 2040. Asia remains a key contributor to the global steel production accounting for a share of 70% of the world's steel production in 2040
- While China remains the world's largest crude steel producer for the foreseeable future, the growth will be mainly driven by other Asian countries
- Middle east is forecast to grow by 70% during 2022-40

REGIONAL CRUDE STEEL PRODUCTION FORECAST, MTPA

Region	2022	2040	2050
Africa	22	58	91
China	1016	1129	1146
Middle East	53	90	112
Other Asia	367	646	821
CIS	86	138	164
Europe	182	244	271
Latin America	62	105	130
North America	93	89	84
Oceania	6	6	6
Grand Total	1888	2506	2824

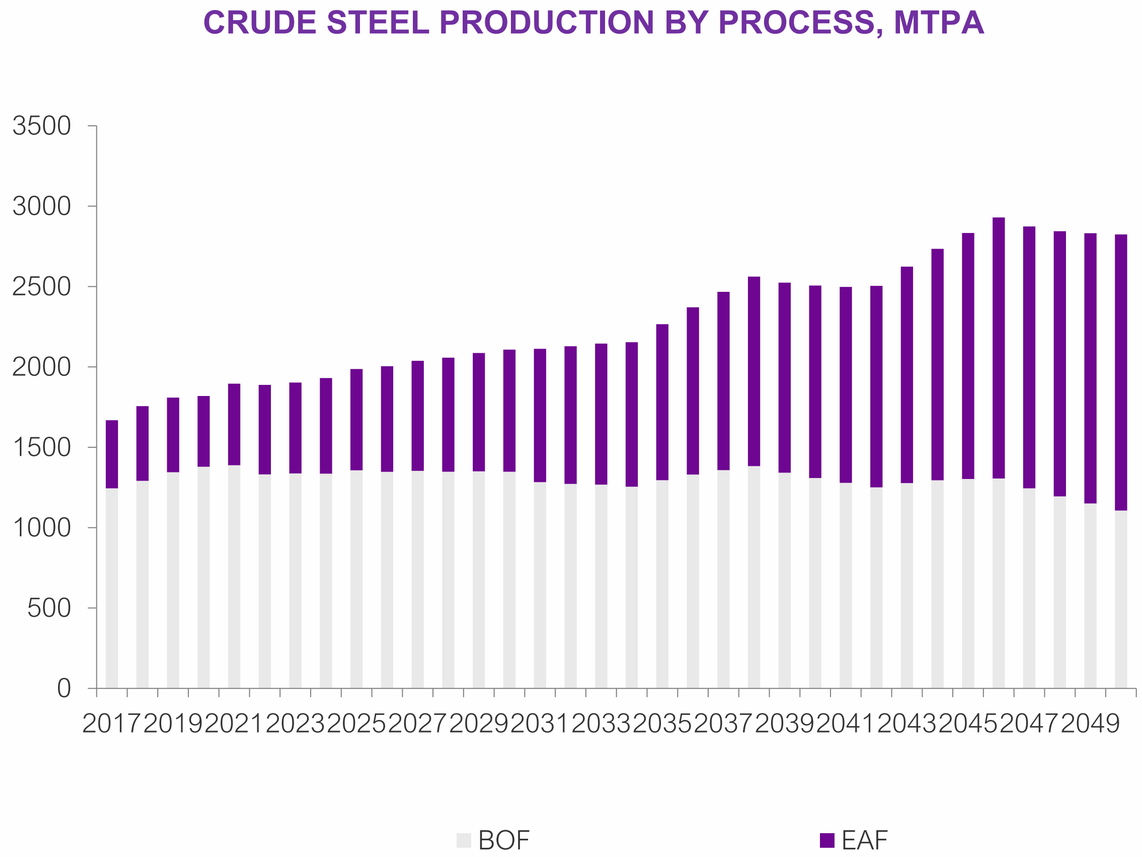
Other Asia breakdown	*2022*	*2040*	*2050*
Japan	*89*	*76*	*68*
S.Korea	*7*	*73*	*74*
Taiwan	*21*	*26*	*28*
Rest of Other Asia	*250*	*472*	*651*
Grand Total	*367*	*646*	*821*

CRUDE STEEL PRODUCTION FORECAST, MTPA

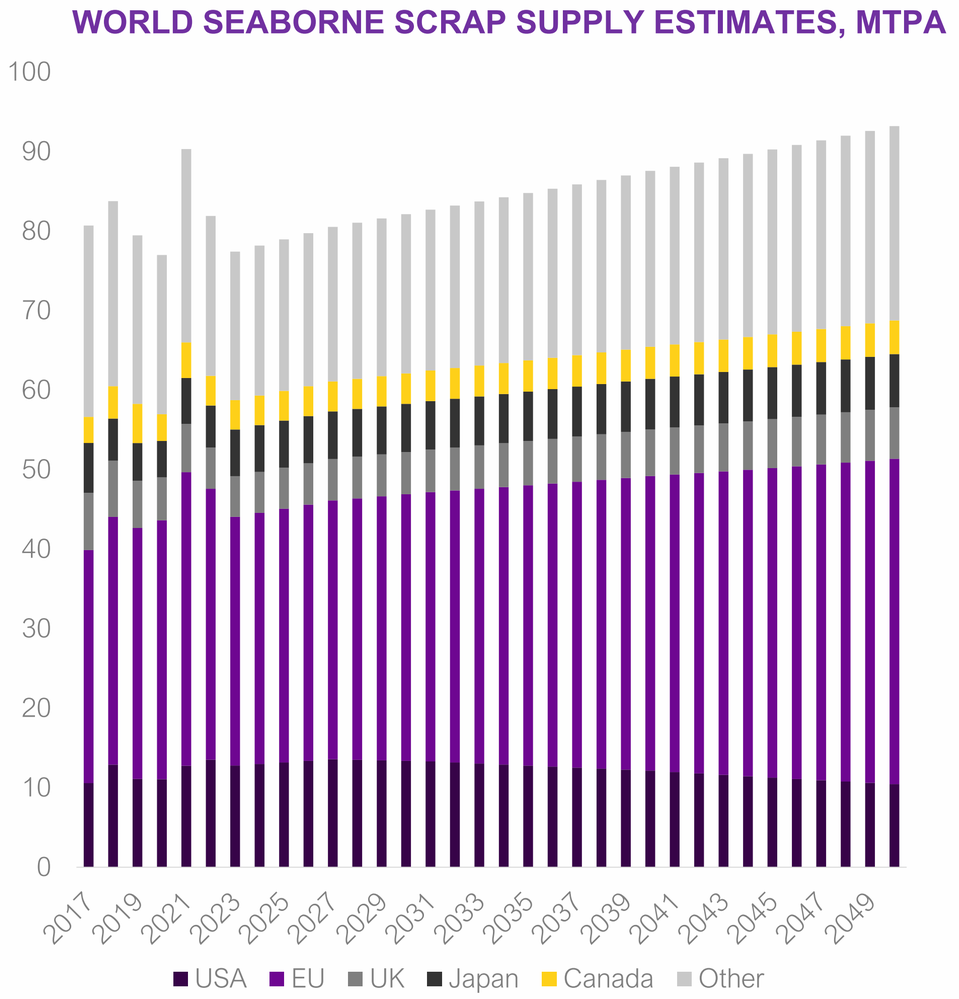


Globally, EAF based steel production will gain significance supported by growing scrap reserves in China and emphasis on green steel programmes in Europe

- The share of EAF in the overall crude steel production is forecast to grow relative to BOF over the period 2022-46.
- The growing scrap reserves in China, driven by several years of industrialisation, is supporting greater scrap use in BF-BOF and installation of new EAFs. The environment regulations are driving the phase out of old and less efficient production facilities in favour of newer EAFs and thus driving the demand for scrap
- Other Asian countries such as India are also expanding their respective steel making capacities across BF-BOF and EAF processes in response to the domestic demand growth
- Other regions such as the Europe are forecast to add EAF capacity as part of the H2DRI-EAF production format driven by green steel programmes adopted across the region



The global seaborne demand for scrap is forecast likely to be mainly met by EU and USA supported by others such as UK and Canada where there is very limited domestic opportunity



- USA and EU will continue to be the main exportersof scrap into the global seaborne market
- UK with limited domestic demand will continue to be a major exporter of scrap
- Japan although a significant net exporter, may restrain some of its exports due to growing domestic demand. One of the decarbonisation goals being enhancing the use of scrap in steel making
- Additionally, there are seaborne scrap suppliers from Canada who would continue to export especially with limited domestic consumption opportunities
- Although China is expected to build a large scrap pool in the future, the scrap thus generated is likely to be consumed within the country leaving very little for exports

Source: Trade data, Fastmarkets

NEW SLIDE

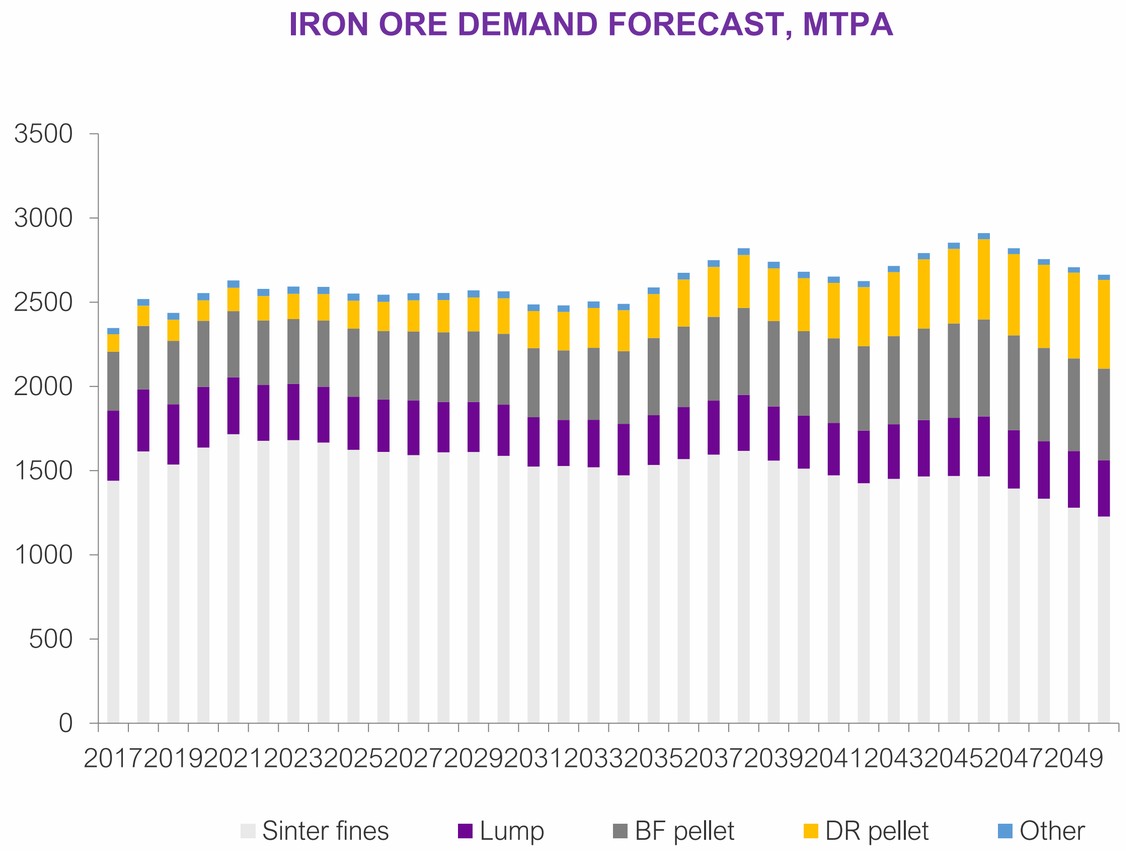
The process route – BF-BOF/ EAF (incl. DRI) determines the demand for pig iron and DRI. China leads the world demand for pig iron and Middle East leads in DRI

REGIONAL OUTLOOK SUMMARY

Country/ region	BF-BOF Production (2022), ktpa	EAF Production (2022), ktpa	Commentary
Africa	3	19	▪ The region as a whole is a net exporter of iron ore ▪ The region offers some of the best iron ore resources with high Fe content. However, there are several challenges associated with infrastructure particularly port and rail
Asia	1108	276	▪ China is the dominant producer in the region and is a significant importer of Iron ore feedstock due to inadequate supply of high quality from domestic sources. China also has abundant domestic coking coal to support BF-BOF production process ▪ Other significant producers in the region include India, Japan and S. Korea ▪ India is a major producer of both DRI and pig iron. However, DRI is mainly coal based ▪ India and SE Asian countries are amongst the fastest growing countries in the region in terms of steel demand and production
Middle East	200	167	▪ With the exception of Iran, the region is entirely dependent on imported iron ore for the production of DRI ▪ Limited domestic availability and hence dependent on imported iron ore
CIS	57	29	▪ The region is self-sufficient in iron ore and coking coal ▪ In addition, Russia has abundant natural gas availability to support production and export of DRI ▪ The region as a whole is a net exporter of iron ore and coking coal ▪ The on-going Russia-Ukraine war risks continued and reliable supply of seaborne pig iron and DRI
Europe	93	89	▪ The region has a limited iron ore production capability led by Sweden. Sweden's LKAB is one of the largest producers of pellet in the world and a major exporter pf DR pellet to the Middle East and particularly GCC countries
South America	34	29	▪ The region is not only self-sufficient for iron ore but also a major exporter of iron ore products led by Brazil
North America	30	63	▪ The region is largely self-sufficient and a small net exporter of iron ore, mainly from Canada ▪ North America is also amongst the largest BF pellet producers in the world and the output is mainly consumed within the region
Oceania	5	1	▪ The region, led by Australia, is export oriented and is the world's largest exporter of iron ore ▪ Australia is also a significant exporter of coking coal
Grand Total	1331	557	

The share of pellet in global iron ore consumption is forecast to increase while sinter is expected to decline in the long term since pellet has superior environmental credentials

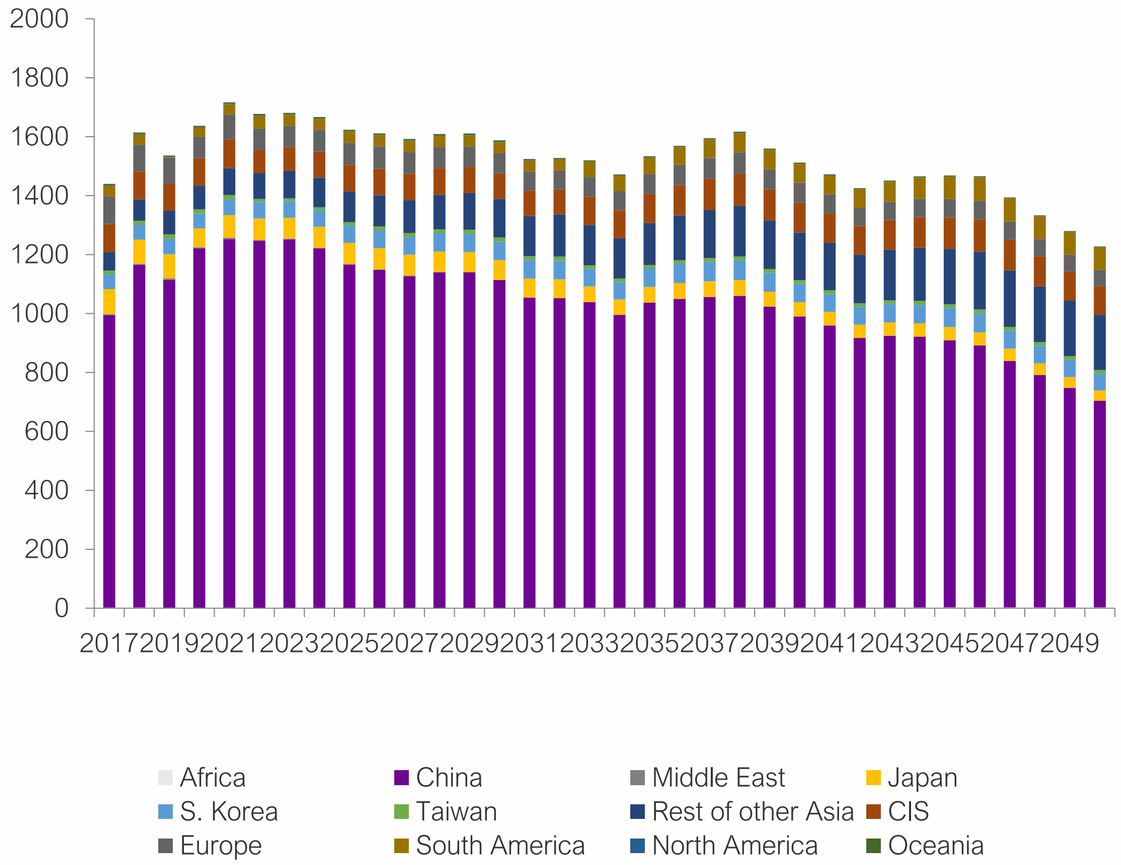
- The share of pellet in the overall iron ore product is anticipated to grow due to its superior environmental credentials and large consumers of iron ore led by China are increasing the use of pellet in blast furnace
- China predominantly uses sinter as the main iron ore input into the blast furnace and accounts for about 70% of the total iron ore input into the furnace. The share of pellet is about 13%. It is anticipated that the share of pellet in the burden is likely to increase in the future
- The share of pellet in Europe has been traditionally on the higher side driven by stricter environment regulations particularly on sinter pollution norms.
- Blast furnace burdens vary across countries and across furnaces within the country itself based on the established practices and availability of input materials
- Pellet accounts for 20-40% in the EU, similar levels in Japan and 10-20% in China. The share of pellet in blast furnace is anticipated to further strengthen in China to comply with stricter environmental regulations in the country



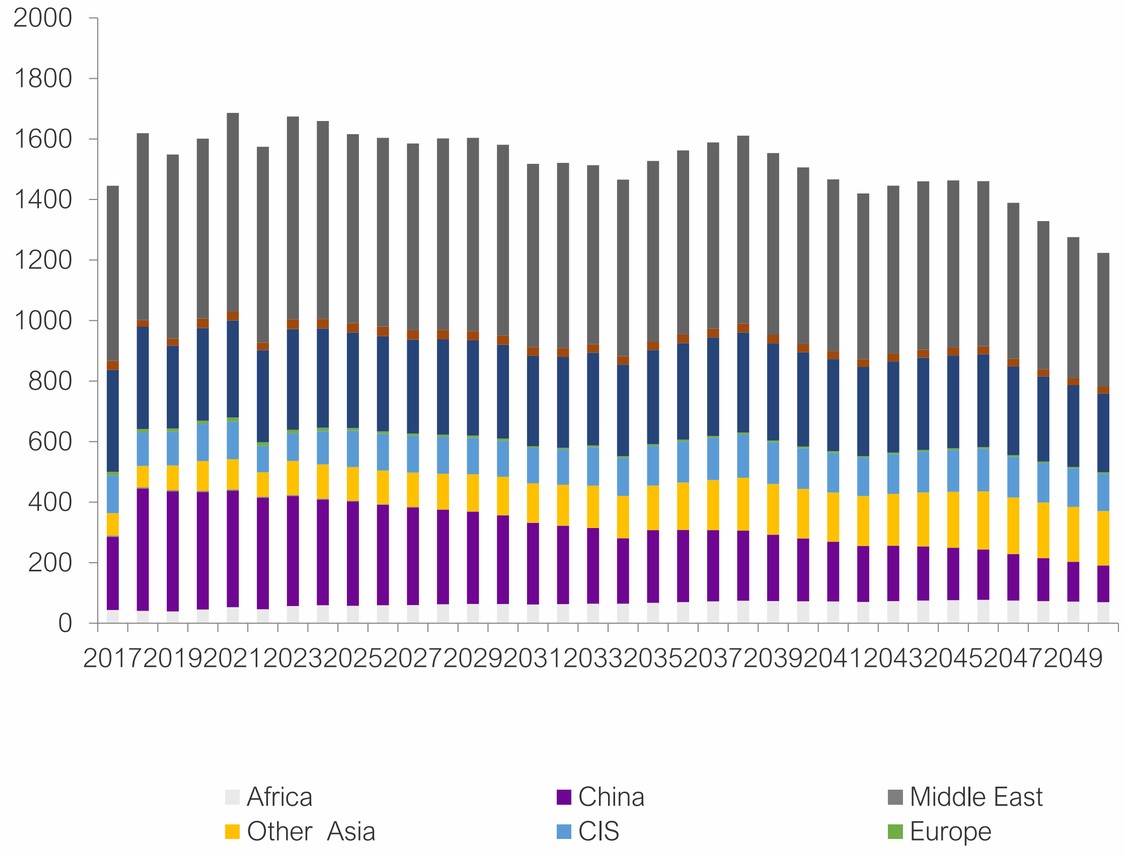
NEW SLIDE

Asia continues to be the dominant consumer of sinter fines in the future. Although China's share declines slightly, only to be replaced by other Asia, led by India

SINTER FINES DEMAND FORECAST, MTPA



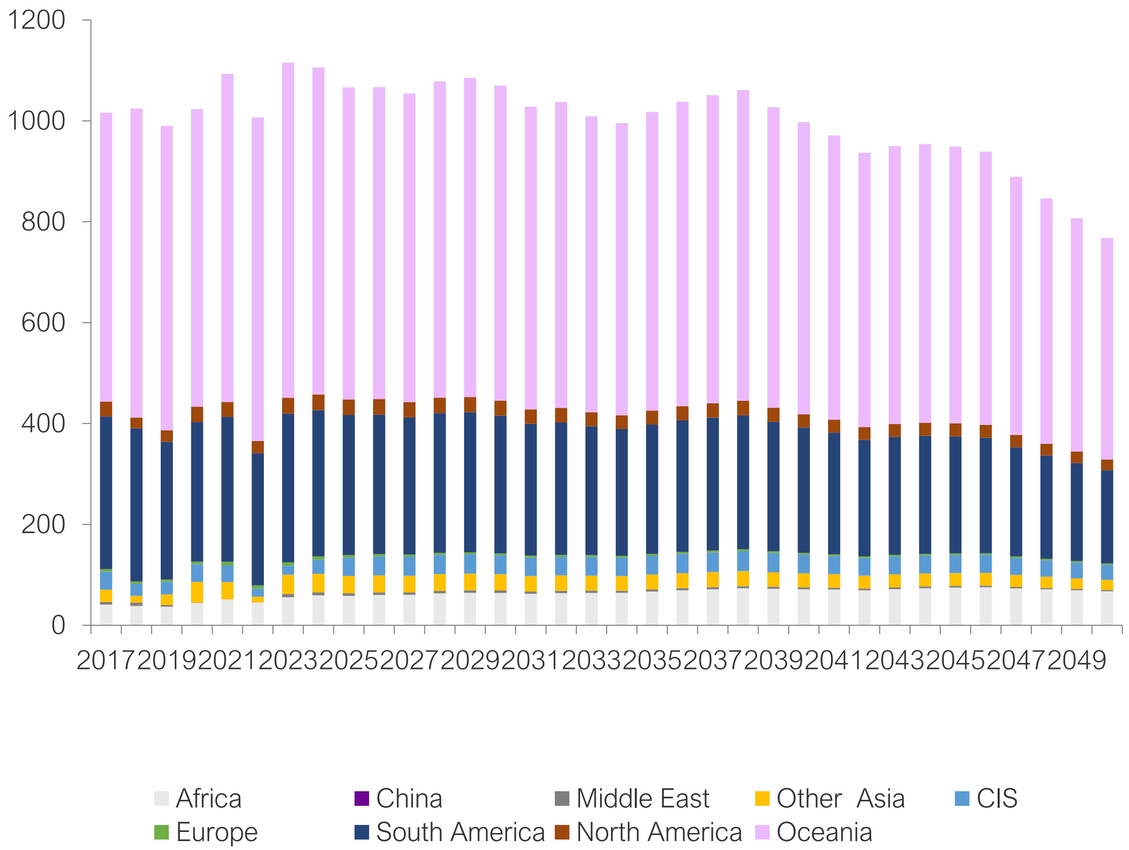
SINTER FINES PRODUCTION FORECAST, MTPA



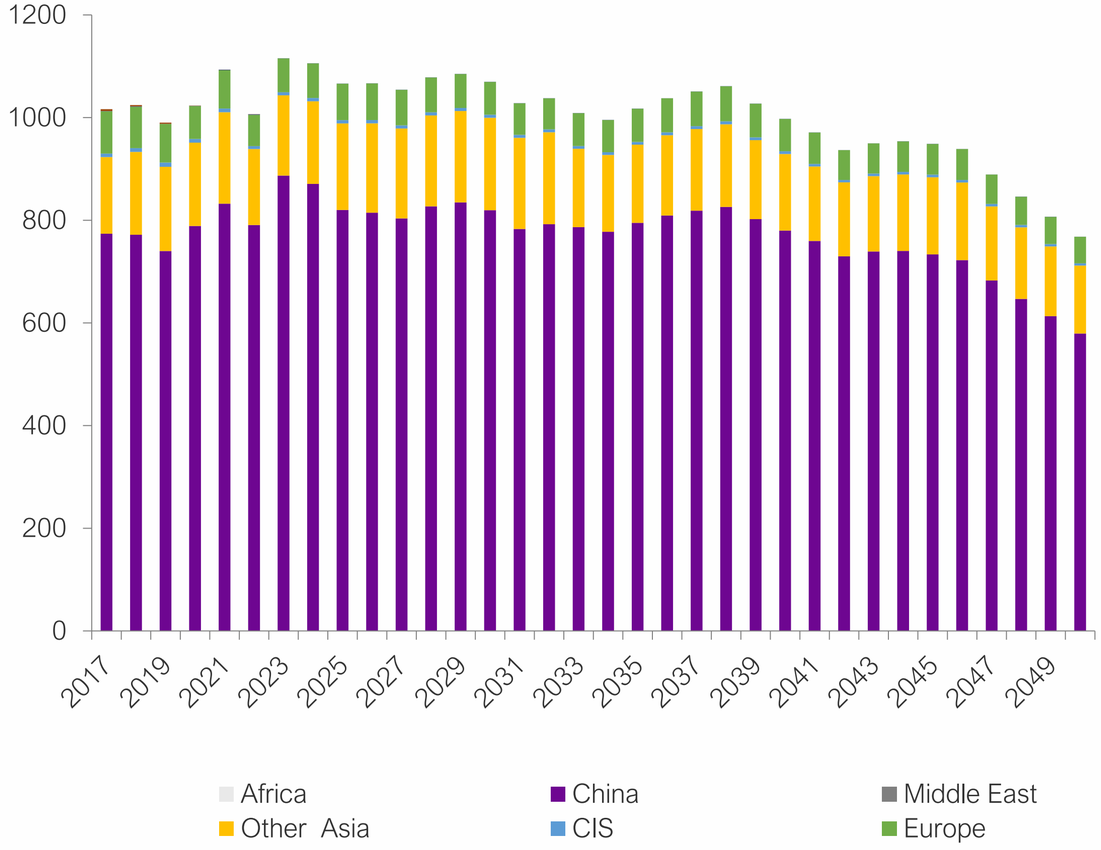
Note: There is no production of sinter fines in Japan, S. Korea and Taiwan

However, China is forecast to remain the dominant importer of sinter fines while Oceania (Australia) is the main exporter

SINTER FINES EXPORTERS, MTPA



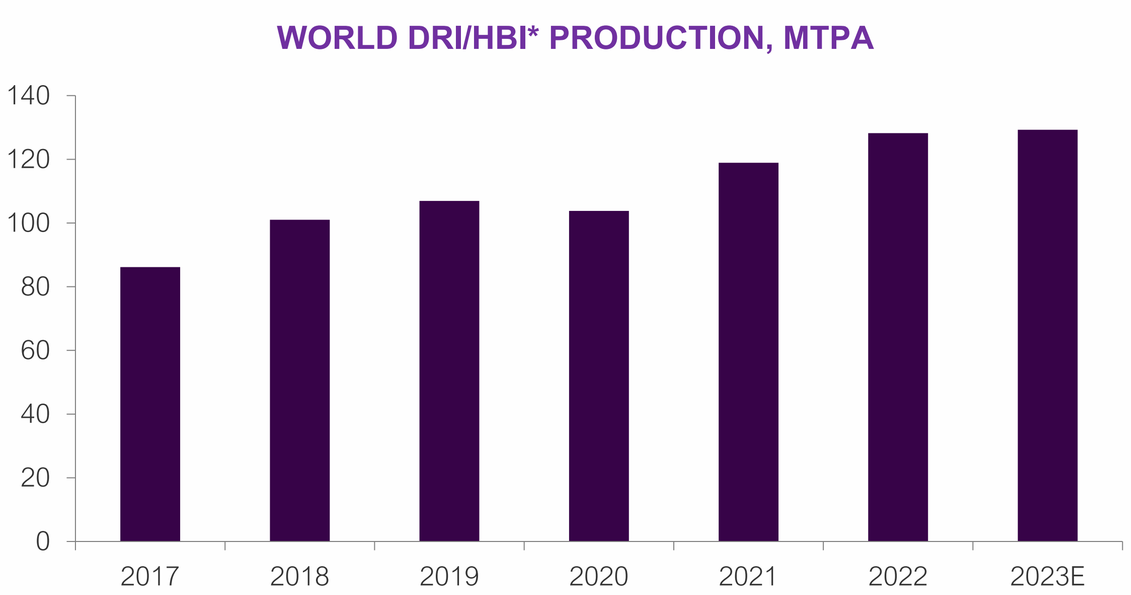
SINTER FINES IMPORTERS, MTPA



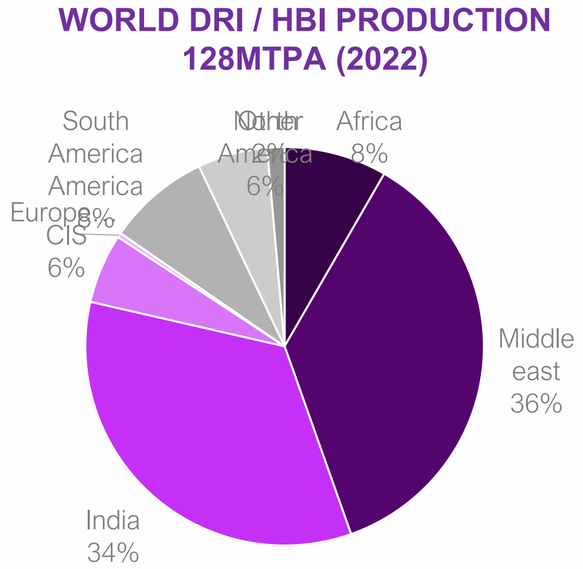
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- Conclusions

The global DRI/ HBI production was estimated to be 128Mtpa in 2022 with Middle east and India accounting for 72% of the world's production



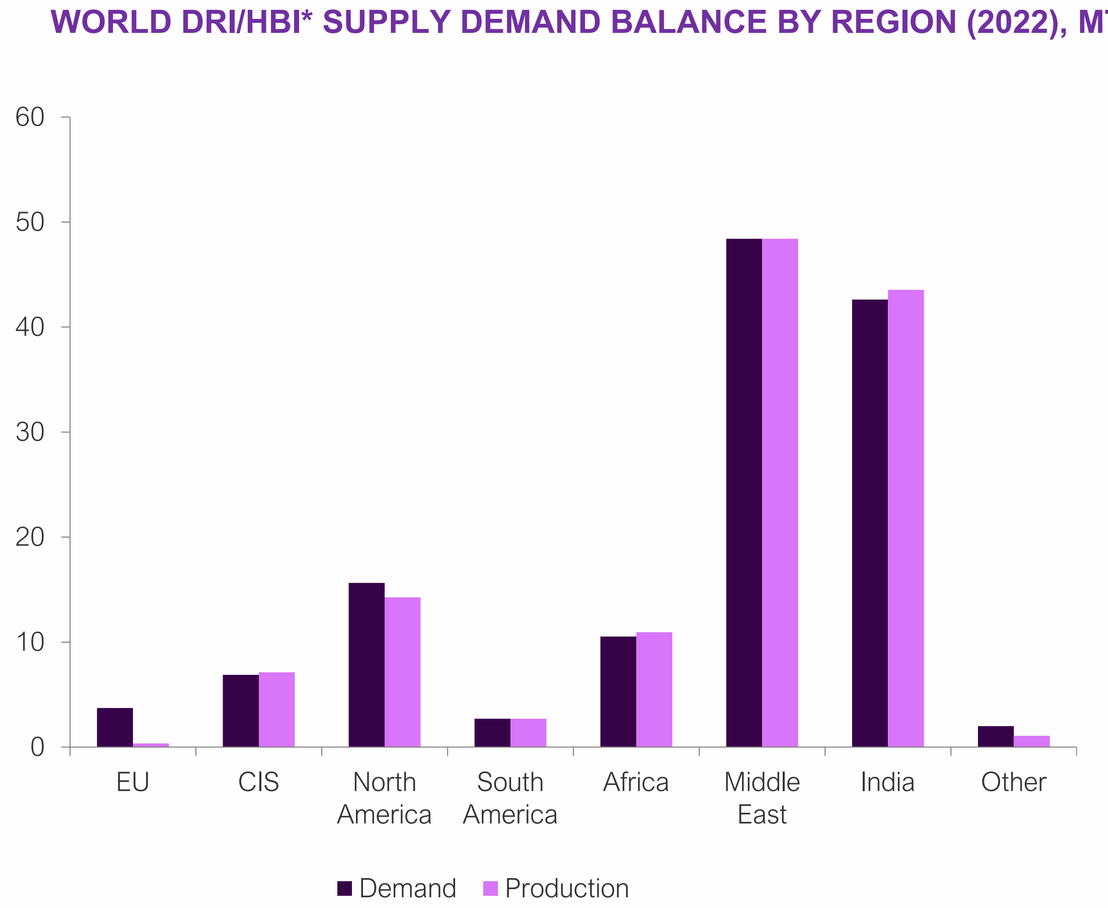
* The report treats all the DRI products as one entity and does not distinguish between DRI or HBI or other similar such products.



- The global DRI/ HBI production was 128mtpa in 2022 and has been growing at 8% CAGR between 2017 and 2022. The growth was mainly driven by Middle east and India, collectively accounting for 72% of the world's DRI production in 2022
- Middle East accounted for a share of 38%. The entire production is natural gas based due to the abundance of this resource within the region. Iran is the dominant producer in the Middle east region and accounts for more than 50% within the region, followed by Saudi Arabia and UAE

Source: Fastmarkets

DRI is largely consumed in the region where it is produced. Trade accounts for ~6% of the global DRI production

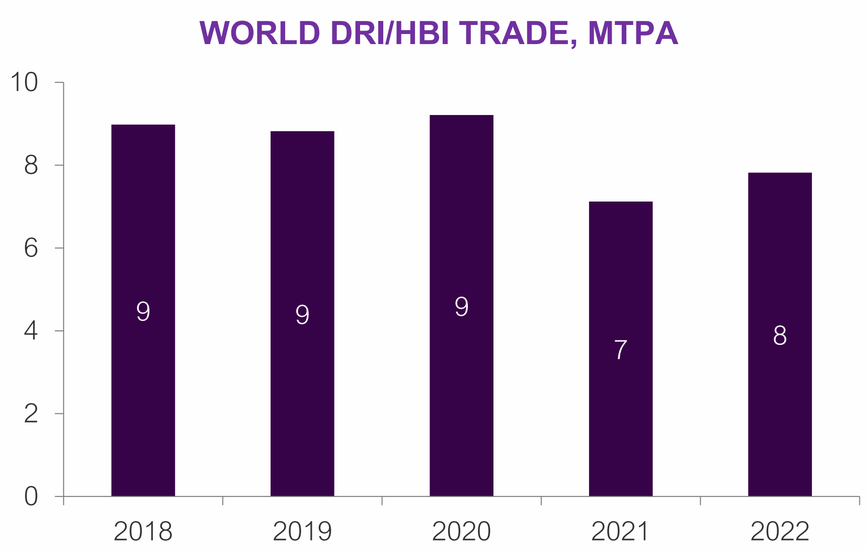


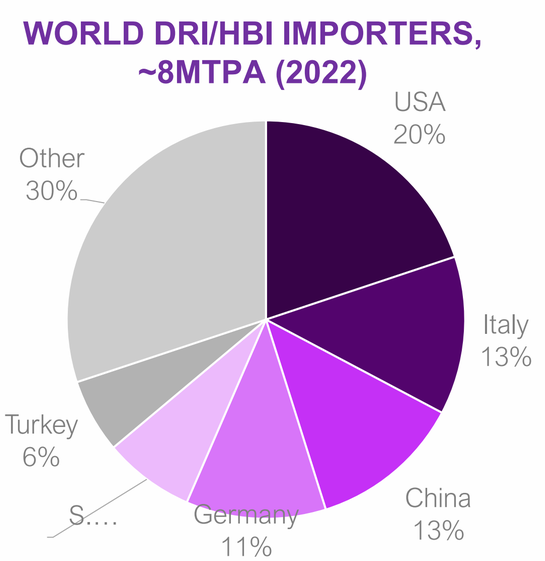
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- Middle East accounted for a share of 38%. The entire production is natural gas based due to the abundance of this resource within the region. Iran is the dominant producer in the Middle east region and accounts for more than 50% within the region, followed by Saudi Arabia and UAE
- The demand for DRI is largely met locally with very little cross border or seaborne trade in the product.
- North America and EU are the key importers of DRI and Russia is the main exporter of the product

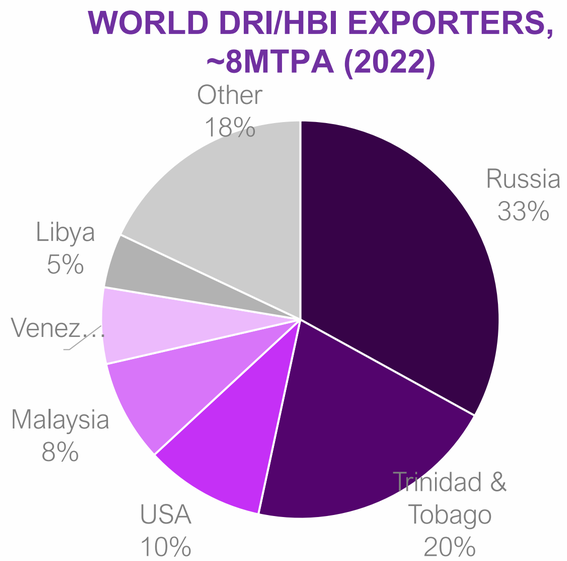
Source: Fastmarkets

NEW SLIDE

The global DRI/ HBI trade was estimated to be ~8mtpa with Russia being the lead exporter and USA being the lead importer







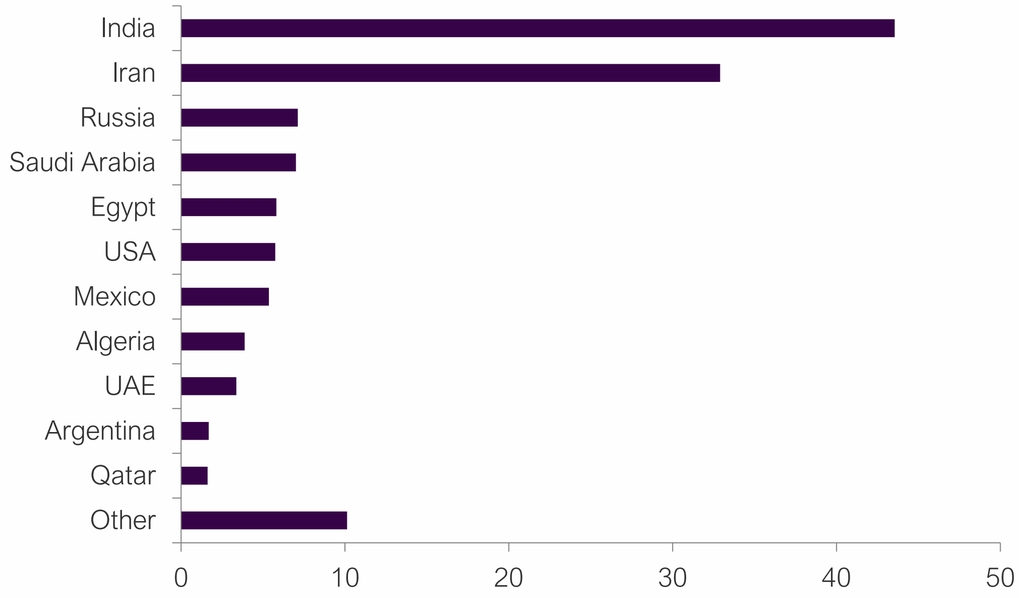
- Majority of the DRI/ HBI production is integrated with downstream steel works, thus limiting the scale of seaborne trade in the product. Global DRI/HBI trade was estimated to be in the range of 7-9mtpa over the period 2018-22
- Russia has been a leading exporter of HBI accounting for a share of 34% in the global DRI exports. Russia's Metalloinvest is the world's leading exporter of HBI and historically exported to Europe and USA among other destinations
- Trinidad accounts for 20% of the world's DRI/HBI exports. The trade is predominantly attributed to Nucor's interplant transfers, which owns the DRI production facility in Trinidad
- Other merchant DRI exporters being India and USA. The exports from India are largely regional, mainly exporting to Nepal and Bangladesh. The USA may be attributed to voestalpine which exports HBI from its DRI facility in Texas, USA to its own works in Austria. However, there may be some excess capacity available to enable supply to other steel mills

Source: Trade data, Fastmarkets

India is the world’s largest producer of DRI followed by Iran. Both have access to domestically sourced iron ore and reductants

- India is the world’s largest DRI producing country accounting for a share of 34% of the world’s production. Key contributing factors being the availability of iron ore and thermal coal within the country
- Although India hosts both gas based and coal-based production routes, the coal-based ones have a much higher share. While coal is abundantly available in the country, natural gas less so. The country is a significant importer of natural gas from the Middle east and other regions
- Middle east accounts for 38% of the world’s DRI production. Within the region, Iran is the largest producer of DRI. Iran benefits from locally available iron ore and natural gas. Other significant DRI producers in the Middle east include Saudi Arabia and UAE, which benefit from locally available natural gas but rely on imported iron ore
- Other DRI producers include Russia, USA, Venezuela which again benefit from the availability of natural gas and iron ore within their respective countries

WORLD DRI / HBI PRODUCTION BY MAJOR COUNTRIES 128MTPA (2022)



Source: Fastmarkets

The demand for DRI will be driven by growth in the Middle east east and Asia and decarbonisation related demand drivers in the EU

REGIONAL OUTLOOK SUMMARY

Country/ region	Commentary
North America	▪ The share of EAF in overall crude steel production is forecast to strengthen during 2023-2033 driven by capacity expansion and new investments ▪ Leading BF-BOF producers such as US Steel migrating to EAF through Big River Steel acquisition ▪ The demand for scrap will strengthen and scrap exports could potentially come under pressure in the future ▪ With the on-going war in Ukraine, supply of pig iron and DRI from the CIS likely to come under strain and thus leading to a greater competition for metallics
Europe	▪ EAF accounts for 40% of the crude steel production and the share of EAF likely to grow in the future driven by green steel investments ▪ EAFs to gradually replace BF-BOFs in the region. A significant share of new EAFs likely to be installed with hydrogen based DRI to address the shortage of quality scrap in the region ▪ However, uncertainty around the development owing to the scale of investments and availability of green energy
Asia	▪ China dominates the region's steel production and is predominantly BOF based. EAF based production accounts for just 9% of the steel production in the country. With the growing scrap pool in the country, the share of scrap used in the BOF has also been increasing ▪ Majority of the crude steel production growth during 2022-2033 is forecast to originate from other Asia led by India followed by Vietnam, Indonesia and others ▪ BF-BOF continues to be the main production route in these countries. Leading producers such as India have access to own iron ore and a certain extend coal to support BF-BOF expansions ▪ Mature markets such as Japan and S. Korea forecast to remain BF-BOF based although they are working on developing green steel alternatives
Middle East	▪ The growth has relatively slowed down in recent years owing to decline in state spending ▪ The region is predominantly EAF based, accounting for 94% of the steel production ▪ However, the input raw material to the EAF is almost entirely DRI which is mostly co located with the steel works ▪ The availability of cheap gas also supports the region's preference for DRI based facilities
CIS	▪ The production route is mainly BOF based, accounting for 73% of the steel production ▪ Majority of the steel producers have own raw materials, iron ore and coking coal ▪ Adequate scrap availability and net exporter of scrap though not on any large scale ▪ Historically, the CIS region dominated the seaborne metallics trade, both pig iron and DRI. However, with the on-going war in the region, supply likely to come under enormous strain

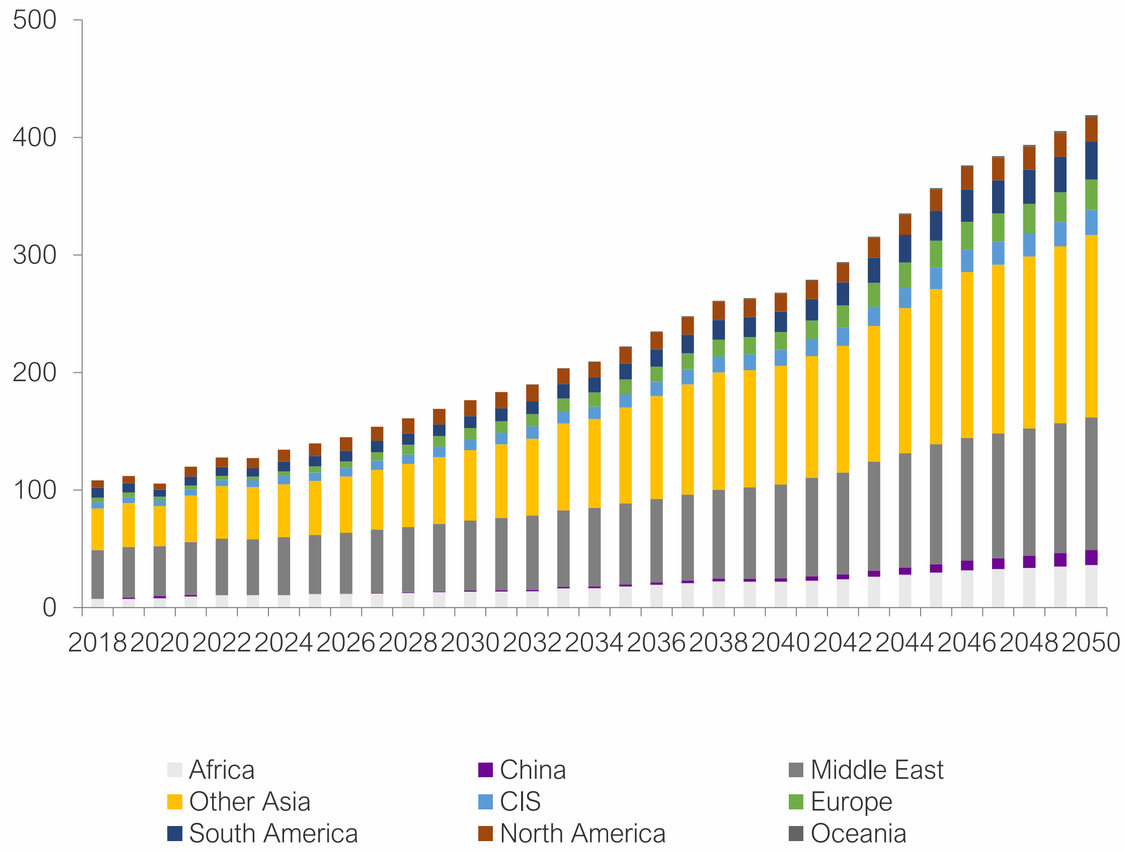
The global DRI/ HBI demand will continue to be led by Middle East and India. Other key players include the EU where EAF-HDRI is being pursued as a solution for decarbonisation

- The global DRI/ HBI production was 128mtpa in 2022 and Middle East accounted for a share of 38%. India is the world's largest DRI producer with a share of 34% of the world's production.
- India and Middle east will continue to be the key drivers of the overall DRI/HBI demand in the future. They continue to account for more than 65% of the world DRI demand
- However, with DRI being the key technology to enable decarbonisation, several asset transformations in the EU are based on phasing out some of the BF-BOF in favour of EAF-hydrogen DRI
- EU has been at the forefront of steel decarbonisation and several projects are being pursued by the leading steel companies in the region including ArcelorMittal, TKS, Salzgitter and others

DRI/HBI DEMAND, MTPA

Region	2022	2040	2050
Africa	11	22	36
China	0	3	13
Middle East	48	80	113
Other Asia	45	101	155
CIS	5	14	21
Europe	4	15	26
South America	7	17	32
North America	8	15	21
Oceania	0	1	2
Grand Total	128	268	419

WORLD DRI/HBI* DEMAND FORECAST, MTPA

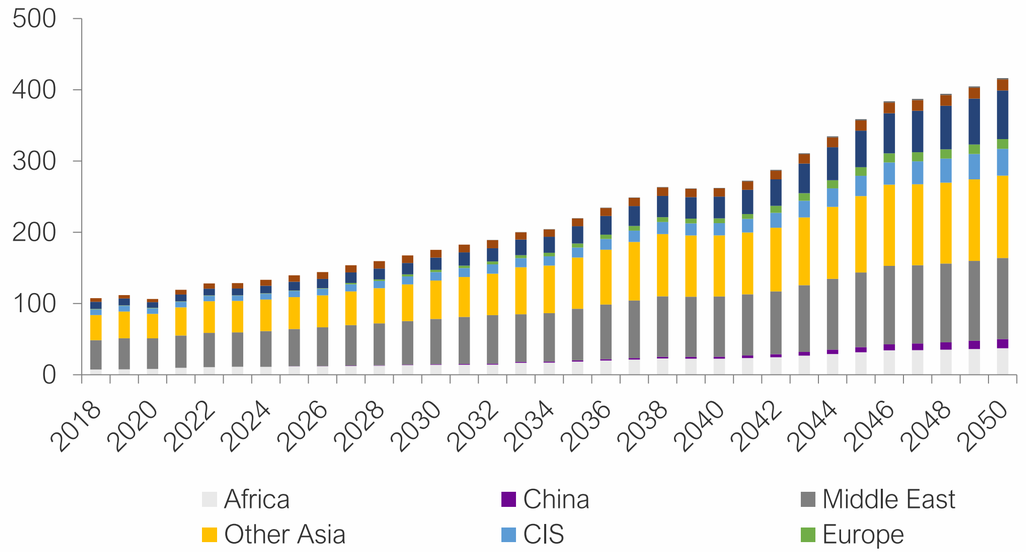


* The report treats all the DRI products as one entity and does not distinguish between DRI or HBI or other similar such products.

The global DRI/ HBI production is forecast to grow to ~262mtpa in 2040 with Middle East and other Asia (mainly India) being the key players in the DRI / HBI market

- The global DRI/ HBI production is forecast to grow to ~262mtpa in 2040 with Middle East and other Asia (mainly India) being the key players in the DRI / HBI market
- While India continues to be a dominant DRI producer in the future, other regions such as Europe and North America are forecast to see some increases in DRI production
- The DRI route in India will be predominantly coal based due to limited availability of natural gas. India's is a net importer of natural gas and the Ministry of Petroleum estimated import dependency in 2021-22 to be 48%
- The coal required for DRI is available within the country and thus limiting the need for imports.
- The DRI production in Europe is mainly driven by the region's decarbonisation efforts where hydrogen based DRI facilities are being set up in the future to meet the Net zero commitments by 2050

WORLD DRI/HBI* PRODUCTION FORECAST, MTPA



DRI/HBI SUPPLY, MTPA

Region	2022	2040	2050
Africa	11	23	37
China	0	3	13
Middle East	48	85	114
Other Asia	44	86	116
CIS	8	17	38
Europe	0	7	14
South America	10	31	68
North America	7	11	16
Oceania	0	1	2
Grand Total	128	262	417

Other Asia's leading producer, mtpa	2022	2040	2050
India	39	83	100

The demand from DRI/HBI in other Asia is forecast to exceed its domestic supply resulting in being a net importer

- Europe has been at the forefront of steel decarbonisation with DRI being a critical technological route to reach netzero by 2050. although new DRI/HBI capacity is envisaged, there may be some shortfall resulting from mismatched project timelines leading to the region being a net importer
- Other Asia is forecast to be lead the world's demand for DRI/HBI during the next 20 years. The key drivers being steel demand growth in India followed by China, Japan and other Asian countries
- India is the largest consumer and producer of DRI/HBI in the world and it continues to strengthen its position. Majority of the DRI is coal based and is likely to remain focused on domestic market with limited imports/ exports
- In the long term new supply is expected to originate from South America . The region led by Brazil has significant DR pellet feed resources, natural gas and renewable energy sources making it a reasonable option for supply of HBI

DRI/HBI SURPLUS/ DEFICIT (-), MTPA

Region	2022	2040	2050
Africa	0	1	1
China	0	0	0
Middle East	0	5	1
Other Asia	0	-15	-40
CIS	3	3	16
Europe	-3	-9	-12
South America	2	13	36
North America	-1	-4	-5
Oceania	0	0	0
Grand Total	0	-6	-2

Several DRI/ HBI production facilities are forecast to be installed over the next 10 years with varying degrees of likelihood. Middle East is expected to remain a key producer of DRI / HBI (… contd.)

WORLD DRI/HBI PROJECTS FORECAST (2023), KTPA

Region	Country	Company	Likelihood (1: least likely; 5: most likely)	Aggregate capacity, ktpa	Project schedule
EU	Belgium	ArcelorMittal	3	2500	2030
EU	France	Liberty Steel Group	2	2000	2025-28
EU	France	ArcelorMittal	4	2500	2025-27
EU	Germany	TKS	4	2500	2026-28
EU	Germany	Salzgitter	4	2000	2025-27
EU	Romania	Liberty Steel Group	2	2500	2027-29
EU	Spain	ArcelorMittal	4	2300	2025-27
EU	Sweden	H2Green Steel	5	5000	2025-26 (Ph.1; 2030 (Ph.2)
EU	Finland	Blastr	2	2000	2030+
EU	Finland	SSAB	1	2000	2030+
EU	Italy	DRI d'Italia	3	2300	2025-27
EU	Finland	GravitHy	2	2000	2030
EU	Spain	Primetals/Hydnum	2	2000	2027-29
CIS	Russia	OMK	2	2500	2026+
CIS	Russia	Severstal	2	1000	2028-30

Source: Company announcements, news items

… (contd.) Several DRI/ HBI production facilities are forecast to be installed over the next 10 years with varying degrees of likelihood. Middle East is expected to remain a key producer of DRI / HBI

WORLD DRI/HBI PROJECTS FORECAST (2023), MTPA

Region	Country	Company	Likelihood (1: least likely; 5: most likely)	Aggregate capacity, ktpa	Project schedule
Middle east	Iran	Makran	n/a	1600	2025-30
Middle east	Iran	Qaenat	n/a	800	2025-30
Middle east	Iran	Saqqez	n/a	1000	2025-30
Middle east	Iran	Sirjan Jahan Co. 2	n/a	900	2025-30
Middle east	Iran	Torbat	n/a	1850	2025-30
Middle east	Saudi Arabia	Essar	2	5000	2030+
Middle east	Saudi Arabia	Saudi Aramco/PIF/Baosteel	3	2500	2028-30
Middle east	Saudi Arabia	Delong/TEDA	1	10000	2030+
Middle east	Oman	Vulcan Green steel	4	5000	2028-30
Middle east	Oman	Kobe-Mitsui, Duqm	1	5000	2028-30
Middle east	UAE	Power Works	2	5000	2025-30
Africa	Algeria	Algerian Qatari Steel	5	2500	2025-27
Africa	Libya	LISCO	2	2000	2030+
China	China	Baosteel Zhangjiang	3	1000	2026-28
China	China	Mingtuo	2	1100	2028-30
Other Asia	Thailand	Meranti	2	2000	2030+
North America	Canada	ArcelorMittal	3	2500	2027-29
South America	Bolivia	Mutun Steel	2	250	2025-27
Oceania	Australia	Liberty Steel Group	2	1500	2025-28
		Global DRI capacity additions		**86600**	

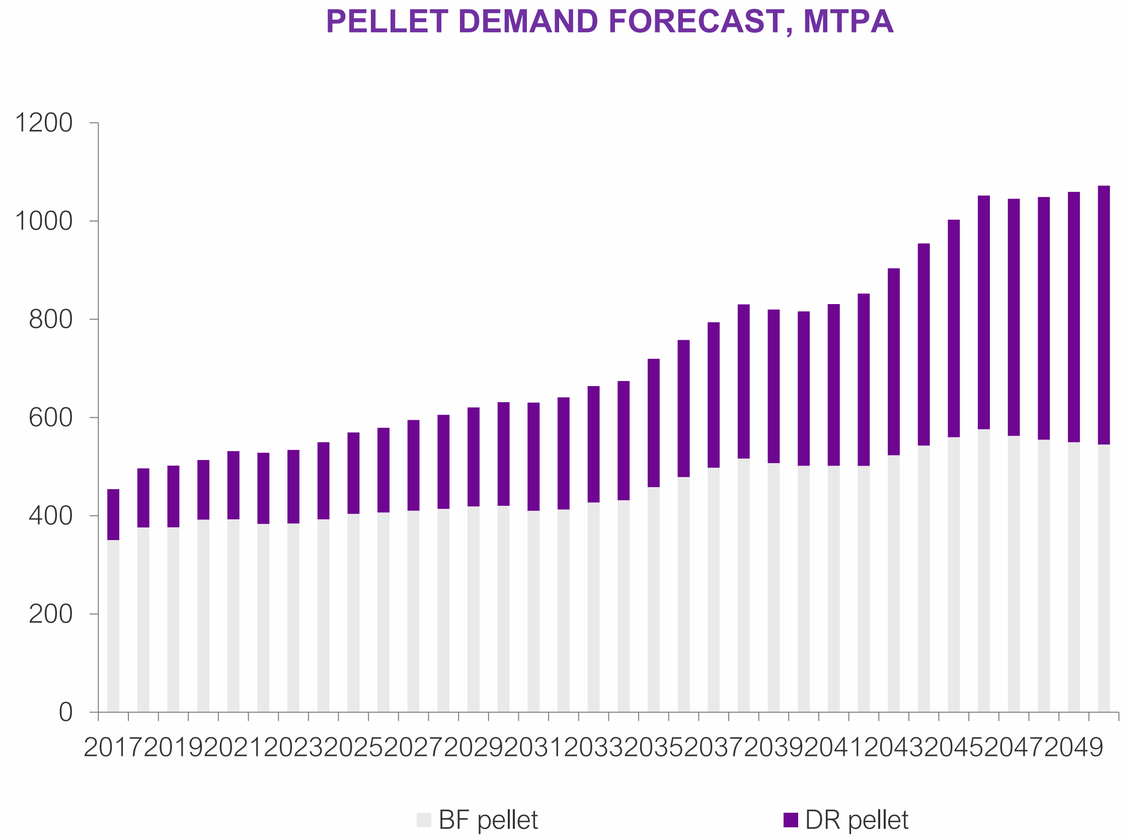
In addition, there are other announcements such as Emirates Steel Arkan that plans to install a DRI plant in the UAE. The details on DRI capacity etc. is yet to be firmed up although they have plans to set up pellet plant, separately mentioned in new pellet capacity table later in the presentation.

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- SIMEC Market positioning
- Conclusions

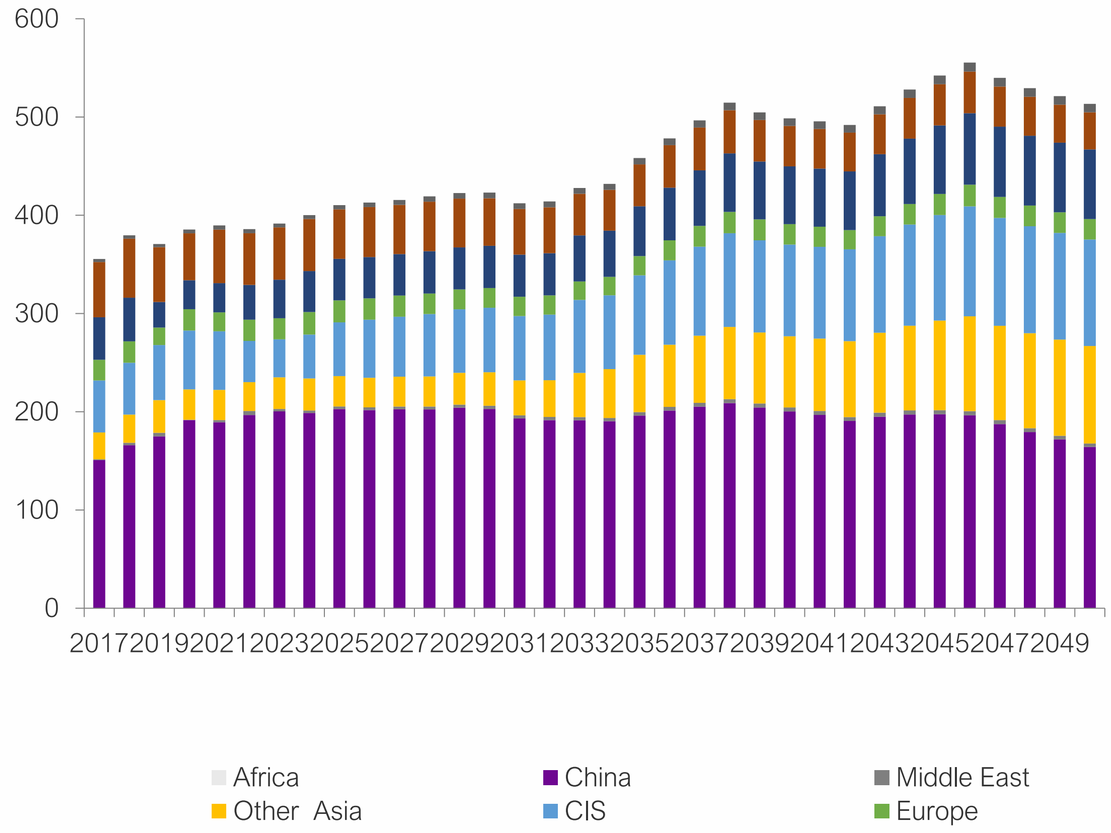
The global demand for pellet estimated at ~530mtpa is mainly driven by BF pellet. However, in the future the share of BF is forecast to decline driven by growth in Middle east and India and decarbonisation efforts in Europe

- The global demand for pellet was estimated to be ~530mtpa in 2023 and has grown by 18% since 2017 driven by strong demand from China
- China has been migrating from sinter to pellet in its blast furnaces to comply with the increasingly strict environmental regulations. As a result, the share of pellet in the BF burden has been growing steadily over the last few years
- Historically, BF pellet accounted for 75-80% of eth total pellet demand due to relatively smaller foot print of DRI production in the overall iron production
- However, the share of DR pellet in the overall pellet consumption is forecast to grow strongly in the long term driven by the growth in DRI production in the Middle east, India and Europe
- The European demand is predominantly led by steel decarbonisation initiatives resulting in migration from BF-BOF to to EAF-hydrogen DRI process and thus adding to the demand for DR pellet

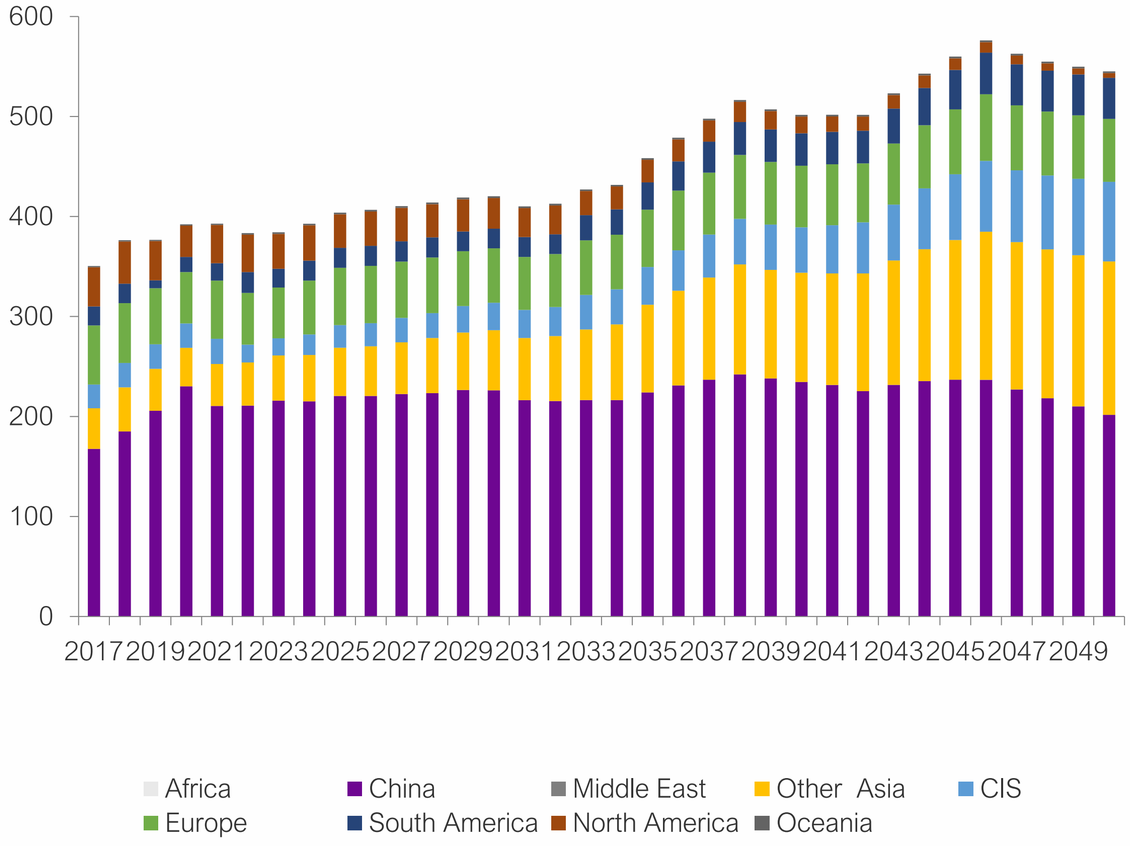


China leads the production and demand for blast furnace grade pellet

BF PELLET PRODUCTION FORECAST, MTPA

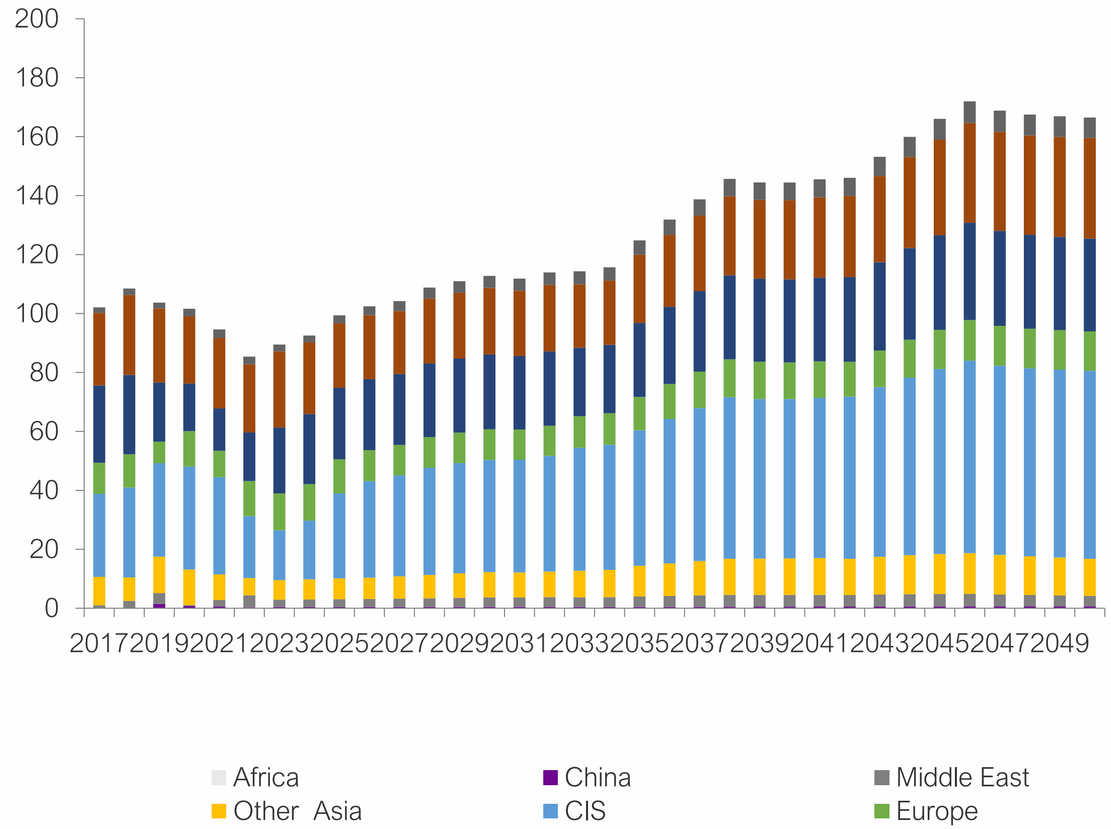


BF PELLET DEMAND FORECAST, MTPA

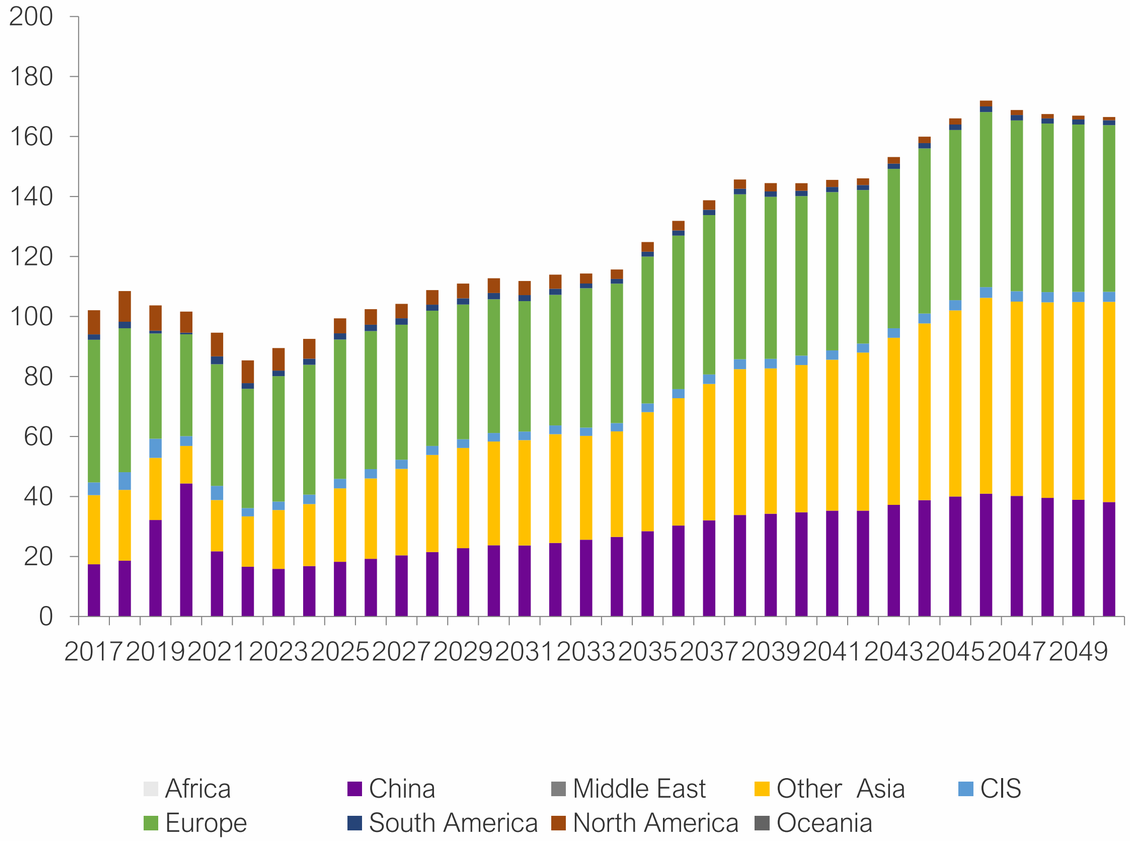


Seaborne BF pellet is forecast to be 120-150mtpa over the long term. Europe and other Asia are forecast to be amongst the lead importers of BF pellet

BF PELLET EXPORTERS, MTPA

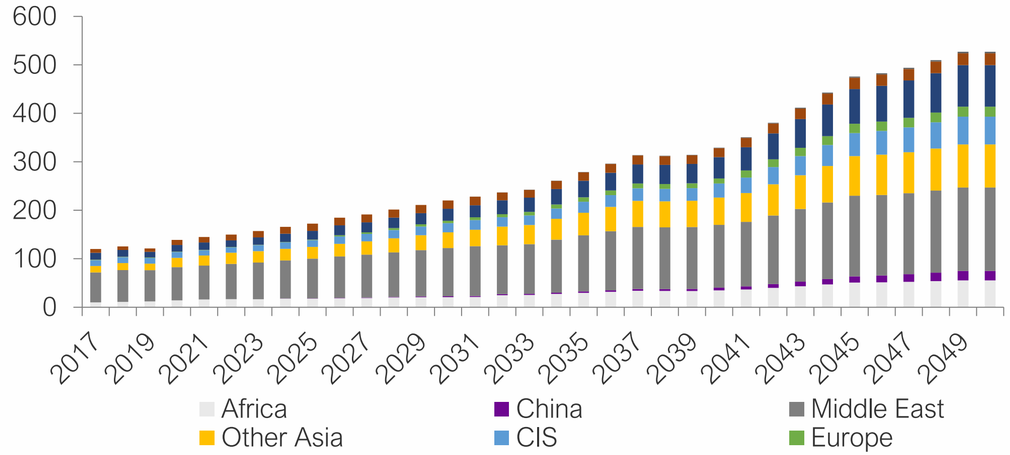


BF PELLET IMPORTERS, MTPA

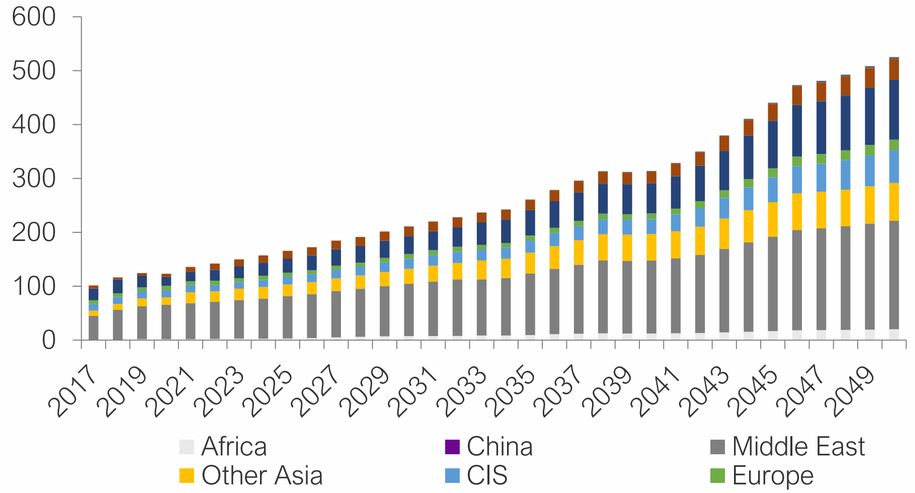


The demand for DR pellet is forecast to grow to 314mtpa in 2040 driven by growth in Middle east and South America

DR PELLET DEMAND FORECAST, MTPA



DR PELLET SUPPLY FORECAST, MTPA



DR PELLET DEMAND, MTPA

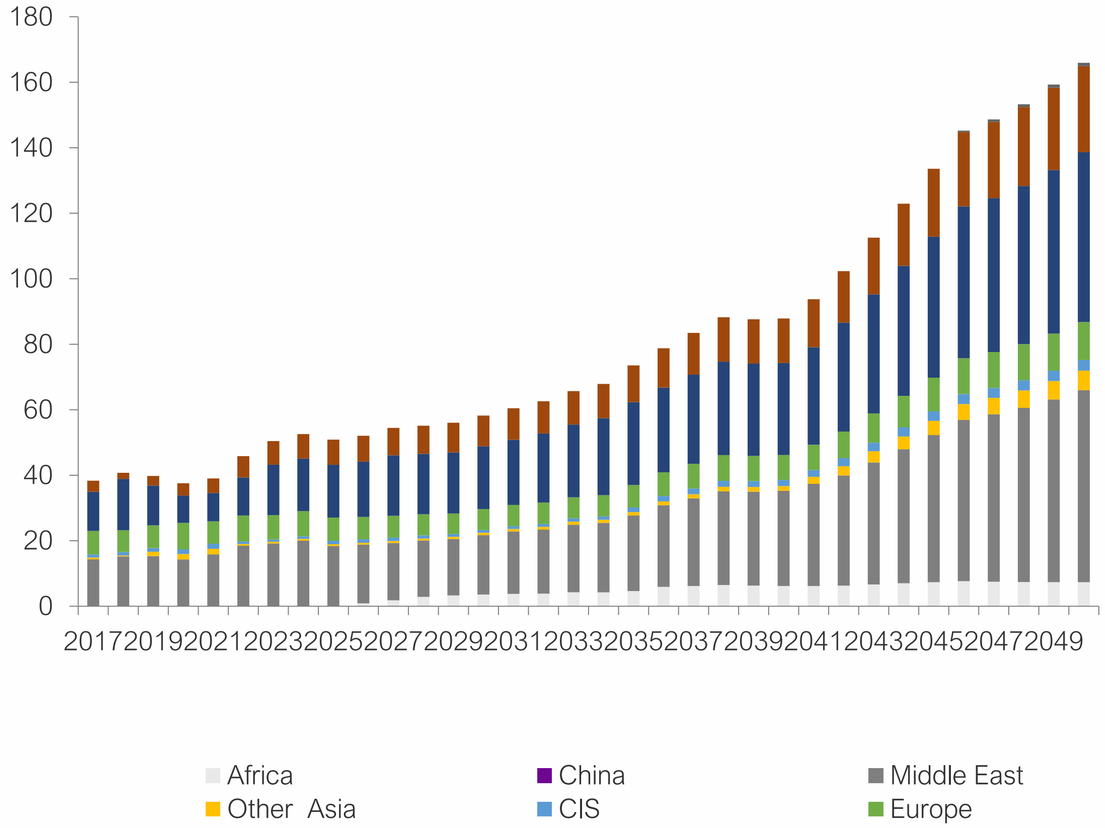
Region	2022	2040	2050
Africa	16	33	55
China	0	4	20
Middle East	70	128	172
Other Asia	21	54	89
CIS	11	26	57
Europe	1	10	21
South America	15	40	86
North America	11	18	24
Oceania	0	1	3
Grand Total	145	314	527

DR PELLET SUPPLY, MTPA

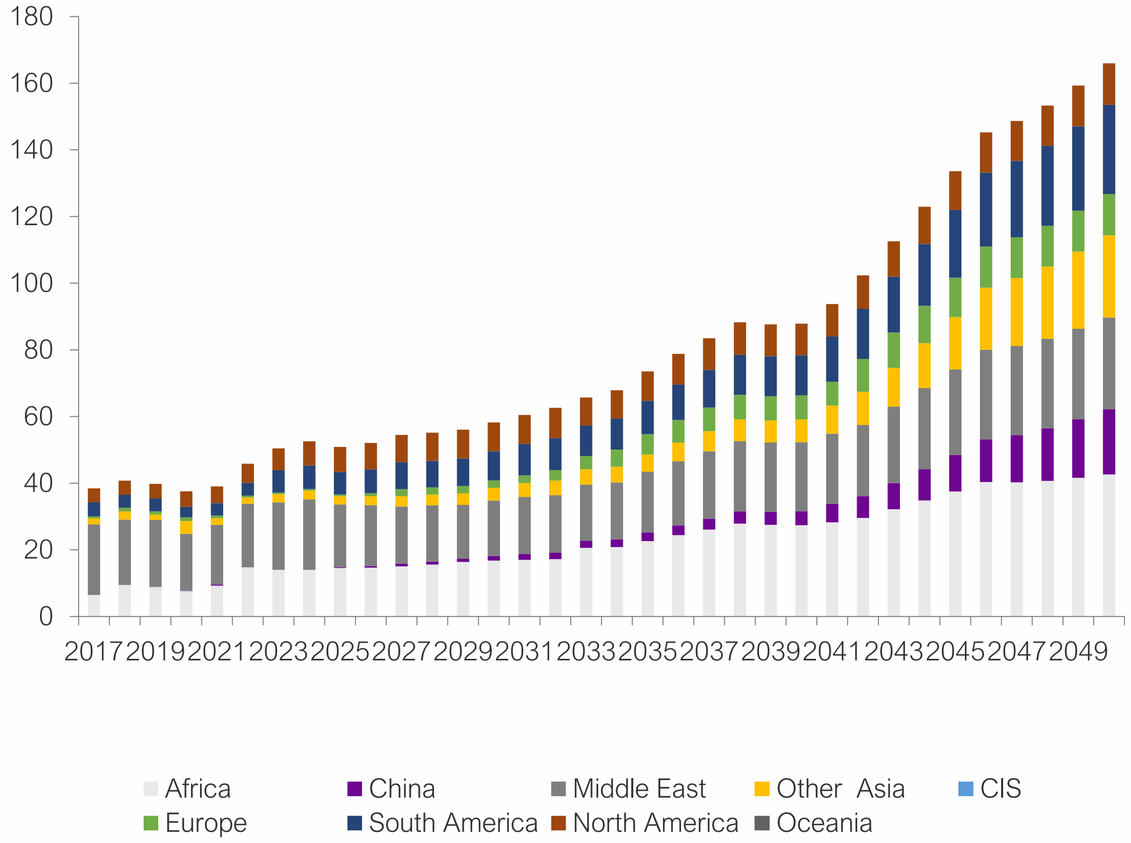
Region	2022	2040	2050
Africa	2	12	20
China	0	0	0
Middle East	69	136	201
Other Asia	19	49	70
CIS	12	28	61
Europe	8	10	20
South America	20	56	111
North America	12	22	38
Oceania	0	1	4
Grand Total	142	314	525

Majority of the DR grade pellet is forecast to be exported from Africa and South America

DR PELLET EXPORTERS, MTPA



DR PELLET IMPORTERS, MTPA



Middle east and South America are forecast to be key exporters of DR pellet driven by the growth in new pelletisation capacity in the region

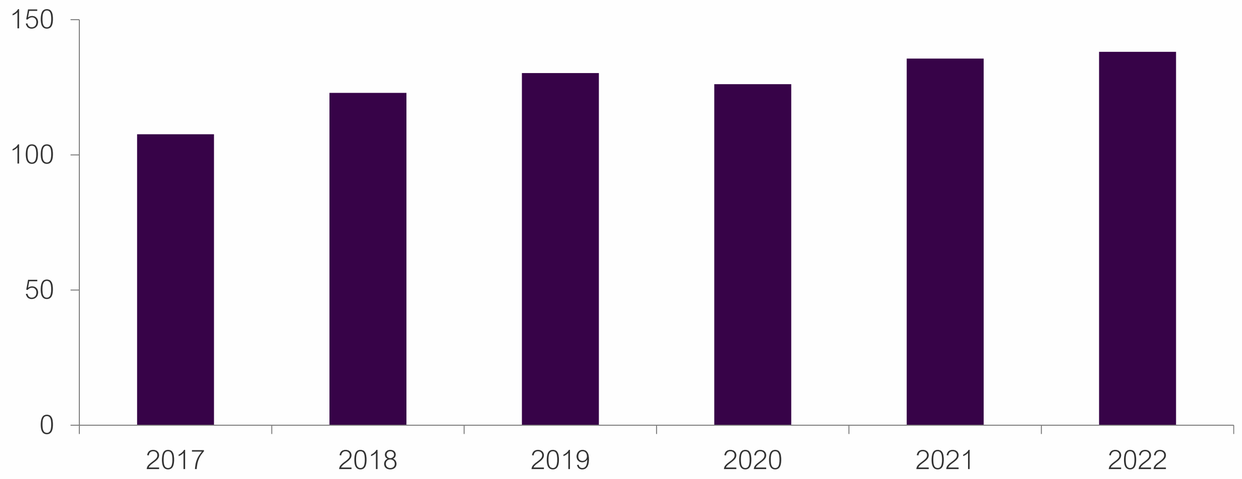
- Middle east and South America will be the key producers of DR pellet. Both the regions are likely to be major exporters of DR pellet
- Brazil led by Vale will be the key supplier of DR pellet from its own assets in Brazil and transplants in Oman
- Bahrain and Oman are already significant exporters of DR pellet. They are further expected to strengthen and grow their capacity to supply to the GCC region and outside of the region
- Iran is self-sufficient in DR pellet and the production is largely meant for internal consumption. The exports are marginal.
- Other significant producer and exporter of DR pellet being Canada. With the growth in new pelletisation capacity and availability of DR pellet feed in the country, it is well positioned to be a net exporter of DR pellet
- European DR pellet exports, attributed to Sweden's LKAB, are likely to decline with growing domestic demand within the region in the future.
- The biggest shortfall of DR pellet is observed in Africa. Major importers of DR pellet will be Algeria and Egypt

DR PELLET SUPPLY DEMAND BALANCE, MTPA

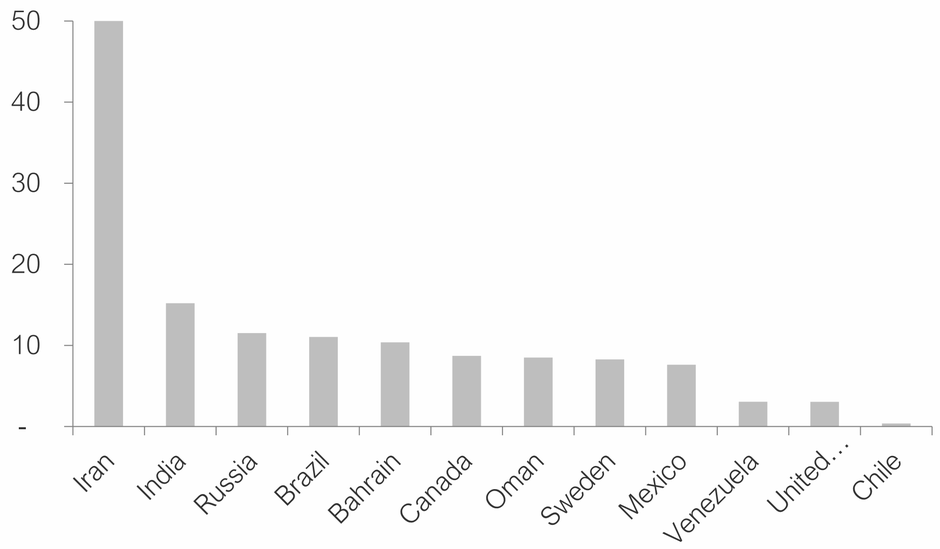
Region	2022	2040	2050
Africa	-14	-21	-35
China	0	-4	-20
Middle East	-1	8	29
Other Asia	-2	-5	-19
CIS	1	2	3
Europe	7	0	-1
South America	5	16	25
North America	0	4	14
Oceania	0	0	1
Grand Total	-3	0	-2

The DR pellet production outlook is forecast to become even more captive with some of the steel mills developing own pelletising facility leading to reduced trade volumes

EVOLUTION OF DR PELLET PRODUCTION, MTPA



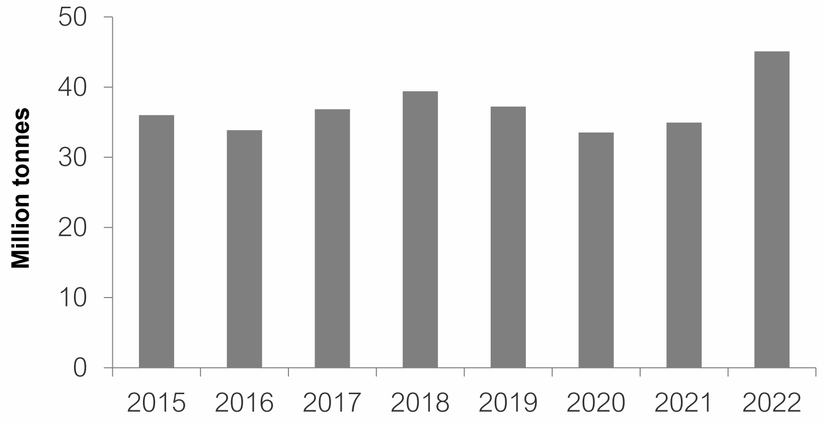
DR PELLET PRODUCTION IN 2022, MTPA



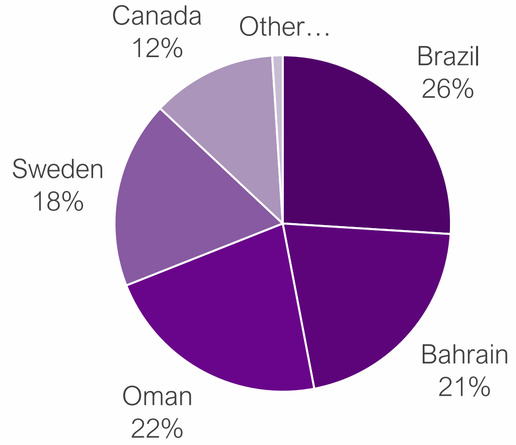
- The global DR pellet production was ~135mtpa in 2022 with Iran accounting for 37% followed by India and others. However, with the growing demand for DR pellet in the future, new capacity expansions are envisaged in the future
- Iran accounts for 37% of the global DR pellet production. Brazil and Sweden are the main seaborne DR pellet suppliers and are likely to remain so for the foreseeable future. Other countries such as Iran, India, USA, Algeria and Mexico remain focused on the domestic market
- It is anticipated that with the development green steel projects, the competition for DR pellets may intensify. Some of the leading DR pellet exporters such as Hadeed in Saudi Arabia are planning to install a pellet plant through a partnership with Vale. Similarly Algerian Qatari Steel and Tosyali are either installing new pelletising facilities or going in for expansions

The global trade in DR pellet was estimated to be 45mtpa with Saudi Arabia being the largest importer and Brazil being the key exporter

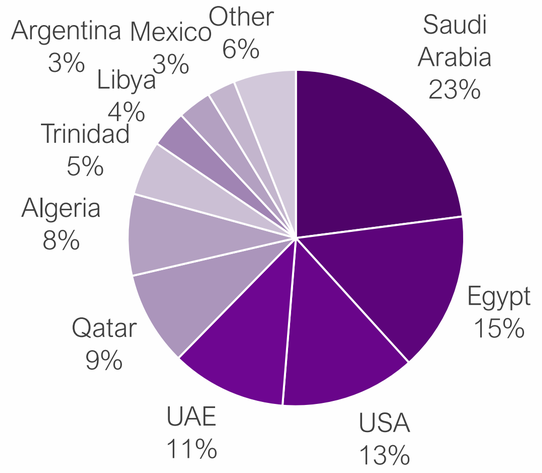
WORLD DR PELLET EXPORT



DR PELLET EXPORTERS (2022)



DR PELLET IMPORTERS (2022)



- The global DR pellet trade was estimated to be ca. 45mt in 2022. Brazil is the world's leading exporter of DR pellet followed by Bahrain and Oman. Saudi Arabia is the world's leading importer of DR pellet. Middle East and North Africa collectively account for ca 70% of the DR pellet imports

- Vale (Brazil and Oman) and LKAB (Sweden) are the leading pellet exporters in the world. Both the producers are fully integrated with own DR pellet feed. Other significant exporter of DR pellet being Bahrain Steel, which is a standalone pellet producer relying entirely on imported pellet feed. Majority of the Middle Eastern DR pellet production is destined for DRI producers within the region and to others in proximity to the region

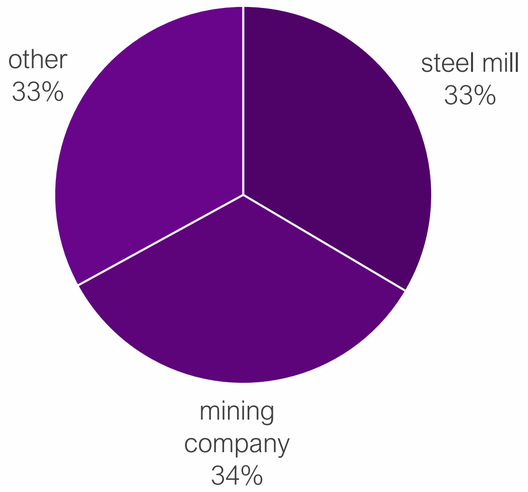
Source: Fastmarkets

Pellet production facilities are mainly associated with either mining or steel companies with limited standalone facilities. Exceptions being China and India

WORLD PELLET PRODUCTION CAPACITY BY RELATIONSHIP (2021), MTPA

Country/ region	Ownership association			Total	Pellet feed imports
Country/ region	Mining	Steel mill	Other	Total	Pellet feed imports
Australia	3	2	0	5	No
China	1	31	179	212	Yes
CIS	23	64	0	88	No
Europe	25	6	0	30	Yes
India	3	44	47	94	No
Middle East and North Africa	47	32	0	79	Yes
North America	50	35	0	85	No
Other Asia	0	4	0	4	Yes
South America	88	21	10	120	No
Total	240	240	237	718	

PELLET OWNERSHIP ASSOCIATION



Notes:

- Pellet plants are generally part of either a mining company or a steel company. There are very few standalone pellet plants operating based on externally procured pellet feed and supplying to third party customers. However, in case of China and India the relationships are not quite clear since there are several small scale operators and there is very limited information with regards to pellet feed sourcing structure
- Pellet plants associated with mining companies are generally located at or close to the mining site and feedstock is sourced from the parent mine
- Steel mills especially in the Middle East and North Africa are becoming actively invested and/ or exploring investments in DR pellet plants to secure raw materials for current production and any future expansions. Examples include Tosyali and AQS in Algeria and SABIC (Hadeed) in Saudi Arabia

The global pellet capacity is likely to grow by ~150mtpa over medium to long term. BF pellet accounting for 65-70%

NEW PELLET PLANT CAPACITIES

Company	Country	DR pellet	BF pellet	Total	Likely schedule	Comments
Samarco	Brazil	8	8	16	2026-30	
NLMK	Russia	4	5	9	2024-27	captive use
Kryvy rog	Ukraine	0	5	5	2023	captive use
Ferrexpo	Ukraine	n/a	n/a	3	2024	The company is likely to focus on high grade DR pellets
Mesabi	USA	0	7	7		
Various	India	0	15	15	2022-25	Multiple projects
Various	China	0	40	40	2021-25	Multiple projects
Various	Iran	10	0	10	2021-25	Multiple projects
ArcelorMittal	Canada	7.7	0	7.7	2026	
Minnesota Steel	USA	0	7	7	2025	
Shougang Hierro Peru	Peru	0	10	10	2021-26	
Tosyali	Algeria	4	0	4	2026+	
JSIS	Oman	6	0	6		
Kobe/ Mitsui	Oman	N/A	N/A	N/A	2027+	Looking to build a 5Mtpa HBI plant and plans to add a pellet facility
Emirates/ JFE	Abu Dhabi	N/A	N/A	N/A	N/A	Initial discussions to build a 6Mtpa pellet plant. Timelines not clear
Power Works	Abu Dhabi	6	-	6	2025-30	
Whyalla pellet plant	Australia			7.5	N/A	
Total		46	97	150		

- The supply demand gap will likely encourage newer capacity additions in the future that are not currently known
- Some of the BF pellet plants with excess capacity may also be repurposed to produce DR pellet. However, this report does not account for any technical and similar such limitations

Source: Fastmarkets

Pellet plants in Middle East and India predominantly produce DR grade pellets. However, those in Japan and China are mainly BF pellet producers

OVERVIEW OF KEY PELLET PLANTS IN ASIA AND MIDDLE EAST(2022)

Company	Country	Production capacity, mtpa	BF Pellet	DR Pellet	Captive ore	Comments
Bahrain Steel	Bahrain	12	5%	95%	N	▪ Imports DR pellet feed. Bahrain Steel is a steel making company with additional pelletisation facility ▪ Consumes pellet within the steel works. However, Bahrain is long on pellet and is an active player in the seaborne pellet market
Vale Oman Pelletizing	Oman	9	0%	100%	Y	▪ Oman pellet plant, Vale JV, is an active seaborne pellet supplier. The plant sources pellet feed from Vale's Brazilian mines
AM/NS	India	14	0%	100%	Y	▪ In addition to own mines, the company also procures pellet feed from 3rd parties located near its pellet plants ▪ Expansion plans to add pelletisation capacity in India and new mine development
BaoWu	China	10	100%	0%	N	▪ Imported pellet feed
Anshan Steel	China	10	100%	0%	N	▪ Imported pellet feed
Kobe Steel	Japan	4	100%	0%	N	• Imported pellet feed

Pellets are either (BF) grade or direct reduction (DR) grade. Key differentiator between the two products being lower level of impurities (e.g.: SiO2) in DR grade

PELLET CHEMISTRY COMPARISON

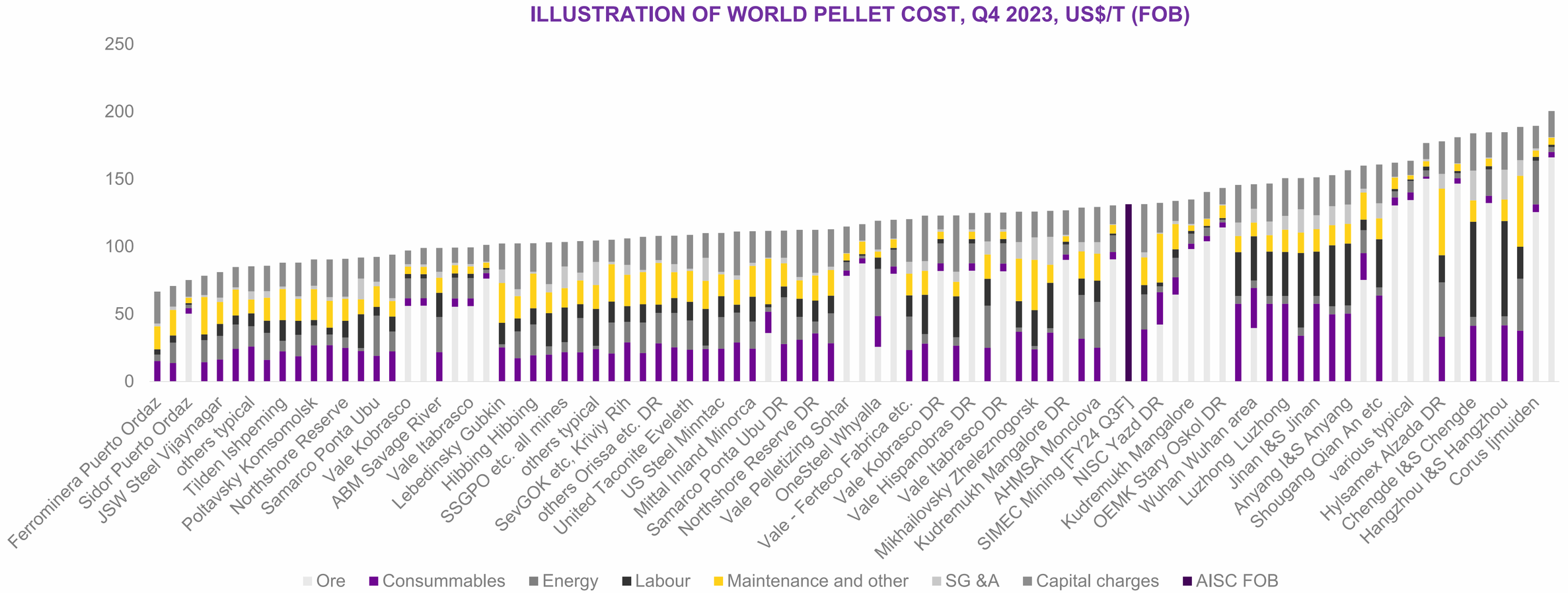
	Tubarao BF	Carajas BF	Oman DR	LKAB DR	CMP Chile DR
Fe (min)	65.7	65.34	67.75	67.9	67.33
SiO2 (max)	2.45	1.8	1.4	0.75	1.4
Al2O3 (max)	0.65	1.4	0.55	0.16	0.23
CaO (max)	2.64	1.8			
P (max)	0.03	0.04	0.03	0.025	0.033
S (max)			0.003	0.002	0.005
Cao/SiO2	1.08	1			

- Pellet chemistry is a critical component determining the application of the pellet either in BF or DRI module. DR grade pellets demand a far lower level of impurities compared to BF grade pellets
- Straight grate and Grate kiln are amongst the major pelletisation technologies that is being widely used in the market
- The economics of these technologies is determined by the flexibility of its operations in handling different types of ore, fuel type and consumption, asset configuration, product quality and capex among others

PELLETISATION TECHNOLOGY OPTIONS

Item	Straight grate	Grate kiln
Iron ore	▪ Mainly haemetite but is flexible enough to use both haemetite and magnetite	▪ Mainly magnetite
Fuel type	▪ Mainly gas or liquid fuels ▪ No solid fuels	▪ Flexible and can use solid, liquid and gas
Fuel consumption	▪ Broadly similar	▪ Broadly similar
Electricity consumption	▪ Higher	▪ lower
Asset configuration	▪ Integrated and one machine	▪ Multiple machines – traveling grate, kiln, annular cooler
Product quality	▪ May risk inconsistent product quality due to variations across the pellet bed	▪ May have better consistency of product quality
Maintenance	▪ Single machine and hence fewer drives to maintain	▪ Multiple machines means multiple drives to maintain
Emissions	▪ Broadly similar	▪ Broadly similar
Capital cost	▪ Lower	▪ Higher

Ferrominera and JSW are amongst the most cost competitive pellet producers in the world



Note:
- The pellet costs have been assessed on total cost basis which includes capital charges
- Ore costs are shown separately only for pellet producers that rely on third party pellet feed (e.g.: Tata Ijmuiden , GIIC etc.) and for producers where pellet plant are not co located with mine (Vale pellet plants)
- The costs are on FOB respective port basis
- SIMEC costs as provided by the company

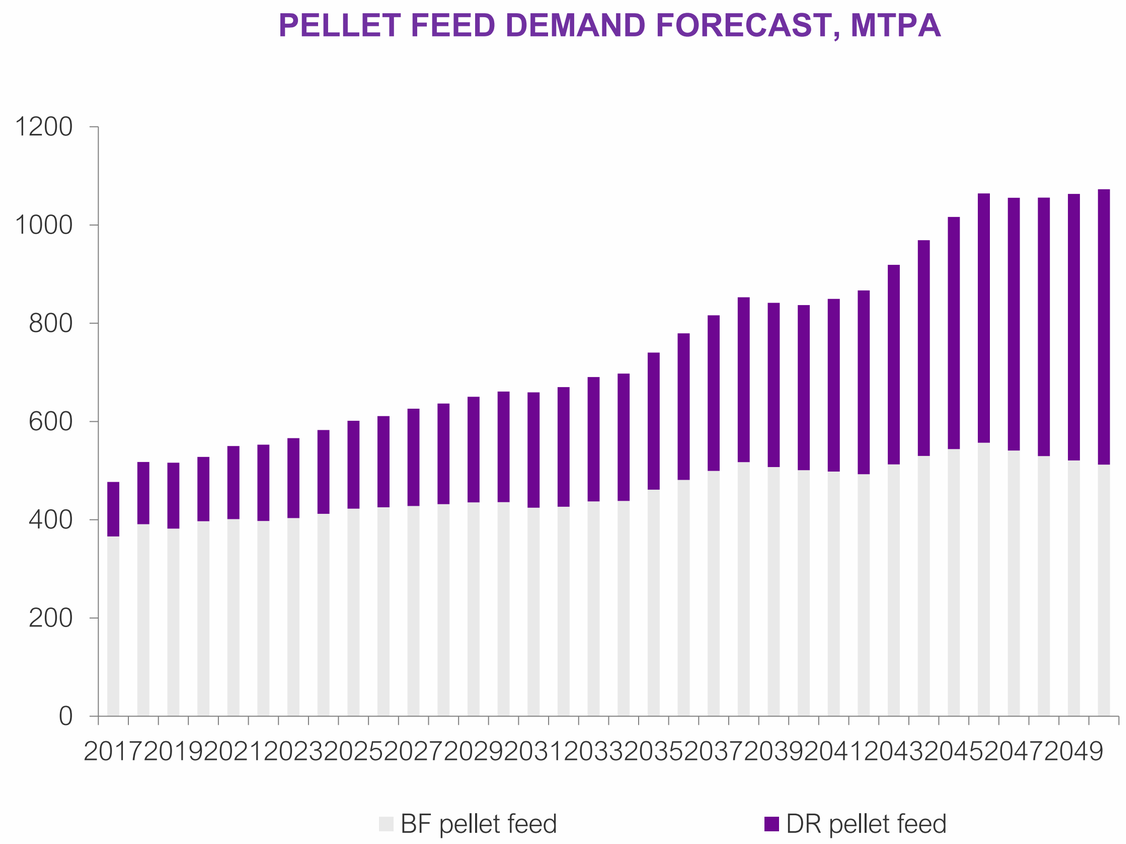
Source: Fastmarkets Cost data

Contents

- Executive Summary
- Global steel production and iron ore market review
- DRI/HBI Market characterisation
- DR pellet market and forecasts
- **DR pellet feed market and forecasts**
- Pricing and VIU analysis
- Green steel market developments
- SIMEC Market positioning
- Conclusions

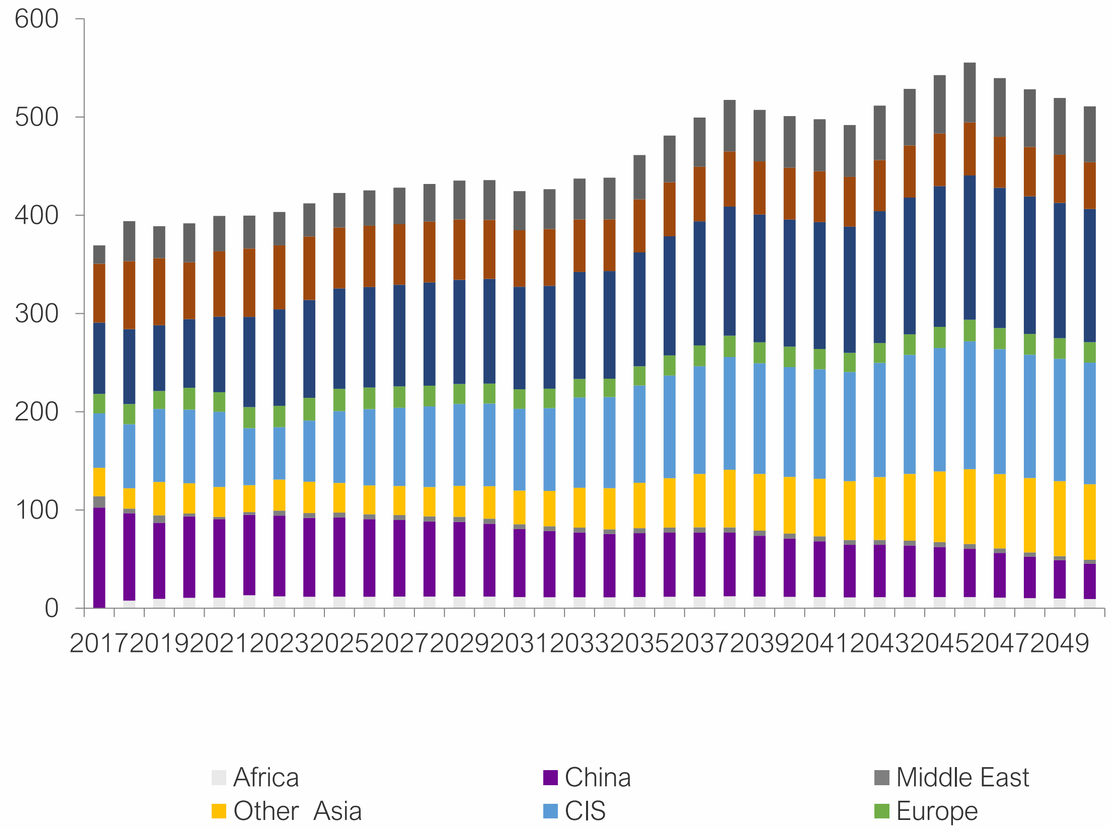
China is the world's largest consumer of pellet feed - entirely BF grade – as it blends imported high grade ore with domestic sources

- Historically, BF grade pellet feed accounted for 70-80% of the total pellet feed demand in the world
- Majority of the pellet feed is consumed in the same country where it is produced. Several of the pellet producers have own pellet feed supply and thus limiting the extent of 3rd party pellet feed supply
- China is the largest consumer of BF pellet feed and relies on a mix of domestic and imported feed sources. It is also the world's largest importer of BF grade pellet feed. The steel mills in China blend the imported high grade pellet feed with domestic feed to produce pellet that is most suitable for the BF burden
- Similarly DR pellet feed and DR pellet production are largely. However, there are a few producers such as Bahrain Steel rely 100% on 3rd party suppliers due to lack of domestic sources. Although Oman is one of the largest importers of DR pellet feed, it is mainly attributed to Vale's internal sales to its pellet plant in Oman

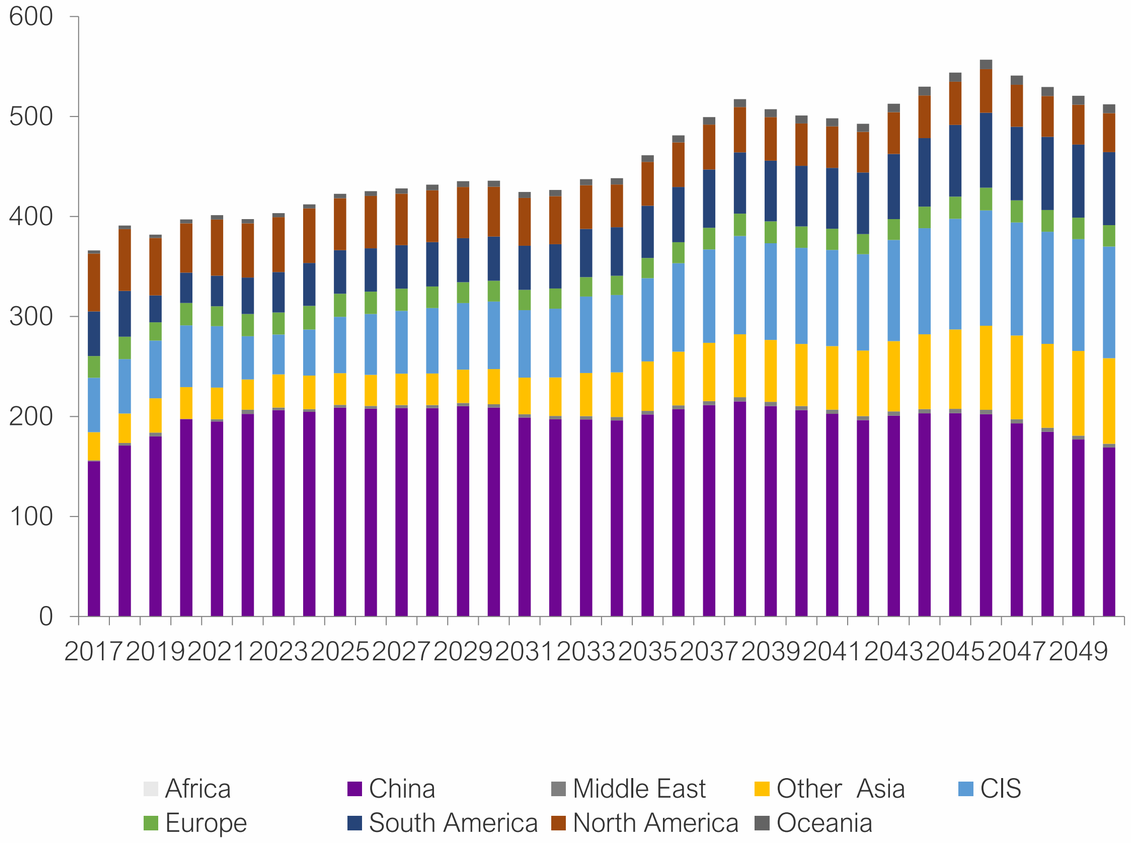


China continues to be the largest consumer of BF pellet feed. The demand will be largely met by supplies from South America and CIS

BF PELLET FEED PRODUCTION FORECAST, MTPA

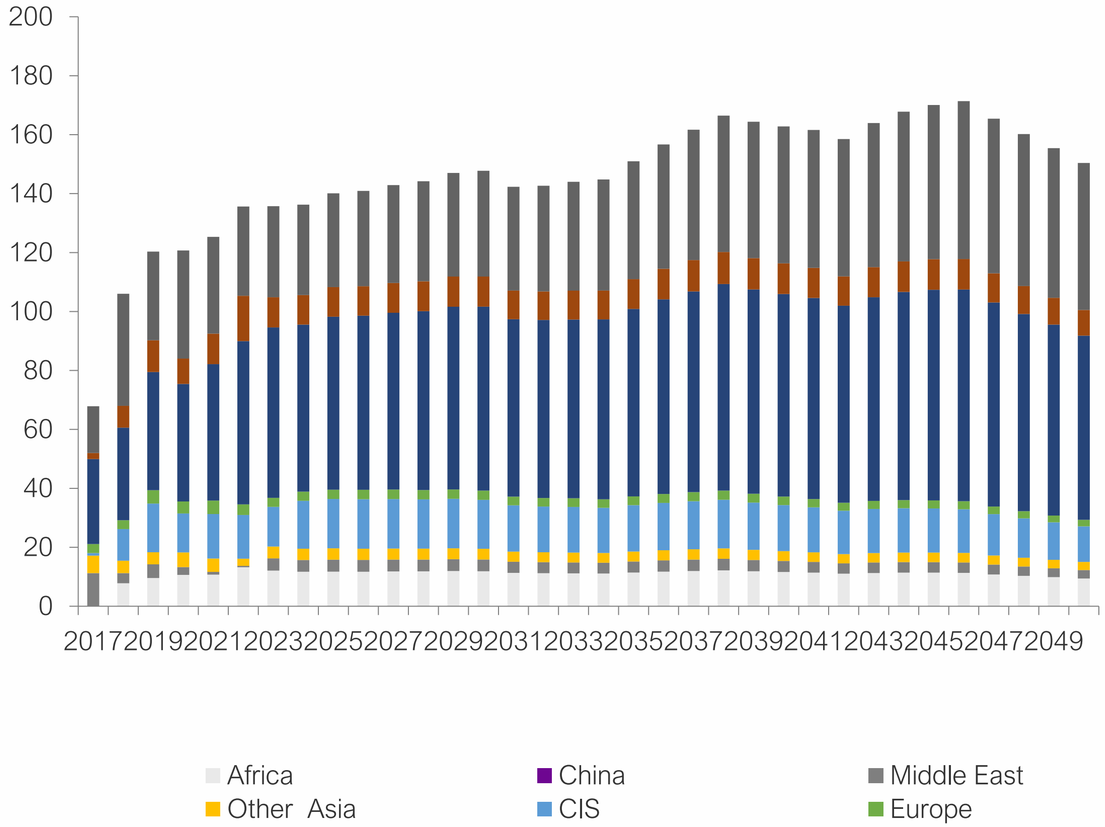


BF PELLET FEED DEMAND FORECAST, MTPA

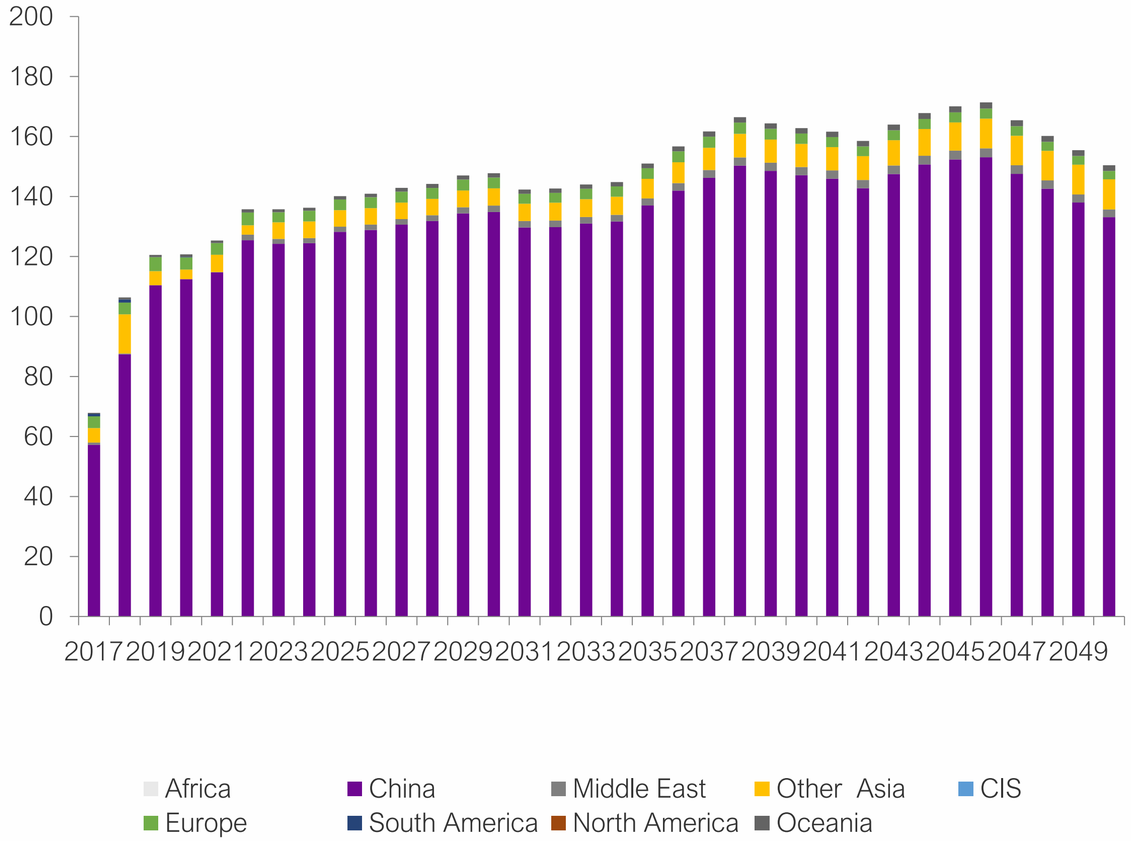


China remains the dominant importer of BF grade pellet feed for the foreseeable future and beyond

BF PELLET FEED EXPORTERS, MTPA



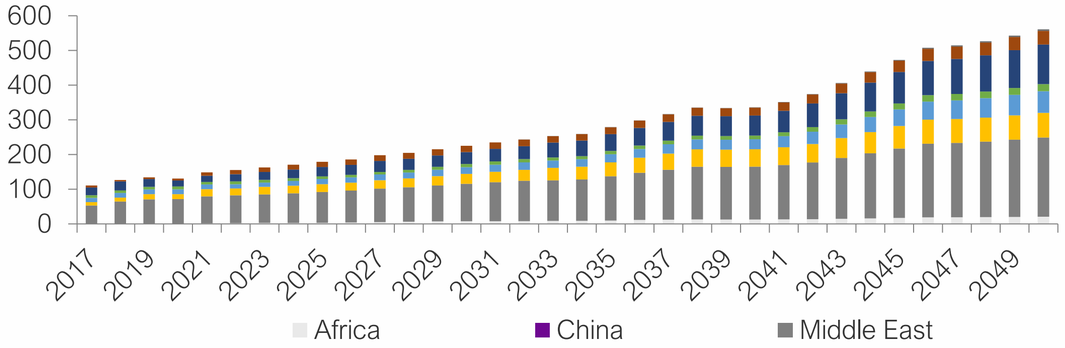
BF PELLET IMPORTERS, MTPA



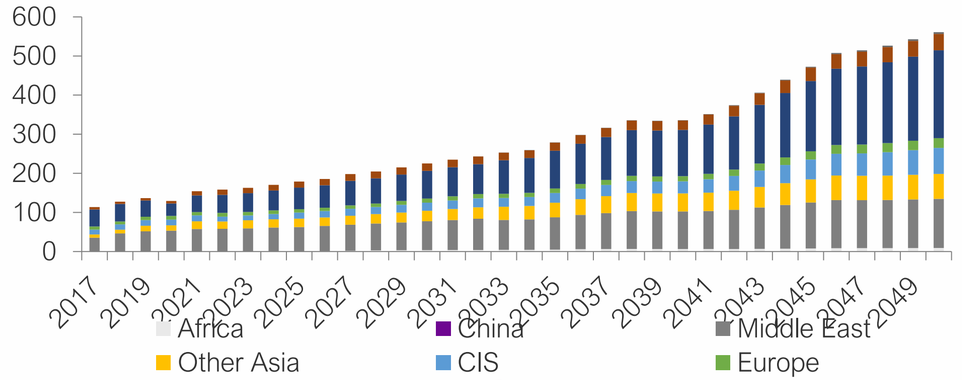
NEW SLIDE

The demand for DR pellet feed is forecast to grow to 336mtpa in 2040 driven by growth in Middle east

DR PELLET FEED DEMAND FORECAST, MTPA



DR PELLET FEED SUPPLY FORECAST, MTPA



DR PELLET FEED DEMAND, MTPA

Region	2022	2040	2050
Africa	2	13	21
China	0	0	0
Middle East	80	152	228
Other Asia	20	50	71
CIS	12	29	62
Europe	8	11	20
South America	21	58	114
North America	12	23	40
Oceania	0	1	4
Grand Total	155	336	561

Other Asia breakdown	*2022*	*2040*	*2050*
Japan	*0*	*0*	*0*
S.Korea	*0*	*0*	*0*
Taiwan	*0*	*0*	*0*
India	*20*	*50*	*71*
Grand Total	*20*	*50*	*71*

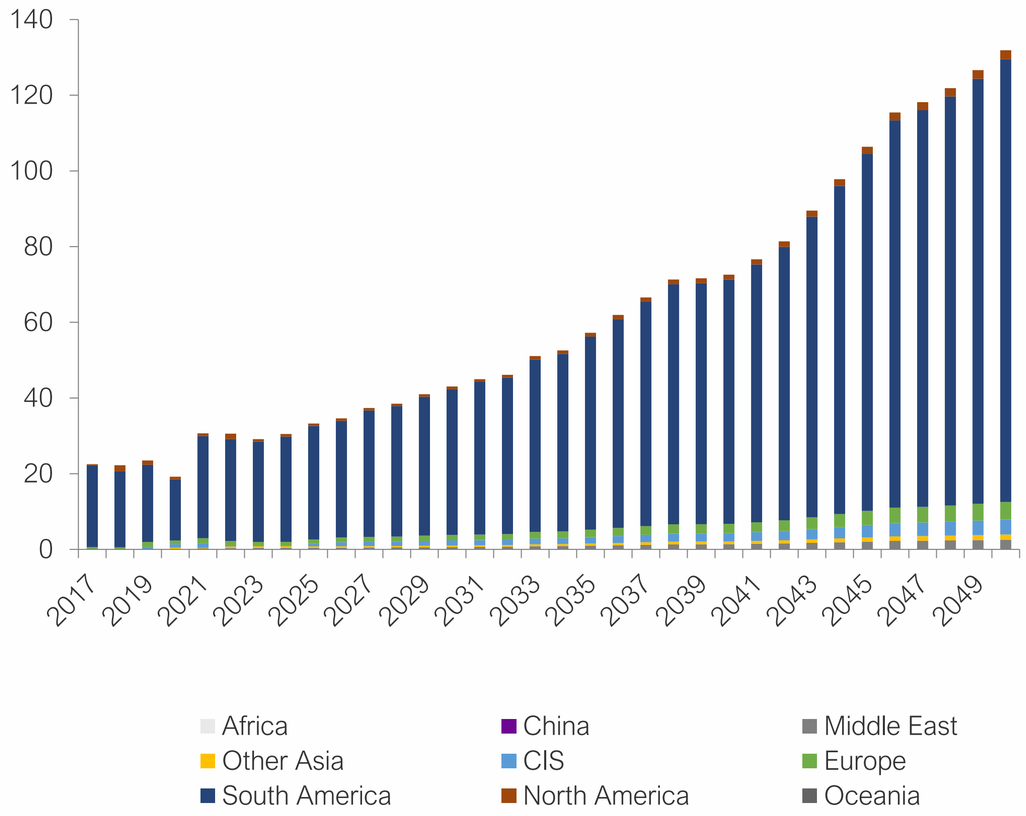
DR PELLET FEED SUPPLY, MTPA

Region	2022	2040	2050
Africa	0	6	9
China	0	0	0
Middle East	58	96	126
Other Asia	19	46	64
CIS	12	31	66
Europe	10	13	25
South America	46	118	225
North America	13	24	42
Oceania	0	1	4
Grand Total	158	336	561

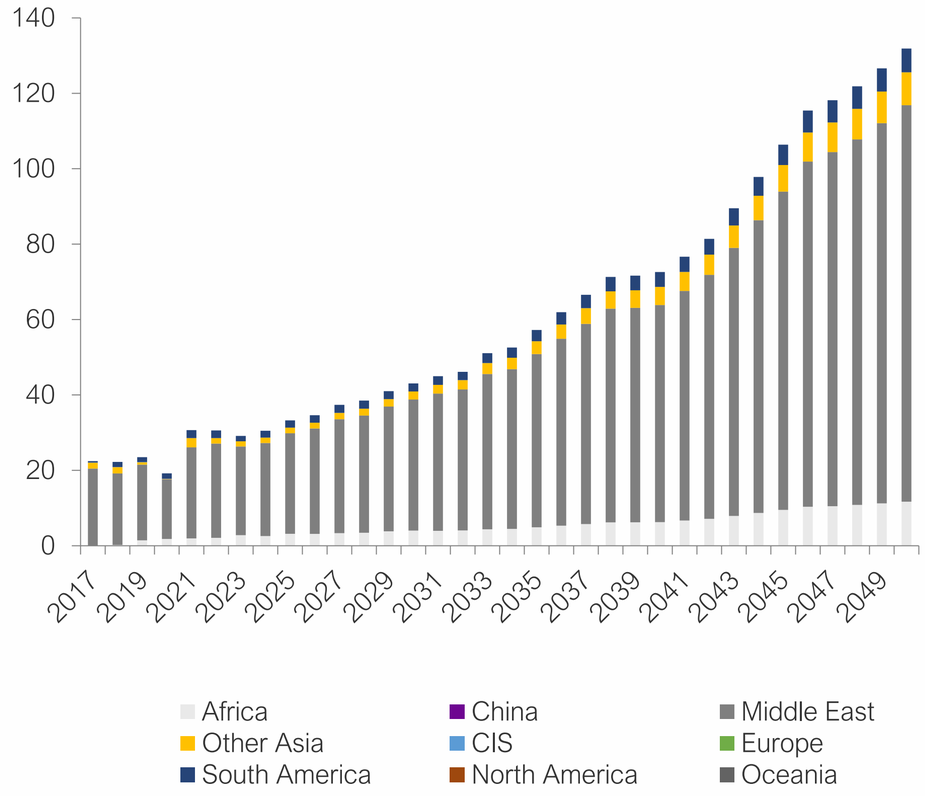
Other Asia breakdown	*2022*	*2040*	*2050*
Japan	*0*	*0*	*0*
S.Korea	*0*	*0*	*0*
Taiwan	*0*	*0*	*0*
India	*19*	*46*	*64*
Grand Total	*19*	*46*	*64*

South America led by Brazil will be the dominant exporter of DR grade pellet feed with Middle east being the dominant recipient

DR PELLET FEED EXPORTERS, MTPA



DR PELLET FEED IMPORTERS, MTPA



The demand for DR pellet feed will be driven by the growth in pelletisation in the GCC countries which entirely rely on imported feed. The DR pellet feed will likely to be imported from Brazil

- The demand for DR pellet feed is mainly driven by Middle east and South America.
- Key demand drivers continue to be Middle east and South America in 2040 and beyond. They account for more than 50% of the pellet feed demand. The demand is driven by growing pelletisation capacity in these regions
- Bahrain and Oman are the main pellet producers and accounted for 25mt of pellet feed imports in the Middle east in 2022. The DR pellet production is forecast to grow with the development of new pelletisation capacity in Saudi Arabia and expansion in Oman among others. These facilities will entirely rely on imported DR pellet feed
- The DR pellet feed supply will predominantly originate from Brazil
- However, there is a risk of supply demand mismatch and the timing especially with pellet feed supply not coming in stream in time to meet the growing demand
- As a result, the DR pellet feed prices may strengthen even more unless more DR pellet feed is identified for supply on time

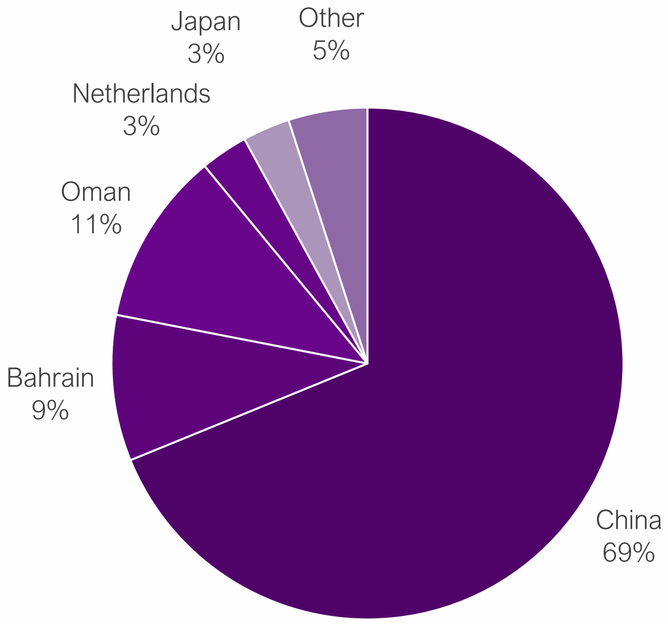
DR PELLET FEED SUPPLY DEMAND BALANCE, MTPA

Region	2022	2040	2050
Africa	-2	-6	-12
China	0	0	0
Middle East	-22	-56	-103
Other Asia	-1	-4	-7
CIS	0	2	4
Europe	1	2	5
South America	25	61	111
North America	1	1	2
Oceania	0	0	0
Grand Total	3	0	0

China accounts for 69% of the world pellet feed imports. Other significant importers being Bahrain and Oman

- Historically, China used its domestic low grade iron ore and used them as pellet feed to make pellet for use in its domestic blast furnaces. The imported ore is blended with domestic ore to to improve the overall pellet Fe content
- Middle East accounts for 20% of pellet feed imports entirely driven by Bahrain and Oman. Pelletisation in Oman is limited to Vale JV and sources its pellet feed entirely from Vale's Brazilian mines. However, the pellet plant in Bahrain is independent and relies 100% on imported sources for pellet feed
- Other significant independent pellet plants include Tata's Ijmuiden facility in Netherlands and Kobe Steel in Japan. In addition, it is understood some of the Indian pellet producers occasionally source pellet feed to blend with their own ore

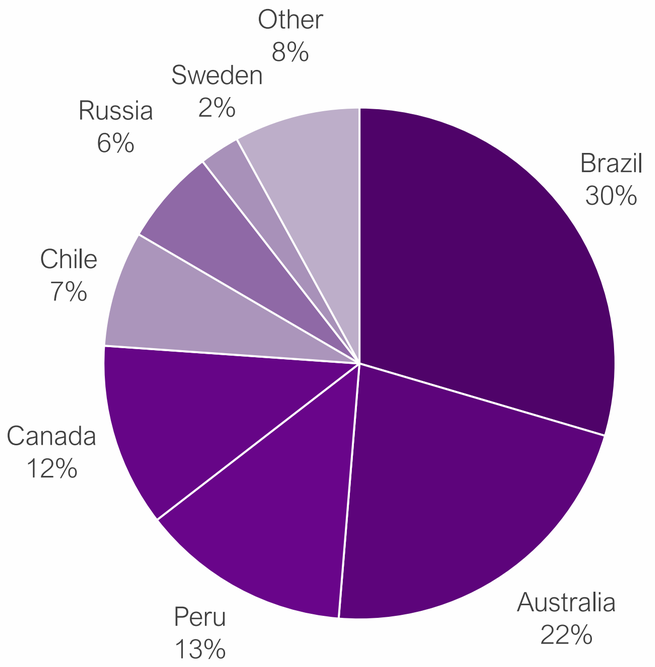
PELLET FEED IMPORTERS
129MTPA (2022)



Brazil is the world’s largest exporter of pellet feed with a share of 30% followed by Australia at 22%

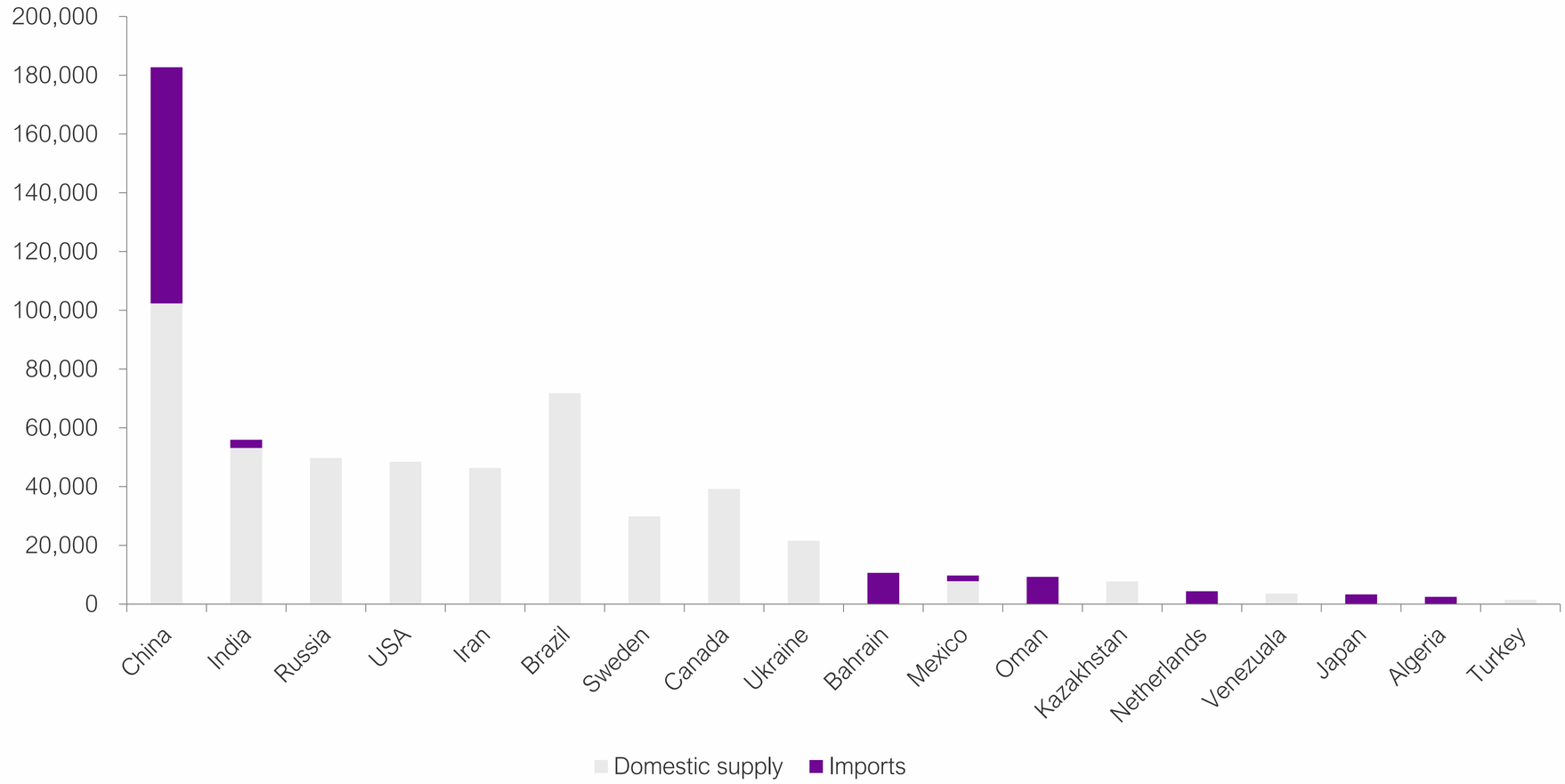
- Brazil accounts for 30% of the global pellet feed exports. Vale and Minas Rio are the major exporters of pellet feed in the country. While Vale’s exports is mainly associated with feeding its pellet plant JV in Oman, Minas Rio supplies to several independent pellet manufacturers
- There has been a strong growth in pellet feed exports in the recent years from Australia. Magnetite producers such as Sino Steel and Karara are major exporters of pellet feed from Australia. The exports are almost entirely directed to China
- Other emerging pellet feed suppliers include those in Chile and Peru. In addition, Ukrainian suppliers such as Metinvest too are actively engaging in export markets and may be opportunistic since exports are mainly driven by weak demand from its own steel mills
- Also, other players such as Kaunis, Sweden and SNIM, Mauritania too have the product capability to meet the pellet feed market requirement

PELLET FEED EXPORTERS
129MTPA (2022)



Excepting China and the Middle East, major pellet producing countries are largely self-sufficient in pellet feed and rely on domestic sources

SHARE OF IMPORTED PELLET FEED AMONG MAJOR PELLET PRODUCING COUNTRIES (‘000 TONNES) (2022 EST)

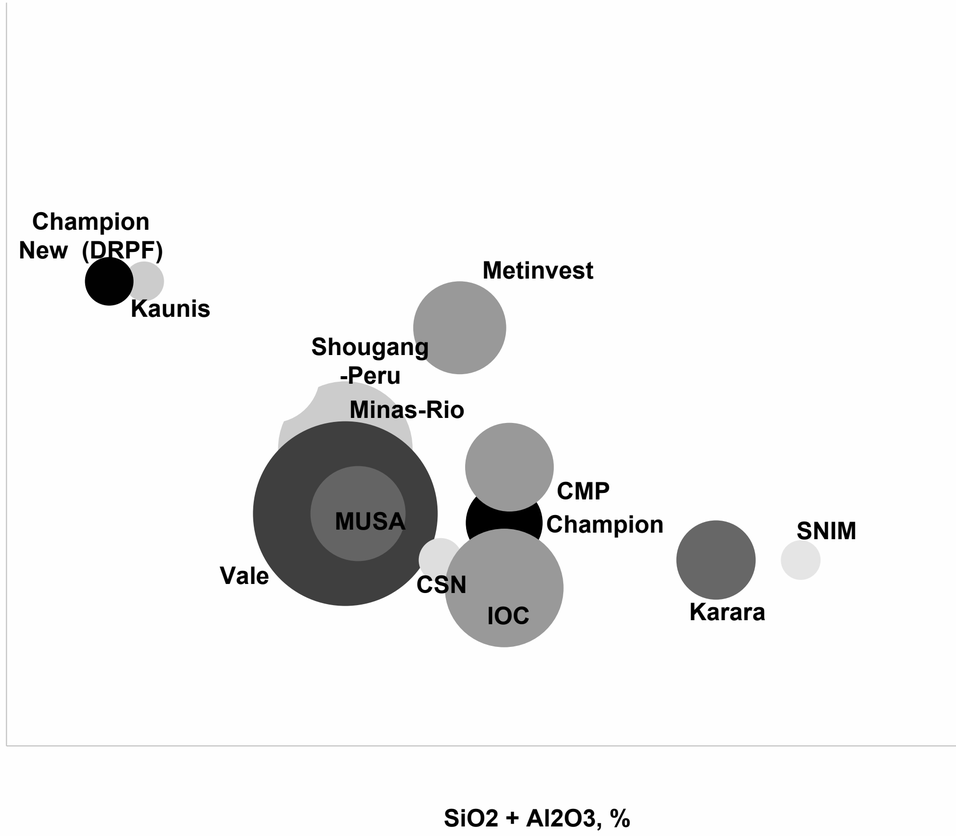


Vale and Minas Rio are amongst the leading pellet feed producers with lower gangue and higher Fe content

Supplier	Location	Indicative volume, Mtpa	Fe, %	SiO2+Al2O3, %
Minas-Rio	Brazil	23	67.2	3.2
Vale	Brazil	43	66.5	3.2
CSN	Brazil	2.5	66	4.1
Champion	Canada	7.5	66.2	4.5
Champion New (DRPF)	Canada	8	68.5	1.2
CMP	Chile	10	67	4.75
Karara	Australia	8	66	6.7
Fortescue Iron bridge	Australia	22	67	5.8
Metinvest	Ukraine	11	68.5	4.28
IOC	Canada	18	65.7	4.7
Shougang Peru	Peru	12	68	2.5
Kaunis	Sweden	2	69	1.3
MUSA	Brazil	11.5	66.5	3.32
SNIM	Mauritania	2	66	7.5

- The volumes shown above are indicative of the overall pellet feed output of these companies and not just seaborne or internal consumption. Vale's pellet feed is mainly internal and not any external sales. However, this may change in the future
- The purpose of the table is to illustrate relative product qualities and volumes to provide a perspective on the competition
- The volumes indicated do not necessarily correspond with 100% of the indicated product grade. There may be significant volume that may deviate from the grades

ILLUSTRATION OF PELLET FEED (BF & DR) PRODUCTS

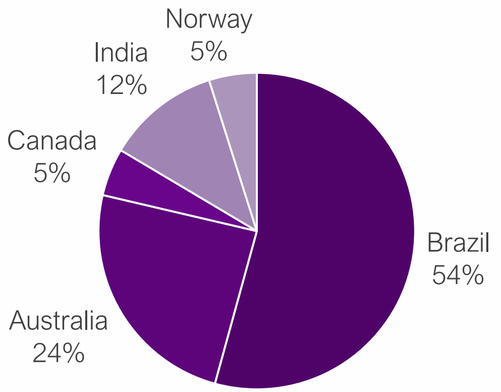


Source: Fastmarkets

Around 170mt of new pellet feed projects, predominantly located in Australia and Brazil, are likely to be commissioned over the next 5-10 years

PELLET FEED PROJECTS AND THEIR LIKELIHOOD, MTPA

Company	Country	Seaborne	Project likelihood	2024	2025	2026	2026+	Cumulative
ArcelorMittal (formerly Essar Steel)	India	N	4	17	0	0	0	17
Carpentaria	Australia	Y	2	0	5	5	0	10
Champion Iron Limited	Canada	Y	5	0	8	0	0	8
CSN	Brazil	Y	4	0	0	15	0	15
ERG	Brazil	Y	3	0	0	20	0	20
Fortescue (FMG) /Formosa	Australia	Y	4	10	10	0	0	20
Gerdau	Brazil	N	3	0	2	0	0	2
Grange Resources	Australia	Y	3	0	10	0	0	10
KIOCL (Kudremukh Iron Ore Company)	India	N	4	0	2	0	0	2
Mineração Usiminas	Brazil	Y	4	0	0	12	0	12
Samarco	Brazil	Y	4	0	0	20	10	30
Sydvaranger	Norway	Y	2	0	0	0	8	8
Vale	Brazil	Y	4	5	5	0	0	10
SIMEC MEP2	Australia	Y	4	0	0	0	7.5	7.5
Grand Total				32	42	72	25.5	171.5



Note:

- Project capacity includes all products such as fines and pellet feed. The above list includes both BF and DR pellet feed products. The share of pellet feed in the overall product mix is not known at this at stage, although anticipated to be on the higher side
- Projects have been rated on their chances of success on a 5 point scale with 1 being least likely and 5 being most likely. It may be noted that the project rating is only based on market knowledge

Source: Fastmarkets

In addition, there are other projects accounting for about 70Mtpa with a relatively lower probability of commissioning

PELLET FEED PROJECTS AND THEIR LIKELIHOOD, MTPA

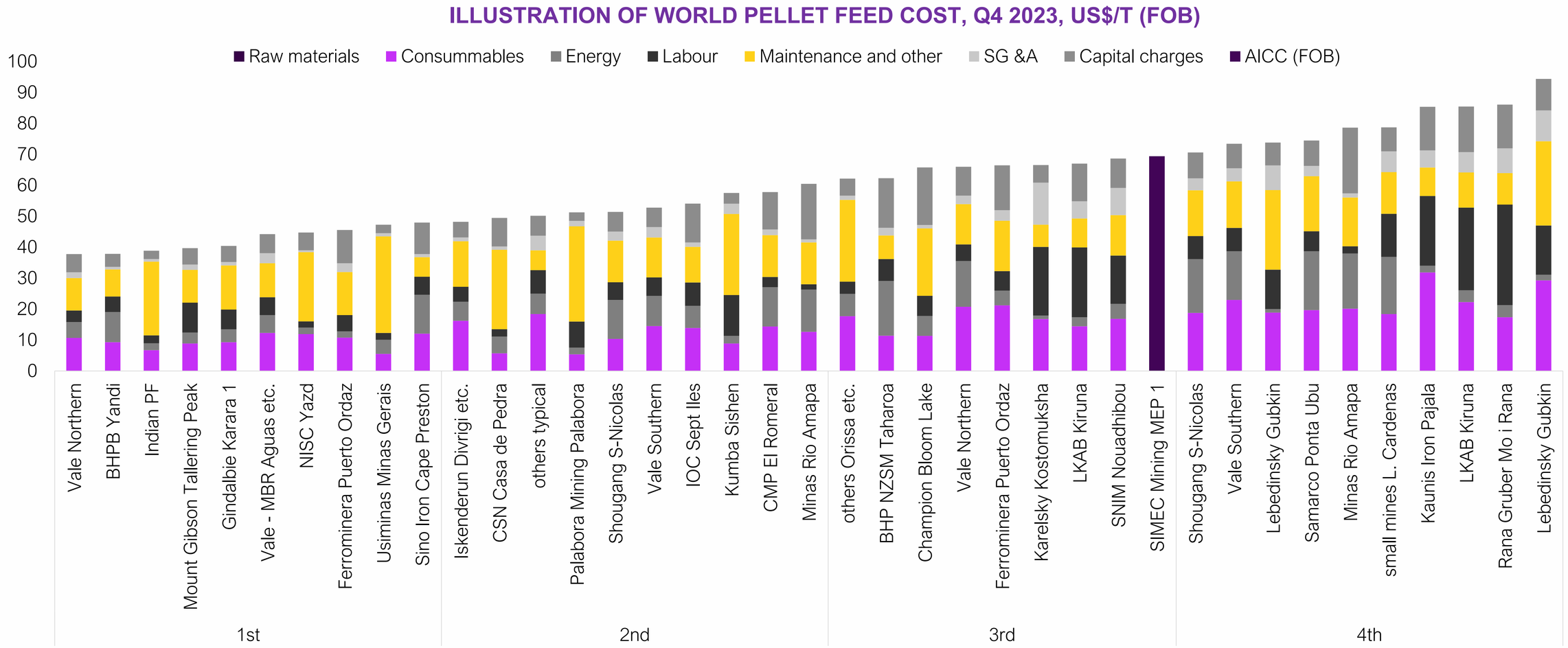
Company	Country	Seaborne	Project likelihood	2025	2026	2026+	Cumulative
Black Iron	Ukraine	Y	2	0	0	4	4
Central Eyre iron Ore Project	Australia	Y	1	0	0	10	10
Champion Iron - Kami	Canada	Y	2	8	0	8	8
Jinzhao Mining	Peru	Y	2	23	0	0	23
Magnetite mines	Australia	Y	1	0	8	0	8
New Millenium Iron	Canada	Y	1	0	9	0	9
Nordic Iron Ore	Sweden	Y	2	0	2	0	2
Todd Minerals	Australia	Y	1	0	0	6	6
Total				23	19	28	70

Note:

- Project capacity includes all products such as fines and pellet feed. The above list includes both BF and DR pellet feed products. The share of pellet feed in the overall product mix is not known at this at stage, although anticipated to be on the higher side
- Projects have been rated on their chances of success on a 5 point scale with 1 being least likely and 5 being most likely

Source: Fastmarkets

Vale Northern and BHPB Yandi are amongst the most cost competitive pellet feed producers in the world



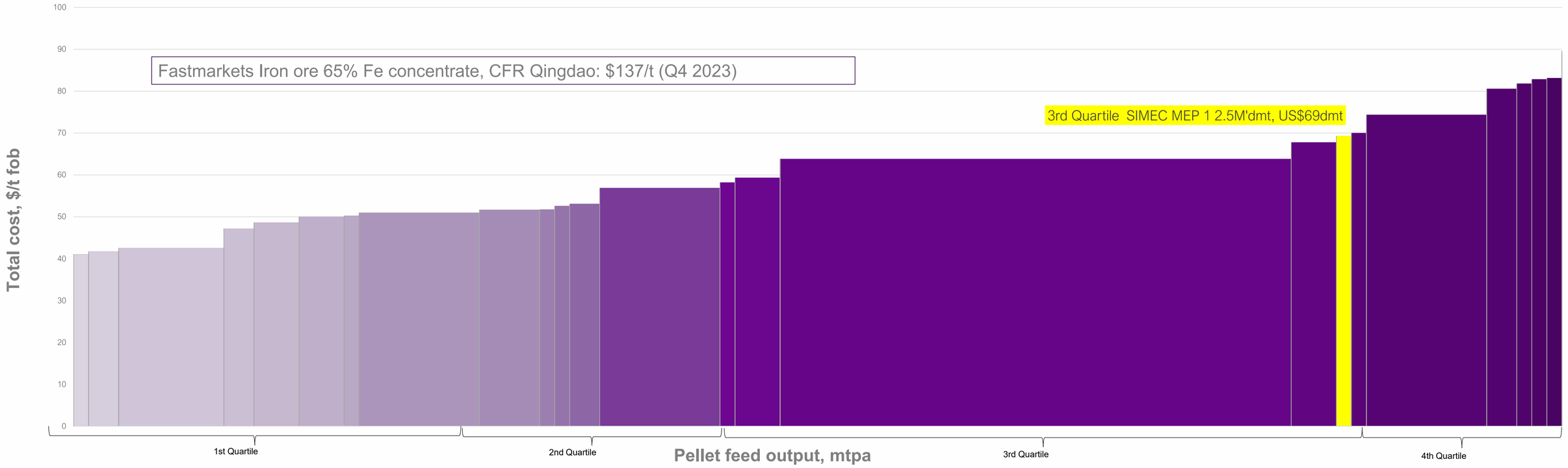
Note:
- The pellet feed costs have been assessed on total cost basis which includes capital charges
- The costs are on FOB respective port basis
- Costs for SIMEC provided by the company

Source: Fastmarkets Cost data

NEW SLIDE

Industry cost curve for pellet feed

ILLUSTRATION OF WORLD PELLET FEED COST, Q4 2023, US$/DMT (FOB)



Note:
- The pellet feed costs have been assessed on total cost basis which includes capital charges
- The costs are on FOB respective port basis

Source: Fastmarkets Cost data

China and Middle East are forecast to be the largest importers of pellet feed with the former being BF grade and latter DR grade

REGIONAL COMMENTARY ON PELLET FEED MARKET OUTLOOK

Region	Comments
Africa	▪ The pellet feed demand growth is mainly attributed to Tosyali's DRI plant in Algeria ▪ It is anticipated to continue to rely on import of pellet feed
China	▪ Increase in the use of pellet share in the blast furnace burden ▪ Decline in domestic ore quality ▪ Growth and / or rationalisation of domestic pellet production and thus leading to bigger pellet plants ▪ However such plants may have to rely on higher grade imported pellet feed to ensure better performance ▪ Leading importer of BF pellet feed
Middle East	▪ Pellet feed demand growth will be driven by increase in DRI production in the region ▪ Regional pellet production is anticipated to grow driven by Vale's projects in Oman which are integrated for pellet feed ▪ Pellet plant in Bahrain will continue to rely on imported pellet feed ▪ Iran is likely to remain self-sufficient for pellet feed ▪ Leading importer of DR pellet feed

South America and Oceania will continue to be the key players in the seaborne pellet feed supply supported by North America

REGIONAL COMMENTARY ON PELLET FEED MARKET OUTLOOK

Region	Comments
South America	▪ The region is a key player in the export of pellet and pellet feed led by Brazil and is expected to remain a key exporter of pellet feed ▪ Other significant exports, mainly pellet feed, include those from Peru and Chile ▪ Brazil's Vale is self-sufficient in pellet feed and exports pellet feed mainly to its own subsidiaries in Oman for further pelletisation. Vale is further strengthening its position as a key pellet exporter especially with the acquisition of Ferrous Resources that gives it an additional 4mtpa of pellet feed capacity ▪ Minas Rio is expected to remain a significant exporter of pellet feed ▪ With Samarco's anticipated return in the near – medium term, pellet production is anticipated to grow in Brazil. However, Samarco is fully integrated for pellet feed ▪ CSN is expanding into becoming a pellet feed producer and may have to rely on exports
North America	▪ North America is forecast to remain self-sufficient in pellet feed ▪ IOC is a major producer of pellet in the region and is fully integrated for pellet feed. IOC is a key player in the pellet export market and exports to Middle East and Europe among others ▪ Champion Iron is anticipated to be a key supplier into the market with presence already established in Asian markets
Oceania	▪ The demand for pellet will be driven by Australia ▪ The pellet producers in Australia are fully integrated and do not import any pellet feed ▪ On the other hand, Australia is a significant net exporter of pellet feed and anticipated to stay that way ▪ New pellet feed producers are likely to commission in the next 5-10 years

Other regions such as CIS and Other Asia are likely to be less significant in the seaborne market since they are mostly self-sufficient

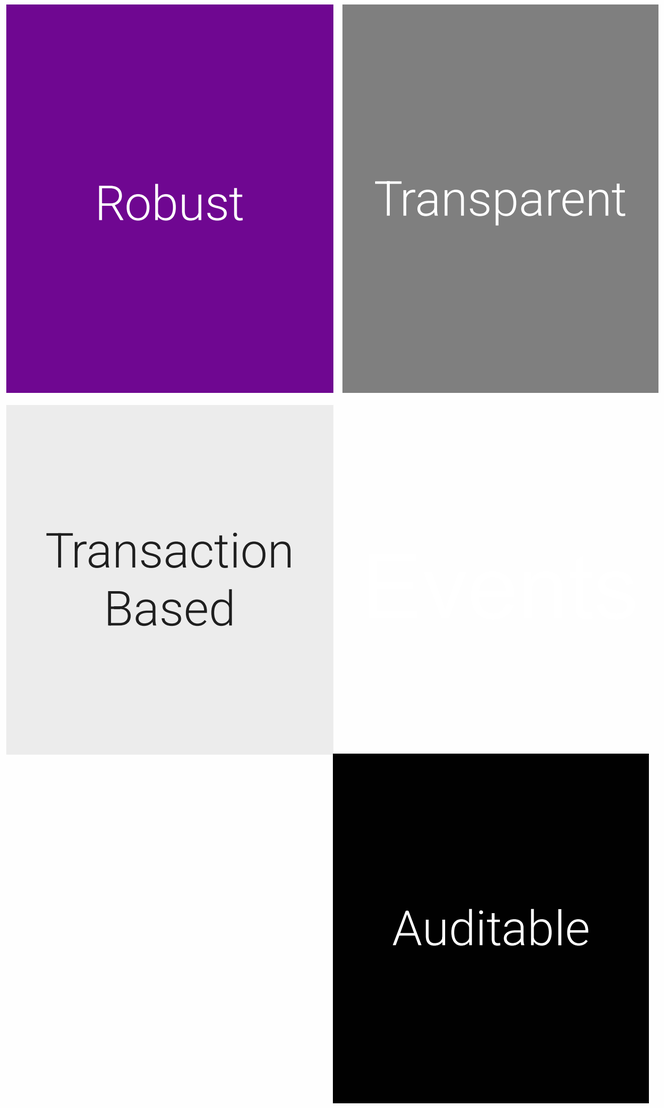
REGIONAL COMMENTARY ON PELLET FEED MARKET OUTLOOK

Region	Comments
Other Asia	▪ The pellet feed demand in “other Asia” will be mainly driven by DRI production in India and a few blast furnace based projects ▪ The pellet producers in India will predominantly source pellet feed from domestic sources ▪ However, there may be occasional instances where pellet feed may be imported to blend with the domestic ores
CIS	▪ Pellet production in the region is anticipated to grow driven by domestic steel production and exports ▪ The region is one of the major exporters of pellet led by Ukraine ▪ Pellet feed is sourced within the region and does not rely on any imports ▪ The CIS region is also a small net exporter of pellet feed, mainly led by Metinvest one of the steel producers in Ukraine. Such exports may be opportunistic and not necessarily strategic in nature
Europe	▪ Pellet feed demand is driven mainly LKAB’s pellet production ▪ LKAB is fully integrated and sources own pellet feed ▪ Tata-Ijmuiden is the only seaborne pellet feed importer ▪ There is hardly any export of pellet feed from Europe

Contents

- Executive Summary
- Executive Summary
- Global steel production and iron ore market review
- DRI/HBI Market characterisation
- DR pellet market and forecasts
- DR pellet feed market and forecasts
- **Pricing and VIU analysis**
- Green steel market developments
- SIMEC Market positioning
- Conclusions

The pricing used in the report is based on Fastmarkets MB iron ore prices



Fastmarkets MB Iron Ore Indices

- ✓ **Fair and representative** - robust calculation methodologies
- ✓ **Tonnage-weighted average -** indices reflect transactions, non-transaction data weighted at specified minimum tonnage
- ✓ Separate sub-indices for producers, consumers & traders mathematically guarantees **balance**
- ✓ Focus on **compliance** – Passed 2018 independent assurance review by PWC on IOSCO principles
- ✓ **Widely-used** market benchmarks (physical and financial)

Iron Ore Index Methodology

Simplified flowchart to the right highlights the mechanistic model with distinct stages:

1. Data collection & input: data submitted under formal DSAs and via survey

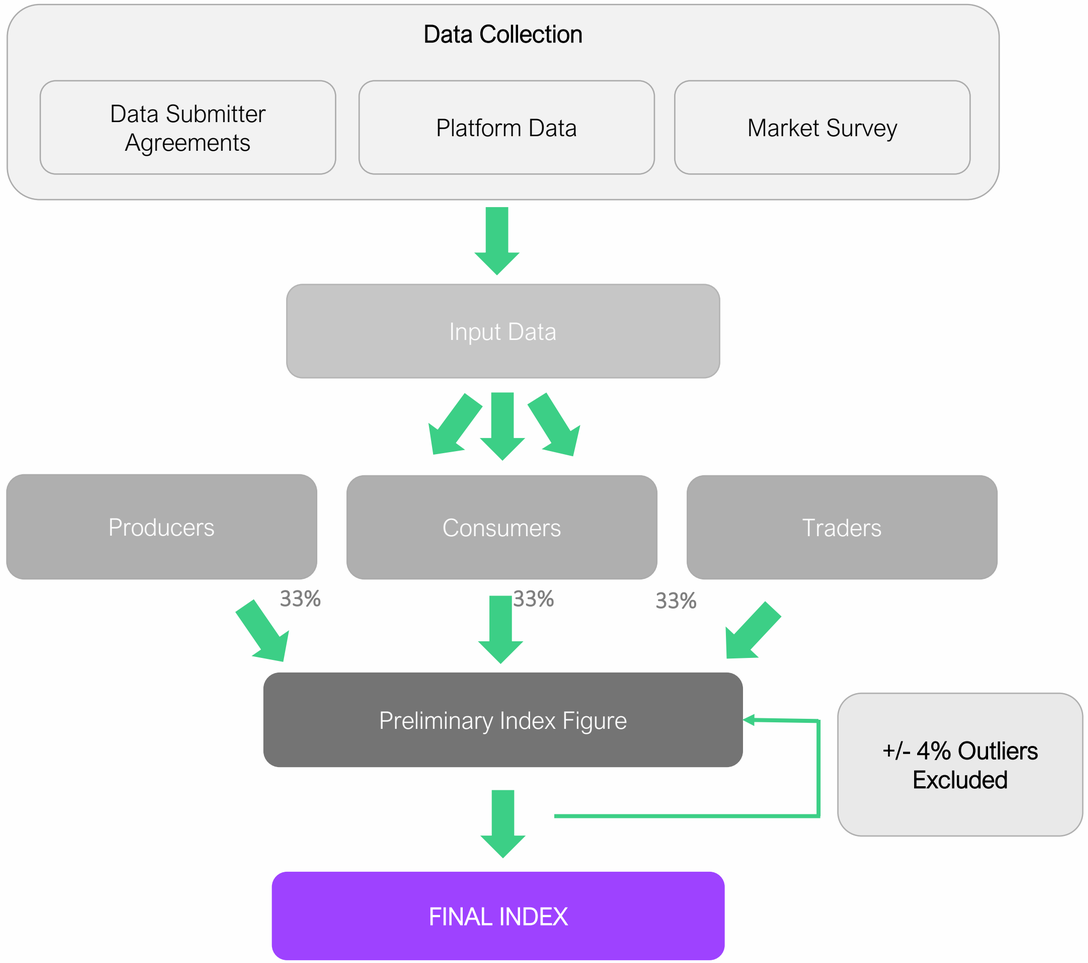
2. Data split between three* tonnage-weighted sub-indices to remove potential bias – data is split according to whether reporter is a producer, consumer or trader

3. Data normalized to base specification if necessary

4. Automatic exclusion of outliers

5. Straight average of sub-index values

**MBIOI-62-LA & MBIOI-CPS do not employ sub-index approach due to nature of these markets*



Pricing structures: the dynamics behind high grade iron ore valuations

- A large percentage of the iron market has seen its pricing shift away from benchmark 62% Fe fines index to more product aligned references in recent years as value differentiation has become more pronounced and inter-grade correlations has weakened.

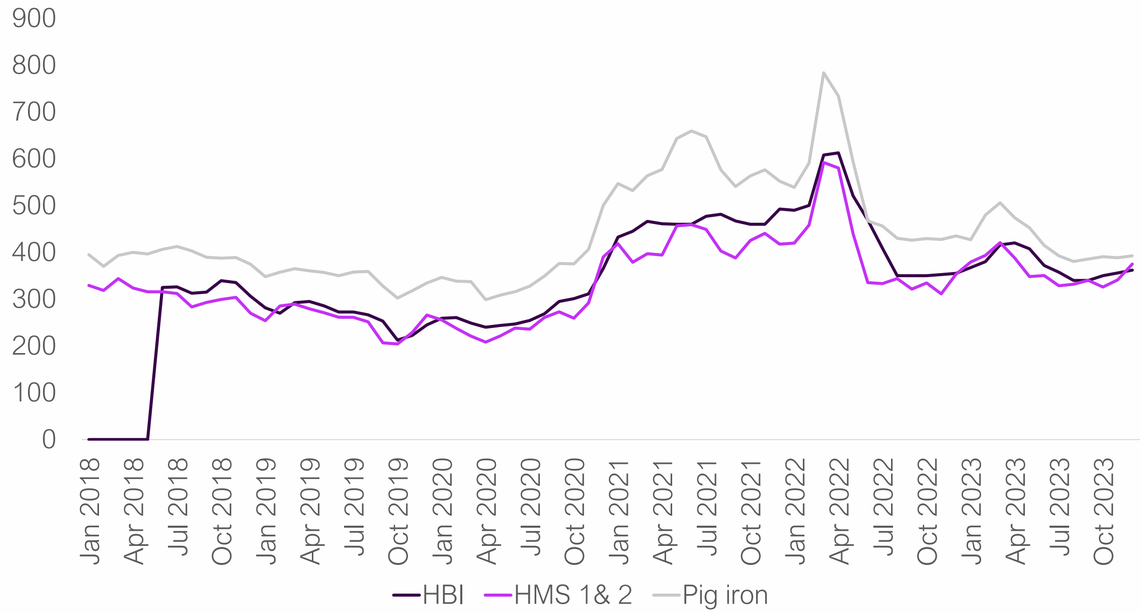
- Not all of the indices launched in recent years (see right) have become industry benchmarks. **Greater levels of transparency in spot trade for products in the high-grade segment have prompted the development and adoption of several indices for high-grade fines, concentrate and pellet that form more appropriate pricing references for these products**. This progression towards product-aligned indexation has helped ease trading frictions by lessening the requirement for substantial negotiated premiums and discounts that are unavoidable in contracts linked to more distant and less representative base indices.

65% Fe Fines Index
- Vale switched from pricing IOCJ on the 62% Fe index + premium to its current mechanism using the 65% Fe index
- Other products, including pellet and many concentrates also now use this price instead of adjusted from the 62% Fe index

66% Fe Concentrate Index
- Anglo American has adopted the 66% Fe concentrate index for the majority of Minas Rio contracts
- Certain other concentrate products have also used this indeed in contracts, and more are expressing interest recently

HBI is a superior product relative to scrap and thus tends to attract a premium based on the value the product in the EAF based steel making

EVOLUTION OF METALLIC PRICES IN EUROPE, $/T



Product	Price basis
HBI	▪ Hot briquetted iron, CFR Italy, $/tonne
HMS 1& 2	▪ Steel scrap HMS 1& 2, FOB Rotterdam, $/tonne
Pig iron	▪ Pig iron, CFR Italy, $/tonne

- Pig iron and HBI/ DRI are both primary metallics used in the EAF as a scrap substitute. Scrap products including HMS1&2 contain inclusions such as copper and others that are detrimental to the quality of steel, particularly flat steel products
- Hence, the EAF mills employ a blend of scrap and primary metallics to meet the required quality attributes. As a result, the price of HBI and pig iron attract a certain premium over conventional scrap products such as HMS1&2
- Pig iron prices are based on deliveries from Russia, Ukraine and Brazil. Whereas, HBI prices primarily reflect the prices of Russian and Venezuelan producers
- However, the supply of Venezuelan HBI declined significantly owing to economic turmoil in the country. Also, it is understood to have certain quality and supply reliability issues
- HBI prices in Italy bear a strong correlation with scrap and attract a premium of $25/t over HMS 1&2 (July 2018-Dec 2023). During the same period pig iron attracted a premium of $106/t over HMS 1&2

Source: Fastmarkets

HBI product demands high grade iron ore with low gangue content resulting in continued demand and the associated premiums for higher grade ores

IRON ORE PRICE TRENDS, US$/T



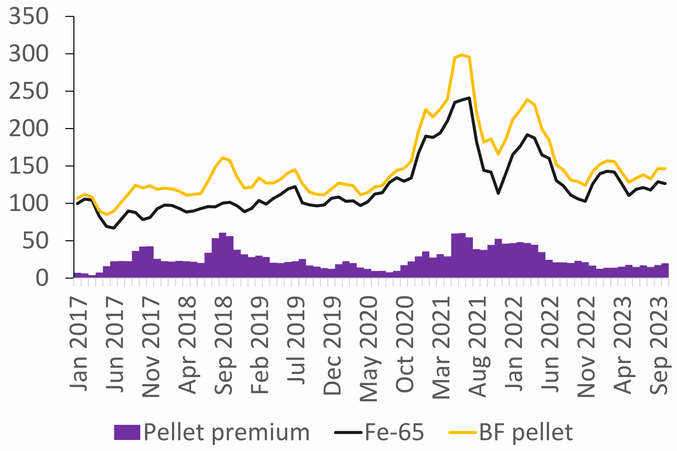
Product	Price basis
DR pellet	▪ Calculated adding Iron ore 65% concentrate and DR pellet premium resulting in a DR grade pellet on CFR Qingdao, US$/t
Fe-65	▪ Iron ore 65% concentrate CFR Qingdao, US$/t
DR pellet premium	▪ Fastmarkets DR pellet premium quarterly, $/t
HBI	▪ Hot briquetted iron, CFR Italy, $/tonne

- The HBI product demands high grade iron ore with Fe content greater than 65% and low gangue content
- Fe-65 has been used as a basis to estimate DR pellet price due to longer price history at Fastmarkets
- Increasingly, there is is a growing demand for even higher Fe content, new indices such as Fe-67.5% is gaining significance and the prices of such products broadly follow the same trend

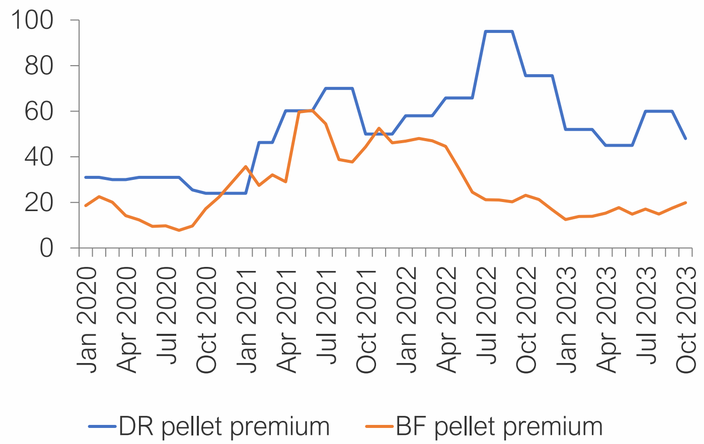
Source: Fastmarkets

Fe-65 is used as a basis to calculate pellet premiums both for BF and DR grade. The premiums capture key product attributes through VIU calculations

BF PELLET PREMIUM, US$/T



BF VS DR PELLET PREMIUM, US$/T



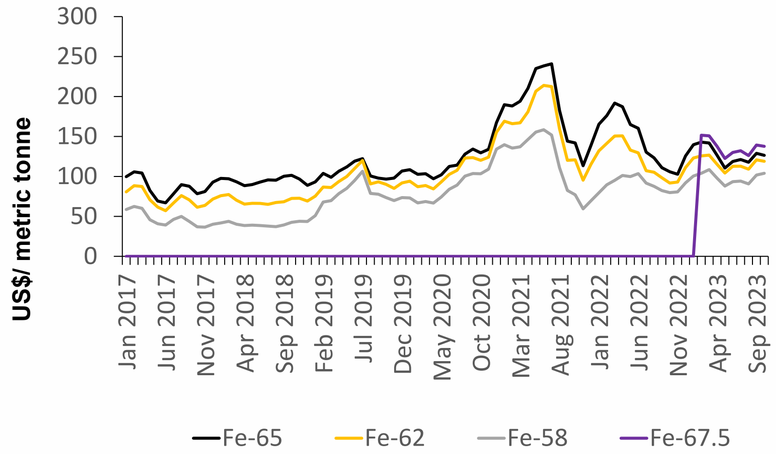
Product	Price basis
DR pellet premium	▪ Iron ore DR grade pellet premium quarterly contract, US$/t
BF pellet	▪ Iron ore Fe 65% blast furnace pellet, CFR Qingdao, US$/t
Fe-65	▪ Iron ore 65% Brazilian origin fines CFR Qingdao, US$/t
BF pellet premium	▪ Difference between BF pellet and Fe-65% product, CFR Qingdao, US$/t

- The premiums for higher grade iron products such as Fe-65 and Fe-67.5 is driven by specific applications such as a pellet feed or high-grade sinter feed
- DR Pellet price at destination = Fe-65% (CFR China) + VIU + Freight netback to destination+ DR pellet premium
- Fe-65 is the key reference price for calculating pellet prices since it has a longer history and better reflects the pellet feed market dynamics. Furthermore, Fastmarkets has started Fe- 67.5% pellet feed pricing coverage starting in Feb 2023 aimed at better reflecting the market for higher Fe customers, especially DR pellet producers.
- The premiums are are largely driven by market dynamics such as margins and / or environmental regulations. During periods of high profitability, mills tend to increase the proportion of higher-grade ores to enhance productivity in the blast furnaces

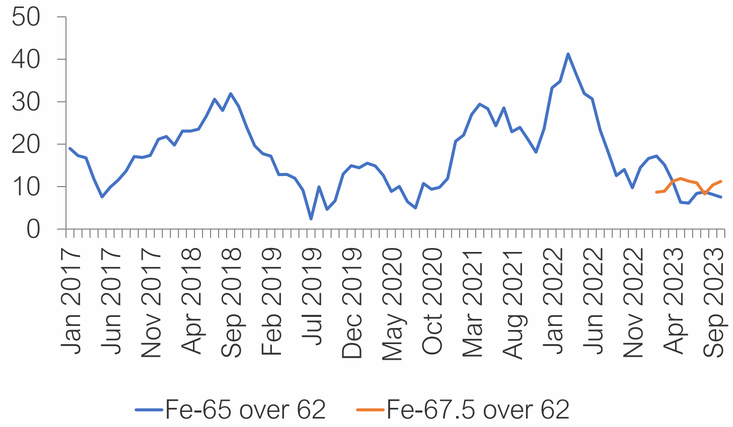
Source: Fastmarkets

The high grade iron ore prices broadly follow a similar trend with merchant Fe-62% sinter fines. The premiums are largely driven by mill margins and regulations

IRON ORE PRICE TRENDS, US$/T



IRON ORE PREMIUMS RELATIVE TO FE-62, US$/T



Product	Price basis
Fe-58	▪ Iron ore 62% fines CFR Qingdao, US$/t
Fe-62	▪ Iron ore 62% sinter fines CFR Qingdao, US$/t
Fe-65	▪ Iron ore 65% Brazilian origin fines CFR Qingdao, US$/t
Fe-67.5	▪ Iron ore 67.5% pellet feed CFR Qingdao, US$/t

- The premiums for higher grade iron products such as Fe-65 and Fe-67.5 are driven by specific applications such as a pellet feed or high-grade sinter feed. The premiums are are largely driven by market dynamics such as margins and / or environmental regulations. During periods of high profitability, mills tend to increase the proportion of higher-grade ores to enhance productivity in the blast furnaces. The premiums bear a good correlation with mill margins.
- Higher grade ores, especially Fe-65 and Fe-67.5 with low levels of gangue content are especially valuable as BF and DR pellet feed. Higher grade ores enable better metallisation of DRI and support decarbonisation in BF-BOF
- The premiums for such higher grade ores will remain strong driven by continued growth in the Middle east and new DRI production in Europe during the next 10 years or so and the challenges associated with DR pellet feed supply with the demand

Source: Fastmarkets

Pricing structures: the dynamics behind high grade iron ore valuations

- A large percentage of the iron market has seen its pricing shift away from benchmark 62% Fe fines index to more product aligned references in recent years as value differentiation has become more pronounced and inter-grade correlations has weakened.

- Not all of the indices launched in recent years (see right) have become industry benchmarks. **Greater levels of transparency in spot trade for products in the high-grade segment have prompted the development and adoption of several indices for high-grade fines, concentrate and pellet that form more appropriate pricing references for these products**. This progression towards product-aligned indexation has helped ease trading frictions by lessening the requirement for substantial negotiated premiums and discounts that are unavoidable in contracts linked to more distant and less representative base indices.

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DR pellet feed is characterised by high Fe content and low gangue content to enable the production of high quality DRI with desired metallisation levels

SIMEC PELLET FEED VS POTENTIAL COMPETITORS

Element	Units	SIMEC 1	Champion DRPF	Minas Rio DRPF
Fe (total)	% (min)	70.45	68.5	68
SiO2	% (max)	1.8	1.00	1.3
Al2O3	% (max)	0.09	0.2	0.5
S	% (max)	0.04	0.02	<0.01
P	% (max)	0.01	0.04	0.043
Blaine index	No.	2300	N/A	N/A
Tumble strength	N/p	2300	N/A	N/A

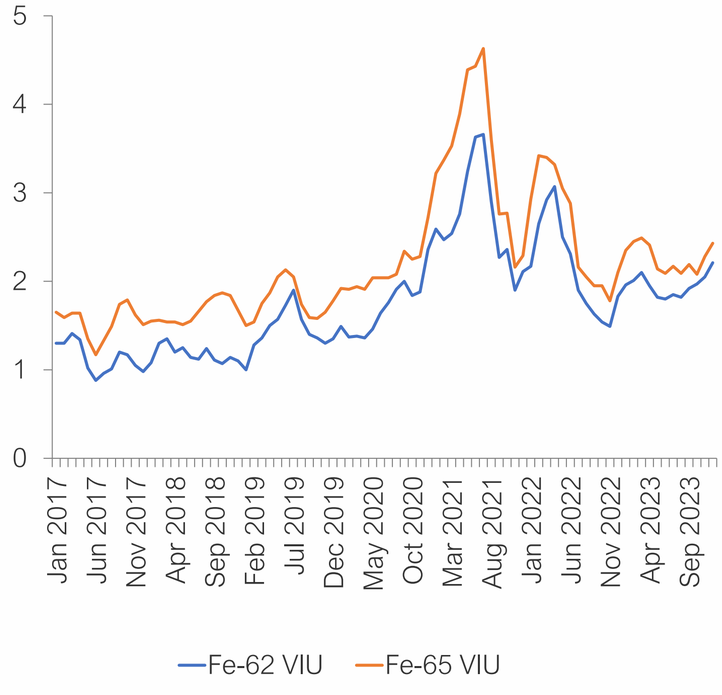
Note:
- The above chemistry and other properties are not comprehensive.
- They are only provided for a broad comparison of various pellet feed products

- SIMEC's products have a higher Fe content and the gangue content is below 3%. The products also benefits from low levels of and phosphorous. Thus SIMEC's products qualify towards being a viable DR pellet feed
- DR pellet feed chemistry directly feeds into DR pellet products. Pelletisation process does not have a provision to enhance the feed material characteristics to align with the DRI and thus feed chemistry is critical to meet the ultimate DRI product specfications
- Higher silica and alumina levels invariably get passed on to DR pellet and subsequently to DRI/ HBI product. The gangue content (SiO2+Al2O3) in pellet feed needs to be below 3%
- Major DRI producers procure pellet from Brazil and Sweden which have a higher Fe and lower gangue content. For example Minas Rio's pellet feed has an Fe content of 68% and gangue content of 1.8%
- The gangue content in Champion's DR pellet feed is amongst the lowest relative to some of the leading DR pellet feed producers in the world

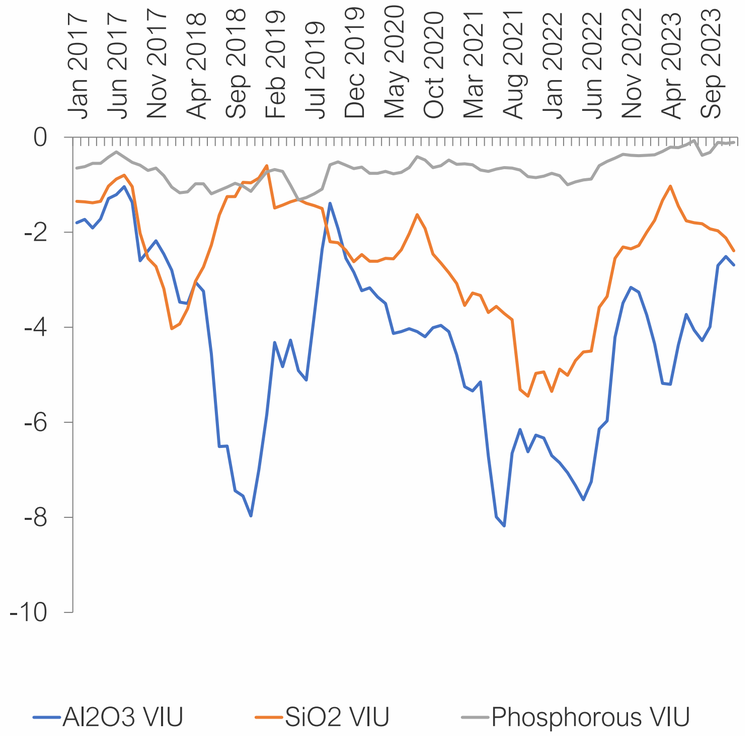
Source: Companies

Market based VIU markers such as Fe, Al2O3, SiO2 and P are used in calculating the attributable premium for higher grade iron ore products suitable for DR pellet

FE VIU, US$/T



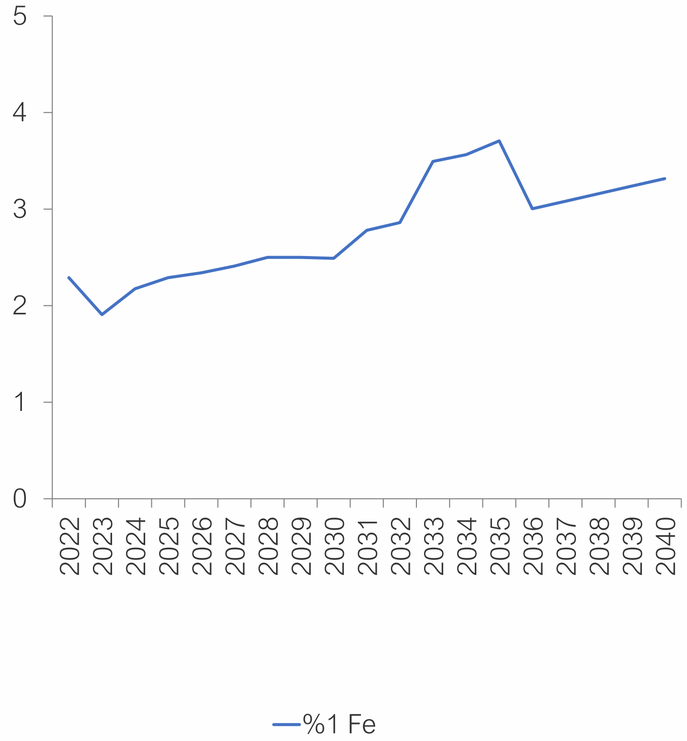
AL2O3, SIO2 AND PHOSPHOROUS VIU, US$/T



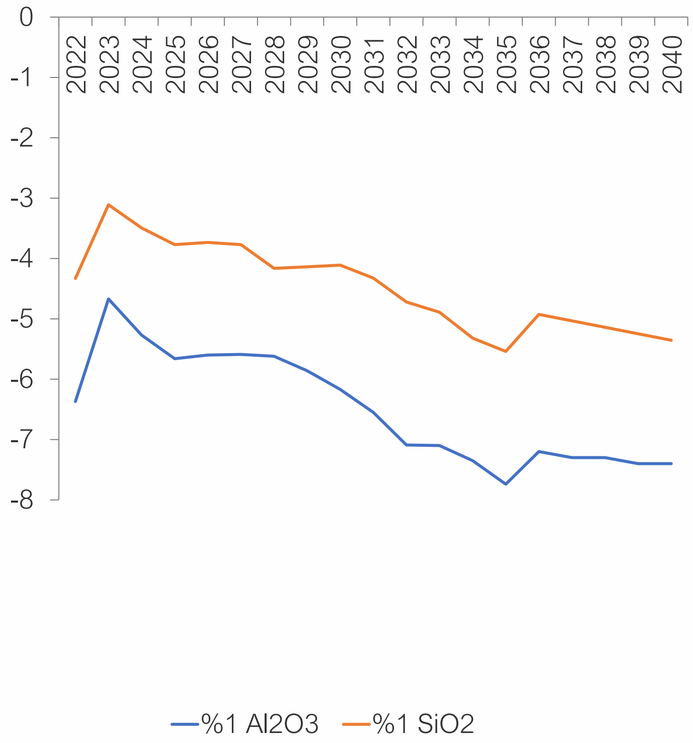
Product	Price basis
Fe 62 VIU	▪ Iron ore 62% Fe fines, % Fe VIU, cfr Qingdao, $/tonne
Fe 65 VIU	▪ Iron ore 65% Fe fines, % Fe VIU, cfr Qingdao $/tonne
Al2O3 VIU	▪ Iron ore 62% Fe fines, % Al2O3 VIU, cfr Qingdao, $/tonne
SiO2 VIU	▪ Iron ore 62% Fe fines, % Si VIU, cfr Qingdao, $/tonne
Phosphorous VIU	▪ Iron ore 62% Fe fines, 0.01% P VIU, cfr Qingdao, $/tonne

VIU forecasts for Fe, SiO2 and Al2O3

%1 FE UNIT VIU FORECAST, US$/T



AL2O3 AND SIO2 UNIT VIU FORECAST, US$/T



Product	Price basis
Fe 62 VIU	▪ Iron ore 62% Fe fines, % Fe VIU, cfr Qingdao, $/tonne
Fe 65 VIU	▪ Iron ore 65% Fe fines, % Fe VIU, cfr Qingdao $/tonne
Al2O3 VIU	▪ Iron ore 62% Fe fines, % Al2O3 VIU, cfr Qingdao, $/tonne
SiO2 VIU	▪ Iron ore 62% Fe fines, % Si VIU, cfr Qingdao, $/tonne

Explanation of VIU markers

- **The iron (Fe) content** of the iron ore is obviously of great importance, since the purpose of the ironmaking process is to eliminate impurities and retain the maximum possible iron content. The best quality iron ores have total Fe content of over 68% on a dry basis and typical products have content in the range of 64%. Ore products below 60% Fe can be considered to be relatively low grade, but may still be commercially attractive in the right conditions.

- **Sulphur:** Control of sulphur (S) is a critical factor in ironmaking and the performance of the slag in removing sulphur is very important. In a blast furnace sulphur is introduced by iron ore and is also contained in coke, coal and any injected fuel oil. In a coal-fired DRI plant sulphur can be introduced with the coal. Desirable levels of sulphur in steel are a maximum of 0.03% and primary iron (pig iron or DRI) needs to be around 0.05%. Hence the desirable level of sulphur in iron ore is also a maximum of around 0.05%.

- The **alumina (Al2O3)** content of iron ore is of importance, when combined with the silica content, in determining the performance of the slag. Steelmakers adopt varying practices in their blast furnaces in order to optimise slag performance given their available raw materials. Iron ores from Australia have a relatively high alumina content at 1.5-2.0% on a dry basis and Indian ores have a higher content at 2.0-3.0%. This leads the Japanese industry as a whole to use a high-alumina slag practice (i.e. a proportion of alumina in the slag of 13% or over). The slag which results from this practice is often usable as an input to the production of cement.

- **Silica (SiO2)** content is important for slag control and for the content of silicon in the iron. Typical values for silica in Canadian and Australian ores are 4-5%. US iron ore pellets generally have silica in the range of 4.5-6.0%. Ore products from Sweden and Brazil are generally lower than this, with Carajas ore at under 2%. Some operators with a high proportion of low silica ores find it necessary to compensate by the purchase of some siliceous fines with a silica content of around 10%. The silica content of ores for ultimate use in blast furnaces can vary over a range up to 6% depending on the alumina content of the same ores and the operating practices of consumers..

- In a DRI process there is no removal of slag which can take away gangue. Hence gangue in the ore remains in the iron product and passes into the steel furnace. This is important for silica content. Whereas content of sulphur, phosphorus and alumina can be the same as for blast furnace ores, products for use in direct reduction must have significantly lower silica content than those for blast furnaces. DR lump and pellet products have silica as low as possible, with a reasonable maximum of 1.5% on a dry basis. **On an indicative basis 1% increase in Silica results in ~2% drop in the DRI yield (DRI required in EAF); an increase of ~25 KWH/tonne of steel in EAF power consumption and an increase of ~22kg/tonnes of steel for EAF lime and dolomite requirement.**

NEW SLIDE

The VIU of DR pellet feed is determined by attributing a premium for higher Fe content while discounting for penalties associated with higher SiO2, Al2O3 and P

THEORETICAL VIU CALCULATION OF DR PELLET FEED OF SIMEC VS PEERS, $/TONNE (REFERENCE : 2023 ANNUAL)

Item	$/t
Fe-65 CFR China	130
Brazil - China Freight	25
Fe-65 FOB Brazil	105
Brazil/CAN - Middle east (GCC port) freight	18
Fe-65 CFR Middle east	123
Freight net back (=123-130)	-7

Element	Reference content, %	$/t	IOC	$/t	IOC	$/t	Vale Tubarao (Oman) PFPT	$/t	Vale Tubarao (Oman) PFPT	$/t	CSN	$/t	CSN	$/t	Shougang	$/t	Shougang	CMP	$/t	CMP	$/t	SIMEC pellet feed Spec 1	$/t	SIMEC pellet feed Spec 1	$/t
Iron ore base price	65.0	132.4	66	132.4	68	132.4	67	132.4	68	132.4	67	132.4	70.45	132.4
Fe content bonus	1.0	2.3		2.3		6.8		4.5		6.8		4.5		12.3
Phosphorous	0.1	-0.2	0.04	0.0	0.0	0.0	0.0	0.0	0.02	0.0	0.045	0.0	0.01	0.0
Alumina	2.0	-3.9	0.4	7.8	0.5	5.9	0.7	5.1	0.5	5.9	0.75	4.9	0.09	7.4
Silica	3.5	-1.8	1.3	4.1	1.0	4.5	1.9	2.8	2	2.7	4	-0.9	1.8	3.0
Total pellet feed, CFR China				146.5		149.6		144.8		147.7		140.9		155.2
Freight net back China Middle east		-7		-7		-7		-7		-7		-7		-7
DR pellet feed cfr Middle east				139.5		142.6		137.8		140.7		133.9		148.2

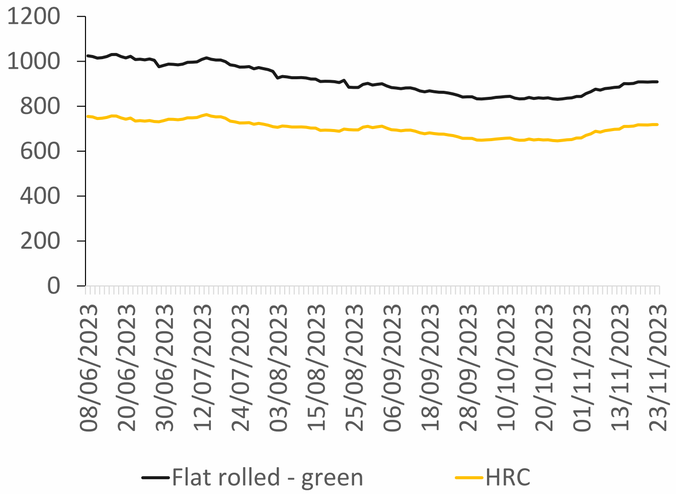
Note:

- The above theoretical calculation was performed to illustrate relative VIU of various DR pellet products exclusively based on chemistry and Fastmarket prices and premium/penalties
- There may be other elements not considered in the above calculation that could impact the overall premium/ penalty attracted by the product
- Magnetite has the potential to attract a premium of $2-3 driven by the benefits associated with energy savings
- Freight net back is based on Fastmarkets freight estimates for Capesize vessels

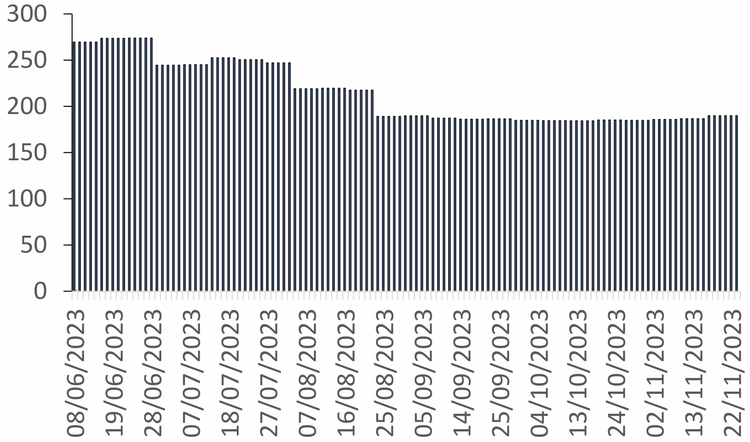
Source: Fastmarkets

Green steel production is one of the key drivers for HBI demand in Europe. Recent premiums for green steel are of the order of $180-200/t for flat products

FLAT ROLLED GREEN STEEL AND HRC PRICES, US$/T



GREEN STEEL DIFFERENTIAL, US$/T



Product	Price basis
Flat rolled green steel	▪ Green steel domestic, flat-rolled, differential to HRC index, exw Northern Europe, €/tonne
HRC	▪ Steel hot-rolled coil index domestic, exw Northern Europe, €/tonne
Green steel differential	▪ Green steel domestic, flat-rolled, differential to HRC index, exw Northern Europe, €/tonne

- With increasing interest for green steel among the steel customers, especially those in the automotive sector, the demand for such steel is likely to grow stronger in the future
- However, producing such Green steel involves sourcing the appropriate raw materials and using decarbonised steelmaking process and all of which increases the production cost significantly
- As a result, the steel thus produced is expected to attract a certain premium over conventional BF-BOF steel that employs fossil fuel
- The market for Green steel products and the associated pricing mechanism is still in the initial stages of development
- Fastmarkets has launched a flat rolled Green steel price applying a certain premium over the HRC index. Currently, the jurisdiction includes Northern Europe and Asia (Vietnam, where the Green steel prices are monitored)

Fastmarkets Green Steel specifications

Product	Price basis
MB-STE-0904: Green Steel domestic, flat-rolled, differential to HRC index, exw northern Europe, € per tonne	Quality: Steel produced with scope 1,2 & 3 emissions of maximum 1 tonne CO2 per tonne of steel Quantity: minimum 10 tonnes Location: Ex-works northern Europe Timing: Open Unit: EUR/tonne Publication: Weekly
MB-STE-0905: Green Steel base price, HRC exw northern Europe, daily inferred, € per tonne	Quality: Steel produced with scope 1,2 & 3 emissions of maximum 1 tonne CO2 per tonne of steel Quantity: minimum 10 tonnes Location: Ex-works northern Europe Timing: Open Unit: EUR/tonne Publication: Daily Notes: This price is calculated by adding the weekly Green Steel differential (MB-STE-0904) to the daily Northern Europe HRC index (MB-STE-0028).
MB-STE-0907: Green Steel, flat-rolled, regional differential to cfr Vietnam HRC index, Japan/South Korea/ Taiwan, $ per tonne	Quality: Steel produced with scope 1,2 & 3 emissions of maximum 1.3 tonne CO2 per tonne of steel Quantity: Minimum 10 tonnes Location: cfr Asia Timing: Open Unit: Per tonne Publication: Weekly, Friday 5-6pm Singapore time
MB-STE-0908: Green steel base price, hot-rolled coil cfr Vietnam, weekly inferred, $/tonne	Quality: Steel produced with scope 1,2 & 3 emissions of maximum 1.3 tonne CO2 per tonne of steel Quantity: minimum 10 tonnes Location: cfr Vietnam Timing: Open Unit: Publication: Weekly, Friday 5-6pm Singapore time Notes: This price is calculated by adding the weekly green steel differential (MBSTE-0907) to the weekly cfr Vietnam HRC (Japan, South Korea, Taiwan-origin) assessment (MB-STE-0888)

- The green steel prices will capture the differential between traditional flat-rolled steel prices and prices for steel produced with low emissions (including Scope 1, 2 & 3) of maximum 1 tonne CO2 per tonne of steel
- All production methods and raw materials will be considered, including scrap-based production and steel made using hydrogen-reduced iron.

The iron ore prices are forecast to come under pressure in the near to medium term due to slower demand growth in China and potential growth in new supply of iron ore

- Fastmarkets forecasts the iron ore prices to decline continuously over the next 5 to 10 years before recovering slightly after that period. This is mainly driven by the pressures on both supply and demand side
- With the declining demand in construction, one of the main drivers of the steel demand in the country, steel mills are under tremendous pressure and the margins are still hovering in the negative territory
- The construction activity, particularly those related to real estate has been struggling. It is understood that the companies in the real estate sector are struggling financially which is impacting new builds / new housing starts. However, government sponsored infrastructure activity has improved. Special infrastructure projects as outlined in 2020 have resumed and thus providing some support for steel demand
- On the supply side of iron ore, new supply is forecast to enter the market including that of domestic ore producers in China. It is forecast that ca. 20mtpa of iron ore will be added to the existing supply in China over the next 2 or 3 years. In addition new supply is forecast to originate from existing seaborne suppliers such as RioTinto and FMG over the medium term
- As a result of weak domestic demand from China and increasing supply of iron ore, the prices are likely to come under pressure over the next 5- 10 years. Although, other countries such as India and SE Asian countries are forecast to grow strongly over the next 5 to 10 years, they have a limited capacity to fill in the gap left by the slowing down of China’s demand
- The prices for metallics and especially scrap is likely to stay a bit more resilient owing to the growing demand for scrap in North America and Europe and limited availability good quality scrap. This may lead to a stronger demand for metallics. However, with the continuing Russia-Ukraine war, there is a limited scope for robust metallic supply (DRI) and thus exerting pressure on prices

The demand for Fe-67.5, is forecast to strengthen in the long term driven by DRI production in emerging regions such as the EU. However, any price support will be driven by customer preference and prevailing steel market conditions at the time

- The long-term demand for higher grade iron ore products such as Fe-65 and Fe-67.5 are for forecast to grow strongly driven by the growth in the DRI production from emerging regions such as the EU. As the decarbonization efforts gather momentum over the next decade, the DRI capacity and associated DR pellet demand will significantly strengthen
- The EU BF-BOF mills have already drawn up strategies for migrating their respective BF-BOF facilities to an EAF-DRI system over the next 20 years. Hydrogen based DRI appears to be the key and overarching aspect of green steel production in EU
- The EU steel mills are already entering into partnerships with energy producers to support the production of fossil free energy with solar and/ or wind power being the chosen route
- With DRI being the main route of production, it is important to secure the supply of DR pellet and / or pellet feed as required, to support the additional DRI production. With limited sources for DR grade pellet feed in the market, the premiums for higher grade products particularly Fe-65 and above including Fe-67.5 is forecast to strengthen in the next two decades
- The market dynamics of the higher grade pellet feed products is anticipated to lend support for newer indices such as Fe-67.5. Although the current Fe-67.5 responds to Chinese demand for higher grade products for use in sinter / BF pelletization, in the future with more DRI capacity coming on stream, may get pegged to the DRI market
- While higher Fe content in the pellet feed may be valuable for DRI product, the product also demands very low gangue content and will ultimately impact the overall premium realizable for higher grade Fe pellet feed. Moreover, the premiums will also be driven by the prevailing steel market conditions. In a bearish market, the steel mills may be reluctant to pay any significant premium

The prices for higher grade iron ore products are forecast to stay resilient driven by decarbonisation efforts leading to greater use of pellet

PRICE FORECASTS (2023$)

Category	Product	Price basis	2023	2030F	2035F	2040F	2045F	2050F
Iron ore products	Iron ore sinter fines, Fe-62%	$/tonne, CFR China	118	97	110	98	81	65
	Iron ore fines Fe-65%	$/tonne, CFR China	131	116	133	125	112	102
	Iron ore fines Fe-67.5%	$/tonne, CFR China	139	130	151	143	134	130
	BF pellet	$/tonne, CFR China	129	145	167	152	142	131
	DR pellet	$/t CFR Middle east	179	176	204	195	186	182
VIU	1% SiO2	$/t CFR China	-3.1	-4.1	-5	-5.3	-5.5	-5.6
	1% Al2O3	$/t CFR China	-4.7	-6.2	-7.4	-7.5	-7.7	-7.8
	1% Fe	$/t CFR China	1.9	2.5	3.7	3.3	3.9	4
Metallics	HBI	$/t CFR Italy	372	399	451	429	414	394
	DRI	$/t CFR Italy	367	394	446	424	409	389

Category	Route	Price basis	2023	2030F	2035F	2040F	2045F	2050F
Freight (Capesize vessel)	Whyalla - Qingdao	$/tonne	11.3	10.8	12.3	13.1	14.0	14.9
	Whyalla - Abu Dhabi	$/tonne	20.0	19.5	22.0	24.0	25.0	26.0
	Whyalla - JPN ports	$/tonne	12.4	11.9	13.5	14.4	15.4	16.4

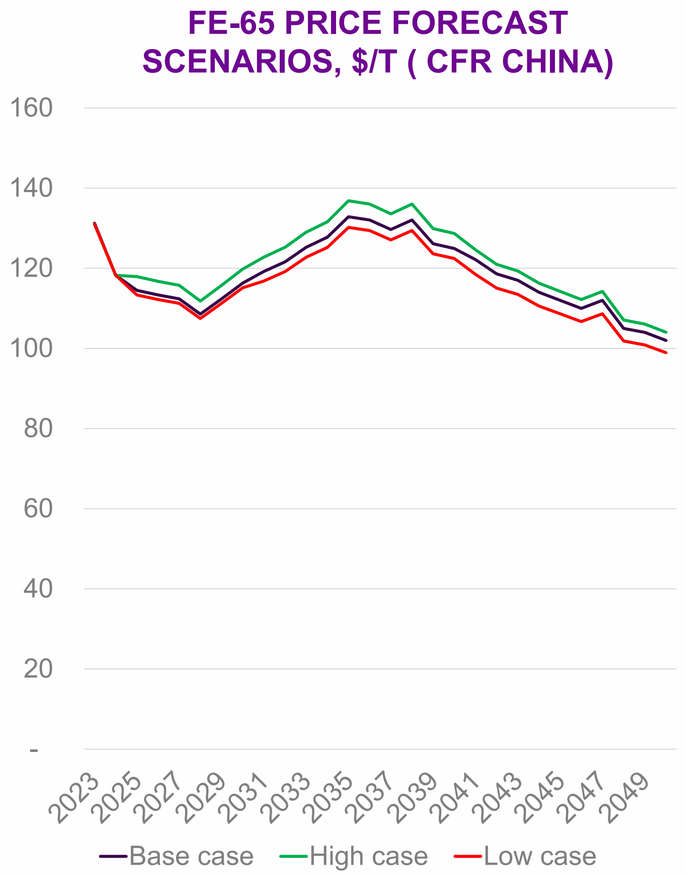
Source: Fastmarkets

Green HBI premium drivers

Item	Comments
Steel decarbonisation	▪ The premiums for green HBI will be ultimately driven by the pace of steel decarbonisation ▪ There is a strong consumer push from automotive industry to incorporate green steel in their future vehicle models ▪ Leading EU steel mills such as ArcelorMittal, TKS and others who are leading suppliers to auto industry have already started the transformation from BF-BOF to EAF-HDRI route
Green DRI	▪ The EU steel mills are embarking on an integrated EAF-HDRI facility resulting in little or no dependence on green HBI ▪ EU mills are not anticipated to be structurally short of HBI ▪ The transition from BF-BOF to EAF-HDRI route is forecast to occur in a phased manner requiring little or no need for any merchant substrates such as DRI ▪ However, large transformation projects run the risk of delays in commissioning and thus resulting in temporary imports of substrates
Green hydrogen	▪ Green hydrogen is critical for the production of Green HBI in the EU ▪ Availability of green hydrogen is a major challenge ▪ Sourcing of renewable energy to produce green hydrogen cost effectively is challenge in the EU ▪ Economic feasibility of installing and operating green hydrogen production facility

NEW SLIDE

The prices for Fe-65 will be driven by greater use of pellet in blast furnaces particularly in China and other Asian markets

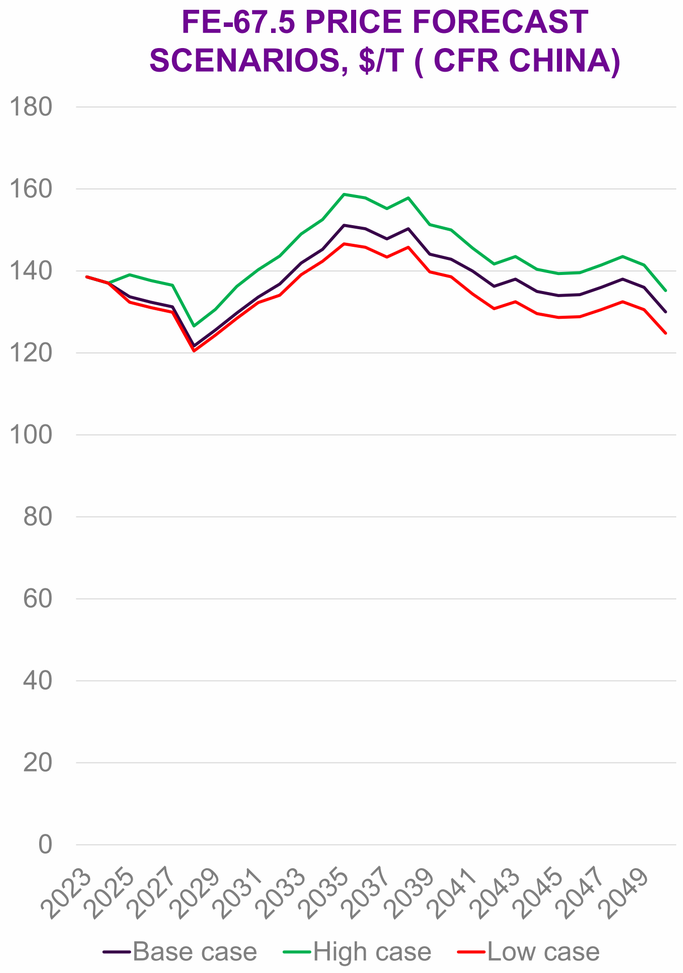


Product	Case	Assumptions
Fe-65	Base case	• Fe-65 is a pellet feed use in the production of BF pellet • The demand for BF pellet is forecast to grow strongly driven by the increasing use of pellet in blast furnace. Environmental regulations sets limits on the production of sinter particularly in China
Fe-65	High case	• Aggressive Implementation of environmental regulations may further increase the product • Greater use of pellet in other emerging markets such as India and SE Asia • India is forecast to experience a strong growth rate providing continued demand support for Fe-62 product. However, there is adequate domestic supply within the country to support its growth programmes
Fe-65	Low case	▪ However, faster decarbonisation may significantly remove sinter capacity and thus low case may be even deeper ▪ New capacity development being even more pellet focused and accelerated use of pellet in China and other major BF-BOF producers

Source: Fastmarkets

NEW SLIDE

The prices for Fe-67.5 are forecast to remain resilient if not get stronger with accelerated decarbonisation efforts



Product	Case	Assumptions
Fe-67.5	Base case	• Fe-67.5 is a pellet feed use in the production of DR pellet • The demand for DR pellet is forecast to grow strongly driven by the production of DRI/HBI in the Middle east and other Asia, led by India • This is further supported by steel decarbonisation in the EU where EAF-DRI production is forecast to grow in the future and thus driving the demand for Fe-67.5
Fe-67.5	High case	• Accelerated decarbonisation efforts, led by EU, may further increase the demand for DRI/HBI • This would drive the demand for DR pellet potentially resulting in greater demand for DR pellet feed • However, it is envisaged that the supply may struggle to keep up with the accelerated demand and thus providing higher support for Fe- 67.5 prices • Thus the high case is a lot stronger and is further supported by potential tightness in the availability of DR pellet feed
Fe-67.5	Low case	▪ New DRI/ HBI projects may not take off as per expected schedule and challenges associated with sourcing green hydrogen may impact the production of green steel via EAF-DRI process ▪ However, even with the slower decarbonisation, efforts to use higher Fe content products may not mitigate since it enables reduction of emissions

Source: Fastmarkets

NEW SLIDE

BF and DR pellet scenarios

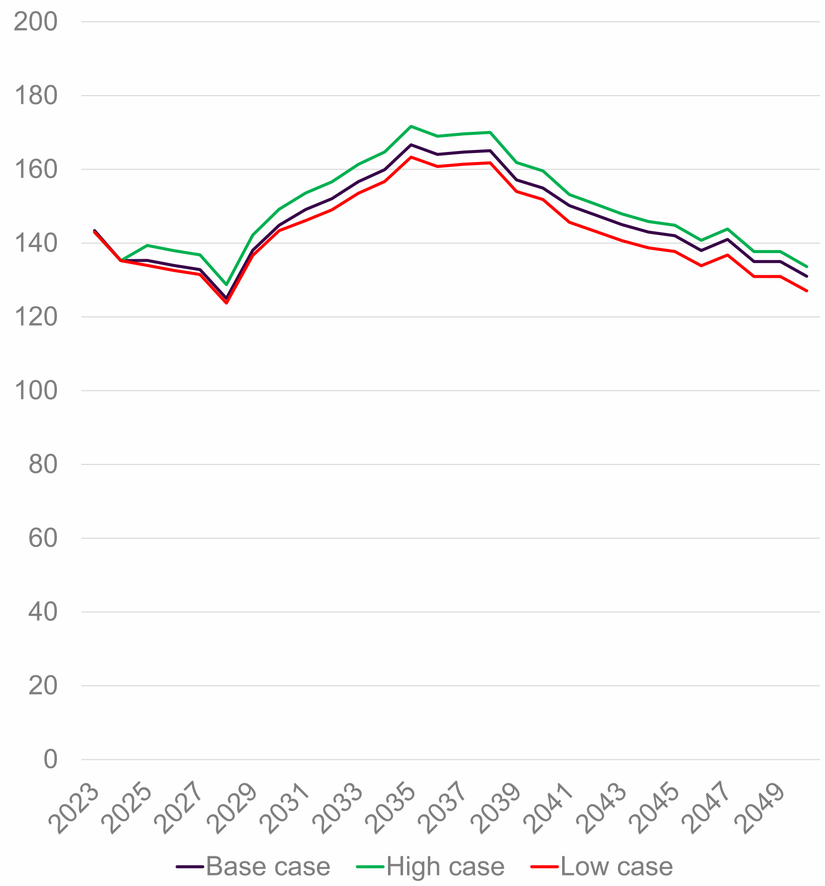
Note:

- The demand for BF grade pellet is driven by BF-BOF steel production and the. Substrate being. BF grade pellet feed
- Thus the trends for BF grade pellet broadly align with Fe-65 grade

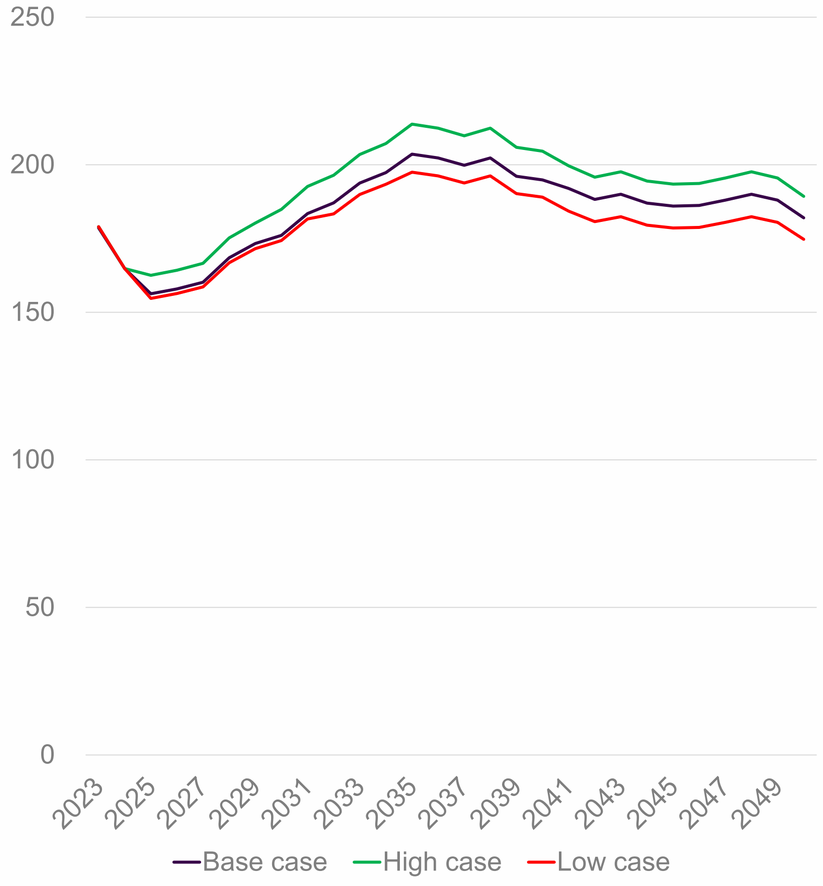
- Similarly, the demand for DR pellet is driven by DRI sbased steel production and eth substrate for DR pellet is DR grade pellet feed

- Thus the trends associated with Fe-67.5 broadly align with DR grade pellet

BF PELLET FORECAST SCENARIOS, $/T (CFR CHINA)



DR PELLET FORECAST SCENARIOS, $/T (CFR MIDDLE EAST)



Source: Fastmarkets

Contents

- Executive Summary
- Global steel production and iron ore market review
- DRI/HBI Market characterisation
- DR pellet market and forecasts
- DR pellet feed market and forecasts
- Pricing and VIU analysis
- **Green steel market developments**
- SIMEC Market positioning
- Conclusions

The demand drivers for green steel are more favourable in the EU relative to other regions, mainly driven by consumers in the automotive industry

GREEN STEEL MARKET UPTAKE IN KEY REGIONS

Region	Commentary
EU	• The interest for procuring green steel is mainly concentrated amongst the direct end users and particularly automotive sector. There is hardly any interest among the stockholders / distributors • SSAB has launched a suite of low carbon products and is understood to have shipped ~50kt of green steel products in 2023 • The premiums for green steel varies widely with very limited interest for premiums beyond euro 60/t. this is largely attributed to the lack of clear guidelines and a reasonable market and pricing structure for low carbon steel products • Currently, the EU allocates free carbon allowances to industrial producers including steel mills and the carbon price was euro 60-69/t in Jan 2024. However, free allocations are on a sliding scale and likely to end by 2034
USA	• Currently, the interest to procure green steel is mainly limited to certain industry sectors such as automotive and renewable energy installations (wind turbine) • Federal programs such as Buy Clean Initiatives lend support to procurement of low carbon emission products including green steel for government projects • Cliffs is understood to have generated some interest in attracting a premium of $44/t for its HBI based steel product
India	• India is anticipated to be the fastest growing steel market in the medium term. Majority of the new output will likely be fossil fuel based – BF-BOF and coal based DRI • There is no adequate interest amongst the consumers for procuring green steel in the domestic market in the near to medium term
China	• China intends to become net zero by 2060. Leading companies such as Baowu aim to achieve a reduction of 30% by 2030 and net zero by 2050. The companies are employing a mix of hydrogen and CCUS to achieve their goals • The urgency is felt even more amongst China's leading steel exporting companies, particularly those exporting to the EU. Measures such as CBAM will further motivate the companies to expedite their green plans

The green steel market penetration in Asia is expected to be slightly slower than the EU

GREEN STEEL MARKET UPTAKE IN KEY REGIONS

Region	Commentary
Japan	• Japanese steel industry aims to become carbon neutral by 2050. The country is heavily invested in BF-BOF based processes to produce flat products. The current use of EAF is mainly limited to long products • The country has embarked on COURSE50 path which aims to address the emissions associated with the existing BF-BOF via various energy management initiatives andCCUS. It also has programmes to migrate to EAF-HDRI when the process is technologically developed to employ on an industrial scale • The steel mills aim to achieve a 30% reduction from 2018 levels by 2030 and ultimately become carbon neutral by 2050
S. Korea	• The government of S. Korea has set a carbon reduction target of 30% from 2018 base year. This is an upgrade from previously set target of 26.3% reduction further underscoring the proactive steps being taken to ultimately achieve carbon neutrality by 2050 • POSCO is the leading steel maker in the country producing 38mtpa of crude steel and produces steel via the integrated (BF-BOF) route. It is a significant exporter flat steel products to countries all over the world • POSCO has developed a carbon mitigation strategy and its pathway includes reduction of CO2 emissions by 10% by 2030 and 30% by 2035 and ultimately becoming carbon neutral by 2050
Taiwan	• The government of Taiwan has introduced a new carbon reduction policy whereby companies emitting more than 25,000tpa of CO2 will be liable to a carbon fees • China Steel Corporation (CSC), Taiwan's only integrated flat steel producer has developed a carbon mitigation and subsequently a net zero strategy. Its pathway includes reduction of CO2 emissions by 7% by 2025 and 25% by 2030 and ultimately becoming carbon neutral by 2050

EAF-Hydrogen based DRI is one of the key technologies being actively pursued as part of decarbonisation in the EU. However, availability of fossil free electricity and green hydrogen is the key to success

INDICATIVE STEEL DECARBONIZATION PROJECTS IN THE EU

Company	Location	Country	Technology
ArcelorMittal	Sestao	Spain	Hybrid EAF
British Steel	Humber region	United Kingdom	Blue hydrogen production with carbon capture and offshore storage
Thyssenkrupp	Duisburg	Germany	Green hydrogen production
ArcelorMittal	Gijon	Spain	EAF facility with HDRI
ArcelorMittal	Ghent	Belgium	EAF+HDRI
H2 Green Steel	Svartbyn	Sweden	EAF+HDRI
LKAB	Kiruna, Malmberget, Svappavaara	Sweden	HDRI
SSAB	Raahe	Finland	BF/BOF to scrap-EAF conversion
ArcelorMittal	Dunkirk	France	HDRI and CCS
Liberty Steel	Dunkirk	France	HDRI
ArcelorMittal	Bremen	Germany	Green hydrogen production
ArcelorMittal	Bremen	Germany	HDRI
Thyssenkrupp	Duisburg (location of hydrogen use)	Germany	Hydrogen production (blue hydrogen with carbon capture and offshore storage) and HDRI
Tenaris	Dalmine	Italy	Green hydrogen production
ArcelorMittal	North Sea (Dutch region)	Netherlands	Green hydrogen production
Tata Steel	Ijmuiden	Netherlands	Green hydrogen production with a view to produce own HDRI

- To ensure that they become carbon neutral by 2050, EU steel companies have embarked on strategies to maximise the use of scrap in their BF-BOF process where still feasible and migrate to EAF based facilities in the future
- However, the existing scrap supply in the EU may not be adequate to meet the quantity and quality requirement to produce high grade flat products
- To ensure appropriate raw material feed, the steel mills are adding hydrogen based DRI facilities and aligning with their carbon neutral strategies
- Although steel mills have outlined a host of projects, the execution of such projects will be driven by the economic environment and funding availability
- The key to the success of decarbonisation projects being the availability of fossil free electricity and green hydrogen to support EAF-DRI production system

The green steel penetration in the EU flat product demand is anticipated to reach ca. 37% by 2045, driven by automotive sector and various policy initiatives supporting the uptake and investment in emission mitigation programmes

- The demand for green steel flat products in the EU has the is forecast to grow to 38mtpa by 2045
- The key drivers of this demand include automotive sector, where the OEMs have already outlined plans to incorporate a certain proportion of green steel in the automobile
- Domestic appliances sector where the volumes are much smaller is also forecast to incorporate green steel driven by customer pressure and market differentiation and brand image
- Energy sector including pipe and tube is forecast to drive some of the growth in the green steel
- Construction sector which is by far the largest consumer of steel may be slightly slower in the uptake of green steel being a highly cost sensitive sector
- However, the share of green steel in government building and infrastructure projects may strengthen

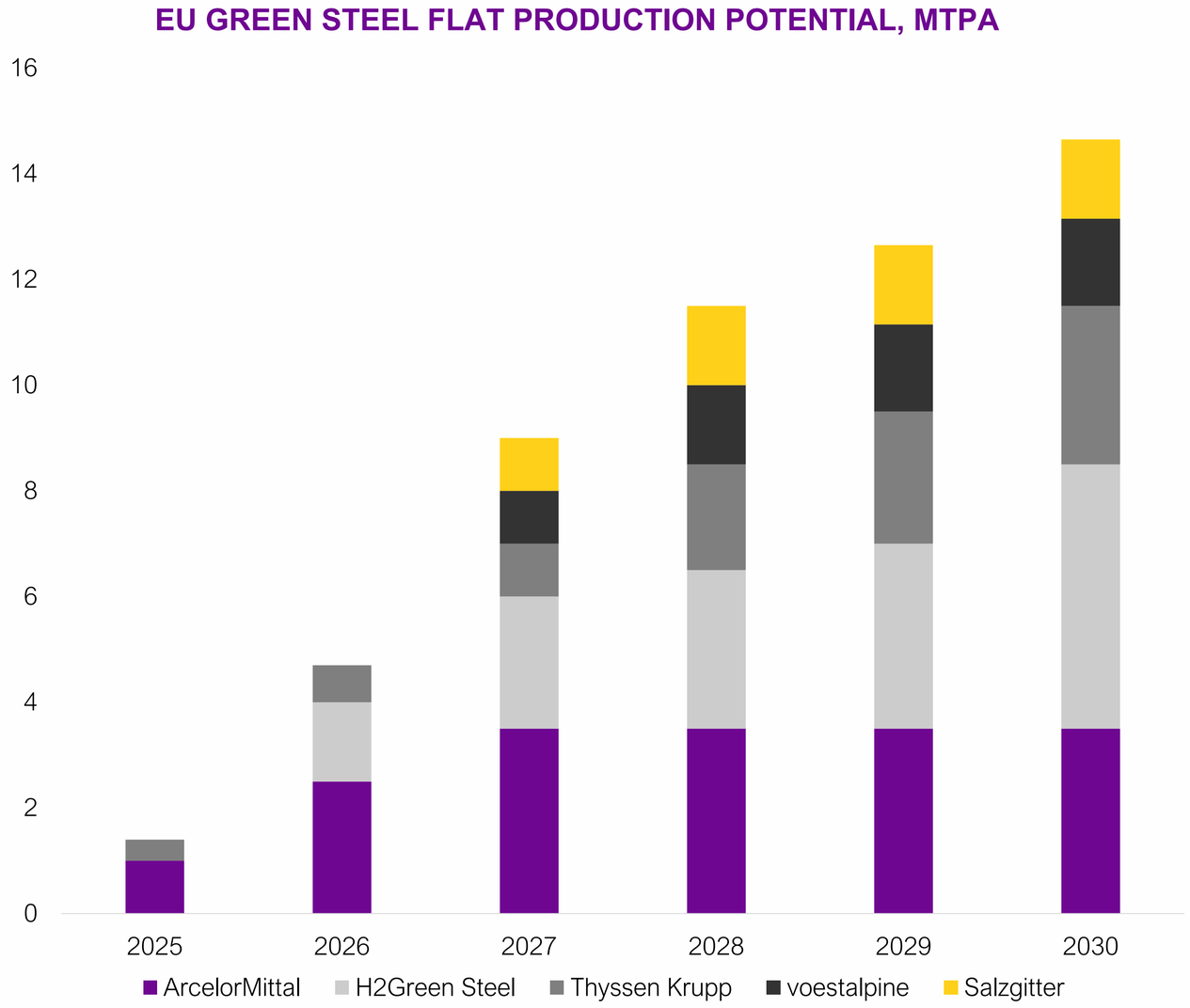
EU GREEN STEEL FLAT PRODUCT DEMAND POTENTIAL, MTPA



Source: EUROFER, Fastmarkets

The flat green steel supply in the EU is forecast to originate from existing leaders such as ArcelorMittal and TKS, supported by new players such as H2Greensteel

- The flat products production in the EU is mainly dominated by BF-BOF based process. These BF-BOF processes are being replaced with greener alternatives such as EAF-HDRI
- The demand for transition to green steel is led by automotive sector, which is a critical steel consuming sector. Automotive companies with their geographically diverse supply chain wield an enormous influence on steel decarbonisation
- EU steel mills, particularly the flat product ones, are deeply invested in the automotive sector being a high value consumer of steel
- Leading flat product producers such as ArcelorMittal and TKS have already embarked on a new green steel projects to meet their interim and long term decarbonisation goals
- In addition, there are new entrants such as H2Greensteel which aims to produce HRC from Sweden using EAF-HDRI technology



Source: EUROFER, Fastmarkets

EU steel mills aim to achieve net zero by 2050 and EAF-HDRI appears to be the most widely pursued route. However, the viability will be determined by the price and availability of green hydrogen

EU STEEL MILL DECARBONIZATION PATHWAYS

Company	Location	Base year	2030	2050	Comments
ArcelorMittal	EU wide	2018	35%	Net zero	• DRI-EAF as a transition technology in Belgium, Spain and Germany in the near to medium • CCUS • Hydrogen based DRI powered by renewable energy for the long term , >2030 • The company is also pursuing a range of other smart carbon technologies such as Carbalyst, Torero, IGAR and others to help meet its net zero targets
ThyssenKrupp	Germany	2018	30%	Net zero	• DRI-EAF as a transition technology in the near to medium • Hydrogen based DRI powered by renewable energy for the long term , >2030
Voestalpine	Austria	n/a	30%	Net zero	• DRI-EAF as a transition technology in the near to medium • Hydrogen based DRI powered by renewable energy for the long term , >2030 • The company is also pursuing CCUS technologies in addition to hydrogen based DRI
Salzgitter	Germany	n/a	50%	95%	• Implementation of SALCOS® programme • EAF-HDRI system replacing BF-BOF by 2033 • Enhanced use of scrap in the steel making
Tata Steel	Netherlands, UK	2020	30%	Net zero	• DRI-EAF as a transition technology in the near to medium at its Ijmuiden works in Netherlands
Liberty Steel	EU wide	n/a	n/a	n/a	• The company has plans to develop its iron ore assets in Australia with view to produce DR pellet feed and ultimately HBI that could be used internally or exported

EAF-Hydrogen based DRI is one of the key technologies being actively pursued as part of decarbonisation in the EU. However, availability of fossil free electricity and green hydrogen is the key to success

INDICATIVE DECARBONIZATION PROJECTS IN THE EU STEEL SECTOR

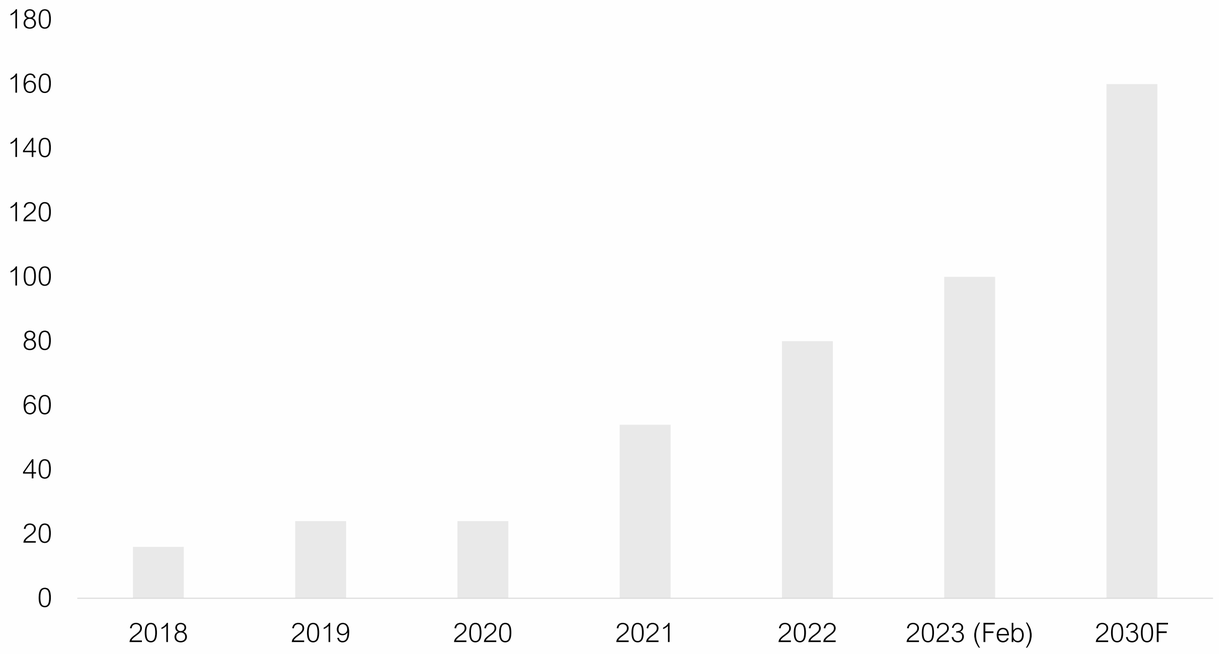
Company	Location	Country	Technology
ArcelorMittal	Sestao	Spain	Hybrid EAF
British Steel	Humber region	United Kingdom	Blue hydrogen production with carbon capture and offshore storage
Thyssenkrupp	Duisburg	Germany	Green hydrogen production
ArcelorMittal	Gijon	Spain	EAF facility with HDRI
ArcelorMittal	Ghent	Belgium	EAF+HDRI
H2 Green Steel	Svartbyn	Sweden	EAF+HDRI
LKAB	Kiruna, Malmberget, Svappavaara	Sweden	HDRI
SSAB	Raahe	Finland	BF/BOF to scrap-EAF conversion
ArcelorMittal	Dunkirk	France	HDRI and CCS
Liberty Steel	Dunkirk	France	HDRI
ArcelorMittal	Bremen	Germany	Green hydrogen production
ArcelorMittal	Bremen	Germany	HDRI
Thyssenkrupp	Duisburg (location of hydrogen use)	Germany	Hydrogen production (blue hydrogen with carbon capture and offshore storage) and HDRI
Tenaris	Dalmine	Italy	Green hydrogen production
ArcelorMittal	North Sea (Dutch region)	Netherlands	Green hydrogen production
Tata Steel	Ijmuiden	Netherlands	Green hydrogen production with a view to produce own HDRI

- To ensure that they become carbon neutral by 2050, EU steel companies have embarked on strategies to maximise the use of scrap in their BF-BOF process where still feasible and migrate to EAF based facilities in the future
- However, the existing scrap supply in the EU may not be adequate to meet the quantity and quality requirement to produce high grade flat products
- To ensure appropriate raw material feed, the steel mills are adding hydrogen based DRI facilities and aligning with their carbon neutral strategies
- Although steel mills have outlined a host of projects, the execution of such projects will be driven by the economic environment and funding availability
- The key to the success of decarbonisation projects being the availability of fossil free electricity and green hydrogen to support EAF-DRI production system

The EU carbon prices are forecast to rise significantly in the future as the free EU carbon allowances are phased down over the next 10 years

- The ETS CO2 auction prices has been a market marker to assess potential carbon price in the EU
- The auction prices have risen drastically since 2019 -20 from Euro 24/tCO2 and has peaked in Feb 2023 at Euro 100/tCO2
- The prices are likely to strengthen even further with the proposed reduction of free allowances starting 2026. It is envisaged that when the free allowances get phased out completely the only functioning carbon price will be a free market price
- However, in the run up to the reduction of free allowances, it is likely that the carbon prices reach beyond euro 160/tCO2 by 2030 and increase even further as the free allowances become zero

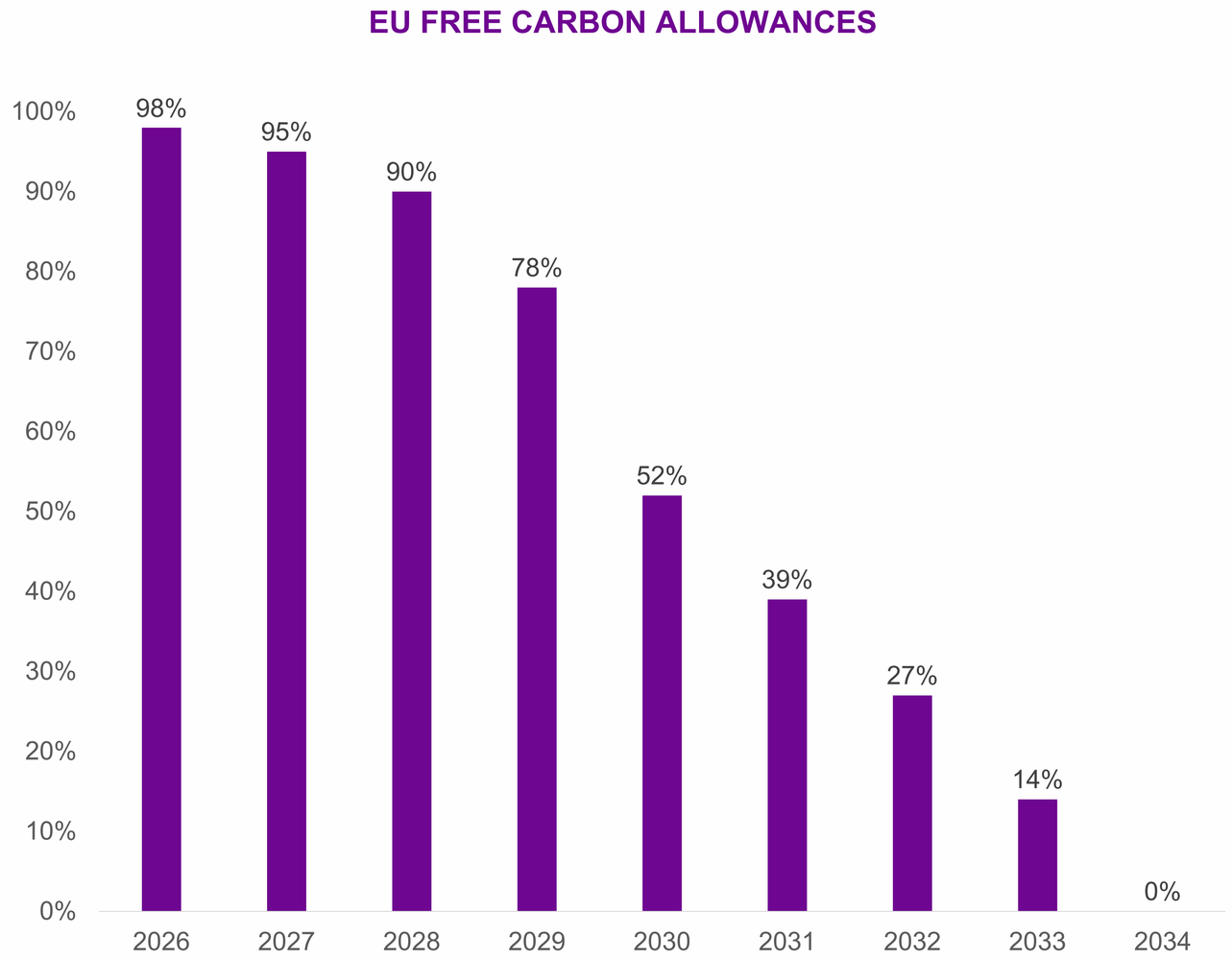
ILLUSTRATION OF EU ETS CO2 AUCTION PRICES AND MARKET FORECAST, EUROS/TCO2



Source: EEX, EURACTIV, Fastmarkets

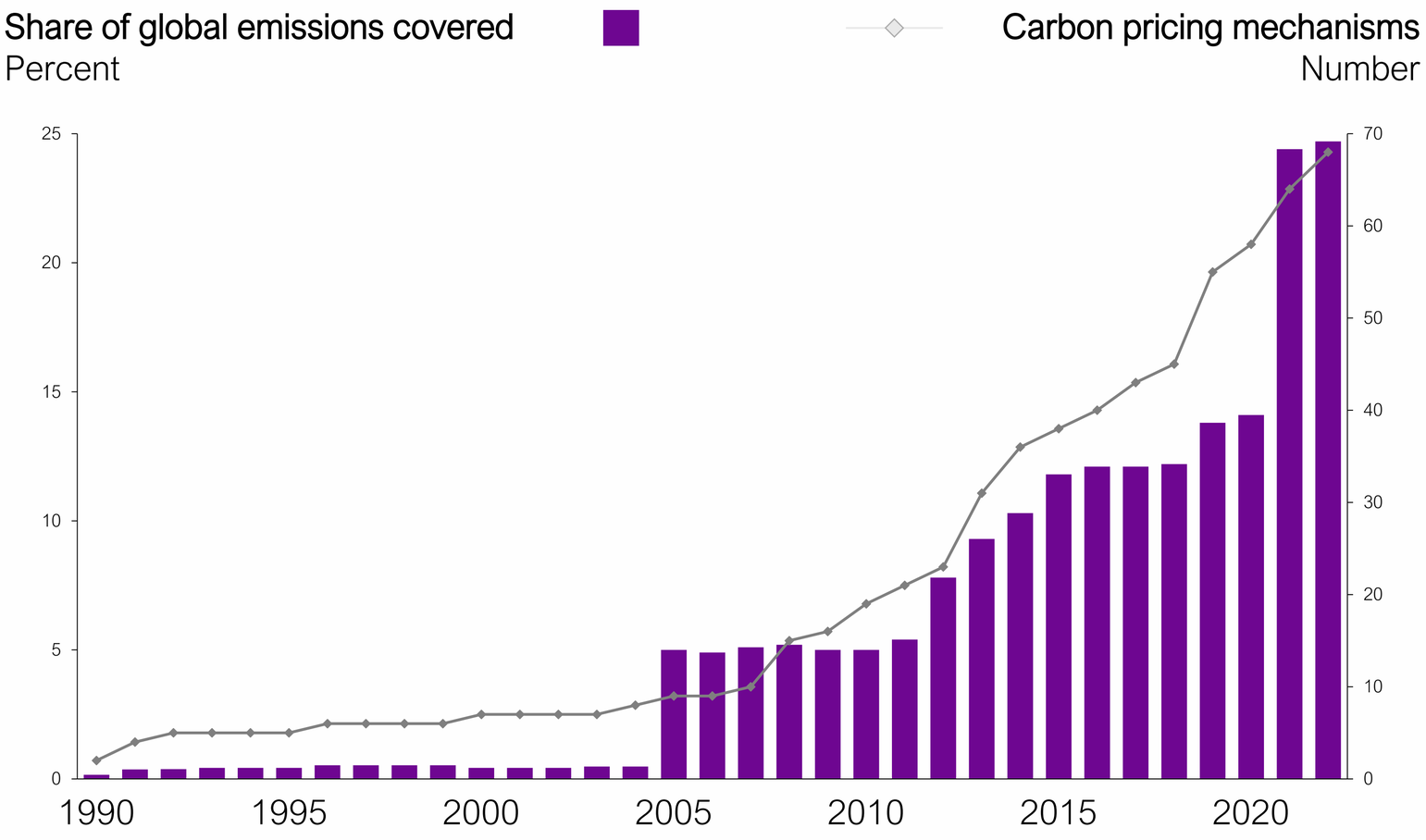
EU’s free carbon allowances are anticipated to decline over the next 10 years leading to a complete elimination in 2034

- Currently, the EU allocates free carbon allowances to some of the sectors and subsectors under the risk of carbon leakage and steel being one of them
- The free allowances cover majority of the steel mills carbon emissions. Any deficit is bought via auctions
- With the potential enforcement of CBAM in 2026, there will be a phased withdrawal of free carbon allowances. As a result, the steel mills will have to buy more allowances from the market impacting their cost competitiveness
- Although the EU BF-BOF mills have embarked on technology transition from BF-BOF to EAF-HDRI process, it is highly unlikely that such a transition will be carried out by 2030



Almost 25% of global emissions are covered by pricing mechanisms

Growth of carbon pricing mechanisms

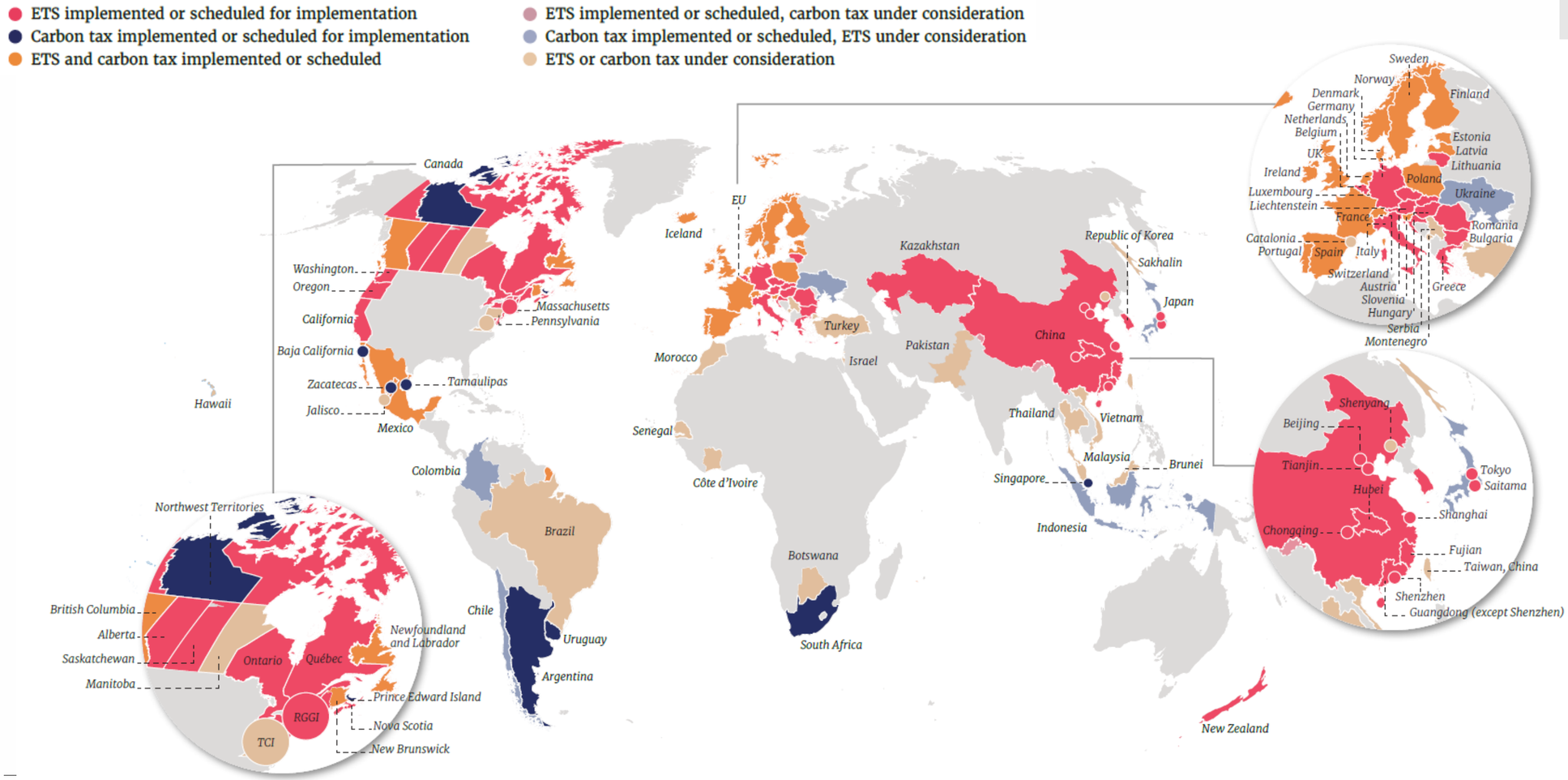


- Pricing carbon is considered a highly effective tool for reducing emissions, by imposing a cost on emitters and rewarding those that reduce their emissions below target levels or remove carbon from the atmosphere (e.g., through afforestation)
- The number of carbon pricing mechanisms, and the share of global emissions they cover, have grown rapidly over the last decade
- In 2022 there were 68 mechanisms globally covering almost 25% of global carbon emissions – up from only 19 mechanisms and 5% of emissions in 2010
- These include cap-and-trade systems (e.g., the EU ETS) and carbon tax (e.g. Japan, Canada)

SOURCE: World Bank (as of 2022)

Carbon pricing mechanisms are gathering momentum globally

Carbon pricing mechanisms globally



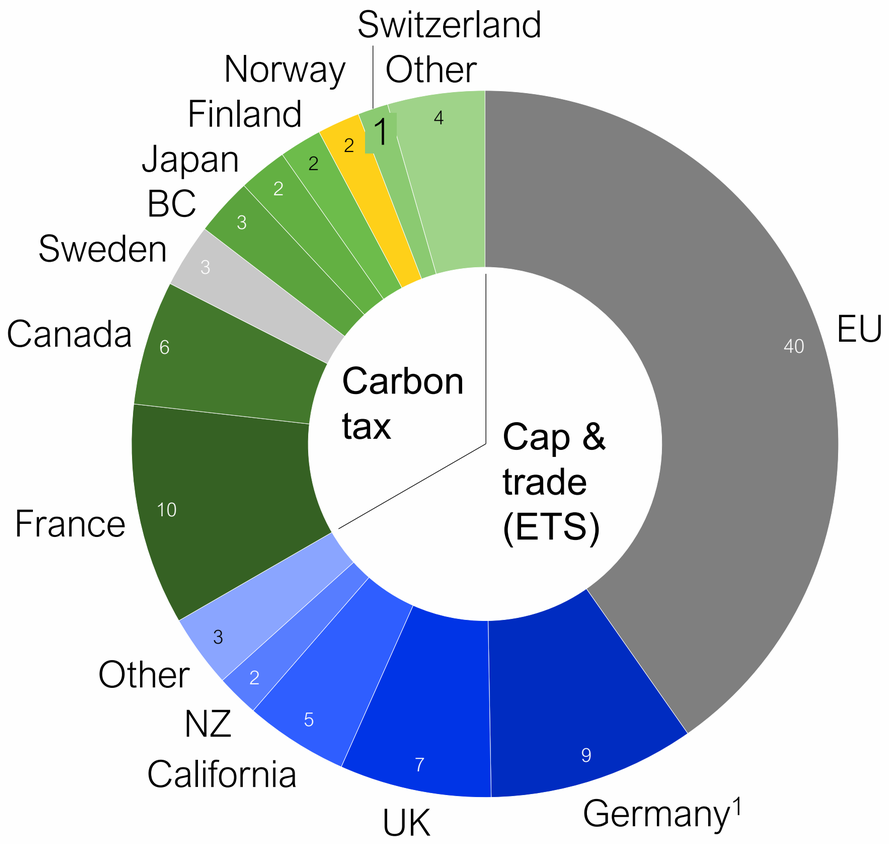
- There are almost 70 carbon pricing mechanisms in place around the world
- They are concentrated in North America, Europe, Asia and Latin America
- Emissions Trading Schemes (ETS) are generally most popular, but carbon taxes are also common – some jurisdictions use both.

SOURCE: World Bank (as of 2022)

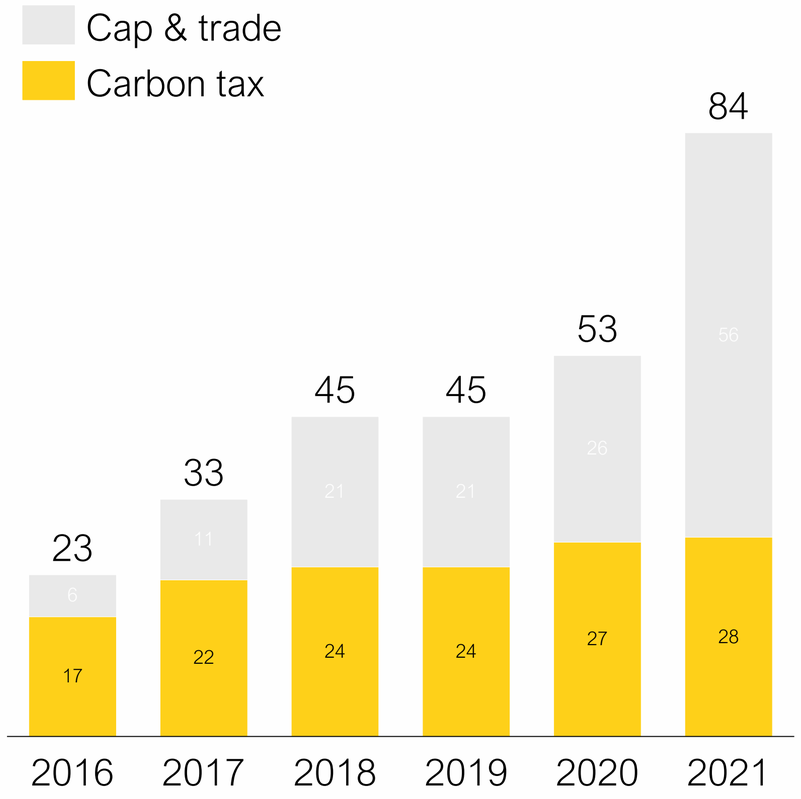
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There is a strong pivot from carbon taxes to market-based systems

Carbon pricing instruments, revenue in 2021
100% = 84 USD billion



Carbon pricing revenue growth
USD billion



- Pricing mechanisms have shifted from carbon taxes to market based systems, e.g. EU emissions trading system
- Rather than regulators setting a price on carbon, they cap allowable emissions and let participants trade their emissions rights – they may either use that right, or sell it to the highest bidder
- Often, participants can opt to buy credits to offset their emissions, from recognized crediting mechanisms.

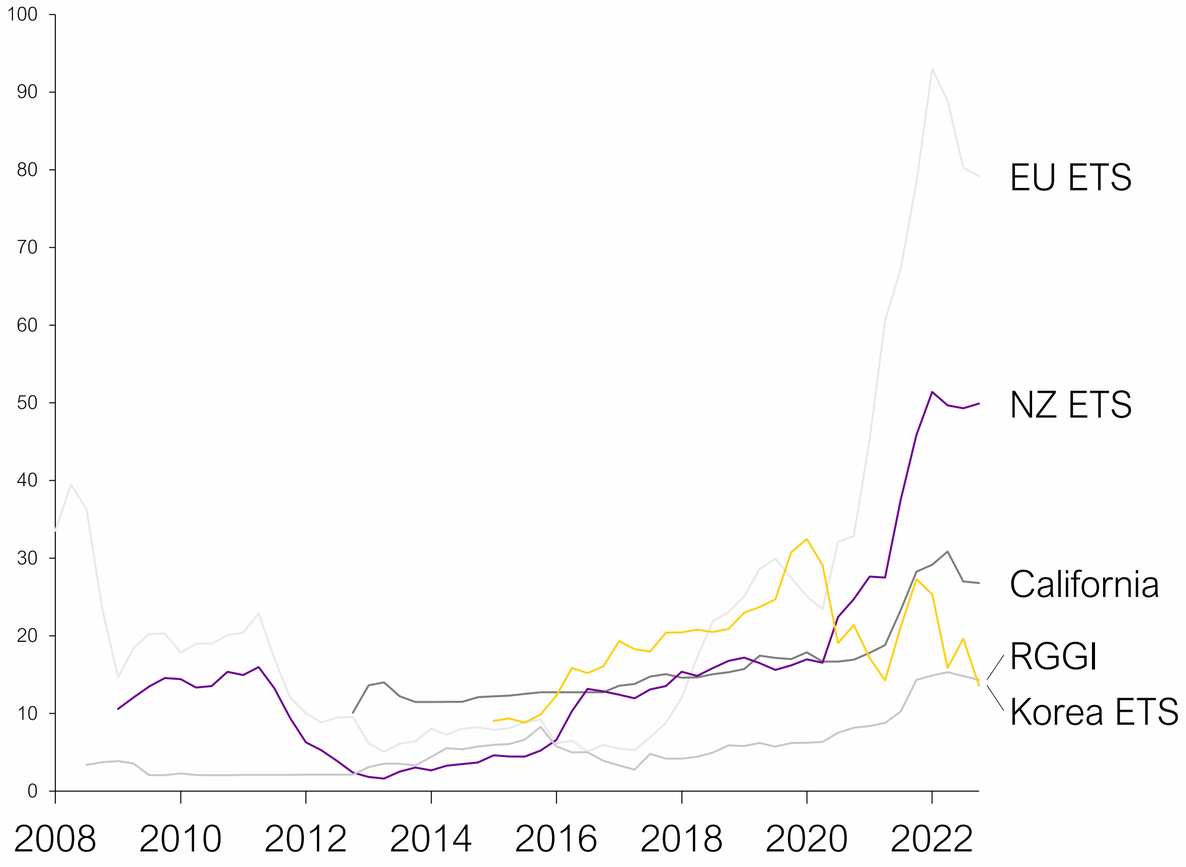
1. The German emissions trading scheme (ETS) includes some emissions not covered by EU ETS, e.g. heating and road transport

SOURCE: World Bank

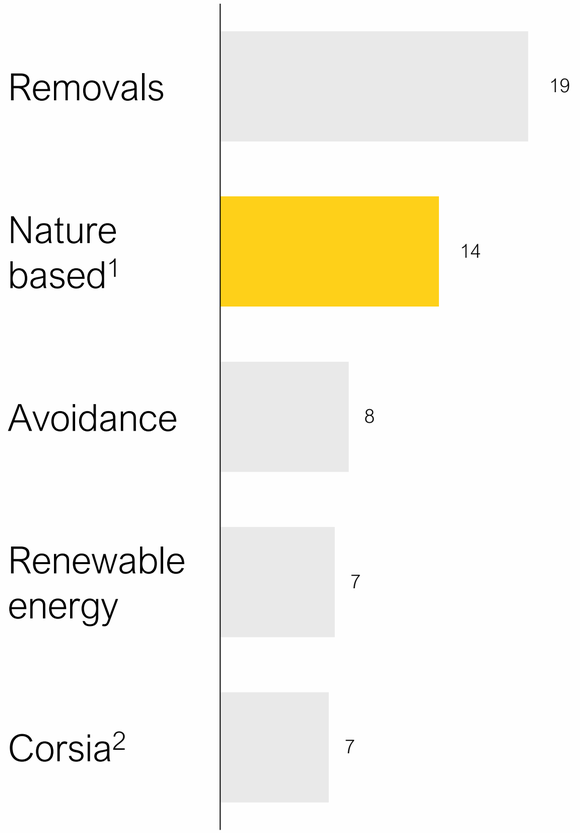
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Prices are rising for carbon emission allowances, and credits from nature-based projects sell at a premium

Global carbon prices on leading exchanges; USD / tonne



Prices by project type, 2022 Q1; USD / tonne



- Prices for carbon credits have risen sharply on most exchanges in 2021 and 2022 – especially on the EU ETS, rising to almost USD 100 per tonne, but also on smaller exchanges including the NZ ETS and California cap-and-trade
- The price for nature-based credits are higher than most other project types, except removals (e.g. carbon capture and storage).

1 Including forestry (e.g. avoided deforestation, afforestation, improved forest management); 2. Mix of credits eligible for use in Carbon Offsetting and Reduction Scheme for International Aviation

SOURCE: ICAP Allowance Price Explorer; World Bank

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Some of the major Asian producers are pursuing BF based transformation in the near to medium term and eventually migrating to HDRI in the long term

KEY STEEL MILL PATHWAYS TO CARBON NEUTRALITY

Company	Country	Technology pathway	
		BF-BOF	EAF-DRI
POSCO	S. Korea	▪ Hydrogen injection	▪ Build large EAFs by 2030 ▪ Develop hydrogen based DRI technology (HyREX) ▪ Coal based DRI – CCUS (FINEX)
Hyundai Steel	S. Korea	• Natural gas/ COG/H2 injection • Pellet + HBI injection	▪ Build new EAFs ▪ Develop hydrogen based DRI technology (Hy-Cube
Nippon Steel	Japan	▪ Hydrogen injection	▪ Build large EAFs by 2030
JFE	Japan	▪ Carbon recycling	▪ Build large EAFs by 2030
CSC	Taiwan	▪ Hydrogen injection ▪ Charging of DR nuggets in blast furnace ▪ Greater use of scrap in BOF	

Source: Fastmarkets

Japanese steel majors focus on BF-BOF technology improvements in the near term while exploring partnerships to produce DRI in the GCC region for the long term

- Japanese steel industry aims to become carbon neutral by 2050. The decarbonization targets of Japanese steel mills are broadly aligned towards this overarching goal
- The path ways are broadly similar, focusing on improving the existing BF-BOF process till such time the EAF –HDRI process is technologically developed to employ on an industrial scale. Currently, trials are afoot mainly on a pilot scale in Europe
- The steel mills aim to achieve a 30% reduction from 2013 levels by 2030 and ultimately become carbon neutral by 2050
- The Japanese mills aim to employ COURSE50 program in the near to medium term (2035), which involves optimising BF-BOF and using low carbon raw material inputs including hydrogen to reduce the overall carbon emissions. The long term strategy involves installation of large EAFs and using hydrogen based DRI as a key input material
- Hydrogen is forecast to play a key role in the transformation both in medium and long term

JAPANESE STEEL MILL PATHWAYS TO CARBON NEUTRALITY

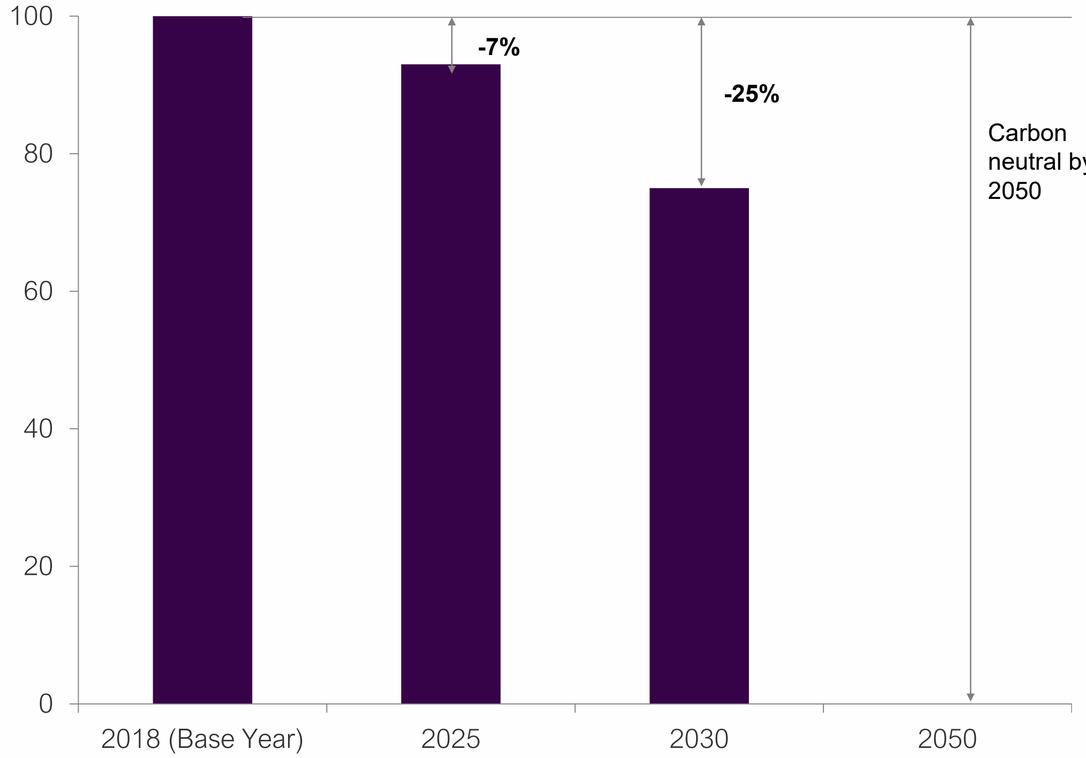
Company	CO2 reduction target			Comments
	Base year	2030	2050	
Nippon Steel	2013	30%	Carbon neutral	• COURSE50 technology (Hydrogen in BF) • Large scale EAFs • EAF-DRI with 100% H2
JFE	2013	30%	Carbon neutral	• Focusing on BF route with CCUS • The company envisages a 20% of CO2 • Large scale EAFs • Discussions with Emirates Steel Arkan for potential partnership to produce DRI
Kobe	2013	30-40%	Carbon neutral	• Utilising AI to obtain operational efficiencies in the BF-BOF • MIDREX NG and MIDREX H2 to produce DRI from low grade iron ores • Large scale EAFs • Discussions with Oman's Public Authority for Special Economic Zones and Free Zones to explore low carbon DRI production in Oman

Source: Fastmarkets

DRI injection in blast furnace is one of the key elements being considered at CSC, Taiwan, as part of its carbon neutrality pathway

- The government of Taiwan has introduced a new carbon reduction policy whereby companies emitting more than 25,000tpa of CO2 will be liable to a carbon fees. The programme is due to commence in 2025 and 2024 emissions will be used as a basis for applying carbon fees. However, the carbon fees is still being worked out
- China Steel Corporation (CSC) is the only integrated (BF-BOF) steel producer in Taiwan and is a key exporter of flat rolled steel products to Europe and elsewhere. It produced ~12mtpa of crude steel (BOF) and ~13mtpa of pig iron (BF) in 2022
- CSC has developed a carbon mitigation and subsequently a net zero strategy. Its pathway includes reduction of CO2 emissions by 7% by 2025 and 25% by 2030 and ultimately becoming carbon neutral by 2050
- Key technological interventions include charging of DRI (nuggets) in BF, incrementally replacing coke with Hydrogen in the BF and increasing use of scrap in the BOF
- With the technological aspects still under development, it is probable that CSC may import DRI intermittently until it becomes self-sufficient. However, the import volumes will be determined by the progress in the implementation of the technology

CSC TAIWAN CO2 MITIGATION PATHWAY (INDEXED)

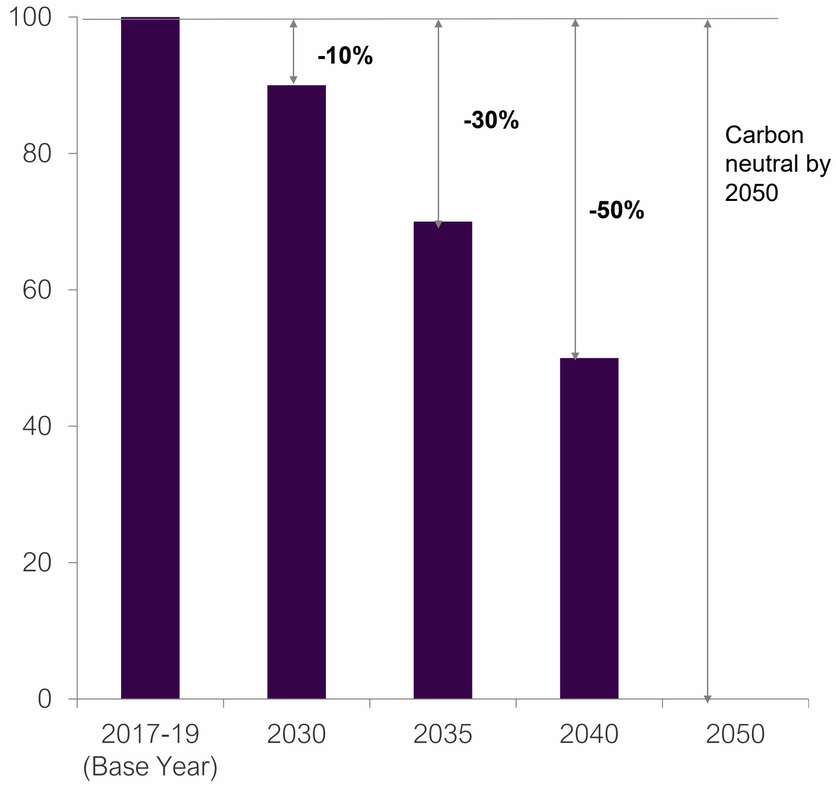


Source Fastmarkets

POSCO intends to achieve carbon neutrality by 2050. It is envisaging the replacement of BF-BOF processes with EAF-DRI (including Hydrogen)

- The government of S. Korea has set a carbon reduction target of 40% from 2018 base year. This is an upgrade from previously set target of 26.3% reduction further underscoring the proactive steps being taken to ultimately achieve carbon neutrality by 2050
- POSCO is the leading steel maker in the country producing 38mtpa of crude steel and produces steel via the integrated (BF-BOF) route. It is a significant exporter flat steel products to countries all over the world
- POSCO has developed a carbon mitigation strategy and its pathway includes reduction of CO2 emissions by 10% by 2030 and 30% by 2035 and ultimately becoming carbon neutral by 2050
- The company has drawn up several technological options to enable it to achieve carbon reduction goals. On a long term basis, the company is planning to use hydrogen based DRI (HyREX) and / or coal based DRI (FINEX) with CCUS to enable carbon neutrality. However, in the interim, it is considering use of hydrogen in blast furnace, increasing the use of pellet, higher use of scrap etc. to reach medium term goals
- It is partnering with Engie to develop a Hydrogen based DRI plant in Port Hedland, Australia as part of its strategy to transition from BF-BOF to EAF-HDRI and plans are afoot to conduct a feasibility study

POSCO CO2 MITIGATION PATHWAY (INDEXED)

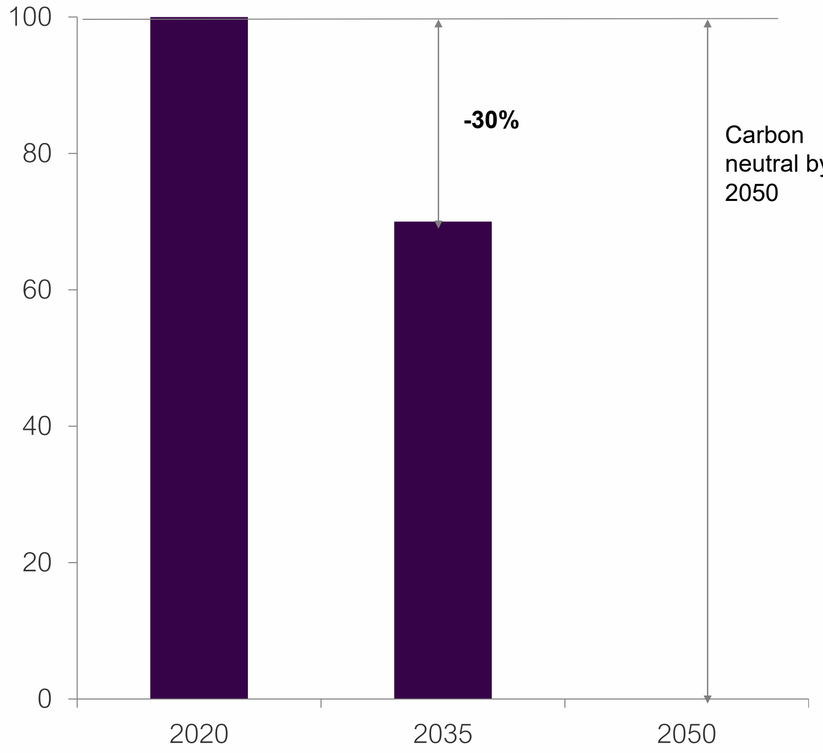


Source: Fastmarkets

BaoWu intends to achieve carbon neutrality by 2050. Its technology options include HyCORF among others

- China's BaoWu is the world's largest steel producer and produced 131mtpa of crude steel in 2022. The production route employed is predominantly BF-BOF
- The company has a wide range of product portfolio supplying to customers in China and overseas. Consistent with the global trends towards steel decarbonisation, BaoWu has launched its own programme aiming at reducing its carbon footprint in the near and medium term and ultimately becoming carbon neutral by 2050
- BaoWu's decarbonisation strategy involves includes mitigating the carbon footprint of its BF-BOF process in the medium term with a view to migrate to EAF-HDRI in the long term
- The company plans to install HyCORF process which involves admission of hydrogen enriched carbonic oxide in the blast furnace and external hydrogen produced using clean energy route. Any CO2 generated from the system will be further processed vis CCUS and supplied to oil and gas and chemical industries
- In addition, a hydrogen based DRI module and EAF will be added to the industrial complex to further reduce the carbon footprint of the steel product in the long term

BAOWU CO2 MITIGATION PATHWAY (INDEXED)



Source: Fastmarkets

Contents

- Executive Summary
- Global steel production and iron ore market review
- DRI/HBI Market characterisation
- DR pellet market and forecasts
- DR pellet feed market and forecasts
- Pricing and VIU analysis
- Green steel market developments
- **SIMEC Market positioning**
- Conclusions

SIMEC aims to produce 2.5mtpa of DR pellet feed in the first phase with a high Fe content and a low gangue content that aligns with DR pellet feed requirement

- SIMEC plans to produce 2.5mtpa of DR pellet feed in the first phase of its project - MEP1 and subsequently scale up to 7.5mtpa - MEP2. The focus of this analysis is MEP1
- Under MEP1, the company aims to produce DR pellet feed conforming to Spec 1 , as provided by the company, aggregating to 2.5mtpa
- Spec 1 is characterised by high Fe content of 70.45% with a relatively lower gangue content of 1.89%
- The gangue(SiO2 + Al2O3) content of the company's products align with a typical DR pellet feed, which require it to be <3%

SIMEC DR PELLET FEED PRODUCT SPECIFICATION

Item	Unit	Spec 1
Fe (total)	%	70.45
SiO2	%	1.8
Al2O3	%	0.09
CaO	%	0.1
MgO	%	0.28
S	%	0.04
P	%	0.01
Moisture	%	8.7
Na2O	%	0.02
K2O	%	0
Mn	%	0.07
TiO2	%	0.03
LOI	%	-2.88
>0.15mm	%	70.45

Source: SIMEC and Fastmarkets

NEW SLIDE

SIMEC's products has a higher Fe content content relative to some of the leading players in the market

SIMEC DR AND BF PELLET FEED CHEMISTRY VS COMPETITORS

		DR	DR	DR	DR	DR	DR	DR	BF	BF	BF
		SIMEC Spec 1	Champion	CMP-HUASCO	Vale Tubarao	CSN	Shougang	Kaunis	Minas Rio	Vale	IOC
Element	Unit	Australia	Canada	Chile	Brazil	Brazil	Peru	Sweden	Brazil	Brazil	Canada
Fe (total)	%	70.45	68.5	68	68	67	68	69	67.2	66.5	65.7
SiO2	%	1.8	1	2.35	0.95	1.9	2	1.1	2.7	2.5	4.5
Al2O3	%	0.09	0.2	0.8	0.5	0.7	0.5	0.2	0.5	0.7	0.2
CaO	%	0.1	0.1					0.05	0.04		0.05
MgO	%	0.28	0.02					2.2	0.04		0.05
S	%	0.04	0.02	0.03			0.22	0.04	<0.01	0.003	0.005
P	%	0.01	0.04	0.03	0.032	0.045	0.02	0.02	0.043	0.045	0.01
Moisture	%	8.7		8.75			8.5	9	8-9		4
Na2O	%	0.02	0.005						0.005		
K2O	%	0	0.005						0.02		
Mn	%	0.07			0.05	0.4	0.02	0.05	0.06	0.15	0.05
TiO2	%	0.03	0.005					0.05	0.09	0.5	0.05
LOI	%	-2.88					0.6	-2.9	0.5		0.2

Note:
- The specifications outlined above are not comprehensive and is only for comparison purposes at a high level
- The items have been presented to the extent information is available and hence the information may not be homogeneous across all the producers

Source: SIMEC and Fastmarkets

NEW SLIDE

SIMEC potential customers

- SIMEC's product has a high Fe content and low gangue elements that is valuable to the DR pellet producers.
- Bahrain Steel is one of the leading DR pellet producers and is reliant entirely on external feed supply.
- SIMEC is geographically better positioned to serve Asian pellet producers especially those in China and Japan
- Asian pellet feed customers are mainly BF pellet producers and may not be able to attribute similar value to SIMEC product the way a typical DR pellet producer may do
- However, Asian pellet producers are far more fragmented as opposed to highly concentrated DR pellet producers. Thus, the risk is somewhat reduced at the expense of potentially lower price realisation

SIMEC POTENTIAL CUSTOMER OFFTAKE , MTPA

Company	Country	Pellet production capacity, mtpa	Pellet type	Estimated pellet feed demand	Potential SIMEC share	Potential SIMEC shipments
Bahrain steel	Bahrain	12.2	DR	12.6	6%	0.8
Kobe Steel	Japan	4	BF	4.1	4%	0.2
BaoWu	China	10	BF	10.3	4%	0.4
Anshan	China	10	BF	10.3	4%	0.4
AM/NS	India	14	BF/DR	14.4	3%	0.4
Trade/ other			BF/DR			0.3
Total						2.5

NEW SLIDE

SIMEC key customer profile

Company	Country	SIMEC's proposed shipments, Mtpa	Strengths	Challenges
Bahrain steel	Bahrain	0.8	• Product quality well aligned with DR pellet production • More flexible in terms of product quality since the company already employs several suppliers • It has the potential to displace other competitors due to its strong product attributes, particularly that of Spec 1	• Strong existing competition • New suppliers such as Champion (Canada) are developing DR pellet feed products with low impurity levels
Kobe Steel	Japan	0.2	• Good product quality relative to competition	• Potential competition from Australian peers • Difficult to ascertain the same value as DR pellet feed since Kobe produces BF grade pellet
BaoWu	China	0.4	• Good product quality relative to competition • Geographical proximity	• Stiff competition from established suppliers
Anshan	China	0.4	• Good product quality relative to competition • Geographical proximity	• Stiff competition from established suppliers
AM/NS	India	0.4	• Fast growing market in Asia • Domestic supply not keeping up with the requirement	• Has access to own ore via its captive mines • Domestic suppliers such as NMDC may pose stiff competition
Trade/ other		0.3	• regular offtake • Reduced SG&A expenses	• Limited scope to strengthen end user market knowledge • Limited scope to build direct presence in the market
Total		2.5		

SIMEC key customer profile

SIMEC ROUTE TO MARKET

Route to market	Pros	Cons
Own sales and distribution	• Enhanced customer relationships • market intelligence and hence better pricing capability • Customer knowledge especially with technology developments and potential influence on product demand • Inventory management	• Higher operational costs • Sunk cost in any physical infrastructure such as distribution centres • Capital outlay • Expensive logistics
Trade sales	• Volume assurances and thus enables better production planning • Limited need for expensive sales and distribution network • Logistics handled by trader	• Indirect customer relationship • Limited knowledge of the market
Partnership with other pellet feed supplier	• Shared distribution infrastructure • Cost effective due to scale • Inventory management	• Conflicts of interest with customers • Challenges in developing a workable agreement • Protecting customer intelligence
Partnership with steel mill	• Offtake assurance • Better pricing environment due to direct dealing • Product alignment	• Exposure to a very small customer base

SIMEC’s DR pellet feed products are cost competitive on delivered basis to Middle east

- SIMEC’s DR pellet feed is cost competitive when supplied to DR pellet producers in the Middle east and North Africa
- In addition, SIMEC’s products attract value driven by higher Fe content and lower gangue content, which are particularly valuable to DR pellet producers
- In case of supply as a BF pellet feed, SIMEC is more cost effective supplying to a Japanese steel mill relative to a European one mainly due to lower freight costs
- SIMEC FOB costs are as provided by the company

SIMEC PELLET FEED DELIVERED COST ESTIMATES, $/T (Q4 2023 BASIS)

Item	Bahrain	Algeria	EU	Japan
FOB cost (operating+ capital charges)	61	61	61	61
Ocean freight : Whyalla to customer port	20	22	25	8
Freight : Destination port to customer	10	10	10	10
Other costs including port handling	10	10	10	10
Total CFR basis	101	103	106	89
Logistics				
Vessel	Capesize	Capesize	Capesize	Capesize
Consignment size, kt	160-200	160-200	160-200	160-200
Spec 1 VIU prices CFR Middle east, $/t	133(2023)			

Source: SIMEC and Fastmarkets

SIMEC’s Spec 1 has the potential to attract a higher value when assessed on Fe-67.5 index

SIMEC 1 VIU CALCULATION

THEORETICAL VIU CALCULATION OF SIMEC 1 ON FE-65 AND FE 67.5 BASIS, $/TONNE (REFERENCE : 2023 ANNUAL)

SIMEC 1	65 basis					67.5 basis			
	%	$/t	%	$/t		%	$/t	%	$/t
Iron ore base price	65	130	70.5	130		67.5	139.9	70.45	139.9
Fe content bonus	1.00	2.3	0.0	12		1.0	2.3	0.0	6.7
Phosphorous	0.10	-0.2	0.0	0		0.1	-0.2	0.0	0.0
Alumina	2.00	-3.9	0.1	7		2.0	-3.9	0.1	7.5
Silica	3.50	-1.8	1.8	3		3.5	-1.8	1.8	3.0
Total pellet feed, CFR China				153.0					157.0
Freight net back China Middle east				-7.00					-7.00
DR pellet feed cfr Middle east				146.02					150.01

Note:
- The above theoretical calculation was performed to illustrate relative VIU of various DR pellet feed products exclusively based on chemistry and Fastmarket prices and premium/penalties
- Bonus/ penalty is calculated on $/ unit % basis (calculation example - Fe content bonus for 70.45 : (70.45-65)*2.3 = 12)
- There may be other elements not considered in the above calculation that could impact the overall premium/ penalty attracted by the product

Source: Fastmarkets

NEW SLIDE

Illustration of pellet feed chemistry across SIMEC's potential competitors

ILLUSTRATION OF PELLET FEED CHEMISTRY ACROSS KEY SUPPLIERS

Company	Units	SIMEC 1	Minas Rio-BFPF	Minas Rio - DRPF	Vale-Tubarao PFFT	Vale Tubarao-Oman DRPF	CSN DRPF	Shougang	CMP	Kaunis	China domestic-1	China domestic-2	Champion 1	Champion 2	IOC
Country		Australia	Brazil	Brazil	Brazil	Brazil	Brazil	Peru	Chile	Sweden	China	China	Canada	Canada	Canada
Fe (total)	% (min)	70.45	67.2	68	66.5	68	67	68	67	69	66.6	63.5	67.5	68.5	65.7
FeO	%		0.3	0.3					30		27.2	21.7			18
SiO2	% (max)	1.8	2.7	1.3	2.5	0.95	1.9	2	4	1.1	5.9	8.7	2.75	1	4.5
Al2O3	% (max)	0.09	0.5	0.5	0.7	0.5	0.7	0.5	0.75	0.2	0.6	1.1	0.27	0.2	0.2
CaO	% (max)	0.1	0.04	0.04					0.55	0.05	0.34	0.03	0.1	0.1	0.05
MgO	% (max)	0.28	0.04	0.04					0.3	2.2	0.33	0.18	0.1	0.02	0.05
S	% (max)	0.04	<0.01	<0.01	0.003			0.22		0.04	0.051	0.06	0.007	0.02	0.005
P	% (max)	0.01	0.043	0.043	0.045	0.032	0.045	0.02	0.045	0.02	0.005	0.046	0.014	0.04	0.01
moisture	% (max)	8.7	8-9	8-9				8.5		9					4
Na2O	% (max)	0.02	0.005	0.005							0.06	0.01	0.02	0.005	
K2O	% (max)	0	0.02	0.02							0.09	0.02	0.01	0.005	
Mn	% (max)	0.07	0.06	0.06	0.15	0.05	0.4	0.02	0.2	0.05	0.07	0.2			0.05
TiO2	% (max)	0.03	0.09	0.09	0.5					0.05			0.16	0.005	0.05
LOI	% (max)	-2.88	0.5	0.5				0.6	2.2	-2.9					

Note:
- The values in the above table are not comprehensive and serves to just highlight the key differences across suppliers
- The values shown are only indicative and should not be construed as a definitive assay of a particular product in the market
- The product offerings are subject to change and the chemistry may vary from time to time

Vale and Minas Rio are key competitors to SIMEC in seaborne DR pellet feed markets

SEABORNE PELLET FEED (BF AND DR) COMPETITORS

Company	Country	Comments	SIMEC implications
Minas-Rio	Brazil	• Established player in the industry • Excellent product with a very high Fe grade and low impurities • Key supplier to China • Product mix also includes sinter feed from Kumba and wide customer base • Strong presence in the middle eastern DR pellet feed market	• Being an early incumbent in the industry especially Chinese pellet feed market, Minas Rio has already invested adequate resources in developing market acceptance of the product • Pellet feed is a strategic product for Minas Rio and likely to ensure all support and investment to continue to retain its position
Vale	Brazil	• Established player in the industry with a wide product mix • Excellent product with a very high Fe grade and low impurities • Key supplier to China • Has a wide customer base in China and Europe for pellet feed and sinter fines • Strong presence in the middle eastern DR pellet feed market with own pellet plants • Large operating scale across multiple iron ore products including pellet	• The operating scale of Vale is significantly larger than SIMEC • Vale has dedicated logistics infrastructure in Brazil and in some of its key export markets • Not a strategic seaborne pellet feed supplier since it has its own pellet production capability

Other potential competitors may be IOC and CMP

SEABORNE PELLET FEED (BF AND DR) COMPETITORS

Company	Country	Comments	SIMEC implications
CMP	Chile	• Major producer and exporter of pellet feed in Chile accounting for ~60% of the product mix • Has own steel mill and consumes some of the production in-house • High Fe concentrate and produces pellet feed, pellet, and sinter feed • Product's gangue content slightly exceeds 3%	• Could be a significant competitor in BF grade pellet feed markets • Company may further develop its capability to supply DR pellet feed or even DR pellet to take advantage of its high Fe content
IOC	Canada	• One of the leading exporters of pellet into Europe • In addition, it is also an exporter of pellet feed to customers in Europe middle east and China • Product has a relatively higher SiO2 levels • The port and rail infrastructure is shared by other pellet feed suppliers in the region	• With several new suppliers building iron ore assets in the Labrador region, there may be challenges in getting appropriate infrastructure support such as rail corridor and port facilities and potentially delay supplies into the market • An established player in the market with dedicated customers in Europe and middle east

SIMEC’s product has the potential to attract additional value for DR pellet feed due to higher Fe and lower gangue

SEABORNE PELLET FEED (BF AND DR) COMPETITORS

Company	Country	Comments	SIMEC implications
Shougang	Peru	• Key exporter of pellet feed and sinter feed to China • Relationship with Shougang • High grade pellet feed • Broad product mix which includes sinter feed, pellet feed, pellet	• Dedicated mining company in Peru focusing on sinter feed, pellet and pellet feed products
Champion	Canada	• New player in the market dedicated to supplying high grade iron ore products including pellet feed • Mainly supplies to customers in Asia and Middle east accounting for 95% of the sales with Asia being 79%	• Plans to develop other assets of similar in product mix and scale • Strengthening its presence in growing pellet feed markets such as China
Sino Iron project	Australia	• Key exporter of pellet feed and sinter feed to China • Strong relationships with Chinese steel mills • Largest magnetite mining and processing facility in Australia – 20mtpa	• Dedicated mining company in Australia focusing on pellet feed • Has long standing relationships with steel mills – Citic and other mills • However, its Fe content is more amenable for BF grade pellet feed and may not be a competition in DR grade pellet feed market

NEW SLIDE

The VIU of DR pellet feed is determined by attributing a premium for higher Fe content while discounting for penalties associated with higher SiO2, Al2O3 and P

THEORETICAL VIU CALCULATION OF DR PELLET FEED OF SIMEC VS PEERS, $/TONNE (REFERENCE : 2023 ANNUAL)

Item	$/t
Fe-65 CFR China	130
Brazil - China Freight	25
Fe-65 FOB Brazil	105
Brazil/CAN - Middle east (GCC port) freight	18
Fe-65 CFR Middle east	123
Freight net back (=123-130)	-7

Element	Reference content, %	$/t	IOC	IOC	Vale Tubarao (Oman) PFPT	Vale Tubarao (Oman) PFPT	CSN	CSN	Shougang	Shougang	CMP	CMP	SIMEC pellet feed Spec 1	SIMEC pellet feed Spec 1
Iron ore base price	65.0	132.4	66	132.4	68	132.4	67	132.4	68	132.4	67	132.4	70.45	132.4
Fe content bonus	1.0	2.3		2.3		6.8		4.5		6.8		4.5		12.3
Phosphorous	0.1	-0.2	0.04	0.0	0.0	0.0	0.0	0.0	0.02	0.0	0.045	0.0	0.01	0.0
Alumina	2.0	-3.9	0.4	7.8	0.5	5.9	0.7	5.1	0.5	5.9	0.75	4.9	0.09	7.4
Silica	3.5	-1.8	1.3	4.1	1.0	4.5	1.9	2.8	2	2.7	4	-0.9	1.8	3.0
Total pellet feed, CFR China				146.5		149.6		144.8		147.7		140.9		155.2
Freight net back China Middle east		-7		-7		-7		-7		-7		-7		-7
DR pellet feed cfr Middle east				139.5		142.6		137.8		140.7		133.9		148.2

Note:
- The above theoretical calculation was performed to illustrate relative VIU of various DR pellet products exclusively based on chemistry and Fastmarket prices and premium/penalties
- There may be other elements not considered in the above calculation that could impact the overall premium/ penalty attracted by the product
- Magnetite has the potential to attract a premium of $2-3 driven by the benefits associated with energy savings
- Freight net back is based on Fastmarkets freight estimates for Capesize vessels

Source: Fastmarkets

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- Executive Summary
- Global steel production and iron ore market review
- DRI/HBI Market characterisation
- DR pellet market and forecasts
- DR pellet feed market and forecasts
- Pricing and VIU analysis
- Green steel market developments
- SIMEC Market positioning
- **Conclusions**

With steel decarbonisation progressing at a rapid pace, there is a strong demand for DR pellet and pellet feed as the industry migrates from BF-BOF to EAF-HDRI during the next few decades

- The demand for DR pellet feed is forecast to grow to ~560 mtpa by 2050 driven by continued growth in DRI production in Middle east and Asian markets, supported steel decarbonisation efforts in the EU. The steel industry is forecast to undergo a significant transformation in the medium to long term with slowing down of demand and production in China and decarbonisation around the world impacting the demand for iron ore
- The demand for sinter fines (Fe 62%) is forecast to slow down in the period to 2030, driven by slow down in China's steel production, increased use of pellet in BF and greater use of scrap in BF-BOF in the medium to long term. As a result, the demand for pellet and thus pellet feed is forecast to grow at a faster rate relative to sinter fines
- The steel industry is under pressure to decarbonise and the EU has been at the forefront on green steel transformation efforts. One of the key strategies being migration from BF-BOF to H2-DRI-EAF process. Leading EU steel mills such as ArcelorMittal, TKS and others are investing in EAF-HDRI process as part of their carbon mitigation and ultimately net zero goals by 2050
- With limited high quality scrap in the world, the demand for DRI and input raw materials such as DR pellet is likely to grow stronger
- With the proposed reduction of free carbon allowances and developing carbon price, the EU mills are under pressure to produce green steel at the earliest. However, this calls for significant scale of investments and above all access to green hydrogen. For sustained availability of green hydrogen, appropriate investments and engagement with other consuming sectors and correspondingly renewable electricity may be required

There is a need to enhance the DR pellet feed supply sources especially if the traditional sources of supply were to embark on own DRI production

- Although, majority of the DRI requirements will largely met by own DRI production in most of the markets, there is a likelihood of some imports resulting from misaligned schedules such as EAF being installed ahead of DRI. With some of the traditional seaborne DRI such as that from Russia coming under pressure, new sources may emerge in the future
- South America could become a a key supplier of DRI in the future, Brazil with DR pellet feed resources and renewable power to support production of green HBI in the long run. For example, Ternium and Vale exploring DRI production and export opportunities. This may constrain the supply of seaborne DR pellet and pellet feed originating from Brazil, driving the need to explore alternative sources of supply
- However, the supply of DR pellet feed that meets higher Fe and lower gangue content (<=3%) specifications are quite limited
- The tightening of pellet feed supply will impact the long term pricing of DR pellet feed and thus pellet. Although, new suppliers are forecast to enter the market, the supply may not be adequate resulting in higher pricing potential for DR pellet feed

However, new DRI installations face challenges due to high CAPEX requirements and the availability of renewable energy, especially in case of EU decarbonisation projects

DECARBONISATION IMPACT ON DR PELLET AND DR PELLET FEED MARKET

Item	Comments
Regional markets	▪ EU - The development of new DRI projects driven by migration from BF-BOF to EAF-DRI will drive additional demand for DR pellet in the future. ▪ Middle East and North Africa – Limited impact of decarbonisation in traditional seaborne markets such as Middle East and North Africa as the countries are yet to adopt any significant policies. Demand for DRI largely driven by domestic growth in steel production ▪ India –largely self-sufficient market with hardly any import/ export of DR pellet. Continue to rely on domestic iron ore resources ▪ Asia – The demand for pellet feed is led by China and Japan. The pellet plants produce BF pellet to meet the demands of their domestic BF-BOF mill. Pellet feed consumption is mainly limited to BF grade pellet feed and is entirely imported
Prices	▪ The prices will be driven by the tightness in DR pellet supply further driven by limited availability of DR pellet feed ▪ The uplift in prices may get further support should the decarbonisation efforts in the EU accelerate in the medium term leading to faster increase in DRI production capacity and thus driving the demand for DR pellet
DRI projects	▪ The successful commissioning of new DRI projects particularly in the EU will be driven by financial investments ▪ With weak domestic market prospects in the EU, the investment returns for such projects may be challenging and potentially risking the smooth progress of such projects ▪ Challenges associated with availability of renewable energy and green hydrogen in the EU
DR pellet/ pellet feed projects	▪ There are several challenges associated with commissioning new DR pellet feed projects such as geopolitical issues ▪ With H2 DRI being the preferred route for decarbonisation in the future and the rest of the world likely progress along the lines of EU's, the challenges to source the appropriate feed material will likely be more adverse



– END OF REPORT –

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Appendix C Self Assessment

Table 0-1: Self Assessment

Change Scenario	Analysis criteria - Change in Operations (Mining Act s56Q)			Analysis criteria - PEPR review (Mining Act s 70C)					Regulatory pathway	Regulatory pathway justification
	Is inconsistent with, or outside the scope of the operations that were approved as part of the original tenement grant?	Will result in a non-compliance with existing lease or licence terms and conditions?	Requires an environmental impact assessment to assess the change?	Is inconsistent with the current approved PEPR?	Requires alterations to approved outcomes & criteria?	Relates to significant alterations to the description of mining operations or control strategies (but does not affect the achievement of outcomes)?	Relates to a new or changes strategy that is an essential control necessary to achieve existing environmental outcomes?	Requires new or changed native vegetation clearance and/or SEB?		
WRD expansion and topsoil stockpile – construction, operation, and closure/rehabilitation	Y First schedule, clause 1 requires amendment to enable WRD expansion and topsoil stockpile construction, operation, and closure/rehabilitation.	Y First schedule, clause 1 requires amendment to enable WRD expansion and topsoil stockpile construction, operation and closure/rehabilitation.	Y Low / insignificant impact/risk – consistent with current SMR operations as described in current approved PEPR. Preliminary EIA undertaken.	Y WRD and topsoil stockpile not currently included in Chapter 3. PEPR requires amendment.	N Outcomes and criteria remain appropriate and achievable.	N Minor amendments to add the WRD expansion and topsoil stockpile will not result in a significant alteration to the description of mining operations.	N Standard existing control measures appropriate to manage environmental impacts/risks.	Y Approximately 148 ha of native vegetation to be cleared. PEPR amendment required to update Native Vegetation Management Plan (NVMP).	Change in operation	Inconsistent/Outside scope of MPL32 Licence conditions under section 1.1 and 1.5 of Terms of Reference 025.

Appendix D Impact Assessment Reports

D1 Surface Water Assessment

South Middleback Ranges – Magnetite Expansion Project, Phase 1

Surface Water Assessment

Evolution Mining, ICA Partners

Doc. Ref.: SMR-001-B2

Date: 15 August 2024

Rev. No.	Doc Ref.	Report Date	Report Author	Reviewer
0 [DRAFT]	SMR-001-B	11 July 2024	AH	MGB
1	SMR-001-B1	7 August 2024	AH	MGB
2	SMR-001-B2	15 August 2024	AH	MGB

For and on behalf of **HydroBalance**
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1 Introduction

1.1 Background

SIMEC Energy Australia (SIMEC) own and operate mining operations at South Middleback Ranges (SMR), located approximately 60 km southwest of Whyalla in South Australia (see Figure 1.1). SMR incorporates six mining domains, namely Iron Duke, Iron Magnet, Iron Duchess, Iron Duchess South, Iron Knight, and Iron Chieftain as well as associated processing infrastructure.

The SMR is connected by rail to the Whyalla Port, which contains processing facilities held by SIMEC Mining and Whyalla Ports Pty Ltd. The SMR is also connected to the Whyalla Steelworks via an underground pipeline corridor, enabling magnetite concentrate slurry produced at the SMR Magnetite Concentrator to be pumped to the Whyalla Pellet Plant for the production of iron ore pellets. The underground pipeline corridor also accommodates a return water line between the Whyalla Pellet Filter Plant and the SMR Magnetite Concentrator.

SIMEC is considering expansion of magnetite mining at SMR, through the Magnetite Expansion Project (MEP), which includes two phases (MEP1 and MEP2). The MEP1 Project bridges the gap between existing operations at the SMR and the future MEP2 Project and is the focus of this report.

HydroBalance was commissioned by JBS&G on behalf of SIMEC to support the approvals deliverables relevant to the MEP1 Project. JBS&G require HydroBalance to prepare a Surface Water Assessment (SWA) and Surface Water Management Plan (SWMP).

The SWA and SWMP will support the revision of the project Program for Environment Protection and Rehabilitation (PEPR) and preparation of Change in Operation (CiO) documentation, both of which are being prepared by JBS&G. The PEPR and CiO will be submitted to the Department for Energy and Mining (DEM) for their assessment and approval.

1.2 Project description

SIMEC Mining's current and historical operations throughout the Middleback Ranges extend over approximately 60 km from Iron Duke in the south to Iron Princess in the north. The layout of the existing operations is shown in Figure 1.2.

The MEP1 Project bridges the gap between existing operations at the SMR and the future MEP2 Project. The activities included as part of MEP1 are:

- Extension of the existing magnetite pit Duchess A & B;
- TSF embankment raise 9;
- Waste Rock Dump (WRD) expansion north, south and east (within existing tenements);
- Duchess South water storage moved to Duchess North;
- Diversion of mine access track around the new WRD;
- New topsoil stockpile area;
- Increase in onsite vehicles (number to be confirmed); and
- Upgrades to the existing processing circuit, including:
    - Upgrades to the Direct Reduction (DR) Flotation Plant, to enable processing of high silica ore; and
    - Repurposing of equipment from OBP to dewater concentrate to enable rail transport to Whyalla Port to supplement existing slurry pipeline.

The general arrangement of the MEP1 Project is shown in Figure 1.3.

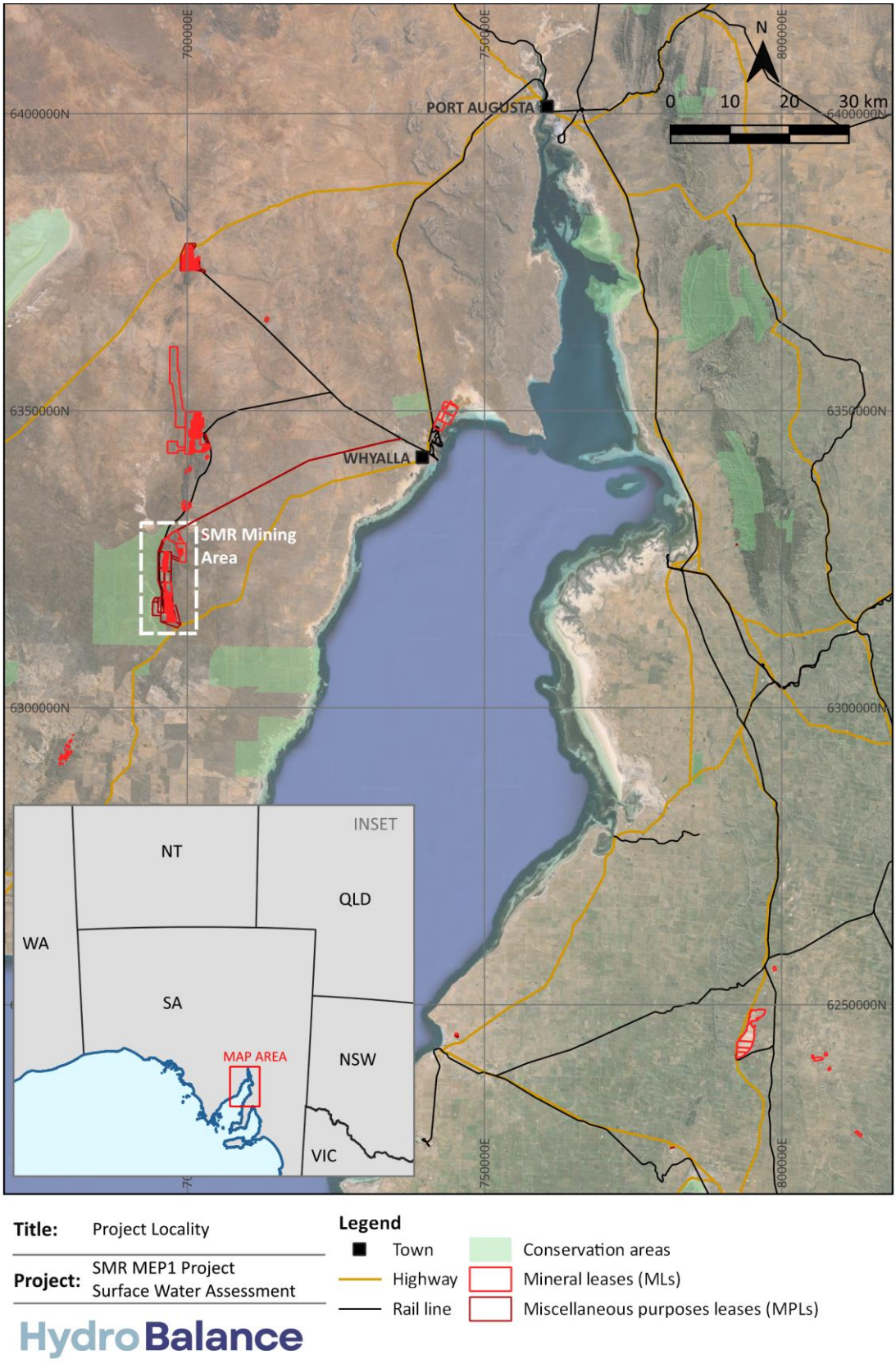


Figure 1.1 - Project locality

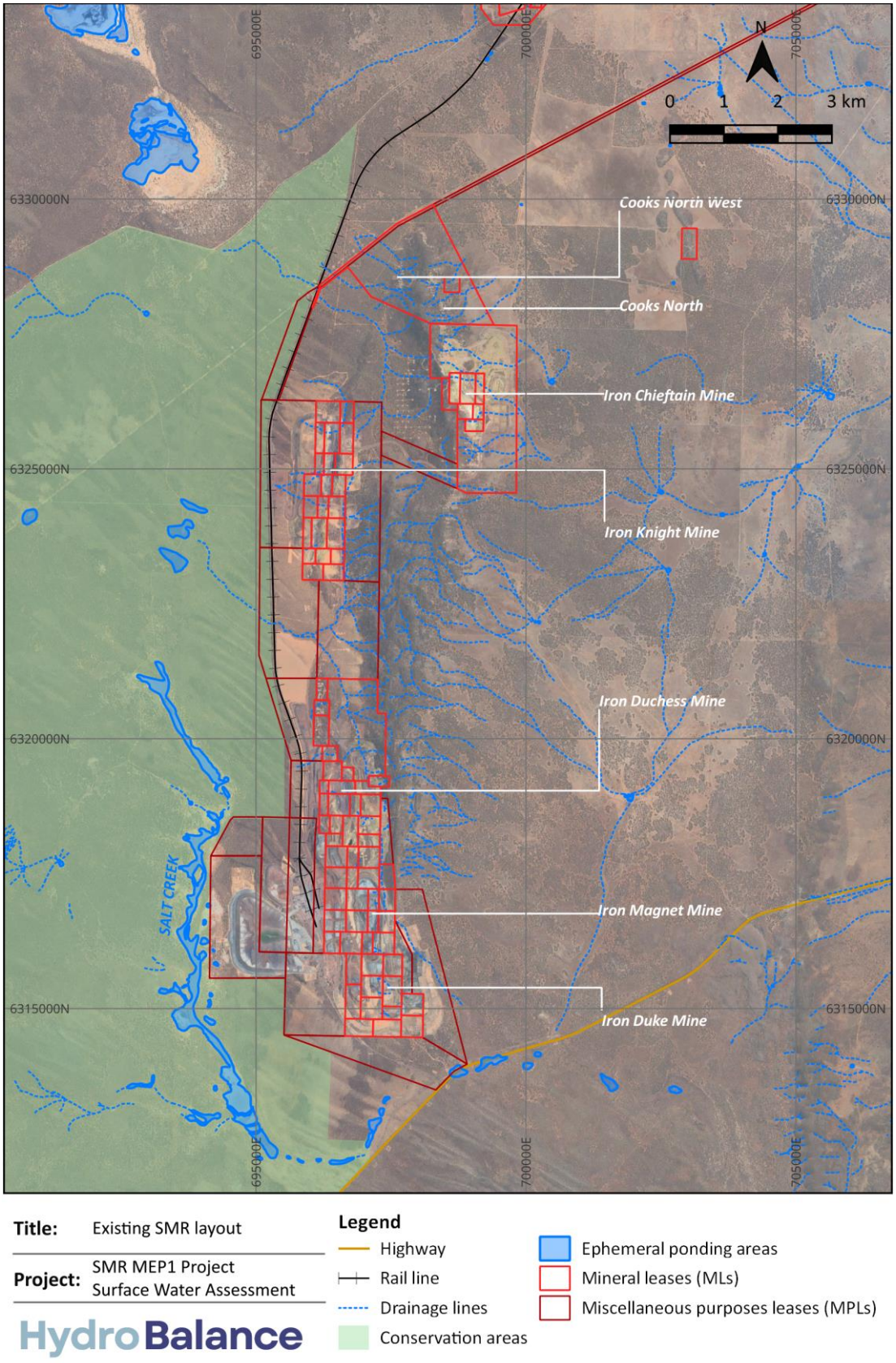


Figure 1.2 – Existing SMR layout

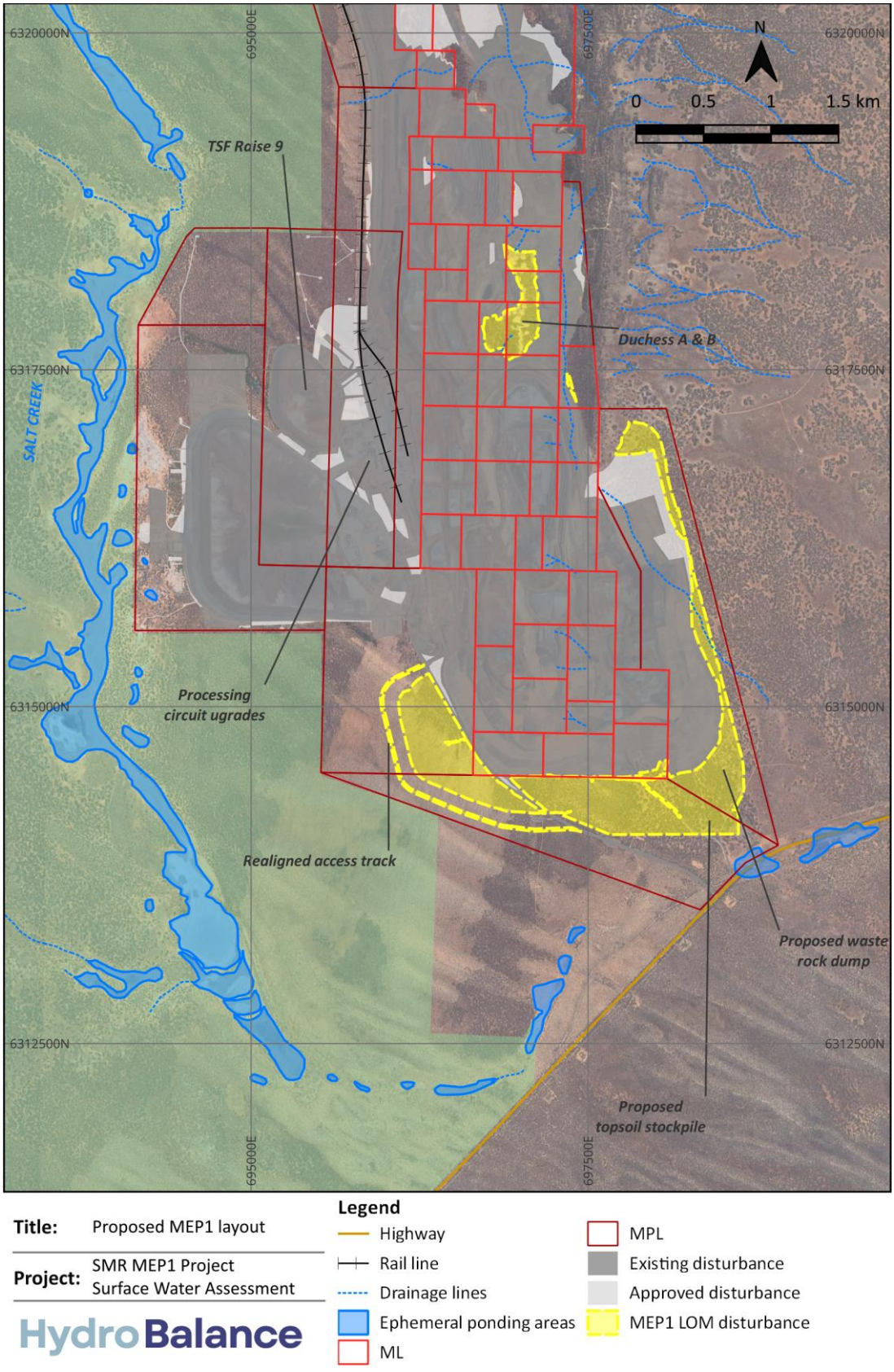


Figure 1.3 - Project general arrangement

1.3 Report structure

This report is structured as follows:

- Section 2 describes the regulatory requirements relevant to the Project.
- Section 3 describes the existing surface water environment including the regional and local drainage characteristics.
- Section 4 describes the conceptual surface water management strategy.
- Section 5 presents the outcomes from the flood modelling assessment.
- Section 6 describes the outcomes from the impact assessment for surface water, with proposed mitigation and management measure.
- Section 7 provides a list of references.
- Appendix A describes the setup and configuration of the hydrologic model.
- Appendix B describes the setup and configuration of the hydraulic model.

2 Regulatory requirements

2.1 Program for Environment Protection and Rehabilitation

This Surface Water Assessment will support the revision of the Program for Environment Protection and Rehabilitation (PEPR), which has been prepared in accordance with Part 10A of the *Mining Act 1971* (Mining Act) and regulation 63 the *Mining Regulations 2020* (Mining Regulations). This assessment has been prepared to satisfy the requirements of the *Terms of References for Metallic and Industrial Mineral PEPRS – 005* issued by the Department for Energy and Mining (DEM) in March 2021.

This assessment, which forms part of the PEPR, addresses the Terms of Reference (TOR) relevant to flooding and hydrology. Table 2.1 lists the elements of the TOR relevant to this assessment and the sections of this report where those TORs are addressed.

Table 2.1 – PEPR ToR – items relevant to surface water infrastructure, flooding and hydrology

PEPR TOR item	Requirement	Report section
2 Description of the mining operations		
2.5 Crushing, grinding, processing and product transport		
2.5.4	*Process Water Management* Provide a water balance including: • approximate water volumes required; • a summary of the inputs and outputs (with consideration of any purge requirements); • determination of net surplus or deficit; and • process flowsheet showing all streams including stormwater management and mine dewatering where these are • connected to the processing circuit. Provide a description of all water ponds, including: • size, capacity, layout and location of ponds; • design and construction methods; • chemical composition of the solution to be stored in each pond; • minimum freeboard to be maintained; and • plans (as per 7.1.2.1).	No significant changes to the Process Water Management Circuit
2.7 Supporting site infrastructure		
2.7.7	*Stormwater, Silt Control and Drainage* Describe: • location and design of silt management structures; • runoff control on disturbed and rehabilitated areas; • storage, diversion and release of clean water (discharge water must comply with the applicable Environment Protection Authority South Australia water quality policy); and • a whole of site stormwater balance, if not included in the water balance in clause 2.5.4. • Provide a plan showing the surface water movement for the whole mine site (as per 7.1.1).	Section 4
7 Maps, plans, and cross sections		
7.1 Map(s) and Plan(s) required for Description of Operations (as per clause 2)		

PEPR TOR item	Requirement	Report section
7.1.1	*Site Layout Map showing all components of the operation including (but not limited to):* • tenement area boundaries; • **location of surface water and sediment management infrastructure;** • **location of process water dams**; • location of fuel and chemical storage areas; • location of haul/access roads; • location of fixed plant; • location of mobile plant for stage 1 of mining; • location of visual screening measures; • location of fencing; • location and extent of topsoil/subsoil and product stockpiles. • location and extent of all areas proposed to be disturbed from mining including waste rock, silt/slime dams, mine infrastructure, processing plant, process water ponds, waste disposal facilities; and • location and extent of open pit(s) and/or underground workings. • **location of key environmental features that are within or in close proximity to the Tenement and that are relevant to the design of the Site Layout Plan, including but not limited to housing and infrastructure, existing heritage sites, existing ephemeral and permanent rivers, watercourses, creeks or dams and/or existing native vegetation.**	Figure 3.2 shows the local drainage features in the vicinity of the site. Figure 4.1 presents the location of surface water and sediment management infrastructure. No additional process water dams are proposed.

2.2 Change in Operations

This Surface Water Assessment will support the development of a Change in Operations (CiO) report, which has been prepared in accordance with 56R of the Mining Act. This assessment has been prepared to satisfy the requirements of the *Terms of References for Change in Operations Application – 025* issued by the DEM in March 2021.

This assessment, which forms part of the CiO, addresses the TOR relevant to flooding and hydrology. Table 2.2 lists the elements of the TOR relevant to this assessment and the sections of this report where those TORs are addressed.

Table 2.2 – CiO ToR – items relevant to surface water infrastructure, flooding and hydrology

PEPR TOR item	Requirement	Report section
2 Change to authorised operations		
2.2 Assessment of changes to environmental impacts		
2.2.1	*Changes to environmental impacts of the authorised operations* Describe potential impact events the proposed change in operations might have on the environment. The impact assessment must consider each phase of the proposed operations (construction, operation, rehabilitation/closure and post completion). Describe whether the potential environmental impacts identified are additional to or different from those impacts identified in the initial application for a lease or license.	Section 6
2.2.2	*Control strategies* Describe the measures proposed to manage, limit or remedy each additional or different impact. Demonstrate that the measures proposed are commensurate with the potential impacts, achieve compliance with other applicable statutory requirements and promote progressive rehabilitation.	Section 6

PEPR TOR item	Requirement	Report section
2.2.3	*Description of uncertainty* Describe any significant degree of uncertainty pertaining to the impact assessment and effectiveness of control strategies, including (but not limited to) lack of site-specific information, limitations on modelling and quality of data. Describe any assumptions connected with the identified uncertainty. So far as is relevant, identify the sensitivity to change of any assumption that has been made and assess: • whether a change in assumption may result in a new environmental impact • the likelihood of an outcome not being achieved if an assumption is later found to be incorrect.	The modelling assumptions and uncertainties are presented in Appendix A and Appendix B. Modelling shows that, even with conservatively high-yielding parameters, floodwaters would not interact with the Project. Hence, the outcomes of this assessment are not expected to be sensitive to potential uncertainties.
2.2.4	*Assessment of environmental outcomes* Provide an assessment of whether the existing environmental outcomes, as included in the lease/licence and/or the currently approved PEPR, are appropriate or if new or modified environmental outcomes are required. Where modified outcomes are required, provide a statement of the proposed modified environmental outcome(s), which describes the likely consequence of the expected impact on the environment by the proposed operations, subsequent to the implementation of the control strategies described in clause 2.2.2.	Section 6 No impacts to the downstream environment were identified as part of this assessment.
2.2.5	*Changes to criteria* Provide a description of any changes to the criteria to be adopted to measure the existing or modified environmental outcomes. For any proposed changes to criteria, include details about any change to the five elements of criteria set out in Regulation 55(2). Where appropriate, use recognised industry standards, codes of practice or legislative provisions from other Acts as part of the criteria.	No changes to criteria proposed.
4 Assessment of lease and/or licence terms/conditions and the Act		
4	In preparing a statement in accordance with regulation 55(1)(c)(iii) of the Mining Regulations 2020 that demonstrates that the change will not adversely affect the ability of the tenement holder to comply with the other requirements of the Act, the Minister determines in accordance with regulation 55(4)(e) of the Mining Regulations 2020 that the statement must be supported by the following evidence: • With the exception of any proposed changes to lease and/or licence terms and conditions (as per clause 1.3), provide an assessment that demonstrates the proposed change in operations would be compliant with the terms and conditions of the lease/licence.	Section 6

3 Existing surface water environment

3.1 Regional and local drainage networks

SMR is located within the Spencer Gulf basin, draining into the Great Australian Bight. This is a semi-arid region with average rainfalls of less than 275 mm, most of which occurs during the winter months. Significant short duration ex-tropical cyclone and depression related rainfall events can occur during late summer.

In general, there is little surface water in the northern part of Eyre Peninsula, and no permanent streams. Catchments in the Middleback Ranges do, however, feed a number of ephemeral watercourses and local depressions.

Salt Creek is the only significant watercourse in the vicinity of the SMR. Salt Creek, like all the other minor watercourses and drainages on site, is ephemeral, only receiving surface runoff following significant rainfall. The upper reaches of Salt Creek are characterised by series of disconnected pools or salt pans, which cascade from north to south as each of the pools fill and overflow. Each of the pools may contain significant volumes of water, due to the large surface areas and depths of 0.5 m to 3 m. Estimates suggest that the Salt Creek pools would have combined capacity in the order of 5 GL. The large surface areas enhance evaporation and infiltration losses, suggesting that flows would rarely spill from the disconnected pools and flow into the downstream reaches of Salt Creek. The downstream reach of Salt Creek is characterised by a flat (approximately 0.2% longitudinal grade), poorly defined channel which flows to the south of the site, adjacent to the proposed MEP1 stockpile. The downstream reach is located within a gully, between two natural ridges and hence is significantly lower (by up 20 m) than the existing infrastructure.

A small, unnamed drainage line is located approximately 2.5 km to the east of SMR. The drainage line is located within Death Adder Valley, which is formed between the Iron Duke/Iron Duchess ridge and the Cook Range ridge. Given the relatively small catchment draining through Death Adder Valley and its proximity away from the SMR, flows in unnamed drainage line will not interact with the Project.

Figure 3.1 shows the location of the Project, in the context of the wider Spencer Gulf. Figure 3.2 shows the local drainage characteristics, including the catchment of Salt Creek to downstream of the Project and the catchment of the Death Adder Valley to its confluence with Salt Creek.

3.2 Environmental values

The *Environmental Protection Policy (Water and Wetland Biodiversity) 2019* (EPP [Water]), which is subordinate legislation to the Environmental Protection Act 1994, provides a framework for identifying environmental values (EV) for a waterway and deciding water quality objectives (WQO) to protect or enhance those EV's. EV's for water are the qualities of water that make it suitable for supporting aquatic ecosystems and human water uses. These EVs need to be protected from the effects of habitat alteration, contaminated runoff and releases and changed flow to ensure healthy aquatic ecosystems and waterways that are safe for community use.

Runoff from the project area either pools in localised depressions or drains towards Salt Creek. The environmental values listed in the EPP Water Quality Policy (2015) can be categorised into six themes, these themes and their relevance to the project are listed in Table 3.1.

Table 3.1 – Sensitive receptors / environmental values and their relevance to the project area

Environmental values	Relevance to project area
Aquatic ecosystem	There are no aquatic ecosystems in proximity of the project area.
Drinking water for human consumption	The project area is not within a declared Special Water Supply Catchment Area.
Primary industries – irrigation and general water uses	The project area is not within agricultural use areas.
Primary industries - livestock drinking water	The land adjacent to the site is used for livestock grazing. However, there are no waterways or waterbodies in the vicinity of the site that are used for livestock drinking water, due to the unreliability of Salt Creek flows.
Primary industries - aquaculture	The project area is not within the catchment of any aquatic food operations or waterways used for fishing.
Primary, secondary and visual recreation	There are no waterways or waterbodies used for water-based recreation activities in proximity of the project area.

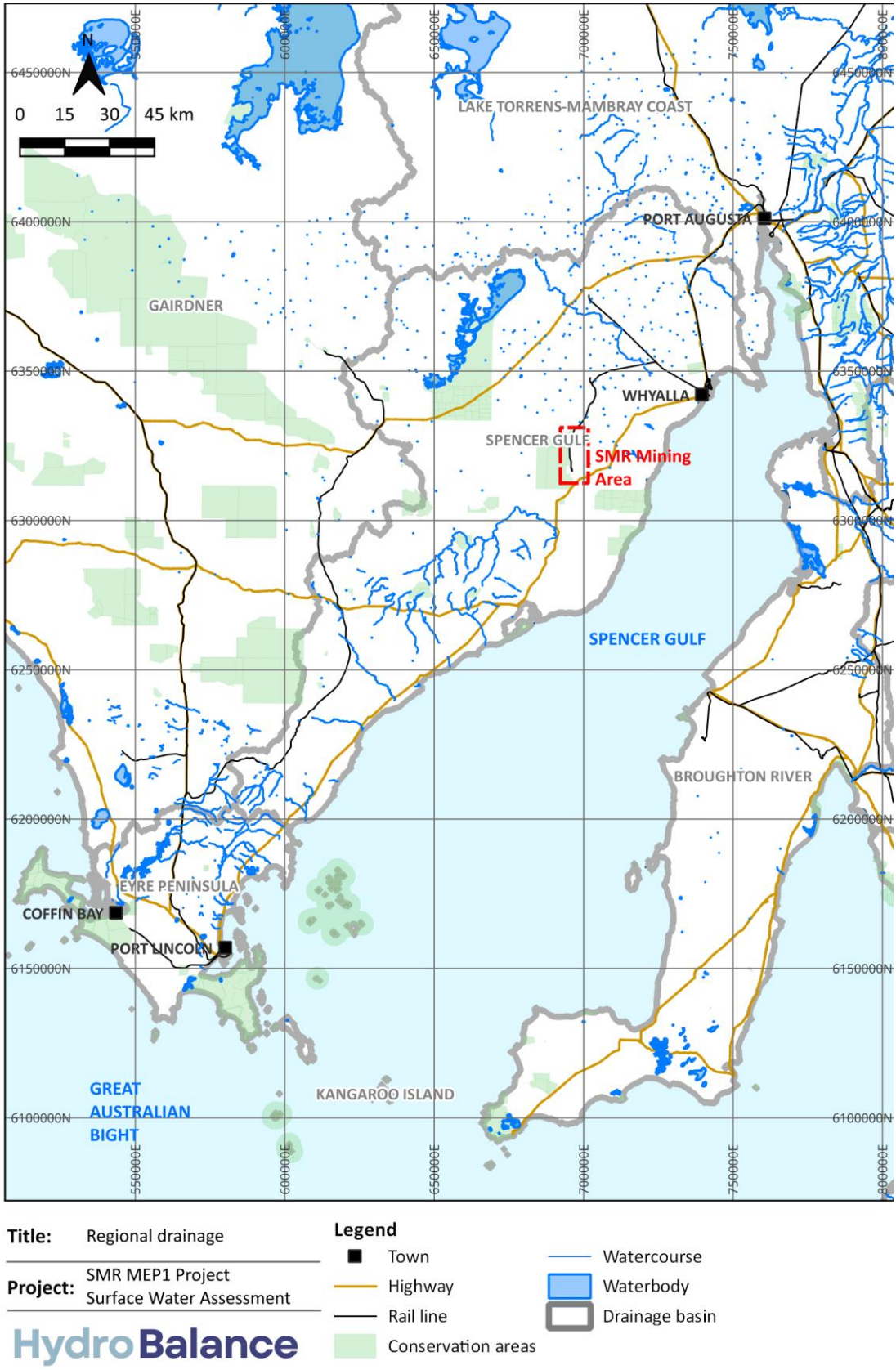


Figure 3.1 – Regional drainage characteristics

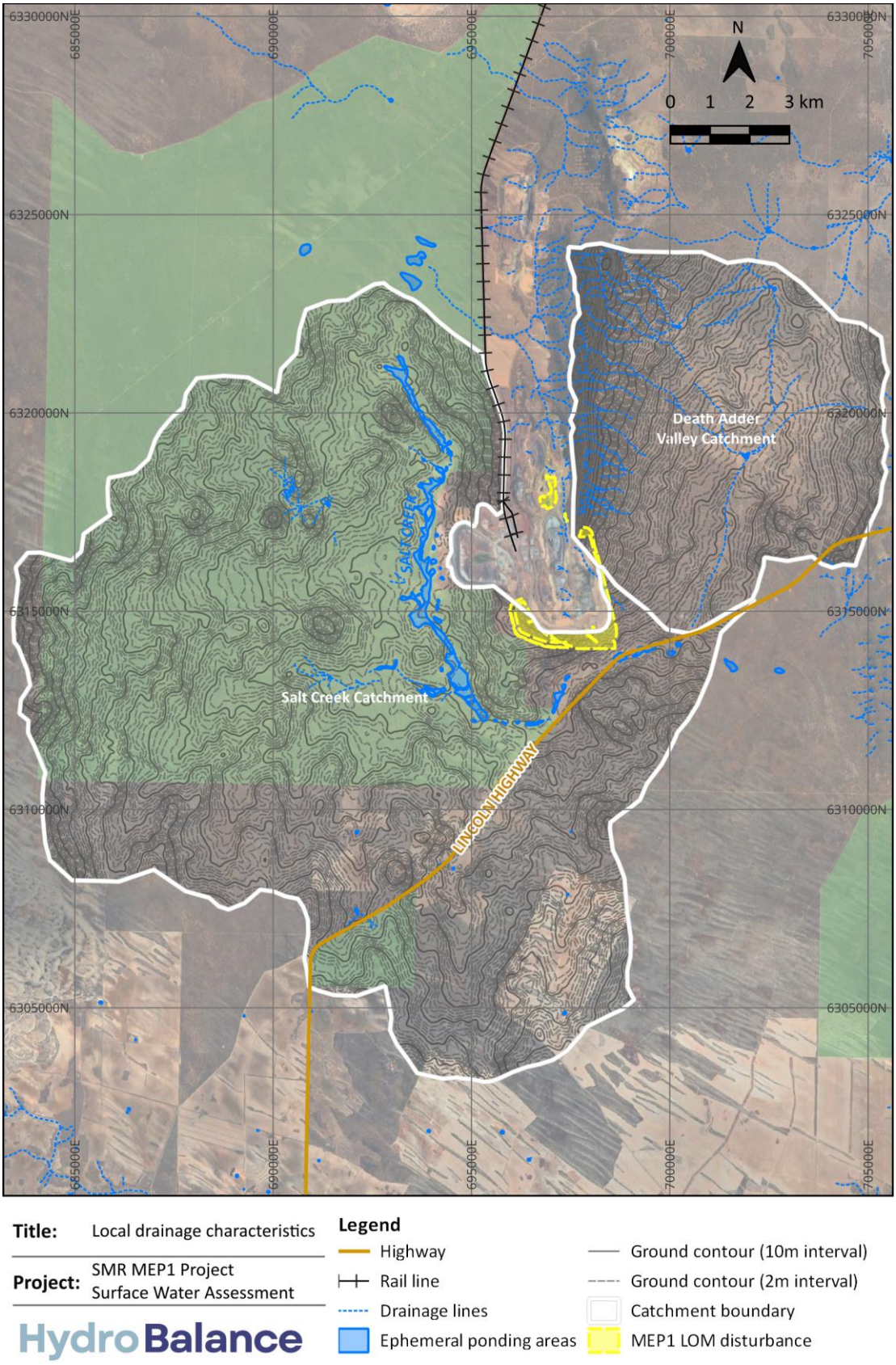


Figure 3.2 – Local drainage characteristics

3.3 Soils and erosion potential

Soils of the South Middleback and the Cook Ranges are generally skeletal but may contain shallow compact loamy soils. Steep gullies and some hill slopes contain loose scree material. To the west sand deposits are approximately 10 to 20 m thick up to the base of the ranges, with some soil development apparent in the top 1 or 2 m. To the east soils are generally brown calcareous earths, with some small dunes.

The area of mining has been largely disturbed by previous mining and exploration activity. Some areas of skeletal soils will be removed during further mining. These skeletal soils grade into sandier soils at the base of Death Adder Valley and to the west of the SMR where waste rock dumps and the Magnetite TSF is located.

Soil quality within the Middleback Range is generally poor in structure and skeletal topsoils are generally deficient in organic material and nutrients due to high cycling rates.

Topsoil will be stripped during clearing and site preparation wherever practicable and safe and reused for onsite revegetation and rehabilitation programs. Appropriate topsoil management is required to ensure the topsoil remains viable for reuse. Activities associated with mine development may contaminate soils if appropriate management measures and controls are not implemented.

3.3.1 Revised Universal Soil Loss Equation

For the purpose of catchment planning, disturbance areas are to be classified based on estimated annual soil loss due to erosion. The estimated soil loss rate shall be calculated using the Revised Universal Soil Loss Equation (RUSLE).

The RUSLE method of estimating annual soil loss due to erosion is documented in the *Best Practice Erosion and Sediment Control Guideline* (IECA, 2008). The annual soil loss due to erosion is calculated as:

$$A = R \times K \times LS \times C \times P$$

Where:

A = annual soil loss due to erosion (t/ha/yr)

R = rainfall erosivity factor

K = soil erodibility factor

LS = topographic factor derived from slope length and slope gradient

C = cover and management factor

P = erosion control practice factor

The rainfall erosivity factor R is a function of the 2 year Average Recurrence Interval (ARI) 6 hour design rainfall intensity for the site being assessed.

The soil erodibility factor K “should be determined from laboratory analysis of soil data wherever practical” (IECA, 2008).

The topographic factor LS is derived from the catchment slope length and slope gradient.

The cover and management factor C and erosion control practice factor P will be assigned on a case-by-case basis. Assuming 0% grass cover (i.e. default construction conditions) C should be set to 1.0. The cover and management factor may be reduced once vegetation becomes established with values of 0.45, 0.22 and 0.10 for grass coverage of 20%, 40% and 60% respectively (IECA, 2008). The default construction phase P should be 1.3 (compacted and smooth).

Further guidance on these parameters can be found in IECA (2008).

Based on the standard parameters for the Project site, the soil loss rate is approximately 144 m^3/ha/year.

4 Surface water management

4.1 Overview

This section describes the objectives and principles of the existing and proposed water management system (WMS), including a description of the infrastructure and systems that have been designed to achieve the objectives and principles.

4.2 Types of water generated on-site

The strategy for the management of surface water at the Project is based on the separation of water from different sources based on anticipated water quality.

Definitions of the types of water generated by the Project are:

- ***Sediment water:*** Surface water runoff from areas that are disturbed by mining operations (including out-of-pit WRDs). This runoff may contain high sediment loads but does not contain elevated level of other water quality parameters (e.g. EC, pH, metals, metalloids, non-metals). This runoff must be managed to ensure adequate sediment removal prior to release to receiving waters.
- ***Clean/diverted water*****:** Surface runoff from areas unaffected by operations. Clean catchment water includes runoff from undisturbed areas and fully rehabilitated areas.

Note that, if runoff generated on the WRDs is found to contain elevated water quality concentrations/values (e.g. EC, pH, metals, metalloids and non-metals but excluding sediment-related parameters), the water should be classified as ***mine-affected water***. The source of the contaminants should be investigated, and additional water management measures should be applied to suitably manage mine-affected water onsite.

4.3 Surface water management objectives

The objective of the site WMS is to manage all types of water onsite to meet operational, social and environmental objectives.

The two key WMS objectives are as follows:

- Maintain sediment laden runoff generated by the Project; and
- Successfully engage with external stakeholders to be a good custodian of society's water resources. The priority issues are the Project's impact on surface water.

Specific objectives for each water type are as follows:

- ***Sediment water*****:** Maintain the quality of water discharging from erosion and sediment control structures to as close to background levels as reasonably possible.
- ***Clean/diverted water*****:** Separate from the mine-affected and sediment water systems as much as reasonable and feasible and allow it to pass uninterrupted through the catchment.

4.4 Surface water management principles

The general principles to manage surface water for the site are as follows:

- The fullest separation possible of clean and sediment water runoff within the limitations of operational requirements.
- Minimise the area of surface disturbance, thus minimising the volume of sediment runoff.
- Release sediment water in a controlled manner (i.e. following settlement) in compliance with the approval requirements for an erosion and sediment control plan.

4.5 Existing water management infrastructure at SMR

The main components of water-related infrastructure at the existing SMR site include:

- active open-cut mining areas;
- sediment dams to collect and treat runoff from out-of-pit waste rock emplacement areas;
- drains to divert sediment-laden runoff from out-of-pit spoil dumps to sediment dams; and
- a mine-affected water system to store water pumped out of the open cut mining areas and to collect runoff from the ore stockpiles, Mine Infrastructure Area (MIA) and other hardstand areas that could potentially generated mine-affected water runoff.

No interaction is proposed between the proposed works and existing SMR water management system.

4.6 Proposed water management infrastructure

Figure 1.3 shows the locations of the key features of the Project WMS. The existing SMR WMS infrastructure will remain unchanged as part of the Project.

The main components of proposed MEP1 water-related infrastructure include:

- Sediment water management infrastructure;
- Waste rock dump (WRD) expansion;
- Stockpile;
- Realigned access track;
- TSF Raise 9 (within existing disturbance footprint); and
- Processing circuit upgrades (within existing disturbance footprint).

Details of proposed sediment water management infrastructure is provided in Section 4.7.

4.7 Sediment water management system

4.7.1 Overview

Sediment water containment (runoff from cleared and disturbed areas) will be managed in accordance with the Surface Water Management Plan (SWMP). The SWMP adopts the three cornerstones of erosion and sediment control (ESC).

- Drainage control – prevention or reduction of soil erosion caused by concentrated flows and appropriate management and separation of the movement of diverted and surface water through the area of concern.
- Erosion control – prevention or minimisation of soil erosion (from dispersive, nondispersive or competent material) caused by rain drop impact and exacerbated overland flow on disturbed surfaces.
- Sediment control – trapping or retention of sediment either moving along the land surface, contained within runoff (i.e. from up-slope erosion) or from windborne particles.

The Project will require a combination of the three control measures to effectively manage sediment and erosion at the site. The locations and number of sediment control infrastructure provided in this assessment is conceptual only. Details of sizing and placement of sediment control infrastructure would be finalised during detailed design of the Project.

Detailed information relating to the proposed ESC measures will be developed prior to the commencement of operations. This will include the development of ESC implementation plans during both the construction phase and operations.

4.7.2 Sediment drain design

The proposed sediment drainage system consists of the following elements:

- Toe drains/bunds;
- Contour berms; and
- Drop structures.

The proposed drain dimensions and expected hydraulic parameters for a 10% AEP design event are presented in Table 4.1. The locations of the proposed drains are shown in Figure 4.1. The site drainage has been designed to convey a 10% AEP design event plus an additional 0.3 m freeboard, which is sufficient to contain the 1% AEP design event.

Table 4.1 – Proposed drain details

Drain ID*	Drain cross section	Longitudinal slope	Base width (m)	Batter slope (V:H)	Finished drain depth (m)	Flow depth† (m)	Flow velocity† (m/s)	Recommended lining
CB1	Windrow	0.6%	-	1:2	0.8	0.5	1.2	Gravel (d_{50}=25mm)
CB2	Windrow	0.4%	-	1:2	0.5	0.2	0.7	Gravel (d_{50}=25mm)
CB3	Windrow	2.8%	-	1:2	0.8	0.5	1.5	Gravel (d_{50}=25mm)
CB4	Windrow	2.6%	-	1:2	0.5	0.2	0.9	Gravel (d_{50}=25mm)
CB5	Windrow	2.0%	-	1:2	0.5	0.2	0.9	Gravel (d_{50}=25mm)
CB6	Windrow	1.0%	-	1:2	0.7	0.4	1.2	Gravel (d_{50}=25mm)
CB7	Windrow	0.4%	-	1:2	0.5	0.2	0.6	Gravel (d_{50}=25mm)
TD1	Windrow	2.4%	-	1:2	0.7	0.4	1.5	Gravel (d_{50}=25mm)
TD2	Windrow	1.9%	-	1:2	0.4	0.1	0.7	Gravel (d_{50}=25mm)
TD3	Windrow	2.1%	-	1:2	0.6	0.3	1.2	Gravel (d_{50}=25mm)
DS1	Trapezoidal	25.0%	1	1:4	0.8	0.5	1.7	Rock (d_{50}=385mm)
DS2	Trapezoidal	25.0%	1	1:4	0.6	0.3	1.4	Rock (d_{50}=215mm)

* TD = toe drain/bund, CB = contour berm, DS = drop structure
† for the 10% AEP design event

Each of the recommended drain types are discussed in the sections below.

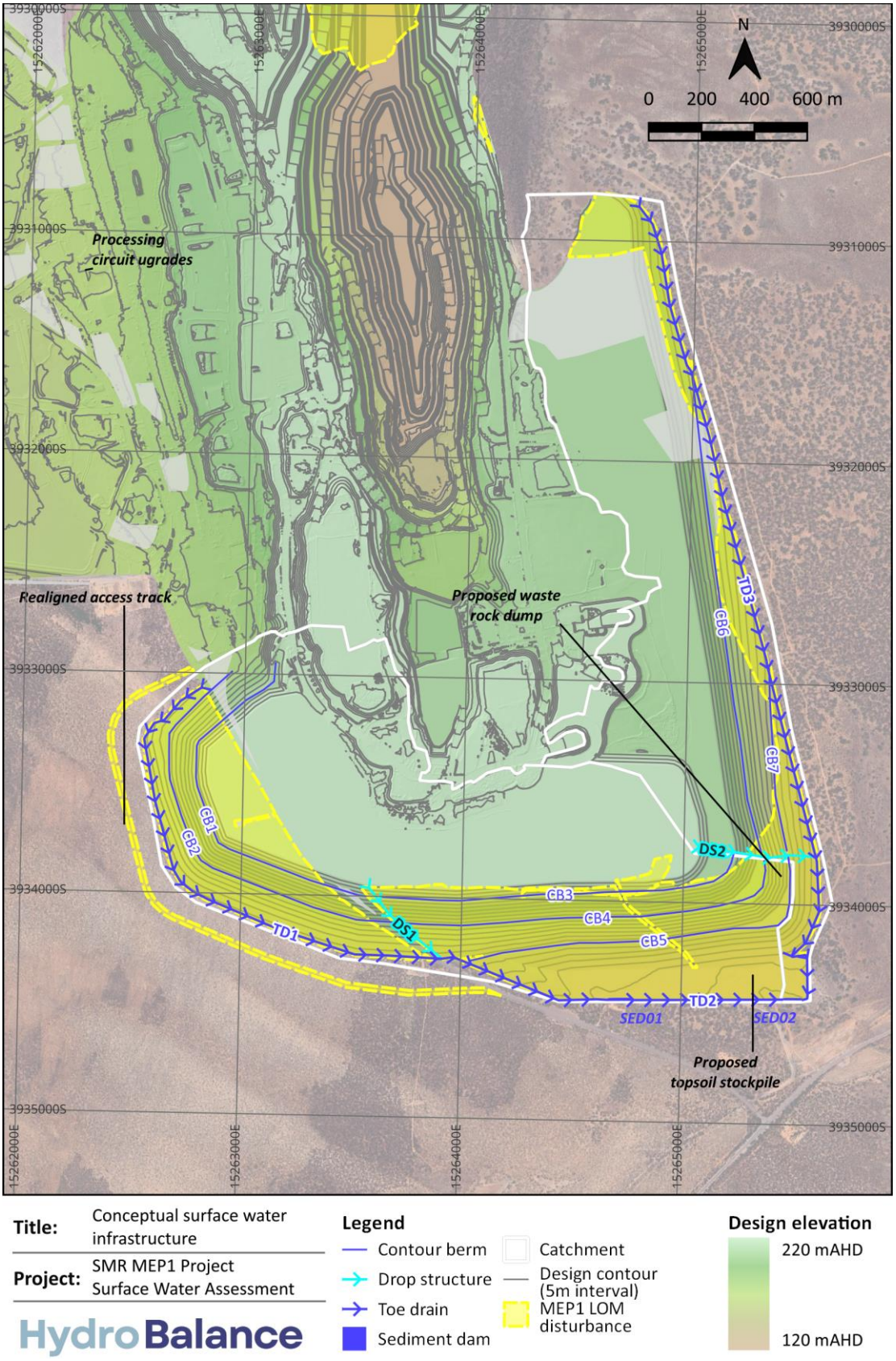


Figure 4.1 – Conceptual site water management system configuration

4.7.2.1 Toe drains/bunds

Open drains should typically contain the features identified below and shown in Figure 4.2 (see https://www.austieca.com.au/documents/item/304):

- The drainage along the toe of the proposed WRDs and stockpiles may be constructed as either trapezoidal drains or windrow bunds;
- Channel batters at least 1V:2H, but preferably 1V:4H;
- Minimum depth of 0.5 m, to contain the 10% AEP design flows, including 0.3 m freeboard;
- Channel grades should not exceed 5%;
- Bank bottom widths will vary depending on the adopted bank batters;
- Diversion banks will be constructed to appropriate engineering standards;
- The channel outlet (level spreader) will be flared out to a minimum width of 1.5 x channel base width. Ground slopes below the channel outlet shall be less than or equal to the channel grade; and
- Stable grass cover to be maintained in the bed and banks of the channel and below the channel outlets (as much as possible).

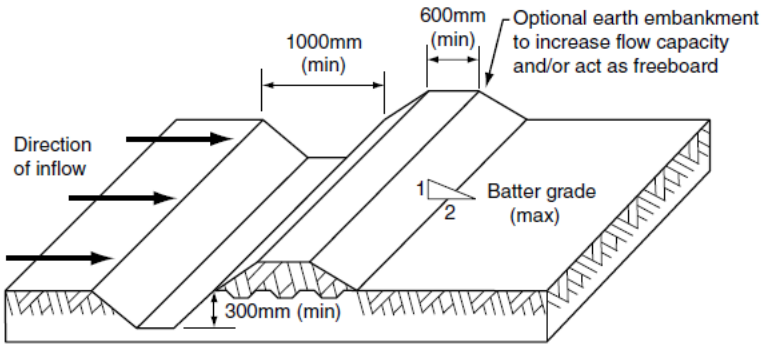


Figure 4.2 – Typical drainage configuration - channel (IECA, 2008)

4.7.2.2 Contour berms

Contour berms typically consist of a raised earth embankment normally placed along level or near level ground. Contour berms are proposed along terraces in the WRD expansion design surface, as shown in Figure 4.1. Contour berms are used to collect sheet runoff from slopes and transport it across the slope to a stable outlet. Constructing contour berms would reduce the slope length down the WRD, hence minimising the likelihood of rills developing and scour occurring. Contour berms should have the features identified in Figure 4.3 (see https://catchmentsandcreeks.com.au/docs/DB1-1.pdf).

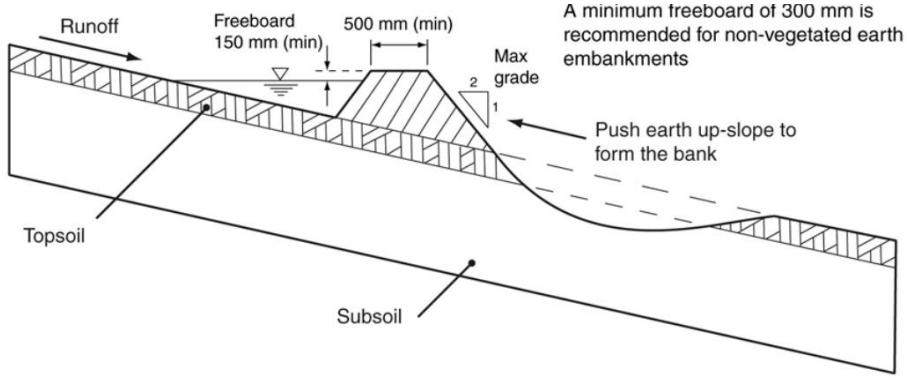


Figure 4.3 – Typical contour berm (IECA, 2008)

4.7.2.3 Drop structures

Drop structures (usually rock chutes) are proposed at various locations on the WRD expansion area (see Figure 4.1). The drop structures will have a longitudinal slope of approximately 25%. A fact sheet relating to the installation of these structures can be found under the following link: https://www.austieca.com.au/documents/item/300.

Figure 4.4 shows the typical components of a rock lined drop structure, which have been conceptually sized for the drop structures. The following features should be included in the construction:

- Rock should have a d_{50} (the mean rock size for which 50% of rocks are smaller) that is sized in accordance with Landcom (2004) and IECA (2008). The maximum rock size should be no greater than 1.5 x d_{50}. The rock should be hard, angular and weathering resistant.
- Drain and contour berm approaches (including the bund/safety berm) within 4 m of the drop structure entrance should be rock lined up to 1 m from the drain invert to limit erosion as water flows from the drain into the drop structure.
- The rocks in the drop structure should be "keyed" in with a 0.5 m deep, 0.65 m cut-off trench at the toe.
- The rock should be underlaid by BIDM A39 geofabric or approved equivalent.

Energy dissipators/erosion protection should be provided at the top and bottom of drop structures prior to entering the downstream drainage network.

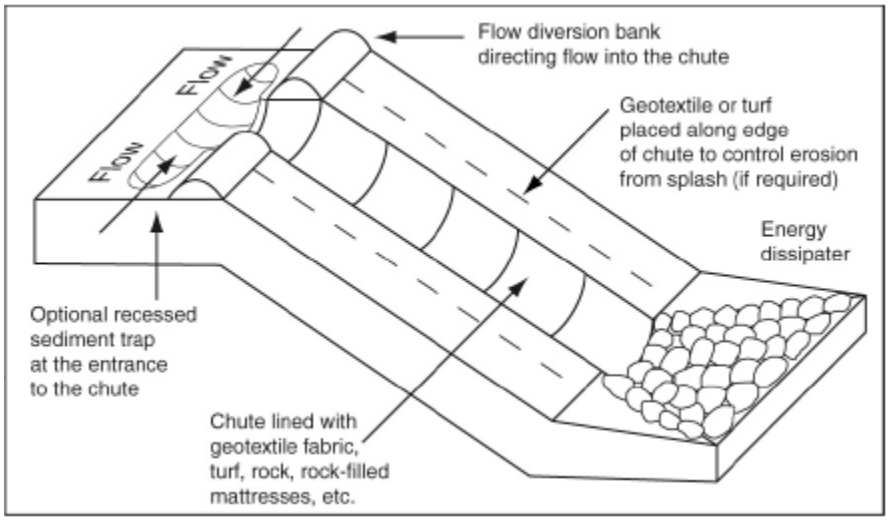


Figure 4.4 – Typical components in a drop structure (IECA, 2008)

4.7.3 Sediment dam design

The location of the proposed sediment dams are shown in Figure 4.1 and have been designed based on the Blue Book guidelines (Landcom, 2004). The soils in the vicinity of the site are skeletal and sandy, with generally coarse grains. Hence, the sediment dams will be designed for *Type C* soils, per Landcom (2004). The sediment dams will have the following key features and considerations:

- Total sediment dam volume = settling zone volume + sediment storage volume. The sediment storage volume is the portion of the dam storage volume that progressively fills with sediment until the dam is de-silted. The settling zone is the minimum required free storage capacity that must be restored within 5 days after a runoff event.
- The design storm event should be based on the following:
    - 50% of the 63.2% AEP design rainfall depth.

- C_{10} runoff coefficient of 0.19, based on soils with low to moderate runoff potential.

- The basin surface area should be equal to 4,100 m^2 per cubic metre of discharge waters per second in the design storm event.
- The minimum depth of the settling zone is 0.6 m.
- The sediment storage zone is determined based on the calculated soil loss rates (see Section 3.3).

The proposed sediment dam specifications are presented in Table 4.2. The sediment dams would passively discharge treated runoff into Salt Creek.

Table 4.2 – Proposed sediment dam specifications

Sediment Dam ID	Dam catchment area (ha)	Total dam capacity (ML)	Dam surface area (m^2)
SED01	210	6.0	1,509
SED02	156	4.4	906

4.8 Clean water management

The MEP1 Project area is located on the centreline of a ridge. As a result, the undisturbed catchment runoff would naturally drain away from the proposed MEP1 Project works, hence no dedicated clean water management infrastructure would be required to separate clean water from sediment water.

5 Flood modelling assessment

5.1 Overview

The TUFLOW hydraulic model described in Appendix B was used to assess potential impacts of the Project on Salt Creek flooding for the 1% Annual Exceedance Probability (AEP) design flood event. The design flood event hydrographs were developed using the HEC-HMS hydrological model described in Appendix A.

5.2 Model outcomes

Modelled 1% AEP flood depths and extents for Salt Creek are shown in Figure 5.2. The flood depths in Salt Creek adjacent to the Project are generally in the range of 2 to 3 m, caused by the flat topography along the channel line, which encourages the formation of pools. Due to the location of the channel at the base of a steep gully, the flood flows are not expected to interact with the proposed works.

The flood level relative to the elevation of the toe of the proposed stockpile is presented graphically as a cross-section in Figure 5.1. The location of the cross-section is shown in Figure 5.2. This cross-section shows that there is a 1.9 m elevation difference between the 1% AEP flood surface and the toe of the proposed stockpile, suggesting that it is unlikely that Salt Creek would interact with the proposed works.

Modelled 1% AEP flood velocities for Salt Creek are shown in Figure 5.3. The velocities are generally low, remaining below 1.5 m/s along most of the creek section. There are some areas of localised high velocities (up to 3 m/s).

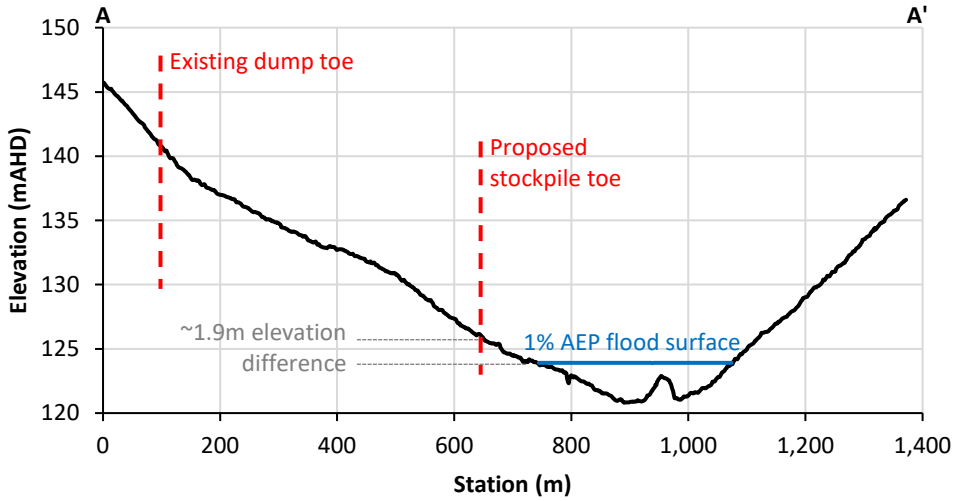


Figure 5.1 – Cross section of 1% AEP flood levels in Salt Creek, relative to the proposed works

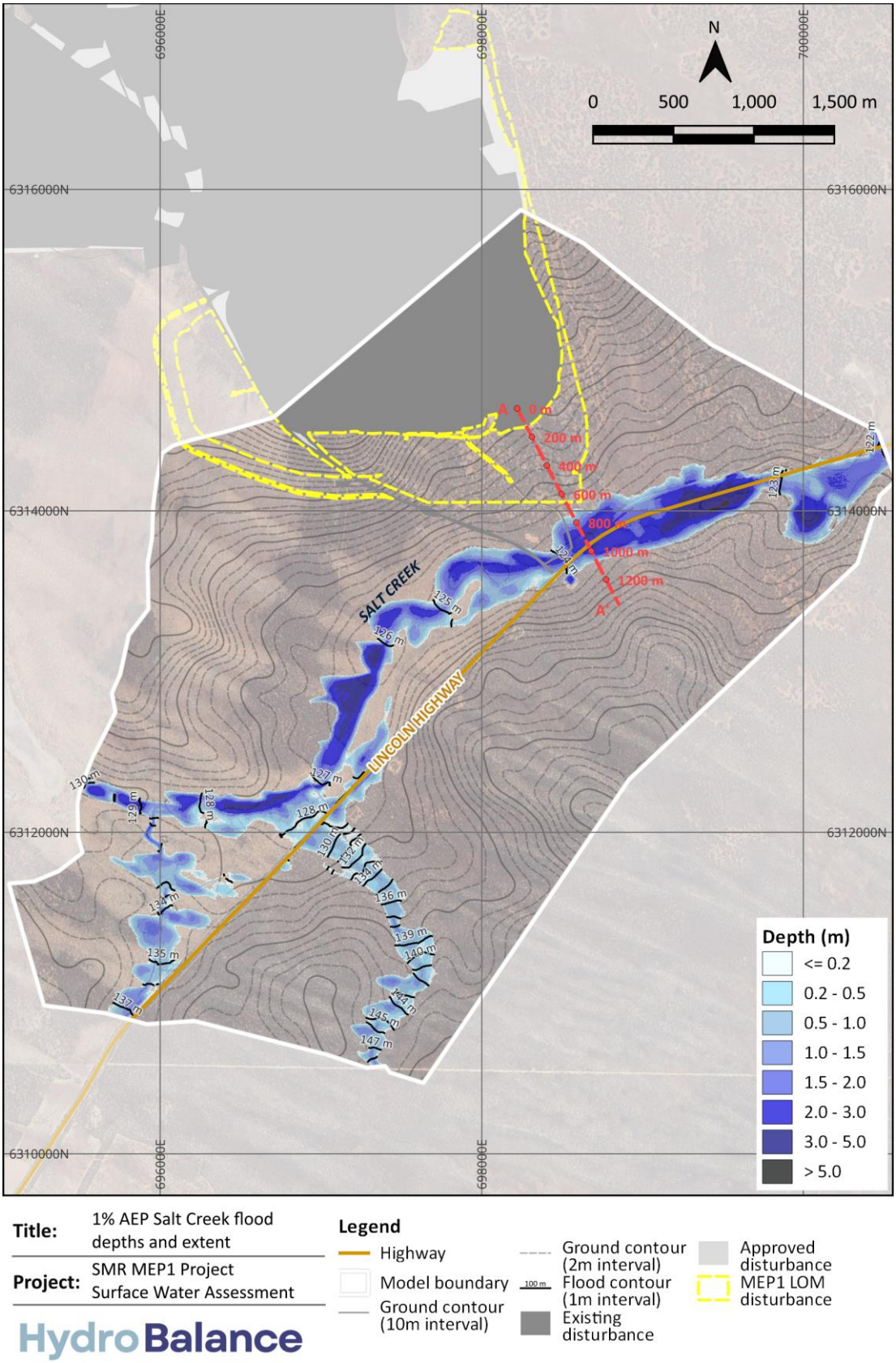


Figure 5.2 –Salt Creek 1% AEP flood depths and heights

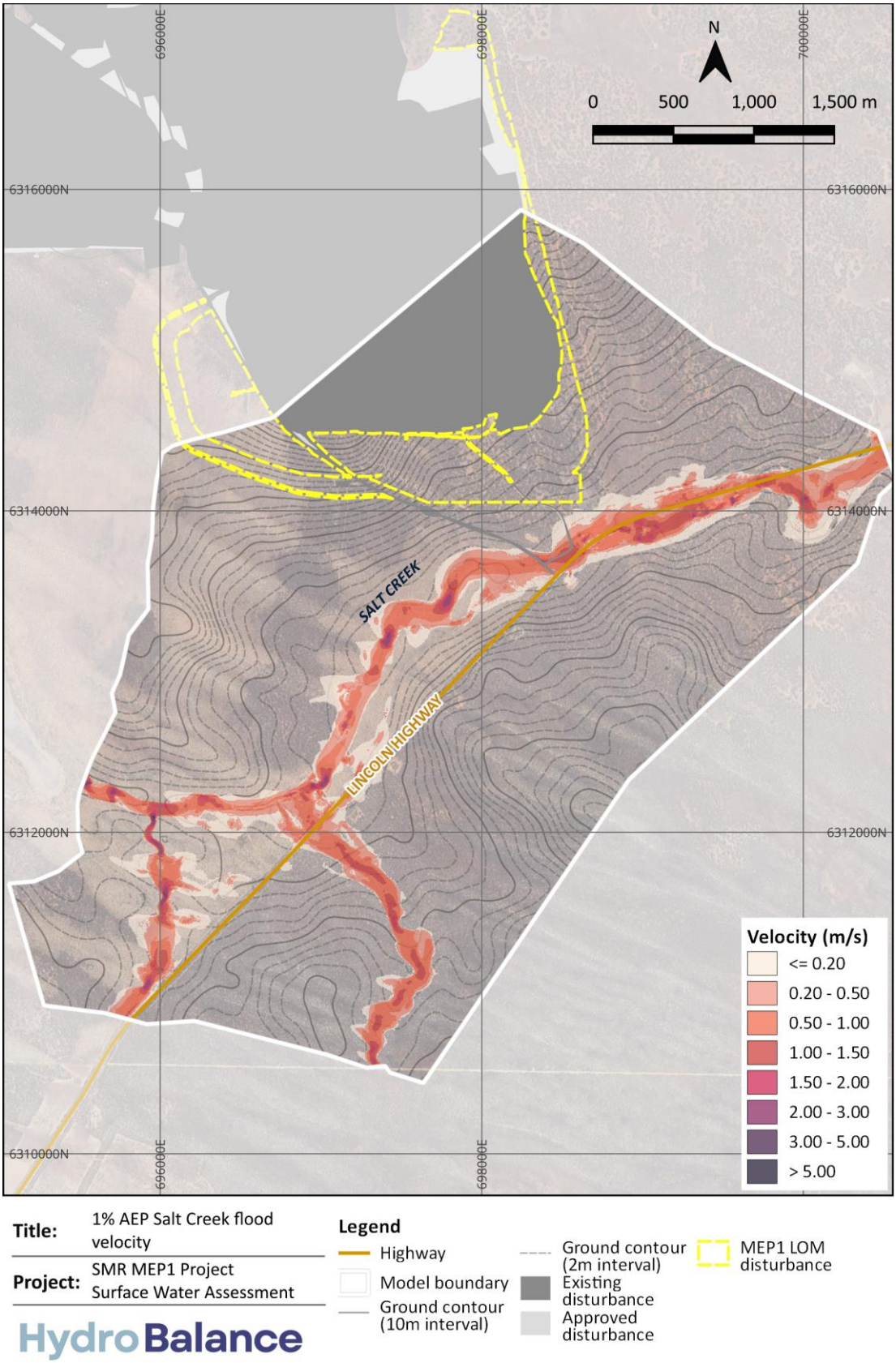


Figure 5.3 –Salt Creek 1% AEP flood velocity

6 Assessment of potential impacts, and mitigation and management measures

6.1 Potential impacts

The potential impacts of the Project on hydrology and flood behaviour include:

- Impacts on flows and the flooding regime in the receiving waterways;
- Impacts on streamflow volumes due to catchment excision;
- Impacts on regional water quality; and
- Cumulative impacts of all projects in the region on flows and the flooding regime in the receiving waterways.

An assessment of each of these potential impacts of the Project is provided in the following sections.

The assessment of flooding impacts has been undertaken based on commonly applied methodologies for the simulation of hydrologic and hydraulic processes using currently available data. The adopted approach is considered suitable for quantifying impacts to a level of accuracy consistent with current industry practice.

6.2 Flooding impacts

No proposed infrastructure associated with the Project is located within the Salt Creek 1% AEP design flood extent. Hence, the expected impact of the Project on the Salt Creek flood conditions is expected to be negligible.

6.3 Streamflow impacts

Surface runoff from the proposed disturbance (including the WRD extension and stockpile) will be treated and passively released via the proposed ESC infrastructure described in Section 4.7. However, there is likely to be some detention of runoff from the Project in the proposed sediment dams (SED01 and SED02). The total catchment area draining to SED01 and SED02 is 366 ha, which represents approximately 1.8% of the Salt Creek catchment to downstream of the Project (20,644 ha). Hence, the maximum potential impact to Salt Creek streamflow volumes is 1.8%, which is considered negligible. In reality, the impact on Salt Creek streamflow volumes due to the Project is likely to be significantly less than 1.8% as the majority of the flow-producing events in Salt Creek would be sufficient to allow the sediment dams to passively release flows back into Salt Creek.

6.4 Regional water quality and environmental values

The disturbed areas (WRD extension and stockpile) will be managed to mitigate potential impacts on regional water quality and environmental values through the preparation of a Surface Water Management Plan (SWMP). The SWMP will comprise a practical guide to manage risks to soil and water associated with specific management measures for all discrete disturbance areas.

Potential impacts on downstream water quality due to the disturbed areas will be mitigated through best-practice runoff management methods as described in Section 4.7.

6.5 Cumulative impacts – flooding

There are no other projects located upstream or downstream of Salt Creek (or the local waterways). As such, there are no cumulative impacts in relation to flows and the flooding regime for the Project.

6.6 Proposed mitigation measures

The potential impacts of the Project on hydrology and flooding behaviour in the receiving waters have been mitigated through the careful design and location of proposed Project infrastructure.

7 References

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Appendix A. Hydrological modelling

Overview

The flood impact assessment analysed peak flows in Salt Creek. A HEC-HMS (Hydrologic Engineering Centre – Hydrologic Modelling System version 4.11) model was used to estimate the 1% AEP peak design discharges for a range of durations. Rainfall data (rainfall depths, areal reduction factors and temporal patterns) were applied in accordance with ensemble event procedures in Australian Rainfall & Runoff (ARR) (Ball et al., 2019).

Due to the arid nature of the region, there is no available recorded streamflow data to validate or calibrate the hydrologic model. However, the flood modelling results suggest that flood levels in Salt Creek are at least 1.9 m below the toe of the proposed stockpile (see Figure 5.1). Hence, the uncertainty due to the lack of calibration or validation is unlikely to impact upon the overall outcomes of this assessment.

HEC-HMS model configuration

Spatial configuration

Figure A.1 shows the HEC-HMS model configuration. The HEC-HMS model subcatchments were delineated based on a combination of site LiDAR and SRTM data and covers the drainage in the vicinity of the site. The model has a total catchment area of 206 km^2 and includes 32 subcatchments ranging in size from 2.6 km^2 to 9.6 km^2.

Subcatchment parameters

The key HEC-HMS subcatchment parameters are summarised in Table A.1. The hydrological routing through the model was estimated using the lag routing method. The lag time was calculated by comparing the channel length with the flood wave velocity, approximated by the Mannings Equation.

Table A.1 – HEC-HMS subcatchment parameters

Catchment ID	Area (km^2)	Mannings 'n'	Channel length (km)	Catchment averaged slope (%)	Equal area slope (%)
1	3.46	0.06	2.09	2.35	0.52
2	5.05	0.06	3.28	2.39	1.18
3	6.09	0.06	3.94	3.03	0.61
4	8.45	0.06	6.23	2.16	0.82
5	6.80	0.06	2.96	2.38	0.53
6	7.83	0.06	4.85	2.29	0.89
7	9.58	0.06	4.64	2.37	1.43
8	8.99	0.06	3.81	2.95	1.66
9	9.30	0.06	4.44	2.02	0.71
10	9.53	0.06	5.02	1.94	0.40
11	5.99	0.06	3.54	2.99	2.07
12	4.87	0.06	3.81	2.81	1.61
13	6.95	0.06	3.92	3.10	1.17
14	9.54	0.06	3.71	2.12	1.11

Catchment ID	Area (km^2)	Mannings 'n'	Channel length (km)	Catchment averaged slope (%)	Equal area slope (%)
15	6.03	0.06	3.39	2.36	0.64
16	4.99	0.06	2.59	2.43	1.19
17	2.59	0.06	2.65	2.43	1.39
18	3.00	0.06	2.78	2.26	0.82
19	4.29	0.06	2.41	2.23	0.89
20	3.18	0.06	2.01	2.40	1.20
21	5.82	0.06	3.40	2.44	1.09
22	5.52	0.06	4.15	2.02	0.97
23	7.99	0.06	4.20	1.69	0.47
24	7.94	0.06	3.03	2.43	1.63
25	8.84	0.06	3.58	2.37	1.35
26	8.83	0.06	3.69	2.30	1.16
27	5.90	0.06	2.88	2.29	1.46
28	5.40	0.06	3.44	2.61	1.65
29	5.67	0.06	2.50	2.61	1.90
30	4.90	0.06	3.14	2.05	1.08
31	6.90	0.06	3.64	2.95	0.44
32	5.46	0.06	2.63	2.81	1.39

Areal variability

A design rainfall intensity-frequency-duration (IFD) relationship was determined for the centroid location of the HEC-HMS catchment and applied to each of the model subcatchments equally. Table A.2 summarises the rainfall intensities for a range of durations.

Areal reduction factors (ARF) were determined based on the total model catchment area and applied to Salt Creek.

Table A.2 – Adopted rainfall depths

Duration (hrs)	1% AEP design rainfall intensity (mm)
3	49.4
6	68.0
12	89.4
24	115.9
36	130.0
48	140.0

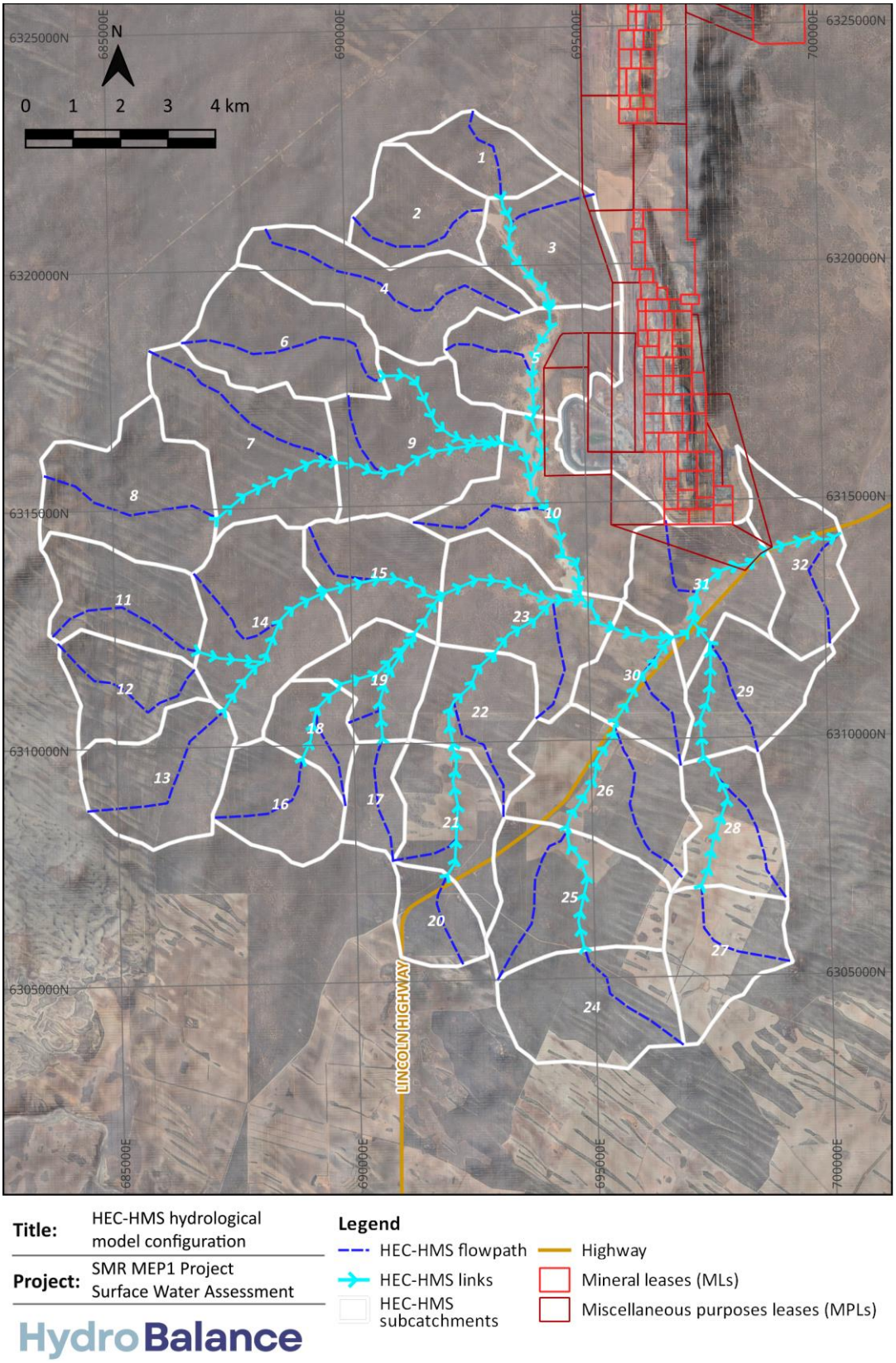


Figure A.1 – HEC-HMS hydrological model configuration

Temporal patterns

The Rangelands temporal patterns from ARR Data Hub (Geoscience Australia, 2019) were used for the 1% AEP event.

Design rainfall losses

The design rainfall losses were adopted based on values adopted for another flood study undertaken in the region outside Adelaide (Tonkin, 2018). The losses applied to the 1% AEP design were a 11.1 mm initial loss and 2.5 mm/hr continuing loss.

Design discharges

Design discharges were determined using an 'ensemble' of 10 temporal patterns, which produces 10 design hydrographs (and peak discharges) for each duration. The temporal pattern which results in a peak discharge closest to, but higher than, the ensemble mean is selected as the representative temporal pattern for that storm duration.

The hydrological modelling resulted yielded the following for the 1% AEP event:

- 156 m^3/s peak discharge.
- 6 hour critical duration.
- Temporal pattern number 6.

Flows for a range of durations for Salt Creek are presented as a boxplot in Figure A.2.

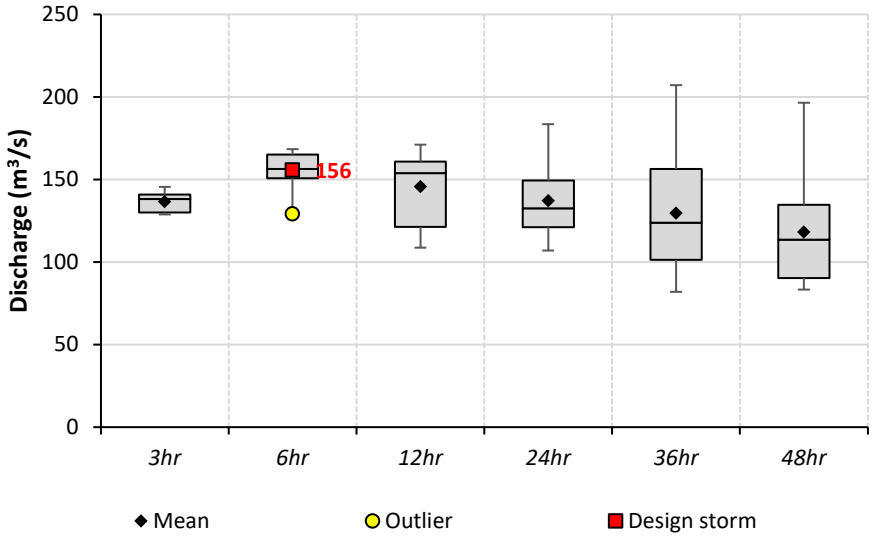


Figure A.2 – 1% AEP in Salt Creek, downstream of the Project (subcatchment 32)

Appendix B. Hydraulic modelling

Overview

The two-dimensional TUFLOW hydrodynamic model (BMT, 2023) was used to simulate the flooding behaviour of Salt Creek in the vicinity of the Project including flood extents, depths and velocities.

TUFLOW represents hydraulic conditions on a fixed grid by solving the full two-dimensional depth averaged momentum and continuity equations for free surface flow (BMT, 2023). The model automatically calculates breakout points and flow directions within the model area. The most recent version of the TUFLOW software (Build 2023-03-AC) was used for this study.

The TUFLOW model was run using the Heavily Parallelised Compute (HPC) CPU solver which uses adaptive time stepping.

The configuration of the TUFLOW model is presented in Figure B.1.

Topographic data

The TUFLOW model uses Light Detecting and Ranging (LiDAR) topographic data provided by the Proponent, covering the full model extent.

Model extent and resolution

Figure B.1 shows the configuration of the TUFLOW model. The hydraulic model includes Salt Creek. The section of Salt Creek extends from 3.3 km upstream of the Project to 1.3 km downstream of the Project.

A grid size (resolution) of 4 m was adopted for the TUFLOW model.

Inflow and outflow boundaries

Figure B.1 shows the locations of the 2D inflow and outflow boundaries used in the TUFLOW model. The discharge hydrographs estimated using the HEC-HMS runoff-routing model were adopted as inflows to the TUFLOW model. The TUFLOW inflow location have been located upstream of the identified potential impacts associated with the proposed Project infrastructure. The HEC-HMS inflows for all watercourses were applied concurrently.

Inflows from the hydrological model draining to the upstream extents of the hydraulic model were applied as total hydrograph inflows at these locations. The positions of these inflow boundaries were chosen so that flows were as confined as possible at their point of entry into the hydraulic model, with minimum flow break out. The flows from the subcatchments within the hydraulic model were applied as local source area inflows. These source areas apply the flow to the lowest cells within the source area polygons.

The outflow boundary is located on the Lincoln Highway, 1.3 km downstream of the Project. The outflow boundary was placed to be sufficiently downstream of the Project, such that no boundary anomalies would propagate upstream enough to impact results in the vicinity of the Project. The outflow boundary is assumed to have a water surface slope of 0.1%, based on available topography.

Adopted Mannings ‘n’ roughness

The TUFLOW model uses Manning’s ‘n’ values to represent hydraulic resistance. Manning’s ‘n’ values were adopted based on typical published values (for example those of Chow, 1959).

Table B.2 shows the adopted Mannings ‘n’ values for the TUFLOW model and Figure B.1 shows the location of each landuse.

Table B.3 – Adopted Mannings 'n' values

Land use	Mannings 'n'
Bare earth	0.02
Unpaved road	0.02
Sparse vegetation	0.04
Moderate vegetation	0.06
Dense vegetation	0.08
Grazing	0.04
Channel	0.04
Stockpile	0.03
Paved road	0.01

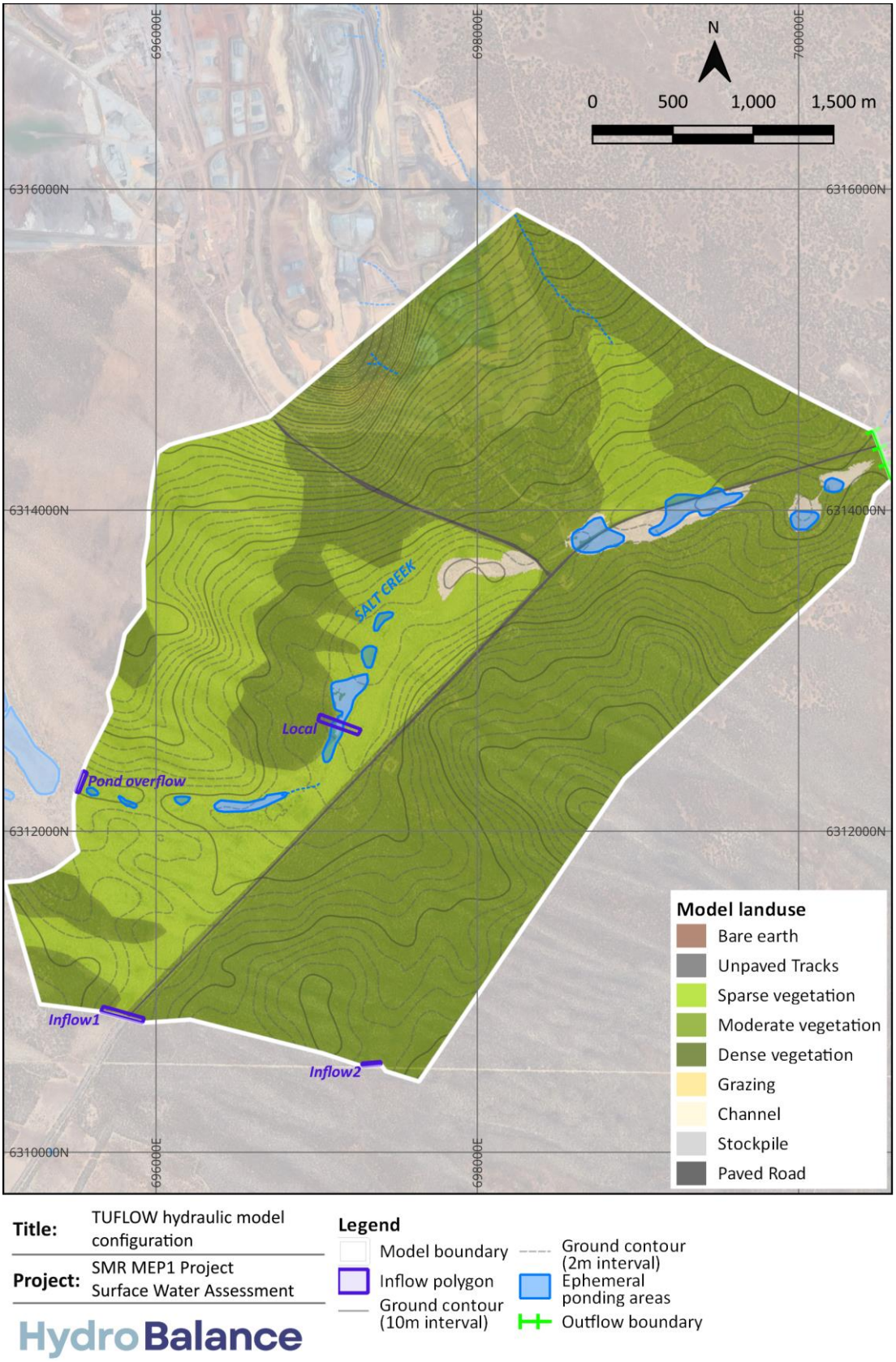


Figure B.1 – TUFLOW model configuration

D2 Air Quality Assessment

Intended for
SIMEC Mining

Date
May, 2024

SIMEC MINING MAGNETITE EXPANSION PHASE 1 PROJECT

AIR QUALITY ASSESSMENT



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SIMEC MINING MAGNETITE EXPANSION PHASE 1 PROJECT
AIR QUALITY ASSESSMENT

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EXECUTIVE SUMMARY

SIMEC is seeking to expand its magnetite production at their existing South Middleback Range (SMR). The expansion is referred to as the Magnetite Expansion Phase 1 (MEP1). To support the proposed expansion, an air quality assessment was undertaken that considered the following:

- Expansion of already existing mine pits which will be designated as Iron Duchess A and Iron Duchess B;
- New and expanded processing facilities located at the south of the SMR mining area which will include a new Wate Rock Dump (WRD) and a new tailings waste management facility; and
- Updates to ore and waste rock annual throughput tonnages.

In addition to the MEP1 project, mining will resume at the Iron Knight South pit as part of the Program for Environment Protection and Rehabilitation (PEPR). This will involve mining and waste dumping on mostly pre-existing disturbed land with the creation of six new WRDs.

The CALPUFF air quality model was used to predict maximum 24-hr average and annual average ground level concentrations of PM_{10} and $PM_{2.5}$ as well as monthly deposition of particulates for the current SMR scenario and the proposed MEP1 scenario.

The key findings of the air dispersion modelling are as follows:

- One scenario based on existing operations at the SMR, and two scenarios based on the proposed operations involving the MEP1 expansion were modelled to assess the impacts of the MEP1. The year 2027 for the proposed operations was selected based on this year representing the worst-case dust emissions. The two proposed MEP1 scenarios differ only in the dust controls applied. The mitigation scenario includes dust controls including water spraying during drilling, screening, conveying and dumping; watering of roads, stockpiles, WRDs and pits. The unmitigated scenario does not have any dust controls in place.
- The two MEP1 scenarios predicted higher concentrations of PM_{10} and $PM_{2.5}$ compared to the existing SMR scenario. This is likely a result of the increased excavation, dumping and higher throughput rates of ore, resulting in greater truck movement.
- When no dust controls are in place, in the unmitigated MEP1 scenario, the area precited to exceed the criteria for PM_{10}, $PM_{2.5}$ and deposition as TSP is much larger than the mitigated scenario.
- Cumulative PM_{10} and $PM_{2.5}$ GLCs were predicted to exceed the corresponding SA EPA guidelines at a number of locations close to the operations. No exceedances were predicted at any of the sensitive receptors during the MEP1 mitigated scenario. During the unmitigated MEP1 scenario, no exceedances were expected at any sensitive receptors beside one day which was predicted to exceed the $PM_{2.5}$ criteria at the Pine Hill Homestead.
- TSP deposition results show deposition levels at all sensitive receptor locations are predicted to remain below relevant guidelines.

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1. INTRODUCTION

1.1 Background

GFG Alliance is structured in three business areas; the steel group (Liberty), the aluminium group (Alvance) and the mining group (SIMEC). The Middleback Ranges (MBR) is comprised of three mining regions the South Middleback Range (SMR), the Iron Baron Mining area (IBMA), and the Iron Knob Mining Area (IKMA). The sites are located to the south-west, west and north-west of the Whyalla town, respectively.

SIMEC Mining (SIMEC), through its legal entity OneSteel Manufacturing Pty Limited, own and operate mining operations at South Middleback Ranges (SMR), which incorporates Iron Duke, Iron Magnet, Iron Duchess North and South, Iron Knight North and South, and Iron Chieftain, Cooks North and associated processing (Figure 3). These operations are connected by rail to the Whyalla Port facilities held by SIMEC and Whyalla Ports Pty Ltd.

The SMR is also connected to the Whyalla Steelworks via an underground pipeline corridor, enabling magnetite concentrate slurry produced at the SMR Magnetite Concentrator to be pumped to the Whyalla Pellet Plant for the production of iron ore pellets, providing the ferrous feedstock to the Whyalla Steelworks, and for direct export. The underground pipeline corridor also accommodates a return water line between the Whyalla Pellet Filter Plant and the SMR Magnetite Concentrator.

1.2 Project Description

1.2.1 MEP1

SIMEC is seeking to expand its magnetite production in the Middleback Ranges. The Magnetite Expansion Phase 1 (MEP1) is the optimisation and de-bottlenecking of production and involves relatively minor changes of existing infrastructure entirely on the existing footprint of the SMR Mining Area. New and expanded processing facilities will be required to support the proposed operations, including an expanded mine pit and associated new tailings and waste rock management facilities.

MEP1 will maintain the current mining method, employing conventional open cut mining using drill and blast methods, with ore and waste rock removed from the pit with excavators, loaders and haul trucks. The site has a network of haul roads and run of mine (ROM) pads, stockpiles and waste rock dumps (WRDs). Product will continue to be transported from the existing concentrator via existing pipelines. Specifically, MEP1 will comprise of:

- An extension to 'Life of Mine' (LOM) magnetite mining beyond the current magnet pit is proposed. This would use the current concentrator facilities, and is designated as Iron Duchess A and Iron Duchess B, adding approximately 20 years to LOM;
- Some waste rock produced during the MEP1 project will be accommodated in the existing waste rock dumps, however it is expected that some additional vegetation clearance would be required by approximately mid-2025 in order to accommodate further waste rock disposal;
- The existing tailings storage facility (TSF) is also proposed to be used in the early years of MEP1, with additional tailings disposal in a mined-out pit (Iron Knight North), not requiring additional vegetation clearance;
- Duchess South water storage moved to Duchess North;
- Diversion of mine access track around the new WRD;

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- New topsoil stockpile area;
- Upgrades to the Direct Reduction (DR) Flotation Plant to enable the processing of high silica ore; and
- Repurposing of equipment from OBP to dewater concentrate to enable rail transport to Whyalla to supplement the existing slurry pipeline.

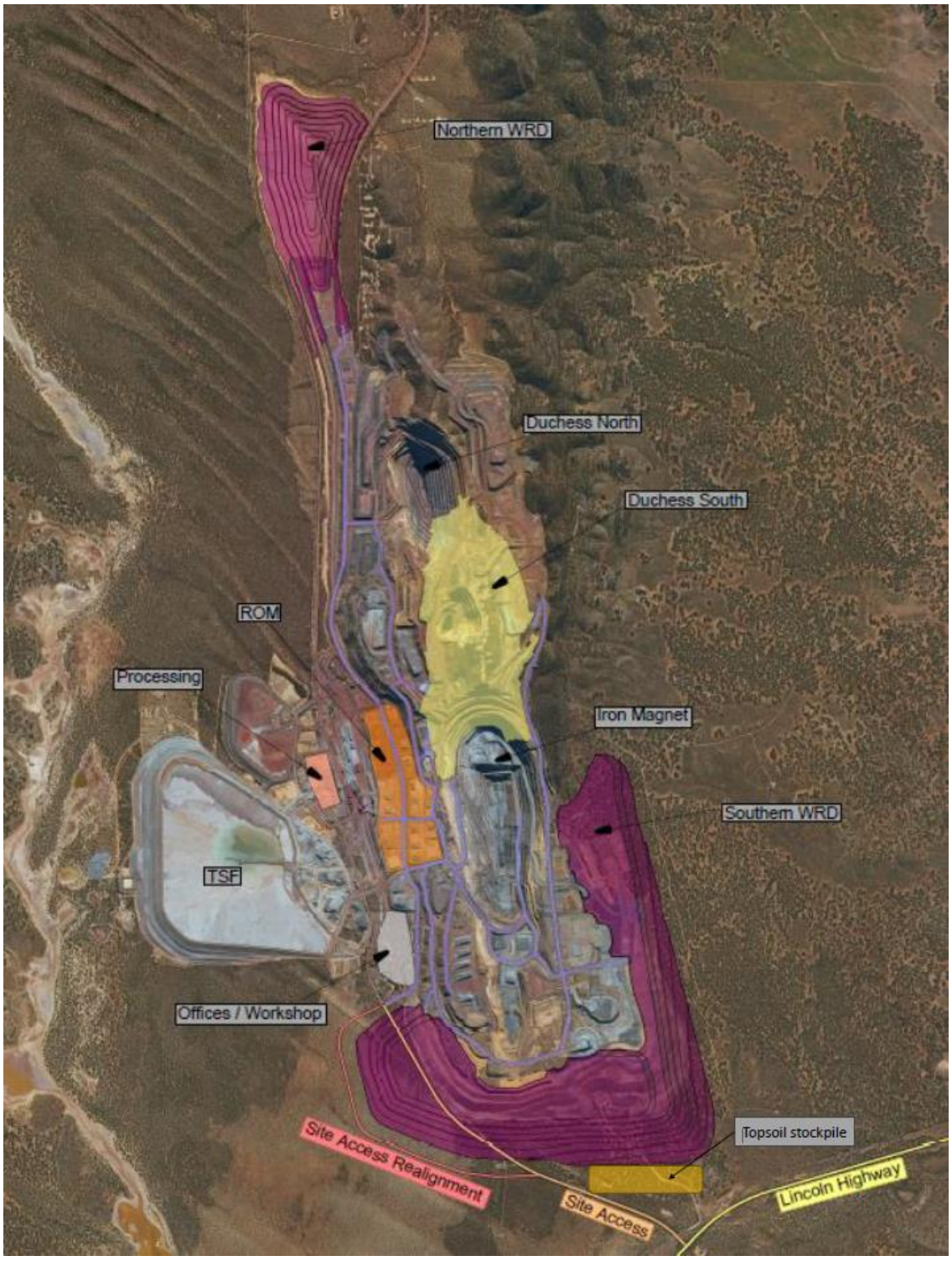


Figure 1: Site Location

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1.2.2 PEPR

SMR operates in accordance with the Program for Environment Protection and Rehabilitation (PEPR) MPEPR2023/026 (SIMEC WPC-243 Rev 1), which was approved by the Department for Energy and Mining (DEM) on 19 September 2023. This program, known as PEPR, is tailored to facilitate the Iron Knight operation specifically. It delineates the authorized scope of activities, which include Iron Knight North and South open-cut mining operations, interconnected haul roads and minor roadways, Run of Mine (ROM) pad, WRDs, crushing and screening facilities, train loading facilities, basic site amenities, and explosive storage facilities.

To support the run-of-mine (ROM) operations, SIMEC is planning to resume mining activities at the Iron Knight South pit and undertake additional development of six small WRDs. The Iron Knight operation encompasses both the Iron Knight North and Iron Knight South pits. The Iron Knight North pit is considered fully excavated, with no remaining economically viable reserves. A smaller pit situated south of the Iron Knight South pit has been previously developed and mined out. Figure 2 illustrates the proposed cutback layout at the site.

All mining and waste dumping activities will occur on pre-existing disturbed land, except for the expansion of the western dump's southern section, which will encompass an area of approximately 3.25 hectares and has previously received clearance approval. To facilitate the ongoing and resumed mining operations, there is a proposal to relocate the mobile crusher plant from the ROM rail crusher pad (located east of the rail line) to the Chieftain South Waste Rock Dump (WRD) for a period of approximately 60 days to support mining activities at Cooks North. Subsequently, the mobile crusher will be relocated to the west of the Knights North pit to aid mining operations at Knight South.

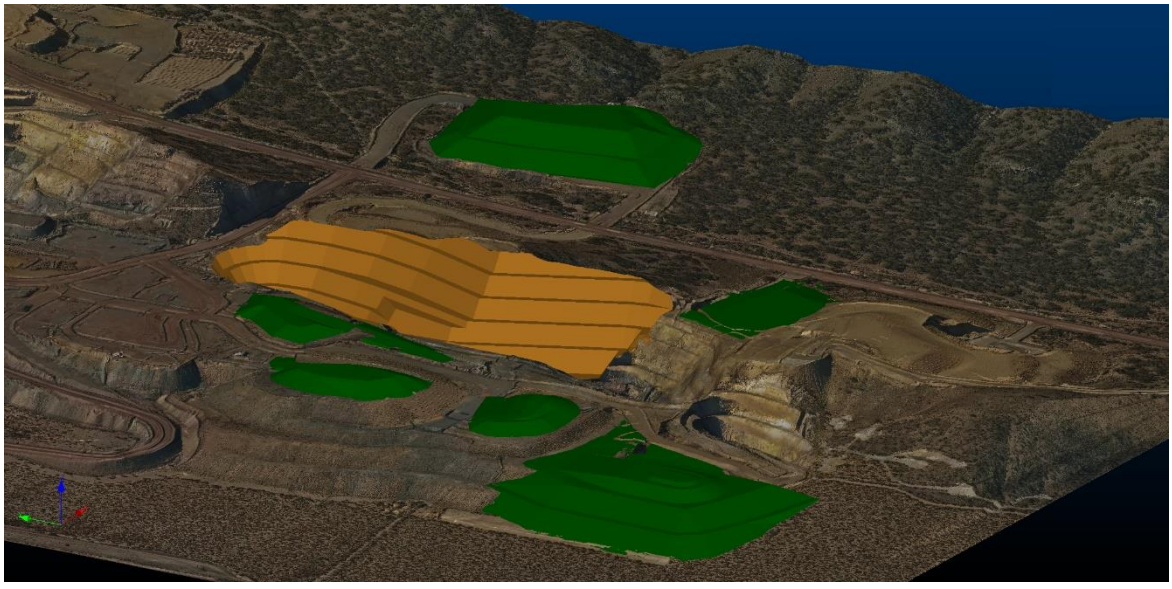


Figure 2: Iron Knight South extension design and waste rock dump design (yellow: pit cutback, green: WRDs)

1.3 Purpose of this Report

This report presents the assessment of the potential ambient air quality impacts and dust deposition rates associated with fugitive particulate emissions associated with the existing operations labelled SMR and the MEP1 proposed operations. The approach, methodology and results of the air dispersion modelling are detailed as well as the predicted impacts.

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1.4 Model Scenarios

The main potential change in dust emissions as a result of MEP1 will be from the management and storage of tailings. Both existing and future tailings storage on site include three tailings streams:

1. Fine Tailings
2. Coarse Tailings; and
3. DLIMS Rejects.

The tailings disposal for each of these streams varies across the timeline for MEP1 and as such, to capture a detailed understanding of the changes to air quality impacts from the tailing's disposal, as well as the broader site operations and MEP1 activities, multiple scenarios have been run. Additionally, material movement (both ore and waste) varies between MEP1 operating years and as such, the models have considered the changes to tailings management, as well as highest materials movement years.

Three scenarios have been modelled to predict the change in dust emissions from the current SMR operations, and the potential worst-case years associated with the proposed MEP1 Project (based on changes to tailings management and material movement quantities). These scenarios include:

1. **SMR** – the current operations in the SMR, including Cooks North Operations
2. **MEP1** – The proposed scenario for the Financial Year (FY) 2027 where approximately 21.7 Mt of material is mined and processed as ore or waste. In this scenario, tailings from the Iron Knight South mine are moved to the surrounding WRDs and tailings for the Iron Duchess A & B mine are to be moved to the following locations:
    - Fine tails will be wet pumped to the TSF (Raise 9);
    - Coarse rejects will be stockpiled in a stockpile adjacent to the TSF; and
    - DLIMS will be trucked to the south WRD.

    To understand the impacts of dust when no dust control methods are applied the following two scenarios were modelled for the MEP1 future scenario:

    a. **Mitigated** – dust controls applied, including water spraying during drilling, screening, conveying and dumping; watering of roads, stockpiles, WRDs and pits.

    b. **Unmitigated** – no dust controls applied.

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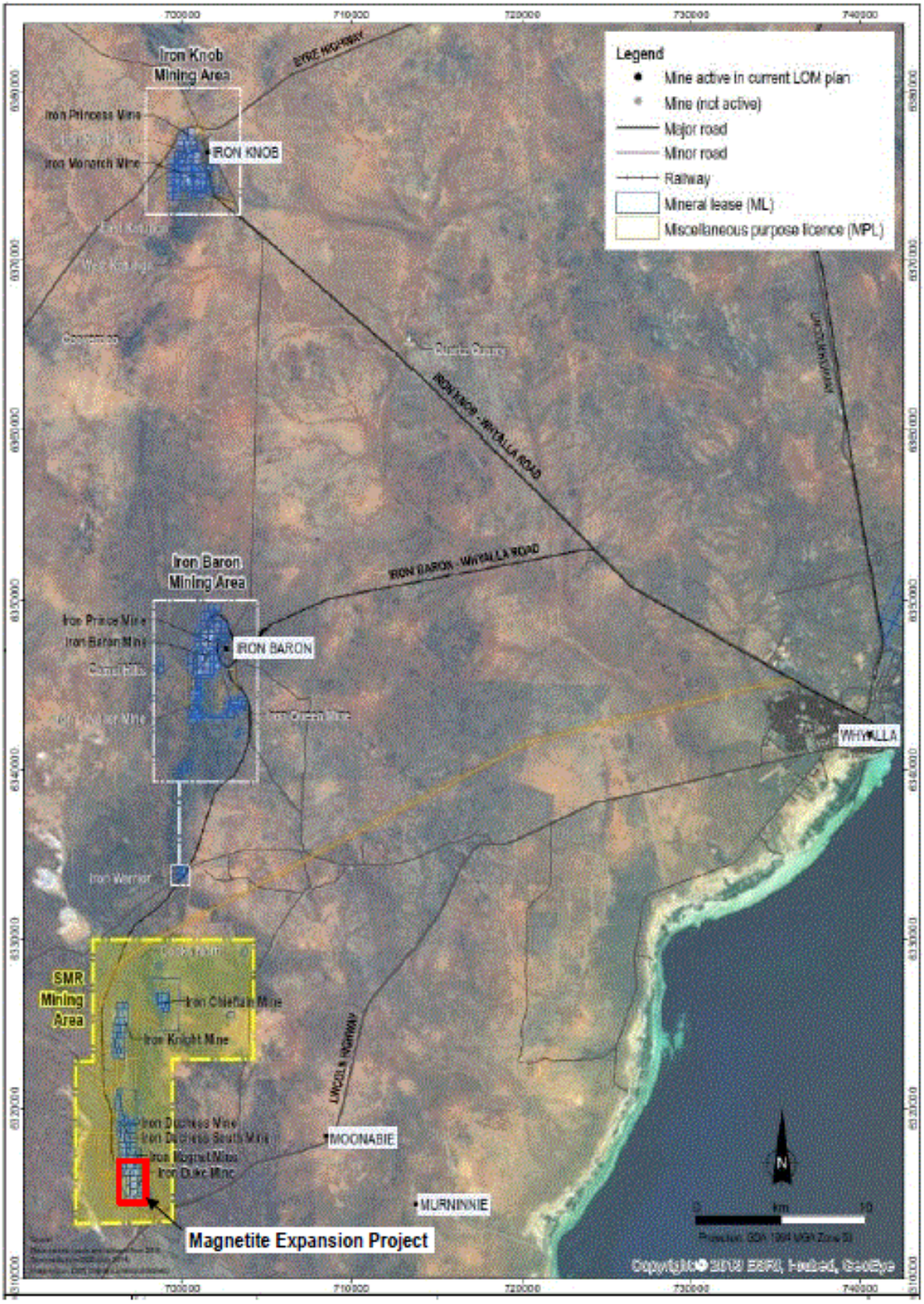


Figure 3: Middleback Ranges Mining Area

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2. EMISSIONS ESTIMATES

2.1 Introduction

Currently the SMR mining area produces approximately 7 million tonnes per annum (Mtpa) of ore and overburden material that result in emissions of particulates to the atmosphere. With the proposed MEP1, mining production is anticipated to increase to a maximum of 9.1 Mtpa with a concentrate production rate of 2.5 Mtpa. The following sections outline the methodology used to quantify emissions estimates from various sources for use in the air dispersion modelling.

2.2 Emission Factors

Emission factors (EFs) and emission inventories have long been fundamental tools for air quality management. An EF is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of the pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per tonne of ore or waste mined). In most cases, these factors are simply averages of all available data of acceptable quality and are generally assumed to be representative of long-term averages for all similar facilities. However, there are inherent uncertainties associated with the use of EFs, as test data from representative sources may not always be of sufficient quantity or quality to calculate robust EFs and may not reflect the variability of actual emissions.

Data from source-specific emission tests or continuous emission monitors are typically preferred over the use of EFs to estimate source emissions as they provide the best representation of emissions from the tested source. However, in the absence of source-specific emission testing data, EFs are often the most appropriate or only method available for estimating emissions.

2.2.1 NPI Emissions Factors

The EFs proposed for use in this assessment are primarily based on the default EFs published in the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) NPI Emissions Estimation Techniques (EET) Manual for Mining (2012) (NPI mining manual) (with the exception of wind erosion). In lieu of site-specific data, it is common practice for mining operations within Australia to utilise the default EFs from the NPI mining manual in order to estimate emissions. Further information on the NPI mining manual can be found in Appendix 1.

2.3 Emission Sources

To predict particulate deposition rates in a realistic manner, hourly estimates of particulate emissions are required from all major sources in the area. Factors which are important for particulate generation include:

- Ore type being handled - This is related to the size distribution of the material, shape and composition of the fines fraction;
- Moisture content - Increasing the moisture content decreases the dustiness of the ores with there normally being a moisture threshold above which particulate generation by material handling is negligible, known as practical extinction. This occurs as moisture acts to apply adhesive forces between particles;
- The operation occurring - Factors which are important are the drop height, the degree to which the falling ore is exposed to the wind such that winnowing can occur, and the particulate control mechanism used. Control mechanisms may include enclosing the operation, the use of water sprays and particulate extraction to a bag filter or to a wet scrubber;
- Quantity of ore/overburden being moved and the number of movements;
- Size of stockpiles and level of activity;

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- Level of vehicle traffic; and
- Ambient wind speed - For material handling operations exposed to the air, particulate emissions increase with increasing wind speed. For wind erosion, particulate emissions are negligible below a wind speed threshold, but increase rapidly above the threshold. Dust emissions from wind erosion are also dependent on the erodibility of the material which is dependent on the size distribution of the material and whether a crust has been developed.

The equations used to determine the emissions of TSP, PM_{10} and $PM_{2.5}$ associated with the emissions sources of the modelled scenarios are presented in Appendix 1. Table 1 presents a summary of the equations within Appendix 1.

Table 1: Summary of Equations associated with Emissions Sources for TSP, PM_{10} and $PM_{2.5}$

Emission Source	Equation		
	TSP	PM_{10}	$PM_{2.5}$
Drilling	Equation 1	Equation 2	Equation 3
Blasting	Equation 4	Equation 5	Equation 6
Loading Ore	Equation 7	Equation 8	Equation 9
Unloading Ore	Equation 10	Equation 11	Equation 12
Bulldozing	Equation 13	Equation 14	Equation 15
Primary Crushing	Equation 16	Equation 17	Equation 18
Secondary Crushing	Equation 19	Equation 20	Equation 21
Tertiary Crushing	Equation 22	Equation 23	Equation 24
Screening	Equation 25	Equation 26	Equation 27
Handling/ Transfer	Equation 28	Equation 29	Equation 30
Haul Roads	Equation 31	Equation 32	Equation 33
Wind Speed Dependence for Material Handling	Equation 34	Equation 35	Equation 36

2.3.1 Wind Erosion

Dust emissions generated by wind are generally negligible below a wind speed threshold but increase rapidly when wind speeds exceed the threshold. Dust emissions from wind erosion are also dependent on the erodibility of the material which in turn is dependent on the size distribution of the material and whether a crust has developed. In general, material with a large (>50%) fraction of non-erodible particles (generally particles greater than 1 mm to 2 mm) will not erode as the erodible fraction is protected by these particles. Fine ores are generally much more erodible by wind erosion, particularly if they have a large fraction of particles in the range from 0.1 mm to 0.25 mm which can be dislodged by wind and then rolled and skipped along the surface (saltation). These larger particles can then dislodge the smaller (<50 µm) dust fraction which can remain suspended in the air.

The NPI EET Manual for Mining (NPI, 2012) specifies a wind erosion factor for PM_{10} of 0.2 kg/ha/hr for all sources with the exception of coal stockpiles. However, this factor is considered approximate as it does not consider variations in the climate of an area or the soil or ore type. Previous studies investigating the impact of dust emissions from mining facilities have used the Shao (2000) equation to parameterise particulate emissions for disturbed open areas and surrounding roads. The same method was also adopted to estimate the wind erosion factor for this assessment, as follows in Equation 35:

Equation 35: Wind Erosion

$$E_{wind} = 2.78^{-7} * WS^3 * (1-(WS_T/WS_{10})^2))$$

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Where:

WS_T is the threshold for wind erosion in m/s, taken to be 6.5 m/s; and
E_{wind} is the PM_{10} emissions ($g/m^2/s$).

Dust emissions generated by wind erosion were considered in this assessment for all exposed surface areas. At windspeeds greater than the threshold, emission rates are scaled up based on the wind speed.

2.3.2 Rainfall Dependence

To account for the effects of rainfall in reducing dust emissions, a simple scheme was adopted. With regards to wind erosion, rainfall was assumed to not only suppress dust emissions at the time rain was occurring, but to also result in a suppression of the dust emissions that gradually decreases over time as the areas dry out. Without stockpile activity, material can form a strong crust and be resistant to wind erosion for extended periods.

Dust emissions were taken to linearly return to a rainfall unaffected state within 400 hours of the rainfall evaporating if the rainfall event was greater than 25 mm. During the period when it was raining or if the rainfall had not evaporated, emissions were set to zero. The evaporation rate at the surface was assumed to be 1.25 times the amount from a Class A pan with a limit to the amount of water on/near the surface of 75 mm. Daily average evaporation rates for each month were obtained from the BoM for the Kimba monitoring station.

These time scales have been adopted from studies undertaken at iron ore mines in the Pilbara region of Western Australia (ENVIRON, 2004) and were originally based on observations of the time taken for high dust levels to return following a large rainfall event in the Pilbara region. The trend from the studies can similarly be applied for observations in the SMR region. It is noted that the return to dusty conditions is not just a function of the evaporation of the water but is determined more importantly from activity at exposed surface areas; fresh surfaces are created as a result of activities such as bulldozing, reclaiming and vehicle movement.

2.4 Summary of Estimated Emissions

A summary of emissions estimates is presented in Appendix 2 in Table 16 to Table 18 for activities across mining operations related to the MEP1 expansion.

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3. ASSESSMENT CRITERIA

3.1 Ambient Air Quality

Particulate matter (PM) is generally defined as particles that can remain suspended in the air by turbulence for an appreciable length of time. PM can consist of a range of matter including crustal material, pollens, sea salts and smoke from combustion products. PM is commonly defined by the size of the particles including the following:

- Total suspended particulates (TSP), which is all particulate matter with an equivalent aerodynamic particle diameter below 50 µm diameter;
- PM_{10} is particulate matter below 10 µm in equivalent aerodynamic diameter; and
- $PM_{2.5}$ is particulate matter below 2.5 µm in equivalent aerodynamic diameter.

TSP contains PM_{10} and $PM_{2.5}$ fractions and is normally associated with amenity and nuisance impacts. PM_{10} and $PM_{2.5}$ are generally associated with the potential for health impacts as particles this size and below may enter the lungs. This study has focused on predicted PM_{10} and $PM_{2.5}$ ambient air quality concentrations and TSP deposition.

- The Environment Protection (Air Quality) Policy 2016 (Air EPP)

Note the National Environment Protection Council (NEPC) is proposing a variation to the to the $PM_{2.5}$ National Environment Protection Measure (NEPM) in 2025 (NEPC, 2021); however, these variations have not been considered within this assessment.

Table 2. Relevant Air Quality Standards

Pollutant	Averaging Period	Unit[1]	Ambient Air Concentration Criteria	Proposed Variation in 2025	Reference
Particles as PM_{10}	24-Hour	µg/m^3	50	-	(SA Gov. 2016; NEPC 2021)
	Annual	µg/m^3	25	-	(SA Gov. 2016; NEPC 2021)
Particles as $PM_{2.5}$	24-Hour	µg/m^3	25	20	(SA Gov. 2016; NEPC 2021)
	Annual	µg/m^3	8	7	(SA Gov. 2016; NEPC 2021)

Note:

1. Reference to 0 °C and 1 atm

3.2 Amenity

The SA EPA does not have assessment criteria for deposition, but consistent with previous assessments, SIMEC requested that it be assessed. The New South Wales Department of Environment and Climate Change (NSW DECC) have published dust deposition criteria, designed to consider potential amenity impacts, such as dust depositing on fabrics and buildings. The use of these guidelines serves as a reference to the potential magnitude of the impacts associated with dust deposition but is not intended to be used as an indication of the acceptability of the predicted impacts.

The NSW guidelines are based on studies undertaken on coal dust deposition in the Hunter Valley in NSW by the National Energy Research and Demonstration Council (NERDC, 1988). While the dust deposition guideline is expressed as g/m^2/month, the NSW DECC has indicated that the

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monthly average deposition (to be compared against the guideline value) is to be determined from data spanning no less than one year, to account for seasonal variations.

Table 3: Amenity Dust Deposition Criteria

Pollutant	Averaging Period	Criteria (g/m^2/month)
Deposited dust[1]	Annual (increase)[2]	2
	Annual (total)[3]	4

Notes

1. Dust is assessed as insoluble solids as defined by AS 3580.10.1-1991 (AM-19).
2. The maximum increase in deposited dust level.
3. Maximum total deposited dust level.

The NSW EPA advises that the criteria for the maximum increase in deposited dust of 2 g/m^2/month is applicable when no baseline data on deposited dust exists, while the total deposited dust criteria of 4 g/m^2/month criteria is applied when baseline data exists.

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4. EXISTING ENVIRONMENT

4.1 Regional Climate

The climate of the region is relatively Mediterranean, with warm dry summers and mild winters. For the regional climate information, data is taken from the nearest Bureau of Meteorology (BoM) monitoring station to the site, Kimba, for which the data shows that during the summer months (December to February) the maximum average temperatures can go as high as 32°C and during the winter months (June to August) the minimum average temperatures can go as low as 5°C. The average maximum and minimum temperature plots can be seen below in Figure 4 and Figure 5 respectively.

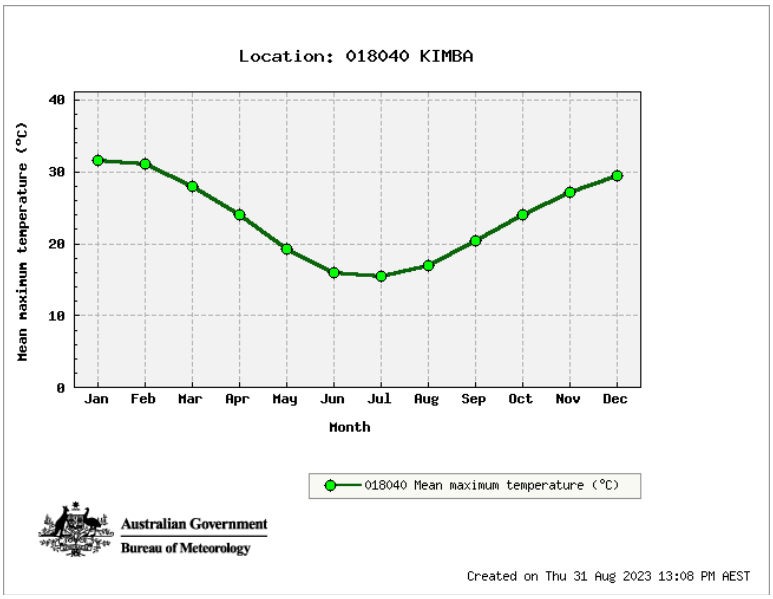


Figure 4: Mean Maximum Temperature Recorded at BoM Monitoring Site - Kimba (1967 - 2023)

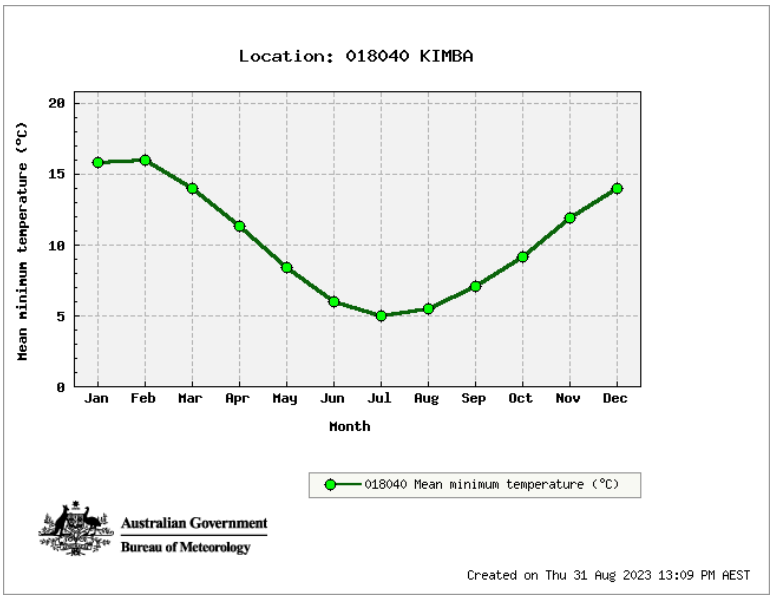


Figure 5: Mean Minimum Temperature Recorded at BoM Monitoring Site - Kimba (1967 - 2023)

The annual average rainfall at the nearest meteorological station (Kimba) is 346 millimetres. The majority of the rainfall within the region occurs between May to September, and the remaining period October to April is usually dry with warm to hot and sunny conditions. The plot for the mean annual rainfall can be seen in Figure 6 below.

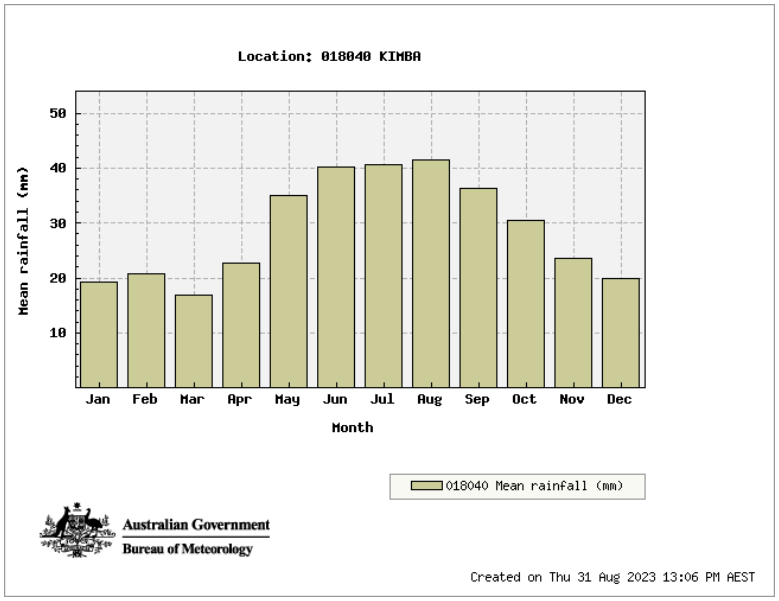


Figure 6: Mean Rainfall at BoM Monitoring Station - Kimba (1967 - 2023)

Figure 7 presents annual average wind roses for the period 1967-2023 at Kimba Monitoring Station. The wind rose indicates that winds from a generally westerly direction are predominant in the region.

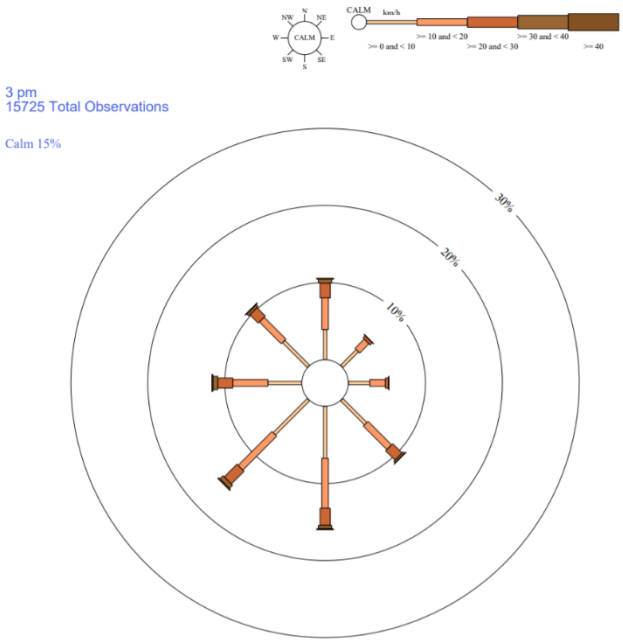


Figure 7: Rose of Wind Direction VS Wind Speed in km/hr at Kimba Monitoring Station (1967 - 2023)

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4.2 Background Concentrations

The assessment of air quality impacts should consider existing air quality conditions in the vicinity of the emission sources. Existing air quality is dependent on the type and number of other emission sources in the area and is usually determined from the results of ambient air quality monitoring. The study area is relatively remote and with the exception of the existing mines in the region (the subject of this assessment), air quality in the area is currently unlikely to be impacted by anthropogenic PM_{10} and $PM_{2.5}$ emissions. SA EPA 'Ambient air quality assessment' document states:

> *"where applicable, determination of background concentrations can be based on data from the nearest EPA monitoring station, modelled background levels, baseline monitoring performed for the project or advice from the EPA given on a case-by-case basis."*

Although the SA EPA does not provide specific guidance for selection of an appropriate background concentration, the Environment Protection Authority Victoria (Vic EPA) State Environment Protection Policy (Ambient Air Quality) (SEPP (AQM)) (Gov. of Vic., 2001) recommends the 70th percentile concentration (concentration which is exceeded by 30% of concentrations for that averaging period) be adopted. This approach has been applied to determine the background concentrations relevant to this assessment. Where a 24-hour averaging time is used in the model, the background data must be based on 24-hour averages.

SIMEC operates a network of ambient air quality monitoring stations (AAQMS) across the region (Figure 8). The AQM3 monitor, located approximately 13 km from the SMR mining region could be potentially indicative of background concentrations in the area. Therefore, for this project, the 70th percentile and annual average PM_{10} and $PM_{2.5}$ concentrations between the 5th May 2023 and the 1st May 2024 from the AQM3 monitoring station has been used to represent the background PM_{10} and $PM_{2.5}$ concentrations.

Table 4 presents the 70th percentile ambient PM_{10} concentrations and $PM_{2.5}$ concentrations as well as the annual average $PM_{2.5}$ concentrations at the background monitor.

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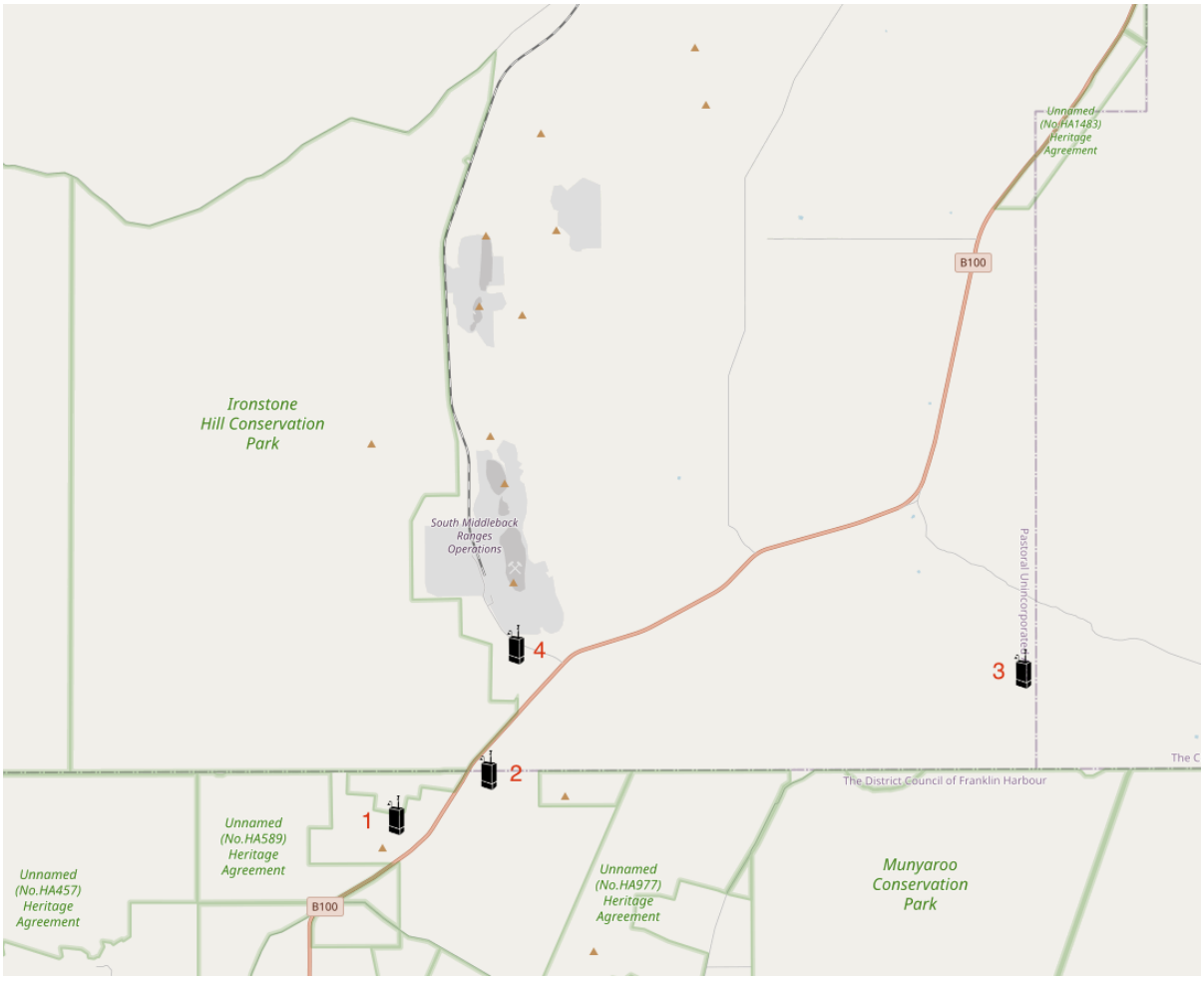


Figure 8: Air quality monitors within the proximity of the SMR operations (AQM3 labelled 3)

Table 4: Background Monitor 70th Percentile and Annual Average Ambient Concentrations for PM_{10} and $PM_{2.5}$

Pollutant	Averaging Period	70th Percentile Concentration (µg/m³)[1]	Annual Average (µg/m³)[1]
PM_{10}	24-hour	5.3	-
	Annual	-	3.0
$PM_{2.5}$	24-hour	3.8	-
	Annual	-	2.5

Notes:

1. Concentrations are referenced to 0 deg C and 101.3kPa.

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5. AIR DISPERSION MODELLING METHODOLOGY

5.1 Selected Model

The SA EPA has stipulated that unless prior agreement has been obtained, all air dispersion modelling should be completed using the CALPUFF air dispersion model using a meteorological dataset from 2009.

CALPUFF is a multi-layer, multi-species, non-steady-state puff dispersion model. It utilises three-dimensional wind fields to simulate the effects of the temporal and spatial meteorological conditions on pollutant transport, transformation and removal. CALPUFF also allows for three-dimensional characterisation of land use and surface characteristics such as height and density of vegetation.

The meteorological information used in the modelling was derived from the prognostic meteorological component of The Air Pollution Modelling (TAPM). The prognostic data from TAPM was used as input into the CALMET meteorological pre-processing program used to generate meteorological files for CALPUFF. TAPM was developed by the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) and consists of coupled prognostic meteorological and air pollution dispersion model components.

5.2 Model Parameterisation

5.2.1 CALMET

The CALMET meteorological processor was used to develop a meteorological file for input into the CALPUFF model. CALMET is a diagnostic meteorological model that produces three-dimensional wind fields based on parameterised treatments of terrain effects such as slope flows and terrain blocking effects. Meteorological observations can also be incorporated to determine the wind field in areas of the domain within which the observations are representative. Fine scale terrain effects are determined by the diagnostic wind module in CALMET.

5.2.2 TAPM

The Air Pollution Model (TAPM) (Version 4) was used to generate a prognostic gridded meteorological dataset for the CALMET model domain. TAPM was developed by the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) and consists of coupled prognostic meteorological and air pollution dispersion model components. The meteorological component of TAPM predicts the local-scale meteorological features, such as sea breezes and terrain-induced circulations, using the larger-scale synoptic meteorology as boundary conditions combined with other data including terrain, land use, soil and surface types. TAPM has been used extensively throughout Australia for generating site specific meteorological files for use in air dispersion modelling studies.

5.2.3 CALPUFF

The following model set up options within CALPUFF were used:

- Computational grid of 20 km by 30 km encompassing the SMR mines and the MEP1 region, associated haul roads, the processing facility and stockpiles, with meteorological grid spacings of 350 m;
- Multiple sampling grids were utilised with grid spacings of approximately 350 m;
- Dry deposition;
- No chemical transformation;

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- Partial Plume Penetration;
- Puff modelling method; and
- Default partial plume path adjustment.

Each emission source was individually modelled in CALPUFF using a fixed emission rate and the resultant outputs for each source were scaled against the corresponding hourly variable emissions to generate predicted concentration and deposition rates for each hour of the year, at each model grid point within the MEP1 region. The predicted concentrations and deposition rates for each source were then combined for each of the modelled scenarios.

An annual wind rose generated by the CALMET meteorological processor for the proposed site location is presented in Figure 9, with the annual frequency of wind speeds presented in Table 5.

Table 5: Distribution of Wind Speeds for 2009 (CALMET-Generated Data)

Wind Speed	Calms	0.5–2.0 m/s	2.0-4.0 m/s	4.0-6.0 m/s	6.0-8.0 m/s	8.0-12.0 m/s	>12m/s
(%)	1.4	17.2	41.0	29.0	9.5	1.8	0.0

The observations show that there is a low frequency of calm wind speeds, and a relatively high frequency of mid-ranges wind speeds (2-6m/s), and a low frequency of high-range wind speeds (>6m/s).

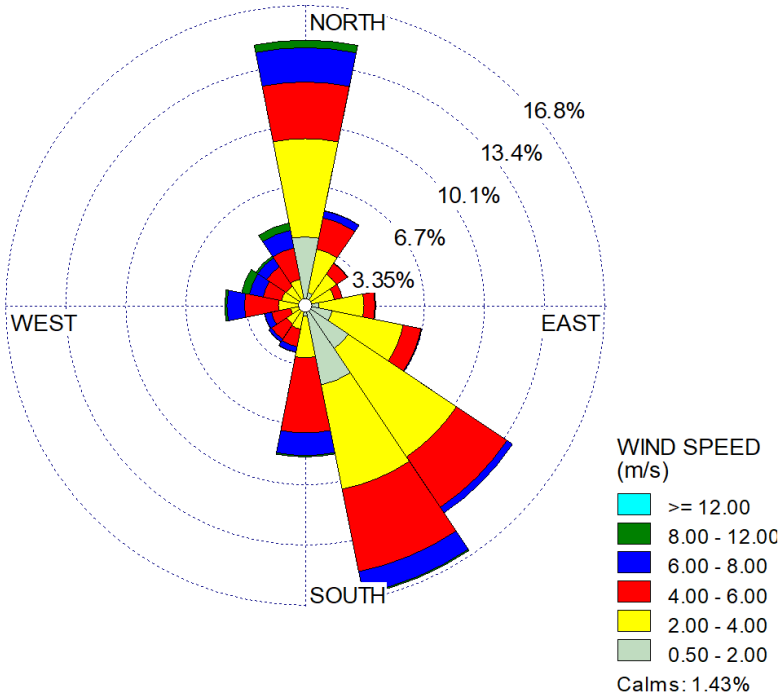


Figure 9: 2009 CALMET – Generated Annual Wind Rose

5.2.4 Particle Size Distribution

Particle size distribution data used in the model for particles in the sub-fraction of TSP emissions were based on analysis of site-specific soil sampling as carried out by ALS Environmental and Bio-Track on behalf of Liberty OneSteel. Multiple soil samples were taken for pit, haul road and tailings locations and analysed to provide a composite particle size distribution for each. These particle size distributions for each location were used to calculate values for the Geometric Mean and

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Geometric Standard Deviation of particulate matter TSP and sub-fractions PM_{10} and $PM_{2.5}$ as used in modelling and presented in Table 6 and Table 7. Additional information regarding the particle size distribution utilised for this project can be found in Appendix 1.

Table 6: Geometric Mean

Pollutant	Sampling Location		
	Pit	Haul Road	Tailings
TSP	29.5	30.2	36.7
PM_{10}	6.6	6.1	5.4
$PM_{2.5}$	1.0	1.0	0.6

Table 7: Geometric Standard Deviation

Pollutant	Sampling Location		
	Pit	Haul Road	Tailings
TSP	1.8	1.6	1.3
PM_{10}	1.4	1.3	1.5
$PM_{2.5}$	1.0	1.0	2.1

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6. MODELLING RESULTS

6.1 Sensitive receptors

Ground level concentrations were predicted at a number of sensitive receptor locations as provided by SIMEC. These receptors are presented in Table 8.

Table 8: Receptors

Easting	Northing	Name
Sensitive receptors		
707281	6332968	Broadview Homestead
704643	6324958	Uplands Homestead
709342	6317224	Moonabie Homestead
693008	6308736	Pine Hill Homestead
696743	6304605	Plane Homestead
702926	6333408	Moola Homestead

Notes:

Coordinates are UTM Zone 53S

6.2 Model Validation

In the absence of long-term on-site concentration data, model validation was carried out by comparing average values of monitored dust deposition data at various SMR receptors with predicted deposition values at those receptors.

Table 9 presents monitored monthly average dust deposition rates provided by SIMEC for operations at SMR at selected key receptors for from 2017-2020. The average deposition values at each receptor across the four-year period is compared against deposition values predicted by modelling. Modelling was completed using the most recent mining operational data provided by SIMEC and meteorological data from 2009 as required for the assessment. Differing meteorological conditions between years will account for some variance in monitored and predicted results.

Deposition data from the Myola 2 Iron Baron Funnel monitoring site was adopted as being representative of regional background levels for evaluation of the modelling. A background level of 1.62 g/m^2/month was calculated as the average across the sampling years 2017-2020.

Table 9 shows modelling generally underpredicts at all sites except at the Chieftain monitoring site which shows reasonable agreement when accounting for background deposition. This may be a function of the representativeness of the emissions factors and particle size distributions utilised in the modelling. It could also be a function of the contributions from other background sources in the region.

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Table 9: Monitored and predicted deposition rates at sensitive receptors

Monitor Site	Deposition (g/m²/month)							
	2017	2018	2019	2020	Monitored Average	Background	Predicted	Cumulative Prediction
Moonabie Homestead	2.39	5.1	4.67	3.56	3.93	1.62	0.03	1.65
Plane Homestead	1.98	3.49	3.53	4.4	3.35	1.62	0.05	1.67
Chieftain	0.87	1.52	1.81	1.86	1.51	1.62	0.12	1.74
South SMR	2.34	4.2	3.43	3.92	3.47	1.62	0.87	2.49
Iron Duke 2	7.28	2.64	3.06	2.58	3.89	1.62	0.59	2.21

Notes

1. Monthly average for each year

6.3 Particulate Concentrations

Two proposed scenarios for the MEP1 expansion have been modelled, as well as the existing operations for the SMR, the results are presented in Table 11 to Table 14. The maximum predicted 24-hour average concentrations at key receptors for PM_{10} and $PM_{2.5}$ are presented in Table 11 and Table 13 which show a comparison between the current operations at SMR compared to the mitigated (M) and unmitigated (UM) MEP1 potential future scenarios. Table 12 and Table 14 show the maximum predicted annual average concentrations for SMR and all MEP1 scenarios of PM_{10} and $PM_{2.5}$. The six homestead sensitive receptors are presented as the key sites of focus for analysis of predicted concentrations. Contour plots for 24-hour and annual average concentrations for PM_{10} and $PM_{2.5}$ for operations in isolation are presented in Appendix 4. Contour plots for cumulative 24-hour and annual average concentrations for PM_{10} and $PM_{2.5}$ are presented in Appendix 5.

Table 11 shows the maximum predicted 24-hour average PM_{10} concentration at any sensitive receptor for the SMR scenarios in isolation (no inclusion of background concentrations) is 18.45 $\mu g/m^3$ predicted at Pine Hill Homestead. The mitigated MEP1 scenario recorded a maximum 24-hour average PM_{10} concentration of 26.42 $\mu g/m^3$, whilst the unmitigated scenario predicted 43.44 $\mu g/m^3$, both predicted at Pine Hill Homestead. When combined with a nominated background concentration of 5.30 $\mu g/m^3$, the predicted value for all scenarios remained below the criteria of 50 $\mu g/m^3$, however the unmitigated scenario came close to exceeding the criteria at Plane Homestead, predicting 97% of the criteria.

Table 12 shows the maximum predicted annual average PM_{10} concentration at any of the receptors for SMR current operations in isolation was 0.88 $\mu g/m^3$, whilst the MEP1 mitigated and unmitigated scenarios recoded 1.01 $\mu g/m^3$ and 1.75 $\mu g/m^3$ respectively. These annual average concentrations were all predicted at the Uplands Homestead. When combined with the background concentration of 3.0 $\mu g/m^3$ these values remain below the criteria of 25 $\mu g/m^3$, representing 16% to 19% of the criteria, for the unmitigated scenario.

The maximum predicted 24-hour average $PM_{2.5}$ concentration at any of the sensitive receptors for the SMR scenario was 8.67 $\mu g/m^3$ predicted at Pine Hill Homestead (Table 13). The mitigated MEP1 scenario recorded a maximum 24-hour average PM_{10} concentration of 12.14 $\mu g/m^3$, whilst the unmitigated MEP1 scenario recorded 21.88 $\mu g/m^3$, both predicted at Pine Hill Homestead. When considered cumulatively, the SMR and MEP1 mitigated scenarios, do not exceed the guideline of 25 $\mu g/m^3$ at any of the sensitive receptors, representing a maximum of 50% and 64% of the $PM_{2.5}$ criteria for the maximum SMR and MEP1 scenarios respectively. Predictions of cumulative 24-hour $PM_{2.5}$ are expected to exceed the PM_{10} 24-hour criteria at Pine Hill Homestead

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during the MEP1 scenario when no dust controls are in place, representing 100% of the $PM_{2.5}$ criteria.

The maximum predicted annual average $PM_{2.5}$ concentration at any of the receptor locations for the SMR operations in isolation was 0.43 µg/m^3, whilst the MEP1 mitigated and unmitigated scenarios recoded 0.48 µg/m^3 and 0.83 µg/m^3 respectively (Table 14). These annual average concentrations were all predicted at the Uplands Homestead. When combined with the background concentration of 2.5 µg/m^3 these values remain below the criteria of 8 µg/m^3, representing 37% to 42% of the criteria.

Cumulative contour plots comparing the location where the guideline was exceeded for all three modelled scenarios are presented in Figure 10 to Figure 13. The MEP1 unmitigated scenario is predicted to exceed the guidelines over a larger area for both PM_{10} and $PM_{2.5}$ compared to the mitigated scenario due to the lack of dust controls on the roads and waste rock dumps. In this scenario, the maximum 24-hour average concentrations are expected to exceed or come close to exceeding the PM_{10} and $PM_{2.5}$ criteria at the Pine Hill homestead. When dust controls are in place however, the area which exceeds the criteria is much smaller and although the impacts are greater than the current SMR scenario there is likely to minimal impact at the sensitive receptors.

6.3.1 Number of days predicted to exceed

The number of days expected to exceed the $PM_{2.5}$ 24-hour average criteria of 25 µg/m^3 when background is added is presented in Table 10. Only one day is predicted to exceed at a sensitive receptor and this is observed at the Pine Hill Homestead during the unmitigated MEP1 Scenario.

Table 10: 24-hour average cumulative $PM_{2.5}$ predictions expected to exceed at Sensitive Receptors

Receptor	Averaging Period	Number of Cumulative Predicted 24-hour Exceedances		
		SMR	MEP1 - M	MEP1 - UM
Broadview Homestead	24-hour	0	0	0
Uplands Homestead	24-hour	0	0	0
Moonabie Homestead	24-hour	0	0	0
Pine Hill Homestead	24-hour	0	0	1
Plane Homestead	24-hour	0	0	0
Moola Homestead	24-hour	0	0	0

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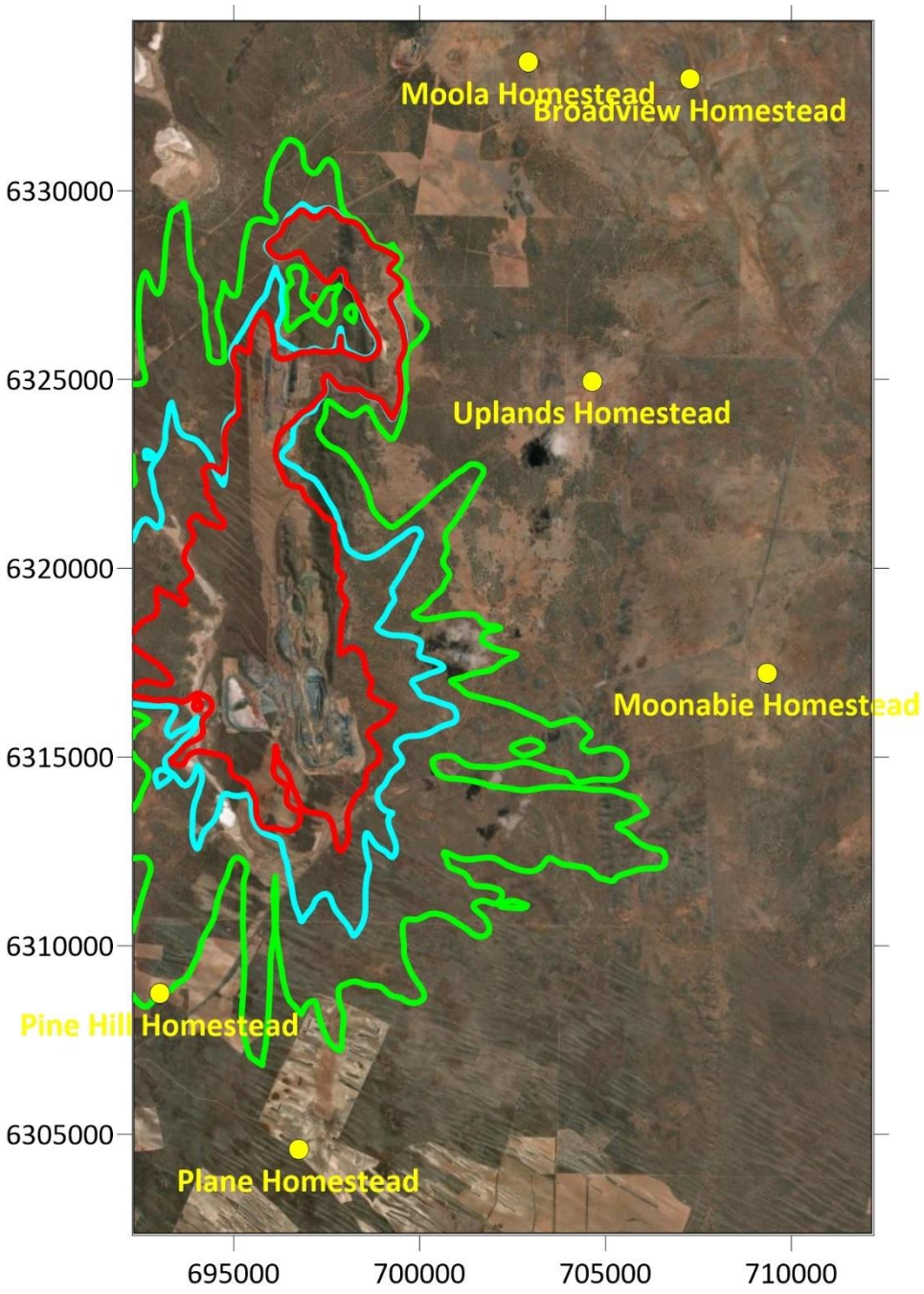


Figure 10: Cumulative 24hr Max Average PM_{10} GLC (µg/m³) Contour Plot of all modelled scenarios with key Sensitive Receptors showing only the contour which depicts the guideline of 50 µg/m³

Note. Red: SMR Existing scenario, blue: MEP1 Mitigated, green: MEP1 Unmitigated

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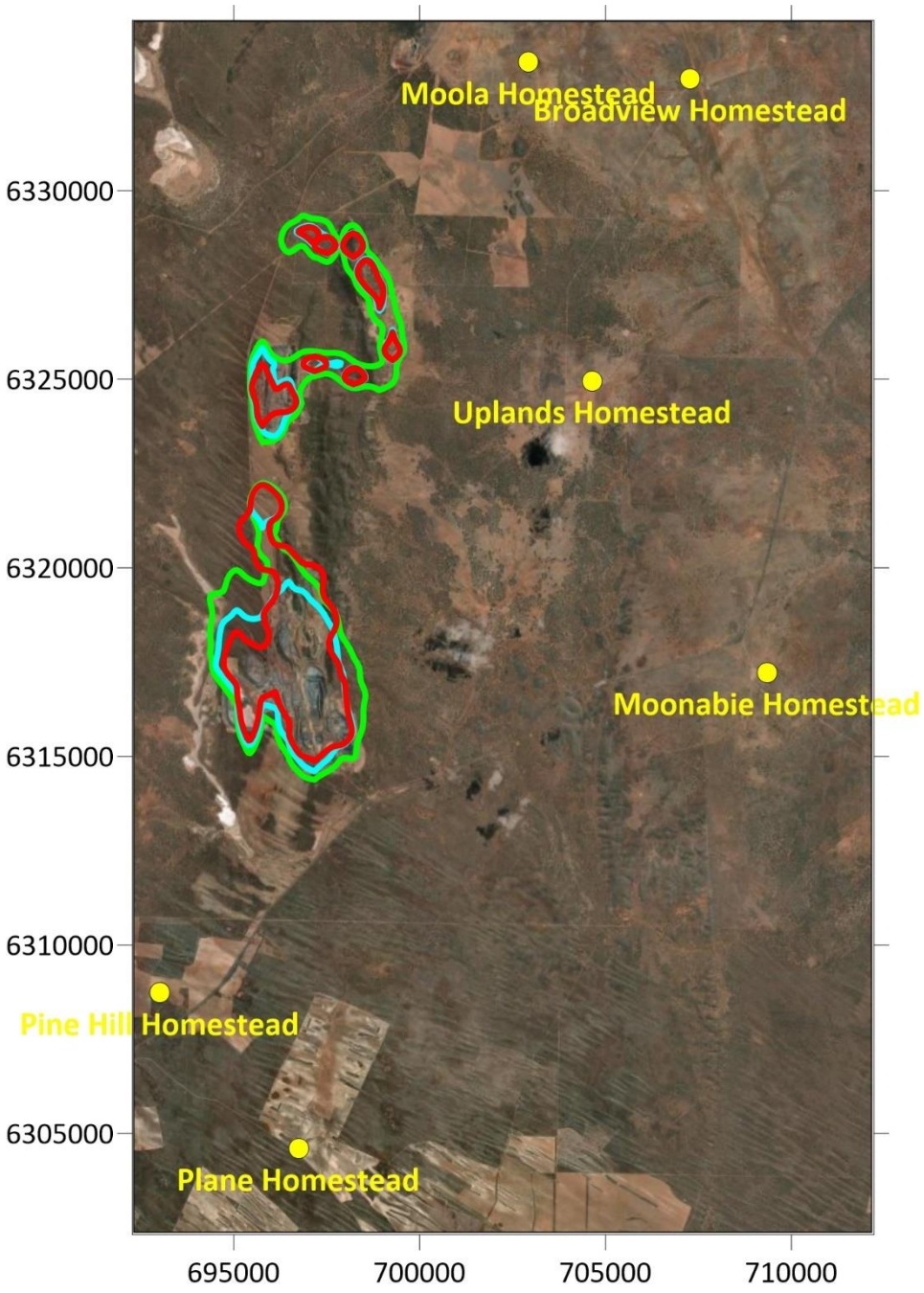


Figure 11: Cumulative Annual Average PM_{10} GLC (µg/m³) Contour Plot of all modelled scenarios with key Sensitive Receptors showing only the contour which depicts the guideline of 25 µg/m³

Note. Red: SMR Existing scenario, blue: MEP1 Mitigated, green: MEP1 Unmitigated

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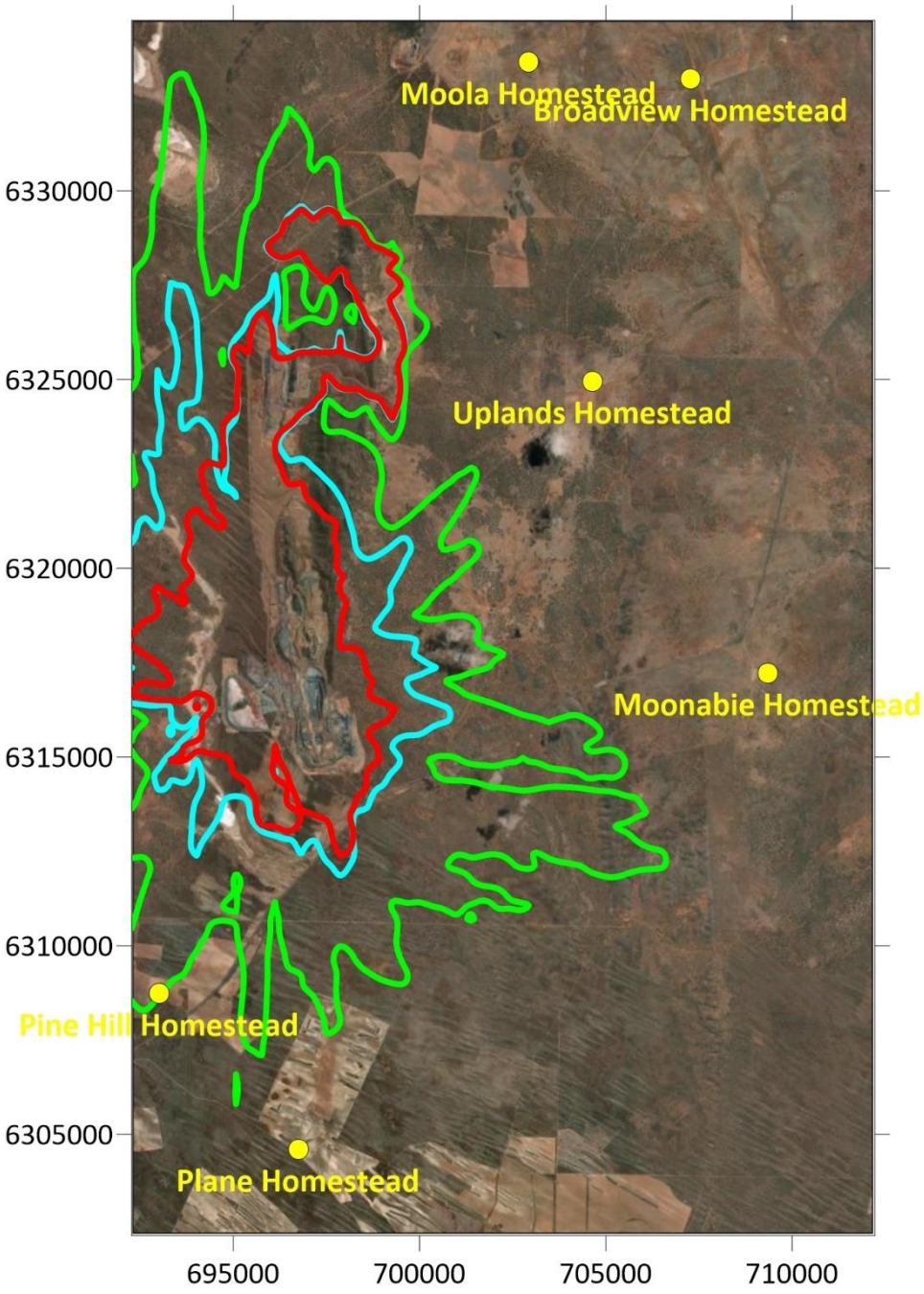


Figure 12: Cumulative 24-hour average $PM_{2.5}$ GLC (µg/m³) Contour Plot of all modelled scenarios with key Sensitive Receptors showing only the contour which depicts the guideline of 25 µg/m³

Note. Red: SMR Existing scenario, blue: MEP1 Mitigated, green: MEP1 Unmitigated

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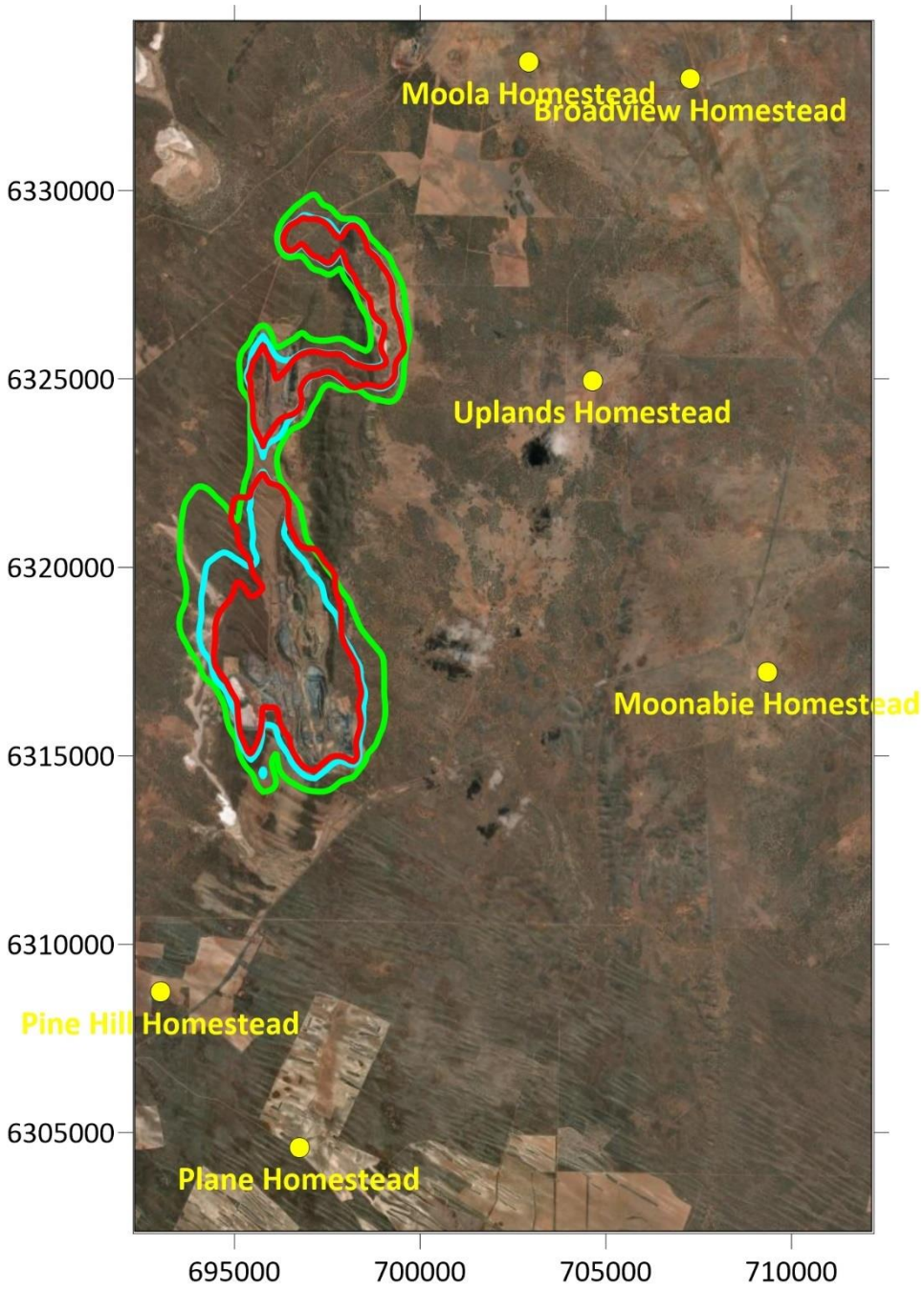


Figure 13: Cumulative annual average $PM_{2.5}$ GLC (µg/m³) Contour Plot of all modelled scenarios with key Sensitive Receptors showing only the contour which depicts the guideline of 8 µg/m³

Note. Red: SMR Existing scenario, blue: MEP1 Mitigated, green: MEP1 Unmitigated

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Table 11: Maximum predicted GLCs for 24-hour averaging period for SMR and MEP1 Scenarios – PM_{10}

Sensitive Receptor	Max 24-hour average PM_{10} GLCs ($\mu g/m^3$) with no Background			Background PM_{10} Concentrations ($\mu g/m^3$)	Cumulative PM_{10} GLCs ($\mu g/m^3$)			PM_{10} Criteria ($\mu g/m^3$)	% of Criteria (Cumulative)		
	SMR	MEP1 - M	MEP1 - UM		SMR	MEP1 - M	MEP1 - UM		SMR	MEP1 - M	MEP1 - UM
Broadview Homestead	4.91	6.03	11.13	5.30	10.21	11.33	16.43	50	20%	23%	33%
Uplands Homestead	9.36	15.47	23.53	5.30	14.66	20.77	28.83	50	29%	42%	58%
Moonabie Homestead	6.33	9.24	16.87	5.30	11.63	14.54	22.17	50	23%	29%	44%
Pine Hill Homestead	18.45	26.42	43.44	5.30	23.75	31.72	48.74	50	47%	63%	97%
Plane Homestead	16.34	22.39	29.75	5.30	21.64	27.69	35.05	50	43%	55%	70%
Moola Homestead	6.68	9.40	15.95	5.30	11.98	14.70	21.25	50	24%	29%	43%
Appendix Figure:	18	19	20		30	31	32				

Table 12: Maximum predicted GLCs for annual averaging period for SMR and MEP1 Scenarios – PM_{10}

Sensitive Receptor	Annual average PM_{10} GLCs ($\mu g/m^3$) with no Background			Background PM_{10} Concentrations ($\mu g/m^3$)	Cumulative PM_{10} GLCs ($\mu g/m^3$)			PM_{10} Criteria ($\mu g/m^3$)	% of Criteria (Cumulative)		
	SMR	MEP1 - M	MEP1 - UM		SMR	MEP1 - M	MEP1 - UM		SMR	MEP1 - M	MEP1 - UM
Broadview Homestead	0.32	0.36	0.62	3.0	3.32	3.36	3.62	25	13%	13%	14%
Uplands Homestead	0.88	1.01	1.75	3.0	3.88	4.01	4.75	25	16%	16%	19%
Moonabie Homestead	0.63	0.84	1.38	3.0	3.63	3.84	4.38	25	15%	15%	18%
Pine Hill Homestead	0.72	1.01	1.61	3.0	3.72	4.01	4.61	25	15%	16%	18%
Plane Homestead	0.61	0.84	1.28	3.0	3.61	3.84	4.28	25	14%	15%	17%
Moola Homestead	0.49	0.56	0.96	3.0	3.49	3.56	3.96	25	14%	14%	16%
Appendix Figure:	21	22	23		33	34	35				

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Table 13: Maximum predicted GLCs for 24-hour averaging period for SMR and MEP1 Scenarios - $PM_{2.5}$

Sensitive Receptor	Max 24-hour average $PM_{2.5}$ GLCs ($\mu g/m^3$) with no Background			Background $PM_{2.5}$ Concentrations ($\mu g/m^3$)	Cumulative $PM_{2.5}$ GLCs ($\mu g/m^3$)			$PM_{2.5}$ Criteria ($\mu g/m^3$)	% of Criteria (Cumulative)		
	SMR	MEP1 - M	MEP1 - UM		SMR	MEP1 - M	MEP1 - UM		SMR	MEP1 - M	MEP1 - UM
Broadview Homestead	3.03	3.84	7.14	3.8	6.83	7.64	10.94	25	27%	31%	44%
Uplands Homestead	4.59	6.95	10.82	3.8	8.39	10.75	14.62	25	34%	43%	58%
Moonabie Homestead	3.23	6.05	11.13	3.8	7.03	9.85	14.93	25	28%	39%	60%
Pine Hill Homestead	8.67	12.14	21.18	3.8	12.47	15.94	24.98	25	50%	64%	100%
Plane Homestead	8.27	9.54	13.10	3.8	12.07	13.34	16.90	25	48%	53%	68%
Moola Homestead	3.44	4.81	8.35	3.8	7.24	8.61	12.15	25	29%	34%	49%
Appendix Figure:	24	25	26		36	37	38				

Table 14: Maximum predicted GLCs for annual averaging period for SMR and MEP1 Scenarios – $PM_{2.5}$

Sensitive Receptor	Annual average $PM_{2.5}$ GLCs ($\mu g/m^3$) with no Background			Background $PM_{2.5}$ Concentrations ($\mu g/m^3$)	Cumulative $PM_{2.5}$ GLCs ($\mu g/m^3$)			$PM_{2.5}$ Criteria ($\mu g/m^3$)	% of Criteria (Cumulative)		
	SMR	MEP1 - M	MEP1 - UM		SMR	MEP1 - M	MEP1 - UM		SMR	MEP1 - M	MEP1 - UM
Broadview Homestead	0.16	0.17	0.30	2.5	2.66	2.67	2.80	8	33%	33%	35%
Uplands Homestead	0.43	0.48	0.83	2.5	2.93	2.98	3.33	8	37%	37%	42%
Moonabie Homestead	0.31	0.39	0.65	2.5	2.81	2.89	3.15	8	35%	36%	39%
Pine Hill Homestead	0.35	0.46	0.75	2.5	2.85	2.96	3.25	8	36%	37%	41%
Plane Homestead	0.30	0.38	0.58	2.5	2.80	2.88	3.08	8	35%	36%	39%
Moola Homestead	0.24	0.26	0.46	2.5	2.74	2.76	2.96	8	34%	35%	37%
Appendix Figure:	27	28	29		39	40	41				

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6.4 Particulate Deposition

Modelling results for dust deposition of TSP for the SMR and MEP1 mitigated (M) and unmitigated (UM) scenarios are presented in Table 15. The background TSP level of 1.62 g/m^2/month from the Myola 2 Iron Baron Funnel monitoring site has been included to give an indication of cumulative deposition. The criteria of 4 g/m^2/month has been assumed for this assessment based on standards set by the NSW DECC in absence of relevant SA EPA assessment criteria. Figure 15, Figure 16 and Figure 17 Appendix 4 show contour plots of deposition in isolation for all scenarios.

The maximum predicted deposition rate for the current SMR operations without operations from the MEP1 scenario is 0.03 g/m^2/month at Plane Homestead. All predicted deposition values for operations at SMR fall under the adopted criteria when considered cumulatively, with Plane Homestead representing a maximum of 41.3% of the guideline.

The maximum predicted deposition rate for the proposed mitigated MEP1 scenario is 0.05 g/m^2/month representing a cumulative 41.8% of criteria at Plane Homestead. Similarly, the MEP1 unmitigated scenario predicts the maximum deposition at Plane Homestead with a predicted deposition of 0.07, representing 42.2% of the criteria.

Deposition values show a general increase in rates relating to the addition of MEP1, particularly when no dust controls are in place. The notable increases at all the homestead locations can be explained by the receptors' proximity to the MEP1 mining operations. Although increases are observed with the addition of the MEP1, the overall deposition is significantly lower than the dust deposition criteria of 4 g/m^2/month.

Table 15: Predicted TSP deposition rates at key sensitive receptors for SMR

Receptor	Averaging Period	Predicted Deposition (g/m^2/month) [1]			Background TSP	TSP Criteria	% of Criteria (Cumulative)		
		SMR	MEP1 - M	MEP1 - UM			SMR	MEP1 - M	MEP1 - UM
Broadview Homestead	Annual	0	0.01	0.01	1.62	4	40.5%	40.7%	40.7%
Uplands Homestead	Annual	0.02	0.03	0.05	1.62	4	41.0%	41.3%	41.8%
Moonabie Homestead	Annual	0.02	0.03	0.04	1.62	4	41.0%	41.3%	41.5%
Pine Hill Homestead	Annual	0.01	0.03	0.04	1.62	4	40.8%	41.2%	41.4%
Plane Homestead	Annual	0.03	0.05	0.07	1.62	4	41.3%	41.8%	42.2%
Moola Homestead	Annual	0.01	0.01	0.02	1.62	4	40.8%	40.8%	40.9%

Notes

1. Annual average of the monthly averages

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7. CONCLUSION

Air dispersion modelling has been completed to assess the potential air quality impacts associated with dust emissions from the mining operations at SIMEC's SMR mining area both in isolation and cumulatively with background concentrations, accounting for the addition of a proposed expansion.

Predicted GLCs have been estimated using the CALPUFF model and meteorological data generated by TAPM, in combination with meteorological monitoring data recorded at the nearest BoM monitoring station located at Whyalla for the 2009 data period.

Deposition monitoring at key receptor locations as provided by SIMEC was used in comparison against predicted values at these sites as validation of modelling results.

The key findings of the air dispersion modelling are as follows:

- One scenario based on existing operations at the SMR, and two scenarios based on the proposed operations involving the MEP1 expansion were modelled to assess the impacts of the MEP1. The year 2027 for the proposed operations was selected based on this year representing the worst-case dust emissions. The two proposed MEP1 scenarios differ only in the dust controls applied. The mitigation scenario includes dust controls including water spraying during drilling, screening, conveying and dumping; watering of roads, stockpiles, WRDs and pits. The unmitigated scenario does not have any dust controls in place.
- The two MEP1 scenarios predicted higher concentrations of PM_{10} and $PM_{2.5}$ compared to the existing SMR scenario. This is likely a result of the increased excavation, dumping and higher throughput rates of ore, resulting in greater truck movement.
- When no dust controls are in place, in the unmitigated MEP1 scenario, the area precited to exceed the criteria for PM_{10}, $PM_{2.5}$ and deposition as TSP is much larger than the mitigated scenario.
- Cumulative PM_{10} and $PM_{2.5}$ GLCs were predicted to exceed the corresponding SA EPA guidelines at a number of locations close to the operations. No exceedances were predicted at any of the sensitive receptors during the MEP1 mitigated scenario. During the unmitigated MEP1 scenario, no exceedances were expected at any sensitive receptors beside one day which was predicted to exceed the $PM_{2.5}$ criteria at the Pine Hill Homestead.
- TSP deposition results show deposition levels at all sensitive receptor locations are predicted to remain below relevant guidelines.

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8. LIMITATIONS

Ramboll prepared this report in accordance with the scope of work as outlined in our proposal to SIMEC Mining dated 24th of January 2024 and in accordance with our understanding and interpretation of current regulatory standards.

The conclusions presented in this report represent Ramboll's professional judgement based on information made available during the course of this assignment and are true and correct to the best of Ramboll's knowledge as at the date of the assessment.

Ramboll did not independently verify all of the written or oral information provided during the course of this investigation. While Ramboll has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to Ramboll was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

8.1 User Reliance

This report has been prepared for SIMEC Mining and may not be relied upon by any other person or entity without Ramboll's express written permission.

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9. REFERENCES

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APPENDIX 1

NPI MINING MANUAL

The NPI mining manual was developed through a process of national consultation involving state and territory environmental departments and key industry stakeholders, including the Minerals Council of Australia (MCA) and the Clean Air Society of Australia and New Zealand (CASANZ). NPI EET manuals are updated on an ad-hoc basis, generally when key stakeholders indicate that the published EFs are no longer applicable. The current NPI mining manual (Version 3.1) was last updated in January 2012. This iteration incorporated a number of recommendations highlighted in the *Improvement of NPI Fugitive Particulate Matter EET* study undertaken by SKM (2005).

Many of the EFs from the NPI mining manual are derived from the United States Environment Protection Authority (USEPA) AP-42 EFs. The USEPA AP-42 represents a compilation of air pollutant EFs, published since 1972 as the primary repository for the USEPA's EFs information. The AP-42 EFs were developed and compiled from source test data, material balance studies and engineering estimates. Factor ratings are assigned to indicate the robustness, or appropriateness, of each AP-42 EF for estimating average emissions for a source activity. The ratings are based on the estimated reliability of the test data used to develop the factors, and on both the amount and the representative characteristics of those data. Factors based on many observations, or on more widely accepted test procedures, are generally assigned higher rankings.

EFs for $PM_{2.5}$ emissions are not included in the NPI mining manual and have thus been determined using various sources including the USEPA AP-42.

The first step in assigning an EF rating is an assessment of the quality and reliability of the emissions data used to develop the factor. Data are rated A through D, according to the following criteria:

A - Tests are performed by a sound methodology and are reported in enough detail for adequate validation.
B - Tests are performed by a generally sound methodology but lacking enough detail for adequate validation.
C - Tests are based on an unproven or new methodology or are lacking a significant amount of background information.
D - Tests are based on a generally unacceptable method, but the method may provide an order-of-magnitude value for the source.

The second step is to assess the representativeness of a factor as an annual average EF for that source activity, and an overall rated is subsequently assigned:

A - Excellent - Factor is developed from A and B rated source test data taken from many randomly chosen facilities in the industry population. The source category population is sufficiently specific to minimise variability.
B - Above average - Factor is developed from A or B rated test data from a "reasonable number" of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with an A rating, the source category population is sufficiently specific to minimise variability.
C - Average - Factor is developed from A, B, and/or C rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with the A rating, the source category population is sufficiently specific to minimise variability.

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D - Below average - Factor is developed from A, B and/or C rated test data from a small number of facilities, and there may be reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source population.
E - Poor - Factor is developed from C and D rated test data, and there may be reason to suspect that the facilities tested do not represent a random sample of the industry.

EMISSION SOURCES

Drilling

The emissions factors for drilling can be estimated using Equation 1, Equation 2 and Equation 3.

Equation 1: Drilling (TSP)	Equation 2: Drilling (PM_{10})	Equation 3: Drilling ($PM_{2.5}$)
TSP = 0.59 kg/hole	PM_{10} = 0.31 kg/hole	$PM_{2.5}$ = 0.02 kg/hole

These equations are sourced from the NPI mining manual, which in turn references the AP-42 EFs. The AP-42 provides an EF for total suspended particulates (TSP) for drilling overburden, which was assigned a factor rating of C (USEPA, 1998a).

Blasting

The emissions factors for blasting can be estimated using Equation 4, Equation 5 and Equation 6 as shown below.

Equation 4: Blasting (TSP)	Equation 5: Blasting (PM_{10})	Equation 6: Blasting ($PM_{2.5}$)
TSP (kg/blast) = $0.00022 \times A^{1.5}$	PM_{10} (kg/blast) = $0.52 \times 0.00022 \times A^{1.5}$	$PM_{2.5}$ (kg/blast) = $0.03 \times 0.00022 \times A^{1.5}$

Where:

A = blast area (m^2)

These equations are sourced from the NPI mining manual, which in turn references the AP-42 EFs for blasting overburden (USEPA, 1998a). The USEPA developed these equations for use in the crushed stone industry based on surface coal data and assigned the EF a rating of D.

Loading and Unloading of Ore and Waste

The emissions factors for loading and unloading of ore and waste can be estimated using Equation 7, Equation 8 and Equation 9 for use of excavators and front-end loaders on ore and overburden, and for truck dumping and general unloading, Equation 10, Equation 11 and Equation 12 can be used as shown below.

Equation 7: Loading Ore or Waste (TSP)	Equation 8: Loading Ore or Waste (PM_{10})	Equation 9: Loading Ore or Waste ($PM_{2.5}$)
TSP = 0.025 kg/tonne	PM_{10} = 0.012 kg/tonne	$PM_{2.5}$ = 0.003 kg/tonne
Equation 10: Unloading Ore (TSP)	**Equation 11: Unloading Ore (PM_{10})**	**Equation 12: Unloading Ore ($PM_{2.5}$)**
TSP = 0.012 kg/tonne	PM_{10} = 0.0043 kg/tonne	$PM_{2.5}$ = 0.001 kg/tonne

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These equations are sourced from the NPI mining manual and are based on the results of the NERDDC (1998) study of Australian coal mine operations. The USEPA has assigned these emission factors with a rating of A.

Bulldozing

The emission rate for bulldozing can be estimated using Equation 13, Equation 14 and Equation 15.

Equation 13: Bulldozing (TSP)	Equation 14: Bulldozing (PM_{10})	Equation 15: Bulldozing ($PM_{2.5}$)
TSP (kg/hour) = $2.6 \times (s^{1.2} / M^{1.3})$	PM_{10} (kg/hour) = $0.34 \times (s^{1.5} / M^{1.4})$	$PM_{2.5}$ (kg/hour) = $0.273 \times (s^{1.2} / M^{1.3})$

Where: S = default silt content of 10%
M = measured average moisture content of 8.22%

This equation is sourced from the NPI mining manual, which in turn references the AP-42 EFs (USEPA, 1998a). The USEPA (1998a) notes that the AP-42 dozer equation result in an emission rate (i.e. kg/hr) rather than an EF. The EF has been assigned a factor rating of D.

Figure 14 below outlines average daily soil moisture values for the Iron Knob region and shows and average moisture content of 8.22% for the area. This average value was utilised as the accepted moisture content in the estimation of emissions. In the absence of site-specific emissions data for silt content, the NPI default value of 10% was considered appropriate for use.

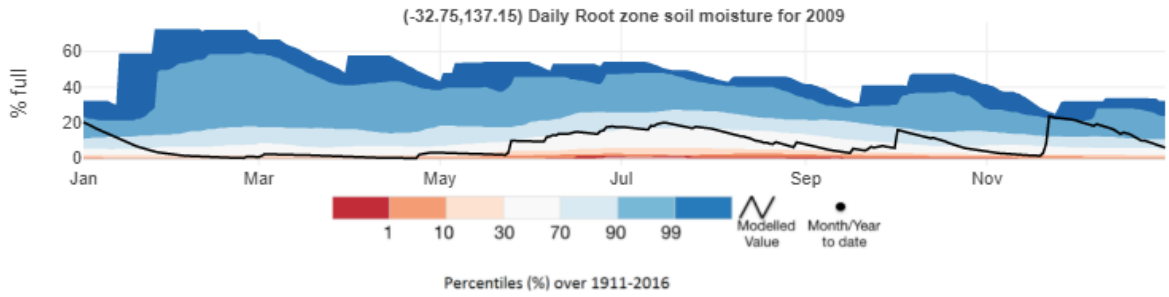


Figure 14: Average Daily Soil Moisture Content 2009 (BoM, 2021)

Crushing (Primary, Secondary and Tertiary)

The emission factors the crushing operations can be estimated using Equation 16, Equation 17 and Equation 18 for primary crushing, Equation 19. Equation 20 and Equation 21 for secondary crushing, and Equation 22, Equation 23 and Equation 24 for tertiary crushing as shown below.

Equation 16: Primary Crushing (TSP)	Equation 17: Primary Crushing (PM_{10})	Equation 18: Primary Crushing ($PM_{2.5}$)
TSP = 0.01 kg/tonne	PM_{10} = 0.004 kg/tonne	$PM_{2.5}$ = 0.0015 kg/tonne

Equation 19: Secondary Crushing (TSP)	Equation 20: Secondary Crushing (PM_{10})	Equation 21: Secondary Crushing ($PM_{2.5}$)
TSP = 0.03 kg/tonne	PM_{10} = 0.012 kg/tonne	$PM_{2.5}$ = 0.0045 kg/tonne

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Equation 22: Tertiary Crushing (TSP)	Equation 23: Tertiary Crushing (PM_{10})	Equation 24: Tertiary Crushing ($PM_{2.5}$)
TSP = 0.03 kg/tonne	PM_{10} = 0.01 kg/tonne	$PM_{2.5}$ = 0.0045 kg/tonne

These equations are sourced from the NPI mining manual, which in turn references the AP-42 EF for crushing of metallic minerals (USEPA, 1982). The EFs for primary, secondary and tertiary crushing represents each process as a whole (i.e. incorporating emissions from components such hoppers, surge bins and transfer points integral to the crushing unit) (USEPA, 1982). This should be taken into consideration to avoid double counting of transfers associated with each crushing unit.

Screening

The emission factors for screening can be estimated using Equation 25, Equation 26 and Equation 27.

Equation 25: Screening (TSP)	Equation 26: Screening (PM_{10})	Equation 27: Screening ($PM_{2.5}$)
TSP = 0.08 kg/tonne	PM_{10} = 0.06 kg/tonne	$PM_{2.5}$ = 0.0018 kg/tonne

These equations are sourced from the NPI mining manual, which does not provide reference information. However, SKM (2005) note the NPI EFs for screening most closely approach the USEPA (2004) EFs for fines screening at crushed stone processing operations (namely 0.15 kg/tonne and 0.036 kg/tonne for TSP and PM_{10} respectively), while EFs for screening associated with primary to tertiary crushing operations are 0.0125 kg/tonne for TSP and 0.0043 kg/tonne for PM10.

Handling/Transfer

The emission factors for handling and transfer can be estimated using Equation 28, Equation 29 and Equation 30.

Equation 28: Handling/Transfers (TSP)	Equation 29: Handling/Transfers (PM_{10})	Equation 30: Handling/Transfers (PM_{10})
TSP = 0.0003 kg/tonne	PM_{10} = 0.00014 kg/tonne	$PM_{2.5}$ = 0.00002 kg/tonne

These equations are sourced from the NPI mining manual, which in turn references the AP-42 EF for the transfer and handling of metallic minerals (including conveyor transfers, ore dumps, or other points where material is allowed to fall freely) (USEPA, 1982). The selected EFs represents 'high' moisture ores (i.e. those with a moisture content of greater than 4%). The USEPA assigns this EF a rating of C.

Haul Roads

The emission factors for the haul roads can be estimated using Equation 31, Equation 32 and Equation 33.

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Equation 31: Haul Roads (TSP)

$$TSP\ (kg/VKT) = (0.4536 / 1.6093) \times k \times (s/12)^{0.7} \times ((W \times 1.023)/3)^{0.45}$$

Where:

k = particle size multiplier (4.9 for TSP)
s = silt content (%) (NPI default of 10% to be applied)
W = vehicle gross mass in tonnes (262 tonnes to be adopted as the average of an empty and fully laden CAT793F haul truck)

Equation 32: Haul Roads (PM_{10})

$$PM_{10}\ (kg/VKT) = (0.4536 / 1.6093) \times k \times (s/12)^{0.9} \times ((W \times 1.023)/3)^{0.45}$$

Where:

k = particle size multiplier (1.5 for PM_{10})
s = silt content (%) (NPI default of 10% to be applied)
W = vehicle gross mass in tonnes (262 tonnes to be adopted as the average of an empty and fully laden CAT793F haul truck)

Equation 33: Haul Roads ($PM_{2.5}$)

$$PM_{2.5}\ (kg/VKT) = (0.4536 / 1.6093) \times k \times (s/12)^{0.9} \times ((W \times 1.023)/3)^{0.45}$$

Where:

k = particle size multiplier (0.15 for $PM_{2.5}$)
s = silt content (%) (NPI default of 10% to be applied)
W = vehicle gross mass in tonnes (262 tonnes to be adopted as the average of an empty and fully laden CAT793F haul truck)

This equation is sourced from the NPI mining manual, which in turn references the AP-42 EFs for miscellaneous sources (USEPA, 2006b). The USEPA (2006b) assigned this EF a factor rating of B.

Wind Speed Dependence for Material Handling

For all material handling processes exposed to the wind, increasing wind speed acts to increase dust emissions through winnowing of the particles from the falling ore. The USEPA batch drop equations (USEPA, 2004a) specify that the dust emission increases with the wind speed to the power of 1.3, as follows in Equation 34.

Equation(s) 34: Wind Speed and Material Handling Emission Rate

$$E_{Actual} = E_{2.2}\,(WS/2.2)^{1.3}$$

Where:

WS is the wind speed at the drop height;
$E_{2.2}$ is the dust emission given for a wind speed of 2.2 m/s; and
E_{Actual} is the final emission rate.

The average source height was assumed to be 5 m above the surface, with the 10 m wind speeds used to estimate the 5 m wind speeds using the 1/7 power law given by:

$$WS_5 = WS_{10}\,(5/10)^{(1/7)}$$

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Where:

WS_{10} is the wind speed at 10 m.

WS_5 is the calculated wind speed at 5 m.

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APPENDIX 2

Table 16: Summary of Fugitive Particulate Emission Estimates for Modelling of Existing SMR

Description	Activity	Materials	EF Unit	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	Activity Units	Activity Value	Control	TSP | PM_{10} | $PM_{2.5}$ Cntl%	Pit %	Hours/ Year	TSP g/s	PM_{10} g/s	$PM_{2.5}$ g/s
Open Pit Drilling	Drilling	Overburden	kg/hole	**0.59**	**0.307**	**0.0177**	hole/Yr	17,520	Water spraying - NPI - 70%	**70%**	100%	8,760	**0.05**	**0.03**	**0.004**
Blasting	Blasting	Overburden	kg/blast	**6.24**	**3.24**	**0.187**	blast/Yr	730	No controls	**0%**	100%	8,760	**0.07**	**0.04**	**0.004**
Excavation	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	18,396,000	No controls	**0%**	100%	8,760	**8.46**	**2.13**	**0.40**
Bulldozing	Bulldozing	Overburden	kg/hour	**2.66**	**0.547**	**0.279**	hour/Yr	3,650	No controls	**0%**	100%	8,760	**0.15**	**0.03**	**0.02**
Topsoil Removal - Cooks North Pit 1	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	18,854	No controls	**0%**	100%	8,760	**0.01**	**0.004**	**0.004**
Topsoil Removal - Cooks North Pit 2	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	17,316	No controls	**0%**	100%	8,760	**0.01**	**0.004**	**0.004**
Topsoil Removal - Cooks North Pit 3	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	14,319	No controls	**0%**	100%	8,760	**0.01**	**0.004**	**0.004**
Topsoil Removal - Cooks North Pit 4	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	118,643	No controls	**0%**	100%	8,760	**0.05**	**0.01**	**0.004**
Topsoil Removal - Cooks North Pit 5	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	87,797	No controls	**0%**	100%	8,760	**0.04**	**0.01**	**0.004**
Topsoil Removal - Cooks North Pit 6	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	89,988	No controls	**0%**	100%	8,760	**0.04**	**0.01**	**0.004**
Haul Trucks - To MW18 WRD (Iron Duchess North B)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	97,288	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**16.21**	**4.77**	**0.48**
Haul Trucks - To MW18 WRD (Iron Duchess North D)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	89,060	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**14.84**	**4.37**	**0.44**
Haul Trucks - To DU17 WRD (Iron Duchess North B)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	42,140	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**7.02**	**2.07**	**0.21**
Haul Trucks - To DU17 WRD (Iron Duchess North D)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	145,008	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**24.16**	**7.11**	**0.71**
Haul Trucks - To DU3 WRD (Iron Magnet)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	71,240	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**11.87**	**3.49**	**0.35**
Haul Trucks - To DT Coarse Rejects (Iron Duke Crusher)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	3,036	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**0.51**	**0.15**	**0.01**
Haul Trucks - To Iron Kinght South Crusher (Cooks North)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	262,331	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**43.70**	**12.87**	**1.29**
Haul Trucks - To Iron Duke (Iron Duchess North D)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	341,869	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**56.95**	**16.77**	**1.68**
Haul Trucks - To Iron Duke Crusher (Stockpile)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	80,714	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**13.45**	**3.96**	**0.40**
Haul Trucks - To Haematite ROM (Iron Duchess North B)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	543,424	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**90.52**	**26.65**	**2.67**
Haul Trucks - To Haematite ROM (iron Magnet)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	112,379	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**18.72**	**5.51**	**0.55**
Haul Trucks - Iron Magnet Pit Backfill	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	143,977	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**23.98**	**7.06**	**0.71**
Haul Trucks - To Lucas Mobile Crusher (Iron Duchess North B)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	58,851	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**9.80**	**2.89**	**0.29**
Haul Trucks - To Lucas Mobile Crusher (Iron Magnet)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	12,170	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**2.03**	**0.60**	**0.06**
Ramp - Cooks North In-Pit Ramp 1	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	14,401	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**2.40**	**0.71**	**0.07**
Ramp - Cooks North In-Pit Ramp 2	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	14,839	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**2.47**	**0.73**	**0.07**
Ramp - Cooks North In-Pit Ramp 3	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**7.88**	**2.32**	**0.232**	VKT/Yr	6,268	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**1.04**	**0.31**	**0.03**
Duty Light Vehicles	Vehicle Wheel Generated Dust - Light Vehicles -Unpaved Roads	Overburden	kg/VKT	**0.379**	**0.11**	**0.0284**	VKT/Yr	120,231	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**0.96**	**0.28**	**0.07**
FEL - Iron Duke Crusher	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	7,884,000	No controls	**0%**	0%	6,570	**8.33**	**4.00**	**0.88**
FEL - Iron Knight South	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**2.78**	**1.33**	**0.29**
FEL - Lucas Mobile Crusher	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.04**	**0.50**	**0.11**
FEL - Cooks North	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	2,082,000	No controls	**0%**	0%	6,570	**2.20**	**1.06**	**0.23**
FEL - Haematite ROM	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**9.62**	**4.62**	**1.01**
Concentrator Feed - Cooks North	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	2,082,000	No controls	**0%**	0%	6,570	**2.20**	**1.06**	**0.23**
Concentrator Feed - Haematite ROM	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**9.62**	**4.62**	**1.01**

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Description	Activity	Materials	EF Unit	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	Activity Units	Activity Value	Control	TSP | PM_{10} | $PM_{2.5}$ Cntl%	Pit %	Hours/ Year	TSP g/s	PM_{10} g/s	$PM_{2.5}$ g/s
Concentrator Feed - Lucas Mobile Crushing	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.04**	**0.50**	**0.11**
Screening - Ore Benefecation Plant	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	2,117,000	Water sprays to keep ore wet - 50%	**50%**	0%	6,570	**0.56**	**0.19**	**0.01**
FEL - Ore Benefecation Plant	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	2,117,000	No controls	**0%**	0%	6,570	**2.24**	**1.07**	**0.24**
Dumping - Iron Knight South Crusher	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	2,630,618	Water spraying - 70%	**70%**	0%	6,570	**0.40**	**0.14**	**0.04**
Primary Crushing - Iron Knight South Crusher	Primary Crushing	ROM	kg/tonne	**0.01**	**0.004**	**0.0012**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**1.11**	**0.44**	**0.13**
Secondary Crushing - Iron Knight South Crusher	Secondary Crushing	ROM	kg/tonne	**0.03**	**0.012**	**0.0036**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**3.34**	**1.33**	**0.40**
Tertiary Crushing - Iron Knight South Crusher	Tertiary Crushing	ROM	kg/tonne	**0.03**	**0.01**	**0.003**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**3.34**	**1.11**	**0.33**
Conveying - Iron Knight South Crusher	Materials Handling / Batch Drop	ROM	kg/tonne	**0.000299**	**0.000141**	**0.0000224**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**0.03**	**0.02**	**0.00**
Screening - Iron Knight South Crusher	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	2,630,618	Water sprays to keep ore wet - 50%	**50%**	0%	6,570	**0.70**	**0.24**	**0.02**
Dumping - Iron Duke Crusher	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	7,884,000	Water spraying - 70%	**70%**	0%	6,570	**1.20**	**0.43**	**0.13**
Primary Crushing - Iron Duke Crusher	Primary Crushing	ROM	kg/tonne	**0.01**	**0.004**	**0.0012**	tonne/Yr	7,884,000	No controls	**0%**	0%	6,570	**3.33**	**1.33**	**0.40**
Secondary Crushing - Iron Duke Crusher	Secondary Crushing	ROM	kg/tonne	**0.03**	**0.012**	**0.0036**	tonne/Yr	7,884,000	No controls	**0%**	0%	6,570	**10.00**	**4.00**	**1.20**
Tertiary Crushing - Iron Duke Crusher	Tertiary Crushing	ROM	kg/tonne	**0.03**	**0.01**	**0.003**	tonne/Yr	7,884,000	No controls	**0%**	0%	6,570	**10.00**	**3.33**	**1.00**
Conveying - Iron Duke Crusher	Materials Handling / Batch Drop	ROM	kg/tonne	**0.000299**	**0.000141**	**0.0000224**	tonne/Yr	7,884,000	No controls	**0%**	0%	6,570	**0.10**	**0.05**	**0.01**
Screening - Iron Duke Crusher	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	7,884,000	Water sprays to keep ore wet - 50%	**50%**	0%	6,570	**2.08**	**0.72**	**0.05**
Dumping - Lucas Mobile Crusher	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	985,500	Water spraying - 70%	**70%**	0%	6,570	**0.15**	**0.05**	**0.02**
Primary Crushing - Lucas Mobile Crusher	Primary Crushing	ROM	kg/tonne	**0.01**	**0.004**	**0.0012**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.42**	**0.17**	**0.05**
Secondary Crushing - Lucas Mobile Crusher	Secondary Crushing	ROM	kg/tonne	**0.03**	**0.012**	**0.0036**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.25**	**0.50**	**0.15**
Tertiary Crushing - Lucas Mobile Crusher	Tertiary Crushing	ROM	kg/tonne	**0.03**	**0.01**	**0.003**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.25**	**0.42**	**0.13**
Conveying - Lucas Mobile Crusher	Materials Handling / Batch Drop	ROM	kg/tonne	**0.000299**	**0.000141**	**0.0000224**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.01**	**0.01**	**0.00**
Screening - Lucas Mobile Crusher	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	985,500	Water sprays to keep ore wet - 50%	**50%**	0%	6,570	**0.26**	**0.09**	**0.01**
Dumping - Haematite ROM	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	9,100,000	Water spraying - 70%	**70%**	0%	6,570	**1.39**	**0.50**	**0.15**
Dumping - Cooks North ROM	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	2,082,000	Water spraying - 70%	**70%**	0%	6,570	**0.32**	**0.11**	**0.03**
Dumping - DT Course Rejects	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	3,036,108	Water spraying - 70%	**70%**	0%	6,570	**0.46**	**0.17**	**0.05**
Dumping - DU17 WRD	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	8,000,000	Water spraying - 70%	**70%**	0%	6,570	**1.22**	**0.44**	**0.13**
Dumping - MW18 WRD	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	8,000,000	Water spraying - 70%	**70%**	0%	6,570	**1.22**	**0.44**	**0.13**
Dumping - DU3 WRD	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	8,600,000	Water spraying - 70%	**70%**	0%	6,570	**1.31**	**0.47**	**0.14**
WE of Cooks North ROM Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	3	Watering	**50%**	0%	8,760	**Variable**		
WE of Haematite ROM Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	18	Watering	**50%**	0%	8,760	**Variable**		
WE of Iron Knight South Crusher Stockpiles	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	0.5	Watering	**50%**	0%	8,760	**Variable**		
WE of Iron Duke Crusher Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	10	Watering	**50%**	0%	8,760	**Variable**		
WE of Iron Duke Concentrator Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	Watering	**50%**	0%	8,760	**Variable**		
WE of Ore Benefication Plant Input Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	0.2	Watering	**50%**	0%	8,760	**Variable**		
WE of Ore Benefication Plant Output Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	0.4	Watering	**50%**	0%	8,760	**Variable**		
WE of MW18 WRD Stockpile	Wind Erosion - Shao Equation - K Factor 1	Overburden	kg/ha/yr	**1750**	**875**	**131**	ha	27	Watering	**50%**	0%	8,760	**Variable**		
WE of DU17 WRD Stockpile	Wind Erosion - Shao Equation - K Factor 1	Overburden	kg/ha/yr	**1750**	**875**	**131**	ha	108	Watering	**50%**	0%	8,760	**Variable**		
WE of DU3 WRD Stockpile	Wind Erosion - Shao Equation - K Factor 1	Overburden	kg/ha/yr	**1750**	**875**	**131**	ha	21	Watering	**50%**	0%	8,760	**Variable**		
WE of DT Course Rejects Stockpile	Wind Erosion - Shao Equation - K Factor 1	Overburden	kg/ha/yr	**1750**	**875**	**131**	ha	0	Watering	**50%**	0%	8,760	**Variable**		
WE of Iron Duchess North D Pit	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	20	Watering	**50%**	100%	8,760	**Variable**		

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Description	Activity	Materials	EF Unit	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	Activity Units	Activity Value	Control	TSP | PM_{10} | $PM_{2.5}$ Cntl%	Pit %	Hours/ Year	TSP g/s	PM_{10} g/s	$PM_{2.5}$ g/s
WE of Iron Duchess North B Pit	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	47	Watering	**50%**	100%	8,760	**Variable**		
WE of Iron Magnet Pit	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	80	Watering	**50%**	100%	8,760	**Variable**		
WE of Cooks North Pit 1	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	Watering	**50%**	100%	8,760	**Variable**		
WE of Cooks North Pit 2	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	Watering	**50%**	100%	8,760	**Variable**		
WE of Cooks North Pit 3	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	Watering	**50%**	100%	8,760	**Variable**		
WE of Cooks North Pit 4	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	7	Watering	**50%**	100%	8,760	**Variable**		
WE of Cooks North Pit 5	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	5	Watering	**50%**	100%	8,760	**Variable**		
WE of Cooks North Pit 6	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	6	Watering	**50%**	100%	8,760	**Variable**		
WE of Lucas Mobile Crusher Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	3	Watering	**50%**	0%	8,760	**Variable**		

Table 17: Summary of Fugitive Particulate Emission Estimates for Modelling of MEP1 mitigated

Description	Activity	Materials	EF Unit	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	Activity Units	Activity Value	Control	TSP | PM_{10} | $PM_{2.5}$ Cntl%	Pit %	Hours/ Year	TSP g/s	PM_{10} g/s	$PM_{2.5}$ g/s
Open Pit Drilling	Drilling	Overburden	kg/hole	**0.59**	**0.307**	**0.0177**	hole/Yr	17,520	Water spraying - NPI - 70%	**70%**	100%	8,760	**0.05**	**0.03**	**0.00**
Blasting	Blasting	Overburden	kg/blast	**6.24**	**3.24**	**0.187**	blast/Yr	730	No controls	**0%**	100%	8,760	**0.07**	**0.04**	**0.00**
Excavation	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	18,396,000	No controls	**0%**	100%	8,760	**8.46**	**2.13**	**0.40**
Bulldozing	Bulldozing	Overburden	kg/hour	**2.66**	**0.547**	**0.279**	hour/Yr	3,650	No controls	**0%**	100%	8,760	**0.15**	**0.03**	**0.02**
Topsoil Removal - Cooks North Pit 1	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	18,854	No controls	**0%**	100%	8,760	**0.01**	**0.00**	**0.00**
Topsoil Removal - Cooks North Pit 2	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	17,316	No controls	**0%**	100%	8,760	**0.01**	**0.00**	**0.00**
Topsoil Removal - Cooks North Pit 3	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	14,319	No controls	**0%**	100%	8,760	**0.01**	**0.00**	**0.00**
Topsoil Removal - Cooks North Pit 4	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	118,643	No controls	**0%**	100%	8,760	**0.05**	**0.01**	**0.00**
Topsoil Removal - Cooks North Pit 5	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	87,797	No controls	**0%**	100%	8,760	**0.04**	**0.01**	**0.00**
Topsoil Removal - Cooks North Pit 6	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	89,988	No controls	**0%**	100%	8,760	**0.04**	**0.01**	**0.00**
Haul Trucks - To DU3 WRD (Iron Magnet)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	71,240	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**12.33**	**3.64**	**0.36**
Haul Trucks - To DT Coarse Rejects (Iron Duke Crusher)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	14,557	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**2.52**	**0.74**	**0.07**
Haul Trucks - To Iron Knight South Crusher (Cooks North)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	262,331	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**45.42**	**13.42**	**1.34**
Haul Trucks - To Iron Duke Crusher (Stockpile)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	93,163	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**16.13**	**4.77**	**0.48**
Haul Trucks - To Haematite ROM (Iron Duchess North B)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	543,424	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**94.09**	**27.80**	**2.78**
Haul Trucks - To Haematite ROM (iron Magnet)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	112,379	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**19.46**	**5.75**	**0.57**
Haul Trucks - Iron Magnet Pit Backfill	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	43,558	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**7.54**	**2.23**	**0.22**
Haul Trucks - To Lucas Mobile Crusher (Iron Duchess North B)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	58,851	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**10.19**	**3.01**	**0.30**
Haul Trucks - To Lucas Mobile Crusher (Iron Magnet)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	12,170	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**2.11**	**0.62**	**0.06**
Haul Trucks - Within MEP1 WRD south	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	29,766	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**5.15**	**1.52**	**0.15**
Haul Trucks - Within MEP1 WRD north	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	11,736	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**2.03**	**0.60**	**0.06**
Haul Trucks - To Iron Magnet (Duchess A&B)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	23,264	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**4.03**	**1.19**	**0.12**
Haul Trucks - To MEP1 WRD (MEP1 WRD)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	21,237	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**3.68**	**1.09**	**0.11**
Haul Trucks - To Lucas Mobile Crusher (Iron Duchess A&B (south))	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	46,736	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**8.09**	**2.39**	**0.24**
Haul Trucks - Haemetite ROM (Iron Duchess A&B (south))	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	431,553	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**74.72**	**22.08**	**2.21**

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Haul Trucks - Iron Duke Crushing (Iron Duchess A&B (south))	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	325,981	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**56.44**	**16.68**	**1.67**
Haul Trucks - Haulage Waste WRD1	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	9,293	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**1.61**	**0.48**	**0.05**
Haul Trucks - Haulage Waste WRD2	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	2,401	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**0.42**	**0.12**	**0.01**
Haul Trucks - Haulage Waste WRD3	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	5,403	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**0.94**	**0.28**	**0.03**
Haul Trucks - Haulage Waste WRD4	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	8,344	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**1.44**	**0.43**	**0.04**
Haul Trucks - Haulage Waste WRD5	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	5,487	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**0.95**	**0.28**	**0.03**
Haul Trucks - Haulage Waste WRD6	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	1,201	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**0.21**	**0.06**	**0.01**
Ramp - Cooks North In-Pit Ramp 1	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	14,401	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**2.49**	**0.74**	**0.07**
Ramp - Cooks North In-Pit Ramp 2	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	14,839	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**2.57**	**0.76**	**0.08**
Ramp - Cooks North In-Pit Ramp 3	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	6,268	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**1.09**	**0.32**	**0.03**
Duty Light Vehicles	Vehicle Wheel Generated Dust - Light Vehicles -Unpaved Roads	Overburden	kg/VKT	**0.379**	**0.11**	**0.0284**	VKT/Yr	120,231	Level 1 watering : 2L/m2/hr - NPI - 50%	**50%**	0%	6,570	**0.96**	**0.28**	**0.07**
FEL - Iron Duke Crusher	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**9.62**	**4.62**	**1.01**
FEL - Iron Knight South	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**2.78**	**1.33**	**0.29**
FEL - Lucas Mobile Crusher	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.04**	**0.50**	**0.11**
FEL - Iron Knight Mobile Crusher	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.04**	**0.50**	**0.11**
FEL - Cooks North	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	2,082,000	No controls	**0%**	0%	6,570	**2.20**	**1.06**	**0.23**
FEL - Haematite ROM	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**9.62**	**4.62**	**1.01**
Concentrator Feed - Cooks North	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	2,082,000	No controls	**0%**	0%	6,570	**2.20**	**1.06**	**0.23**
Concentrator Feed - Haematite ROM	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**9.62**	**4.62**	**1.01**
Concentrator Feed - Lucas Mobile Crushing	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.04**	**0.50**	**0.11**
Concentrator Feed - Iron Knight Mobile Crushing	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.04**	**0.50**	**0.11**
Screening - Ore Benefecation Plant	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	9,100,000	Water sprays to keep ore wet - 50%	**50%**	0%	6,570	**2.40**	**0.83**	**0.06**
FEL - Ore Benefecation Plant	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	2,117,000	No controls	**0%**	0%	6,570	**2.24**	**1.07**	**0.24**
Dumping - Iron Knight South Crusher	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	2,630,618	Water spraying - 70%	**70%**	0%	6,570	**0.40**	**0.14**	**0.04**
Primary Crushing - Iron Knight South Crusher	Primary Crushing	ROM	kg/tonne	**0.01**	**0.004**	**0.0012**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**1.11**	**0.44**	**0.13**
Secondary Crushing - Iron Knight South Crusher	Secondary Crushing	ROM	kg/tonne	**0.03**	**0.012**	**0.0036**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**3.34**	**1.33**	**0.40**
Tertiary Crushing - Iron Knight South Crusher	Tertiary Crushing	ROM	kg/tonne	**0.03**	**0.01**	**0.003**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**3.34**	**1.11**	**0.33**
Conveying - Iron Knight South Crusher	Materials Handling / Batch Drop	ROM	kg/tonne	**0.000299**	**0.000141**	**0.0000224**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**0.03**	**0.02**	**0.00**
Screening - Iron Knight South Crusher	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	2,630,618	Water sprays to keep ore wet - 50%	**50%**	0%	6,570	**0.70**	**0.24**	**0.02**
Dumping - Iron Duke Crusher	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	9,100,000	Water spraying - 70%	**70%**	0%	6,570	**1.39**	**0.50**	**0.15**
Primary Crushing - Iron Duke Crusher	Primary Crushing	ROM	kg/tonne	**0.01**	**0.004**	**0.0012**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**3.85**	**1.54**	**0.46**
Secondary Crushing - Iron Duke Crusher	Secondary Crushing	ROM	kg/tonne	**0.03**	**0.012**	**0.0036**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**11.54**	**4.62**	**1.39**
Tertiary Crushing - Iron Duke Crusher	Tertiary Crushing	ROM	kg/tonne	**0.03**	**0.01**	**0.003**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**11.54**	**3.85**	**1.15**
Conveying - Iron Duke Crusher	Materials Handling / Batch Drop	ROM	kg/tonne	**0.000299**	**0.000141**	**0.0000224**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**0.12**	**0.05**	**0.01**
Screening - Iron Duke Crusher	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	9,100,000	Water sprays to keep ore wet - 50%	**50%**	0%	6,570	**2.40**	**0.83**	**0.06**
Dumping - Lucas Mobile Crusher	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	985,500	Water spraying - 70%	**70%**	0%	6,570	**0.15**	**0.05**	**0.02**
Primary Crushing - Lucas Mobile Crusher	Primary Crushing	ROM	kg/tonne	**0.01**	**0.004**	**0.0012**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.42**	**0.17**	**0.05**
Secondary Crushing - Lucas Mobile Crusher	Secondary Crushing	ROM	kg/tonne	**0.03**	**0.012**	**0.0036**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.25**	**0.50**	**0.15**
Tertiary Crushing - Lucas Mobile Crusher	Tertiary Crushing	ROM	kg/tonne	**0.03**	**0.01**	**0.003**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.25**	**0.42**	**0.13**
Conveying - Lucas Mobile Crusher	Materials Handling / Batch Drop	ROM	kg/tonne	**0.000299**	**0.000141**	**0.0000224**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.01**	**0.01**	**0.00**

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Screening - Lucas Mobile Crusher	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	985,500	Water sprays to keep ore wet - 50%	**50%**	0%	6,570	**0.26**	**0.09**	**0.01**
Dumping - Iron Knight Mobile Crusher	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	985,500	Water spraying - 70%	**70%**	0%	6,570	**0.15**	**0.05**	**0.02**
Primary Crushing - Iron Knight Mobile Crusher	Primary Crushing	ROM	kg/tonne	**0.01**	**0.004**	**0.0012**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.42**	**0.17**	**0.05**
Secondary Crushing - Iron Knight Mobile Crusher	Secondary Crushing	ROM	kg/tonne	**0.03**	**0.012**	**0.0036**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.25**	**0.50**	**0.15**
Tertiary Crushing - Iron Knight Mobile Crusher	Tertiary Crushing	ROM	kg/tonne	**0.03**	**0.01**	**0.003**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.25**	**0.42**	**0.13**
Conveying - Iron Knight Mobile Crusher	Materials Handling / Batch Drop	ROM	kg/tonne	**0.000299**	**0.000141**	**0.0000224**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.01**	**0.01**	**0.00**
Screening - Iron Knight Mobile Crusher	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	985,500	Water sprays to keep ore wet - 50%	**50%**	0%	6,570	**0.26**	**0.09**	**0.01**
Dumping - Haematite ROM	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	9,100,000	Water spraying - 70%	**70%**	0%	6,570	**1.39**	**0.50**	**0.15**
Dumping - Cooks North ROM	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	2,082,000	Water spraying - 70%	**70%**	0%	6,570	**0.32**	**0.11**	**0.03**
Dumping - DT Course Rejects	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	945,000	Water spraying - 70%	**70%**	0%	6,570	**0.14**	**0.05**	**0.02**
Dumping - DU3 WRD	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	8,600,000	Water spraying - 70%	**70%**	0%	6,570	**1.31**	**0.47**	**0.14**
Dumping - MEP1 WRD	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	828,383	Water spraying - 70%	**70%**	0%	6,570	**0.13**	**0.05**	**0.01**
Dumping - MEP1 SP	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	1,499,218	Water spraying - 70%	**70%**	0%	6,570	**0.23**	**0.08**	**0.02**
Dumping - PEPR WRD 1	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	593,856	Water spraying - 70%	**70%**	0%	6,570	**0.09**	**0.03**	**0.01**
Dumping - PEPR WRD 2	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	186,243	Water spraying - 70%	**70%**	0%	6,570	**0.03**	**0.01**	**0.00**
Dumping - PEPR WRD 3	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	364,046	Water spraying - 70%	**70%**	0%	6,570	**0.06**	**0.02**	**0.01**
Dumping - PEPR WRD 4	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	120,539	Water spraying - 70%	**70%**	0%	6,570	**0.02**	**0.01**	**0.00**
Dumping - PEPR WRD 5	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	241,386	Water spraying - 70%	**70%**	0%	6,570	**0.04**	**0.01**	**0.00**
Dumping - PEPR WRD 6	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	342,925	Water spraying - 70%	**70%**	0%	6,570	**0.05**	**0.02**	**0.01**
WE of Cooks North ROM Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	3	Watering	**50%**	0%	8,760	**Variable**		
WE of Haematite ROM Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	18	Watering	**50%**	0%	8,760	**Variable**		
WE of Iron Knight South Crusher Stockpiles	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	0.5	Watering	**50%**	0%	8,760	**Variable**		
WE of Iron Duke Crusher Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	10	Watering	**50%**	0%	8,760	**Variable**		
WE of Iron Duke Concentrator Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	Watering	**50%**	0%	8,760	**Variable**		
WE of Ore Benefication Plant Input Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	0.2	Watering	**50%**	0%	8,760	**Variable**		
WE of Ore Benefication Plant Output Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	0.4	Watering	**50%**	0%	8,760	**Variable**		
WE of MW18 WRD Stockpile	Wind Erosion - Shao Equation - K Factor 1	Overburden	kg/ha/yr	**1750**	**875**	**131**	ha	27	Watering	**50%**	0%	8,760	**Variable**		
WE of DU17 WRD Stockpile	Wind Erosion - Shao Equation - K Factor 1	Overburden	kg/ha/yr	**1750**	**875**	**131**	ha	108	Watering	**50%**	0%	8,760	**Variable**		
WE of DU3 WRD Stockpile	Wind Erosion - Shao Equation - K Factor 1	Overburden	kg/ha/yr	**1750**	**875**	**131**	ha	21	Watering	**50%**	0%	8,760	**Variable**		
WE of DT Course Rejects Stockpile	Wind Erosion - Shao Equation - K Factor 1	Overburden	kg/ha/yr	**1750**	**875**	**131**	ha	0	Watering	**50%**	0%	8,760	**Variable**		
WE of Iron Duchess North D Pit	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	20	Watering	**50%**	100%	8,760	**Variable**		
WE of Iron Duchess North B Pit	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	47	Watering	**50%**	100%	8,760	**Variable**		
WE of Iron Magnet Pit	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	80	Watering	**50%**	100%	8,760	**Variable**		
WE of Cooks North Pit 1	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	Watering	**50%**	100%	8,760	**Variable**		
WE of Cooks North Pit 2	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	Watering	**50%**	100%	8,760	**Variable**		
WE of Cooks North Pit 3	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	Watering	**50%**	100%	8,760	**Variable**		
WE of Cooks North Pit 4	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	7	Watering	**50%**	100%	8,760	**Variable**		
WE of Cooks North Pit 5	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	5	Watering	**50%**	100%	8,760	**Variable**		
WE of Cooks North Pit 6	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	6	Watering	**50%**	100%	8,760	**Variable**		
WE of Lucas Mobile Crusher Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	3	Watering	**50%**	0%	8,760	**Variable**		
WE of MEP1 WRD	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	278	Watering	**50%**	100%	8,760	**Variable**		

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WE of MEP1 SP	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	15	Watering	**50%**	100%	8,760	**Variable**
WE of PEPR WRD 1	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	2	Watering	**50%**	100%	8,760	**Variable**
WE of PEPR WRD 2	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	Watering	**50%**	100%	8,760	**Variable**
WE of PEPR WRD 3	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	2	Watering	**50%**	100%	8,760	**Variable**
WE of PEPR WRD 4	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	Watering	**50%**	100%	8,760	**Variable**
WE of PEPR WRD 5	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	Watering	**50%**	100%	8,760	**Variable**
WE of PEPR WRD 6	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	2	Watering	**50%**	100%	8,760	**Variable**

Table 18: Summary of Fugitive Particulate Emission Estimates for Modelling of MEP1 unmitigated

Description	Activity	Materials	EF Unit	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	Activity Units	Activity Value	Control	TSP | PM_{10} | $PM_{2.5}$ Cntl%	Pit %	Hours/ Year	TSP g/s	PM_{10} g/s	$PM_{2.5}$ g/s
Open Pit Drilling	Drilling	Overburden	kg/hole	**0.59**	**0.307**	**0.0177**	hole/Yr	17,520	No controls	**0%**	100%	8,760	**0.05**	**0.03**	**0.00**
Blasting	Blasting	Overburden	kg/blast	**6.24**	**3.24**	**0.187**	blast/Yr	730	No controls	**0%**	100%	8,760	**0.07**	**0.04**	**0.00**
Excavation	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	18,396,000	No controls	**0%**	100%	8,760	**8.46**	**2.13**	**0.40**
Bulldozing	Bulldozing	Overburden	kg/hour	**2.66**	**0.547**	**0.279**	hour/Yr	3,650	No controls	**0%**	100%	8,760	**0.15**	**0.03**	**0.02**
Topsoil Removal - Cooks North Pit 1	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	18,854	No controls	**0%**	100%	8,760	**0.01**	**0.00**	**0.00**
Topsoil Removal - Cooks North Pit 2	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	17,316	No controls	**0%**	100%	8,760	**0.01**	**0.00**	**0.00**
Topsoil Removal - Cooks North Pit 3	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	14,319	No controls	**0%**	100%	8,760	**0.01**	**0.00**	**0.00**
Topsoil Removal - Cooks North Pit 4	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	118,643	No controls	**0%**	100%	8,760	**0.05**	**0.01**	**0.00**
Topsoil Removal - Cooks North Pit 5	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	87,797	No controls	**0%**	100%	8,760	**0.04**	**0.01**	**0.00**
Topsoil Removal - Cooks North Pit 6	Scraper Stripping Topsoil	Overburden	kg/tonne	**0.029**	**0.0073**	**0.00136**	tonne/Yr	89,988	No controls	**0%**	100%	8,760	**0.04**	**0.01**	**0.00**
Haul Trucks - To DU3 WRD (Iron Magnet)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	71,240	No controls	**0%**	0%	6,570	**24.67**	**7.29**	**0.73**
Haul Trucks - To DT Coarse Rejects (Iron Duke Crusher)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	14,557	No controls	**0%**	0%	6,570	**5.04**	**1.49**	**0.15**
Haul Trucks - To Iron Knight South Crusher (Cooks North)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	262,331	No controls	**0%**	0%	6,570	**90.84**	**26.84**	**2.68**
Haul Trucks - To Iron Duke Crusher (Stockpile)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	93,163	No controls	**0%**	0%	6,570	**32.26**	**9.53**	**0.95**
Haul Trucks - To Haematite ROM (Iron Duchess North B)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	543,424	No controls	**0%**	0%	6,570	**188.17**	**55.60**	**5.56**
Haul Trucks - To Haematite ROM (iron Magnet)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	112,379	No controls	**0%**	0%	6,570	**38.91**	**11.50**	**1.15**
Haul Trucks - Iron Magnet Pit Backfill	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	43,558	No controls	**0%**	0%	6,570	**15.08**	**4.46**	**0.45**
Haul Trucks - To Lucas Mobile Crusher (Iron Duchess North B)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	58,851	No controls	**0%**	0%	6,570	**20.38**	**6.02**	**0.60**
Haul Trucks - To Lucas Mobile Crusher (Iron Magnet)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	12,170	No controls	**0%**	0%	6,570	**4.21**	**1.25**	**0.12**
Haul Trucks - Within MEP1 WRD south	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	29,766	No controls	**0%**	0%	6,570	**10.31**	**3.05**	**0.30**
Haul Trucks - Within MEP1 WRD north	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	11,736	No controls	**0%**	0%	6,570	**4.06**	**1.20**	**0.12**
Haul Trucks - To Iron Magnet (Duchess A&B)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	23,264	No controls	**0%**	0%	6,570	**8.06**	**2.38**	**0.24**
Haul Trucks - To MEP1 WRD (MEP1 WRD)	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	21,237	No controls	**0%**	0%	6,570	**7.35**	**2.17**	**0.22**
Haul Trucks - To Lucas Mobile Crusher (Iron Duchess A&B (south))	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	46,736	No controls	**0%**	0%	6,570	**16.18**	**4.78**	**0.48**
Haul Trucks - Haemetite ROM (Iron Duchess A&B (south))	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	431,553	No controls	**0%**	0%	6,570	**149.43**	**44.16**	**4.42**
Haul Trucks - Iron Duke Crushing (Iron Duchess A&B (south))	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	325,981	No controls	**0%**	0%	6,570	**112.88**	**33.35**	**3.34**
Haul Trucks - Haulage Waste WRD1	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	9,293	No controls	**0%**	0%	6,570	**3.22**	**0.95**	**0.10**
Haul Trucks - Haulage Waste WRD2	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	2,401	No controls	**0%**	0%	6,570	**0.83**	**0.25**	**0.02**
Haul Trucks - Haulage Waste WRD3	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	5,403	No controls	**0%**	0%	6,570	**1.87**	**0.55**	**0.06**

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Haul Trucks - Haulage Waste WRD4	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	8,344	No controls	**0%**	0%	6,570	**2.89**	**0.85**	**0.09**
Haul Trucks - Haulage Waste WRD5	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	5,487	No controls	**0%**	0%	6,570	**1.90**	**0.56**	**0.06**
Haul Trucks - Haulage Waste WRD6	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	1,201	No controls	**0%**	0%	6,570	**0.42**	**0.12**	**0.01**
Ramp - Cooks North In-Pit Ramp 1	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	14,401	No controls	**0%**	0%	6,570	**4.99**	**1.47**	**0.15**
Ramp - Cooks North In-Pit Ramp 2	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	14,839	No controls	**0%**	0%	6,570	**5.14**	**1.52**	**0.15**
Ramp - Cooks North In-Pit Ramp 3	Vehicle Wheel Generated Dust - Unpaved Roads - Haul 1	Overburden	kg/VKT	**8.19**	**2.42**	**0.242**	VKT/Yr	6,268	No controls	**0%**	0%	6,570	**2.17**	**0.64**	**0.06**
Duty Light Vehicles	Vehicle Wheel Generated Dust - Light Vehicles -Unpaved Roads	Overburden	kg/VKT	**0.379**	**0.11**	**0.0284**	VKT/Yr	120,231	No controls	**0%**	0%	6,570	**1.93**	**0.56**	**0.14**
FEL - Iron Duke Crusher	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**9.62**	**4.62**	**1.01**
FEL - Iron Knight South	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**2.78**	**1.33**	**0.29**
FEL - Lucas Mobile Crusher	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.04**	**0.50**	**0.11**
FEL - Iron Knight Mobile Crusher	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.04**	**0.50**	**0.11**
FEL - Cooks North	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	2,082,000	No controls	**0%**	0%	6,570	**2.20**	**1.06**	**0.23**
FEL - Haematite ROM	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**9.62**	**4.62**	**1.01**
Concentrator Feed - Cooks North	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	2,082,000	No controls	**0%**	0%	6,570	**2.20**	**1.06**	**0.23**
Concentrator Feed - Haematite ROM	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**9.62**	**4.62**	**1.01**
Concentrator Feed - Lucas Mobile Crushing	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.04**	**0.50**	**0.11**
Concentrator Feed - Iron Knight Mobile Crushing	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.04**	**0.50**	**0.11**
Screening - Ore Benefecation Plant	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**4.81**	**1.65**	**0.11**
FEL - Ore Benefecation Plant	Truck Loading - Excavators/Shovels/FELs - NPI	ROM	kg/tonne	**0.025**	**0.012**	**0.00263**	tonne/Yr	2,117,000	No controls	**0%**	0%	6,570	**2.24**	**1.07**	**0.24**
Dumping - Iron Knight South Crusher	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**1.33**	**0.48**	**0.14**
Primary Crushing - Iron Knight South Crusher	Primary Crushing	ROM	kg/tonne	**0.01**	**0.004**	**0.0012**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**1.11**	**0.44**	**0.13**
Secondary Crushing - Iron Knight South Crusher	Secondary Crushing	ROM	kg/tonne	**0.03**	**0.012**	**0.0036**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**3.34**	**1.33**	**0.40**
Tertiary Crushing - Iron Knight South Crusher	Tertiary Crushing	ROM	kg/tonne	**0.03**	**0.01**	**0.003**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**3.34**	**1.11**	**0.33**
Conveying - Iron Knight South Crusher	Materials Handling / Batch Drop	ROM	kg/tonne	**0.000299**	**0.000141**	**0.0000224**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**0.03**	**0.02**	**0.00**
Screening - Iron Knight South Crusher	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	2,630,618	No controls	**0%**	0%	6,570	**1.39**	**0.48**	**0.03**
Dumping - Iron Duke Crusher	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**4.62**	**1.65**	**0.48**
Primary Crushing - Iron Duke Crusher	Primary Crushing	ROM	kg/tonne	**0.01**	**0.004**	**0.0012**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**3.85**	**1.54**	**0.46**
Secondary Crushing - Iron Duke Crusher	Secondary Crushing	ROM	kg/tonne	**0.03**	**0.012**	**0.0036**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**11.54**	**4.62**	**1.39**
Tertiary Crushing - Iron Duke Crusher	Tertiary Crushing	ROM	kg/tonne	**0.03**	**0.01**	**0.003**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**11.54**	**3.85**	**1.15**
Conveying - Iron Duke Crusher	Materials Handling / Batch Drop	ROM	kg/tonne	**0.000299**	**0.000141**	**0.0000224**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**0.12**	**0.05**	**0.01**
Screening - Iron Duke Crusher	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**4.81**	**1.65**	**0.11**
Dumping - Lucas Mobile Crusher	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.50**	**0.18**	**0.05**
Primary Crushing - Lucas Mobile Crusher	Primary Crushing	ROM	kg/tonne	**0.01**	**0.004**	**0.0012**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.42**	**0.17**	**0.05**
Secondary Crushing - Lucas Mobile Crusher	Secondary Crushing	ROM	kg/tonne	**0.03**	**0.012**	**0.0036**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.25**	**0.50**	**0.15**
Tertiary Crushing - Lucas Mobile Crusher	Tertiary Crushing	ROM	kg/tonne	**0.03**	**0.01**	**0.003**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.25**	**0.42**	**0.13**
Conveying - Lucas Mobile Crusher	Materials Handling / Batch Drop	ROM	kg/tonne	**0.000299**	**0.000141**	**0.0000224**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.01**	**0.01**	**0.00**
Screening - Lucas Mobile Crusher	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.52**	**0.18**	**0.01**
Dumping - Iron Knight Mobile Crusher	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.50**	**0.18**	**0.05**
Primary Crushing - Iron Knight Mobile Crusher	Primary Crushing	ROM	kg/tonne	**0.01**	**0.004**	**0.0012**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.42**	**0.17**	**0.05**
Secondary Crushing - Iron Knight Mobile Crusher	Secondary Crushing	ROM	kg/tonne	**0.03**	**0.012**	**0.0036**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.25**	**0.50**	**0.15**

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Tertiary Crushing - Iron Knight Mobile Crusher	Tertiary Crushing	ROM	kg/tonne	**0.03**	**0.01**	**0.003**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**1.25**	**0.42**	**0.13**
Conveying - Iron Knight Mobile Crusher	Materials Handling / Batch Drop	ROM	kg/tonne	**0.000299**	**0.000141**	**0.0000224**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.01**	**0.01**	**0.00**
Screening - Iron Knight Mobile Crusher	Screening - rock crushing plant	ROM	kg/tonne	**0.0125**	**0.0043**	**0.00029**	tonne/Yr	985,500	No controls	**0%**	0%	6,570	**0.52**	**0.18**	**0.01**
Dumping - Haematite ROM	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	9,100,000	No controls	**0%**	0%	6,570	**4.62**	**1.65**	**0.48**
Dumping - Cooks North ROM	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	2,082,000	No controls	**0%**	0%	6,570	**1.06**	**0.38**	**0.11**
Dumping - DT Course Rejects	Truck Dumping - NPI	ROM	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	945,000	No controls	**0%**	0%	6,570	**0.48**	**0.17**	**0.05**
Dumping - DU3 WRD	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	8,600,000	No controls	**0%**	0%	6,570	**4.36**	**1.56**	**0.46**
Dumping - MEP1 WRD	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	828,383	No controls	**0%**	0%	6,570	**0.42**	**0.15**	**0.04**
Dumping - MEP1 SP	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	1,499,218	No controls	**0%**	0%	6,570	**0.76**	**0.27**	**0.08**
Dumping - PEPR WRD 1	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	593,856	No controls	**0%**	0%	6,570	**0.30**	**0.11**	**0.03**
Dumping - PEPR WRD 2	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	186,243	No controls	**0%**	0%	6,570	**0.09**	**0.03**	**0.01**
Dumping - PEPR WRD 3	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	364,046	No controls	**0%**	0%	6,570	**0.18**	**0.07**	**0.02**
Dumping - PEPR WRD 4	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	120,539	No controls	**0%**	0%	6,570	**0.06**	**0.02**	**0.01**
Dumping - PEPR WRD 5	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	241,386	No controls	**0%**	0%	6,570	**0.12**	**0.04**	**0.01**
Dumping - PEPR WRD 6	Truck Dumping - NPI	Overburden	kg/tonne	**0.012**	**0.0043**	**0.00126**	tonne/Yr	342,925	No controls	**0%**	0%	6,570	**0.17**	**0.06**	**0.02**
WE of Cooks North ROM Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	3	No controls	**0%**	0%	8,760	**Variable**		
WE of Haematite ROM Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	18	No controls	**0%**	0%	8,760	**Variable**		
WE of Iron Knight South Crusher Stockpiles	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	0.5	No controls	**0%**	0%	8,760	**Variable**		
WE of Iron Duke Crusher Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	10	No controls	**0%**	0%	8,760	**Variable**		
WE of Iron Duke Concentrator Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	No controls	**0%**	0%	8,760	**Variable**		
WE of Ore Benefication Plant Input Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	0.2	No controls	**0%**	0%	8,760	**Variable**		
WE of Ore Benefication Plant Output Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	0.4	No controls	**0%**	0%	8,760	**Variable**		
WE of MW18 WRD Stockpile	Wind Erosion - Shao Equation - K Factor 1	Overburden	kg/ha/yr	**1750**	**875**	**131**	ha	27	No controls	**0%**	0%	8,760	**Variable**		
WE of DU17 WRD Stockpile	Wind Erosion - Shao Equation - K Factor 1	Overburden	kg/ha/yr	**1750**	**875**	**131**	ha	108	No controls	**0%**	0%	8,760	**Variable**		
WE of DU3 WRD Stockpile	Wind Erosion - Shao Equation - K Factor 1	Overburden	kg/ha/yr	**1750**	**875**	**131**	ha	21	No controls	**0%**	0%	8,760	**Variable**		
WE of DT Course Rejects Stockpile	Wind Erosion - Shao Equation - K Factor 1	Overburden	kg/ha/yr	**1750**	**875**	**131**	ha	0	No controls	**0%**	0%	8,760	**Variable**		
WE of Iron Duchess North D Pit	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	20	No controls	**0%**	100%	8,760	**Variable**		
WE of Iron Duchess North B Pit	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	47	No controls	**0%**	100%	8,760	**Variable**		
WE of Iron Magnet Pit	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	80	No controls	**0%**	100%	8,760	**Variable**		
WE of Cooks North Pit 1	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	No controls	**0%**	100%	8,760	**Variable**		
WE of Cooks North Pit 2	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	No controls	**0%**	100%	8,760	**Variable**		
WE of Cooks North Pit 3	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	No controls	**0%**	100%	8,760	**Variable**		
WE of Cooks North Pit 4	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	7	No controls	**0%**	100%	8,760	**Variable**		
WE of Cooks North Pit 5	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	5	No controls	**0%**	100%	8,760	**Variable**		
WE of Cooks North Pit 6	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	6	No controls	**0%**	100%	8,760	**Variable**		
WE of Lucas Mobile Crusher Stockpile	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	3	No controls	**0%**	0%	8,760	**Variable**		
WE of MEP1 WRD	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	278	No controls	**0%**	0%	8,760	**Variable**		
WE of MEP1 SP	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	15	No controls	**0%**	0%	8,760	**Variable**		
WE of PEPR WRD 1	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	2	No controls	**0%**	0%	8,760	**Variable**		
WE of PEPR WRD 2	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	No controls	**0%**	0%	8,760	**Variable**		
WE of PEPR WRD 3	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	2	No controls	**0%**	0%	8,760	**Variable**		

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WE of PEPR WRD 4	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	No controls	**0%**	0%	8,760	**Variable**
WE of PEPR WRD 5	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	1	No controls	**0%**	0%	8,760	**Variable**
WE of PEPR WRD 6	Wind Erosion - Shao Equation - K Factor 1	ROM	kg/ha/yr	**1750**	**875**	**131**	ha	2	No controls	**0%**	0%	8,760	**Variable**

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APPENDIX 3

Certificate of Analysis

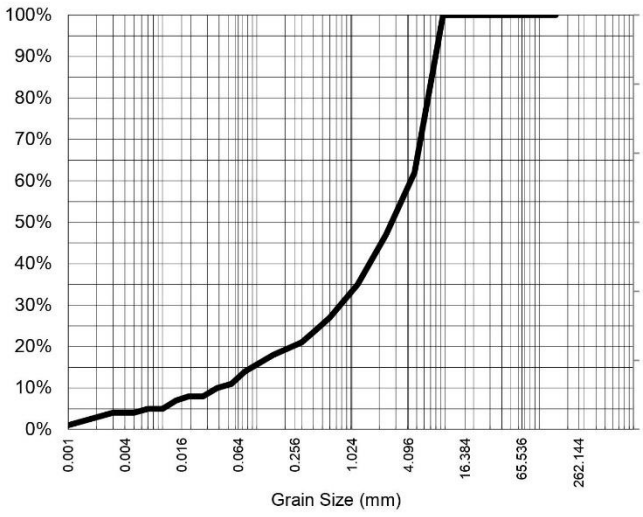
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2 Byth Street
Stafford, QLD 4053
pH 07 3243 7222
samples.brisbane@alsenviro.com

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Brisbane QLD

CLIENT:	LAB RESULTS	**DATE REPORTED:**	8-Mar-2022
COMPANY:	LIBERTY ONESTEEL	**DATE RECEIVED:**	22-Feb-2022
ADDRESS:	Locked Bag 5044 Whyalla South Australia	**REPORT NO:**	EB2205112-001 / PSD
PROJECT:	Magnetite Expansion Phase 2	**SAMPLE ID:**	PIT Sample 1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	62%
2.36	47%
1.18	35%
0.600	27%
0.425	24%
0.300	21%
0.150	18%
0.075	14%
Particle Size (microns)	
54	11%
38	10%
27	8%
19	8%
14	7%
10	5%
7	5%
5	4%
1	1%

Median Particle Size (mm)*	2.838

Analysis Notes

Samples analysed as received.

** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results*

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 4-Mar-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 3.27 (2.85)*

NATA Accreditation: 825 Site: Brisbane
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Soil Senior Chemist
Authorised Signatory

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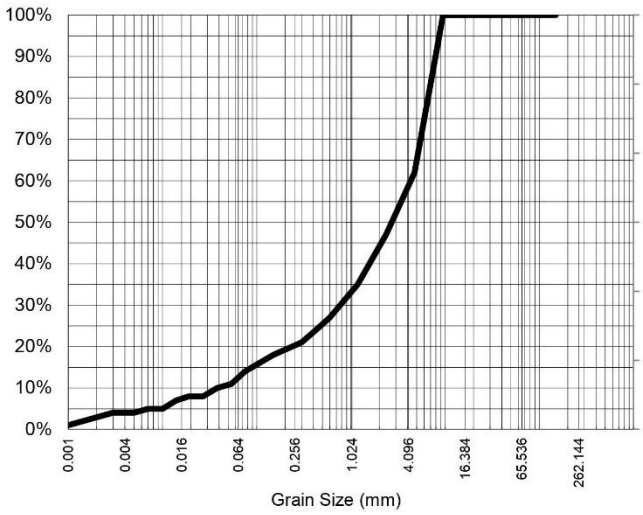
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Brisbane QLD

CLIENT:	LAB RESULTS	**DATE REPORTED:**	8-Mar-2022
COMPANY:	LIBERTY ONESTEEL	**DATE RECEIVED:**	22-Feb-2022
ADDRESS:	Locked Bag 5044 Whyalla South Australia	**REPORT NO:**	EB2205112-001DUP / PSD
PROJECT:	Magnetite Expansion Phase 2	**SAMPLE ID:**	PIT Sample 1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	62%
2.36	47%
1.18	35%
0.600	27%
0.425	24%
0.300	21%
0.150	18%
0.075	14%
Particle Size (microns)	
54	11%
38	10%
27	8%
19	8%
14	7%
10	5%
7	5%
5	4%
1	1%

Median Particle Size (mm)*	2.838

Analysis Notes

Samples analysed as received.

** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results*

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 4-Mar-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 3.27 (2.85)*

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Soil Senior Chemist
Authorised Signatory

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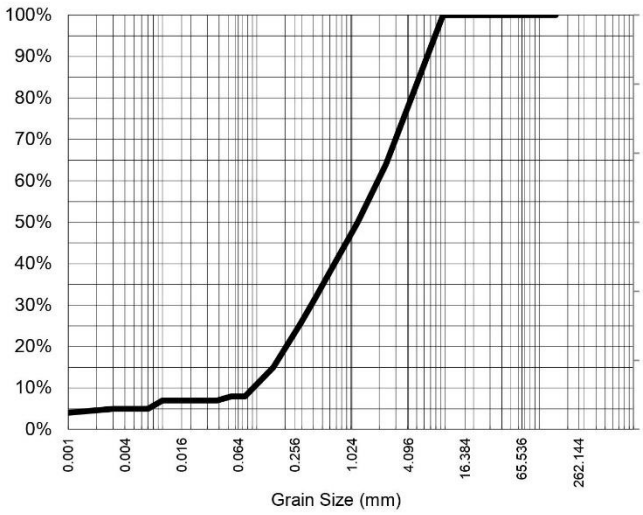
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CLIENT:	LAB RESULTS	**DATE REPORTED:**	8-Mar-2022
COMPANY:	LIBERTY ONESTEEL	**DATE RECEIVED:**	22-Feb-2022
ADDRESS:	Locked Bag 5044 Whyalla South Australia	**REPORT NO:**	EB2205112-002 / PSD
PROJECT:	Magnetite Expansion Phase 2	**SAMPLE ID:**	PIT Sample 2

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	82%
2.36	64%
1.18	50%
0.600	38%
0.425	32%
0.300	26%
0.150	15%
0.075	8%
Particle Size (microns)	
54	8%
38	7%
27	7%
19	7%
14	7%
10	7%
7	5%
5	5%
1	4%

Median Particle Size (mm)*	1.180

Analysis Notes

Samples analysed as received.

** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results*

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:	AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly	**Analysed:**	4-Mar-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:		**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	3.38 (2.85)*		

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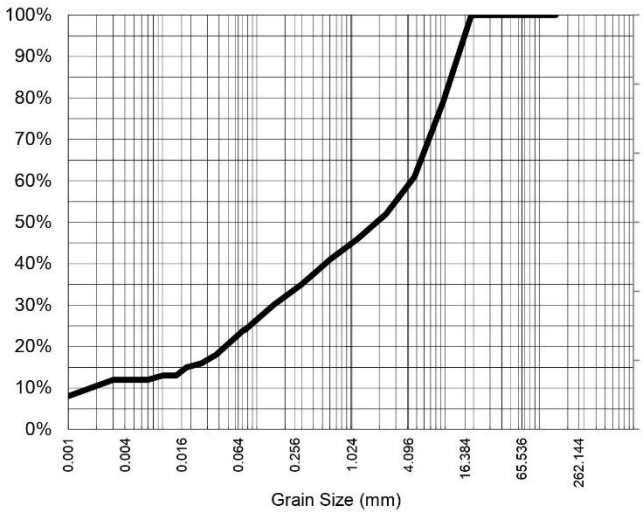
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Brisbane QLD

CLIENT:	LAB RESULTS	**DATE REPORTED:**	8-Mar-2022
COMPANY:	LIBERTY ONESTEEL	**DATE RECEIVED:**	22-Feb-2022
ADDRESS:	Locked Bag 5044 Whyalla South Australia	**REPORT NO:**	EB2205112-003 / PSD
PROJECT:	Magnetite Expansion Phase 2	**SAMPLE ID:**	ROAD - 1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	79%
4.75	61%
2.36	52%
1.18	46%
0.600	41%
0.425	38%
0.300	35%
0.150	30%
0.075	24%
Particle Size (microns)	
52	21%
37	18%
26	16%
18	15%
14	13%
10	13%
7	12%
5	12%
1	8%

Analysis Notes

Samples analysed as received.

** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results*

Median Particle Size (mm)*	1.967

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 4-Mar-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 3.43 (2.85)*

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Satish Trivedi
Soil Senior Chemist
Authorised Signatory

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Certificate of Analysis

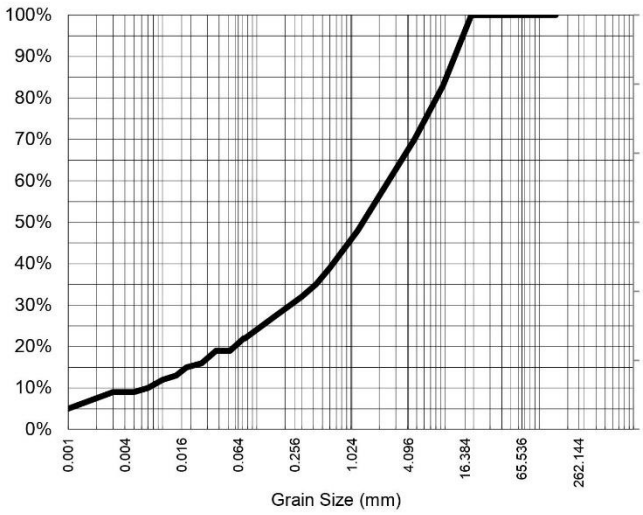
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ALS Environmental

Brisbane QLD

CLIENT:	LAB RESULTS	**DATE REPORTED:**	8-Mar-2022
COMPANY:	LIBERTY ONESTEEL	**DATE RECEIVED:**	22-Feb-2022
ADDRESS:	Locked Bag 5044 Whyalla South Australia	**REPORT NO:**	EB2205112-004 / PSD
PROJECT:	Magnetite Expansion Phase 2	**SAMPLE ID:**	ROAD - 2

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	83%
4.75	70%
2.36	59%
1.18	48%
0.600	39%
0.425	35%
0.300	32%
0.150	27%
0.075	22%
Particle Size (microns)	
52	19%
37	19%
26	16%
18	15%
14	13%
10	12%
7	10%
5	9%
1	5%

Analysis Notes

Samples analysed as received.

** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results*

Median Particle Size (mm)*	1.395

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 4-Mar-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 3.26 (2.85)*

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Soil Senior Chemist
Authorised Signatory

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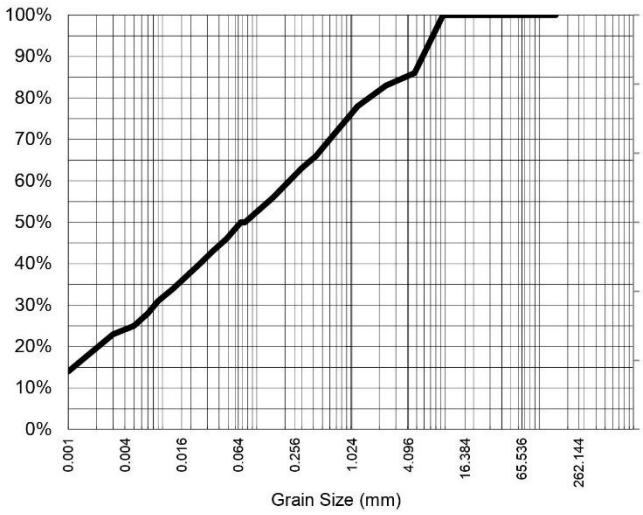
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CLIENT:	LAB RESULTS	**DATE REPORTED:**	8-Mar-2022
COMPANY:	LIBERTY ONESTEEL	**DATE RECEIVED:**	22-Feb-2022
ADDRESS:	Locked Bag 5044 Whyalla South Australia	**REPORT NO:**	EB2205112-005 / PSD
PROJECT:	Magnetite Expansion Phase 2	**SAMPLE ID:**	ROAD - 3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	86%
2.36	83%
1.18	78%
0.600	70%
0.425	66%
0.300	63%
0.150	56%
0.075	50%
Particle Size (microns)	
48	46%
34	43%
25	40%
18	37%
13	34%
9	31%
7	28%
5	25%
1	14%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.075

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 4-Mar-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.8

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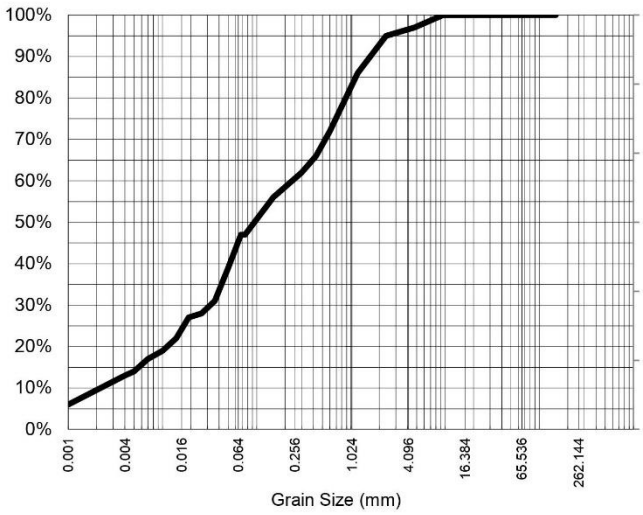
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CLIENT:	LAB RESULTS	**DATE REPORTED:**	8-Mar-2022
COMPANY:	LIBERTY ONESTEEL	**DATE RECEIVED:**	22-Feb-2022
ADDRESS:	Locked Bag 5044 Whyalla South Australia	**REPORT NO:**	EB2205112-006 / PSD
PROJECT:	Magnetite Expansion Phase 2	**SAMPLE ID:**	ROAD - 4

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	97%
2.36	95%
1.18	86%
0.600	72%
0.425	66%
0.300	62%
0.150	56%
0.075	47%
Particle Size (microns)	
50	39%
36	31%
26	28%
19	27%
14	22%
10	19%
7	17%
5	14%
1	6%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.100

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 4-Mar-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.8

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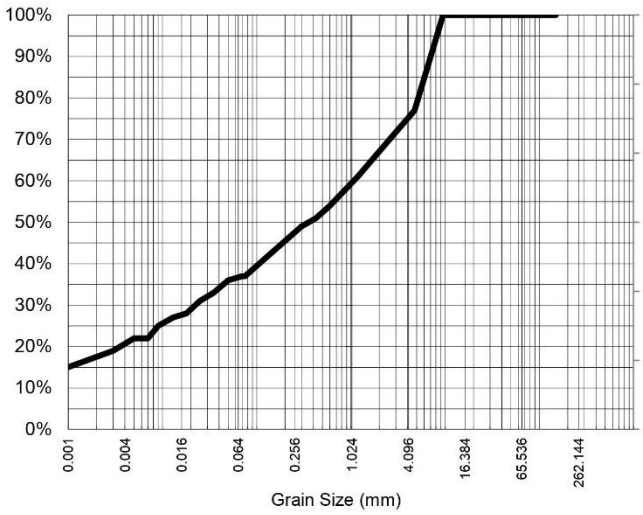
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CLIENT:	LAB RESULTS	**DATE REPORTED:**	8-Mar-2022
COMPANY:	LIBERTY ONESTEEL	**DATE RECEIVED:**	22-Feb-2022
ADDRESS:	Locked Bag 5044 Whyalla South Australia	**REPORT NO:**	EB2205112-007 / PSD
PROJECT:	Magnetite Expansion Phase 2	**SAMPLE ID:**	ROAD - 5

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	77%
2.36	69%
1.18	61%
0.600	54%
0.425	51%
0.300	49%
0.150	43%
0.075	37%
Particle Size (microns)	
50	36%
35	33%
25	31%
18	28%
13	27%
9	25%
7	22%
5	22%
1	15%

Analysis Notes

Samples analysed as received.

** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results*

Median Particle Size (mm)*	0.363

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 4-Mar-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description:

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 3.55 (2.85)*

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APPENDIX 4

CONTOUR PLOTS

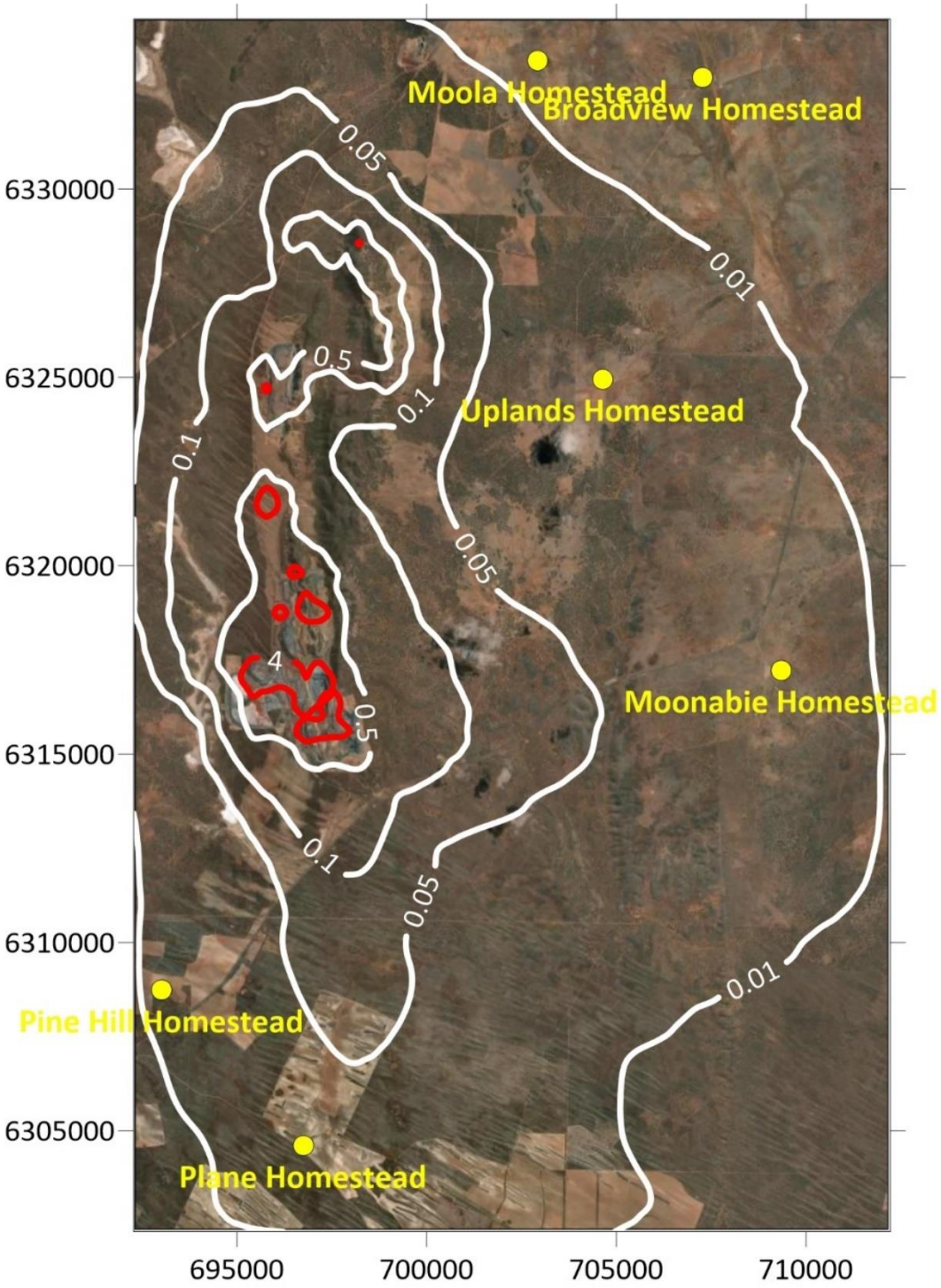


Figure 15: Deposition (g/m^2/month) Contour Plot of Current Operations at SMR in Isolation (Guideline: 2 g/m^2/month)

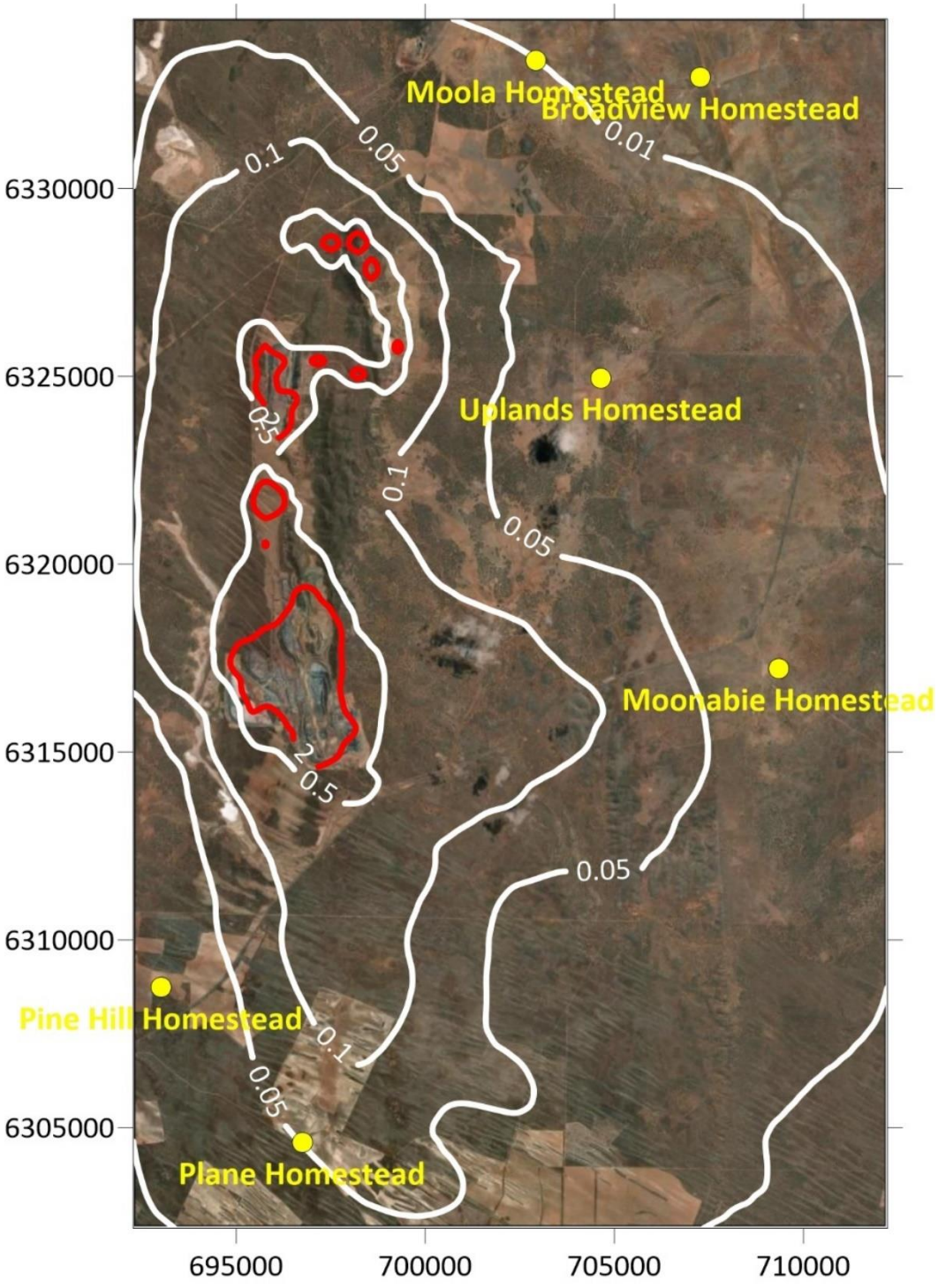


Figure 16: Deposition (g/m²/month) Contour Plot of the MEP1 in Isolation – Mitigated (Guideline: 2 g/m²/month)

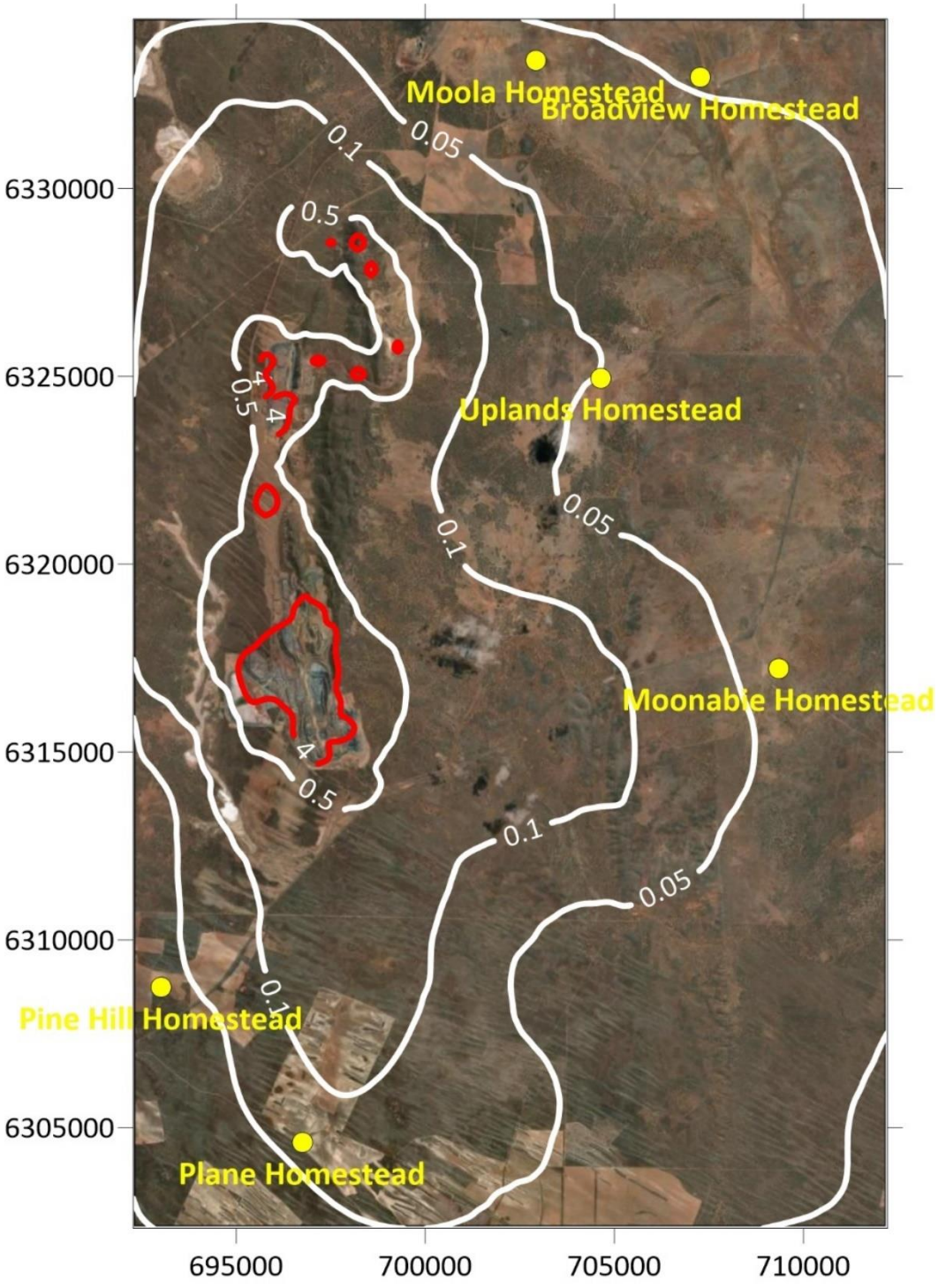


Figure 17: Deposition (g/m²/month) Contour Plot of the MEP1 in Isolation – Unmitigated (Guideline: 2 g/m²/month)

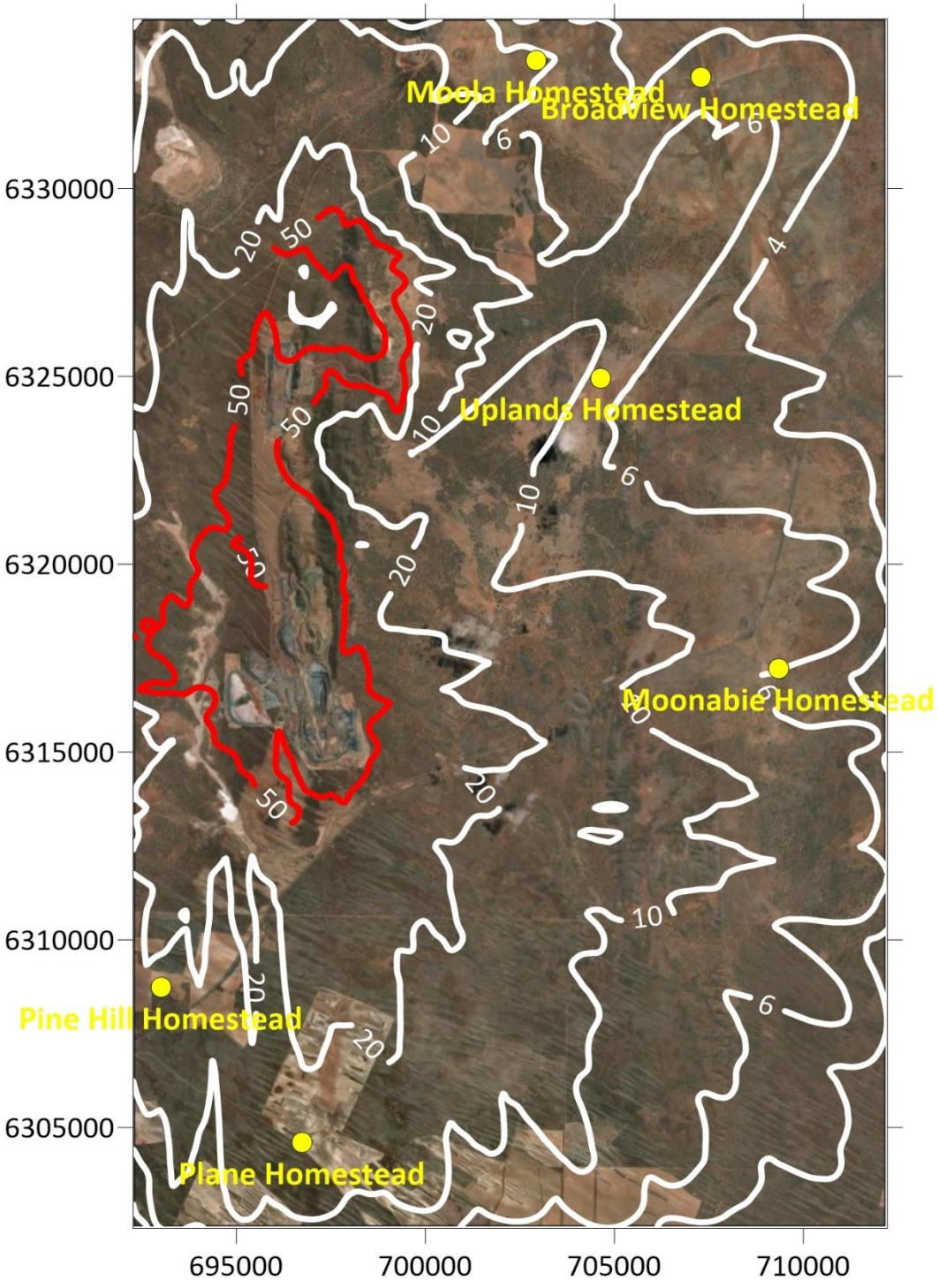


Figure 18: 24hr Max Average PM_{10} GLC (µg/m³) Contour Plot of Current Operations at SMR in Isolation (Guideline: 50 µg/m³)

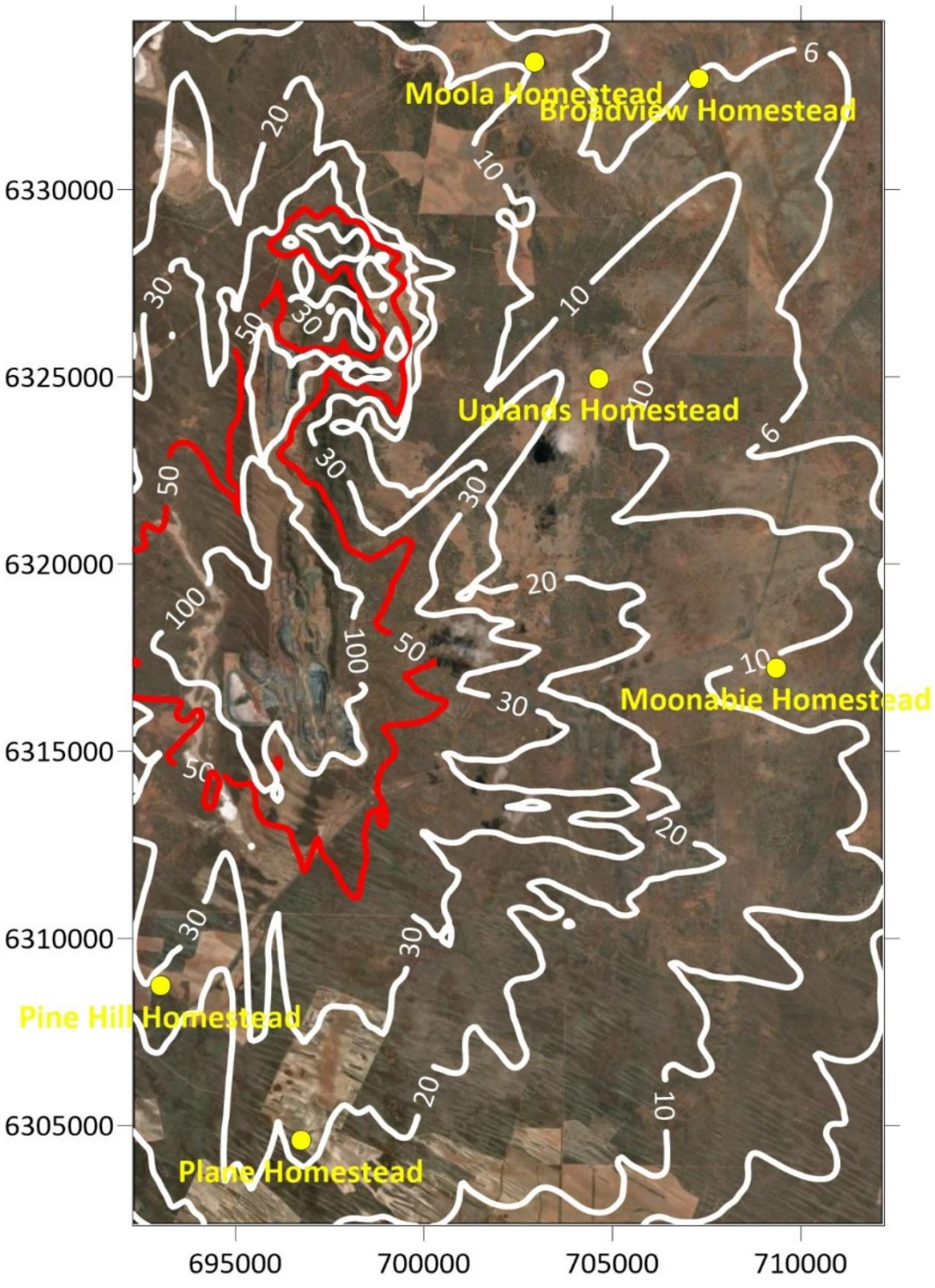


Figure 19: 24hr Max Average PM_{10} GLC (µg/m³) Contour Plot of MEP1 in Isolation – Mitigated (Guideline: 50 µg/m³)

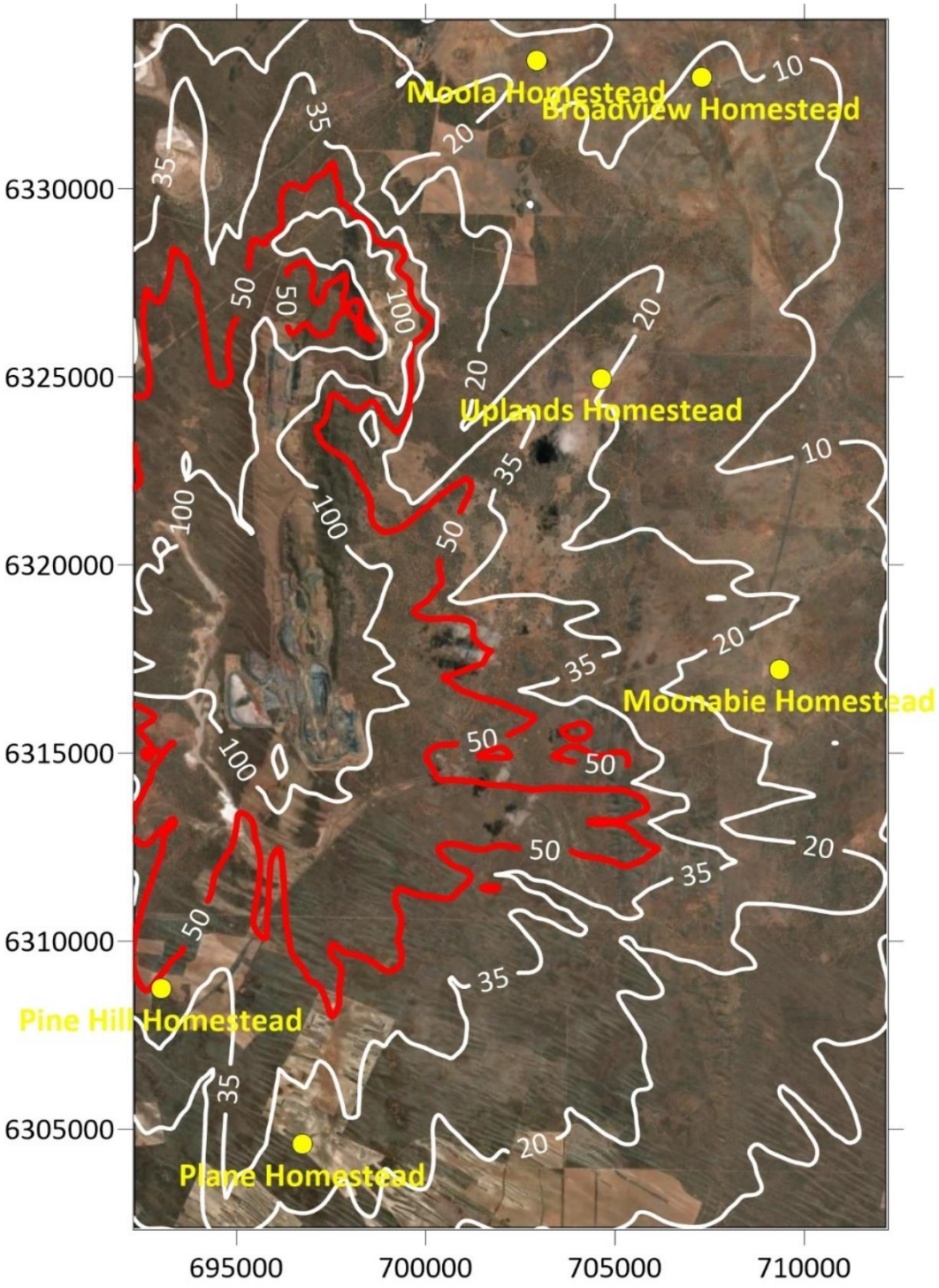


Figure 20: 24hr Max Average PM_{10} GLC (µg/m³) Contour Plot of MEP1 in Isolation – Unmitigated (Guideline: 50 µg/m³)

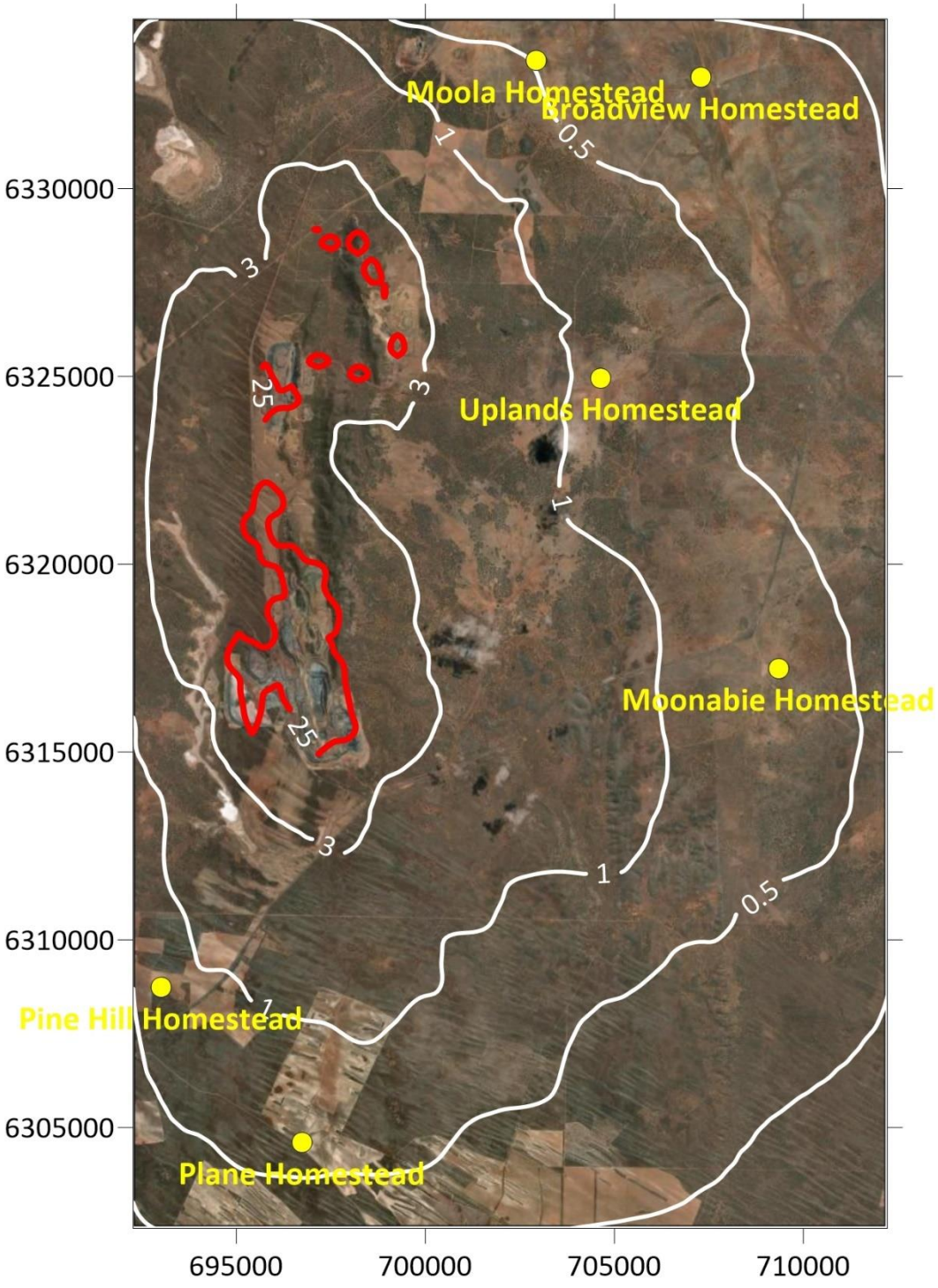


Figure 21: Annual Average PM_{10} GLC (µg/m³) Contour Plot of Current Operations at SMR in Isolation (Guideline: 25 µg/m³)

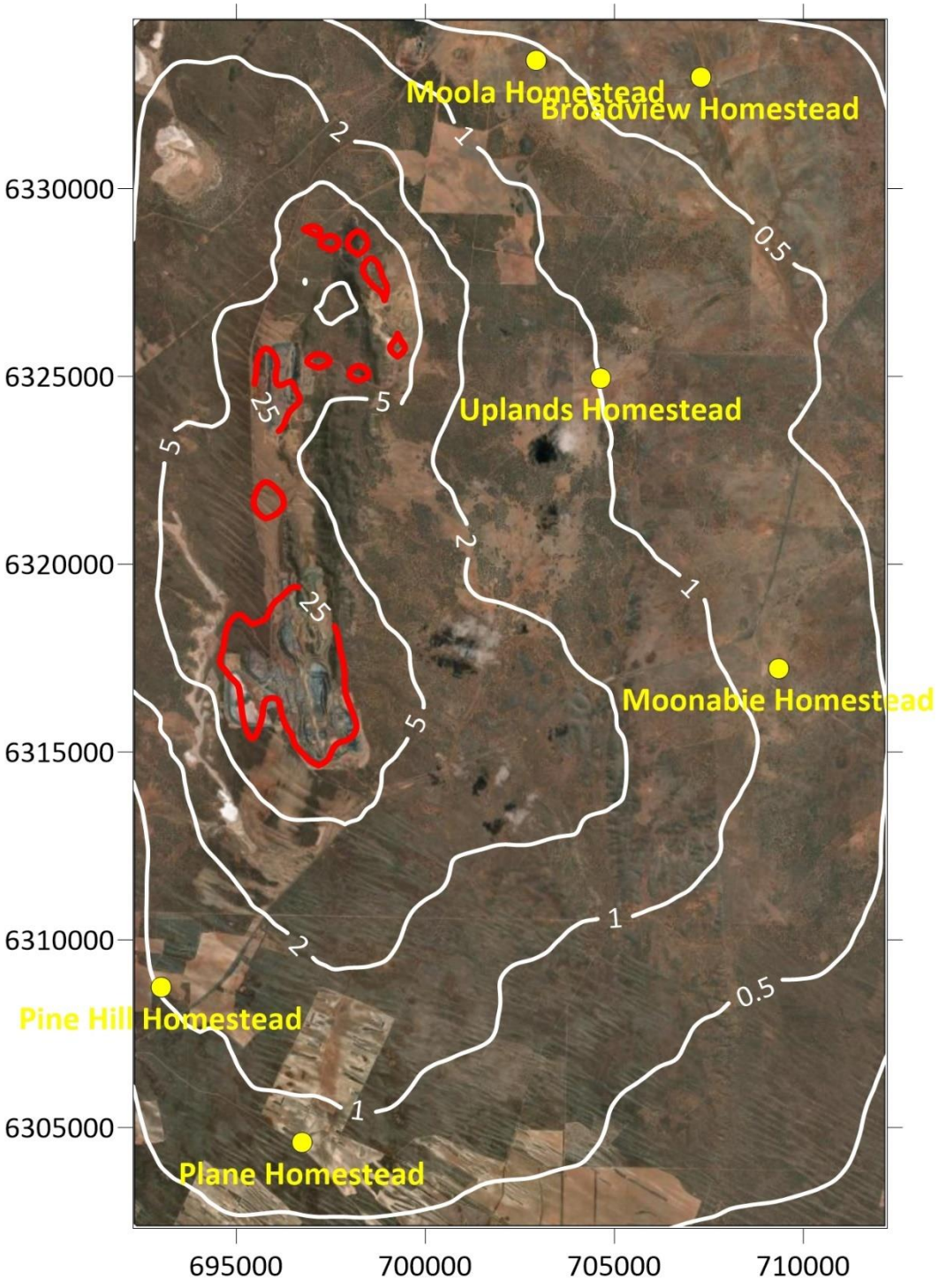


Figure 22: Annual Average PM_{10} GLC (µg/m³) Contour Plot of MEP1 in Isolation – Mitigated (Guideline: 25 µg/m³)

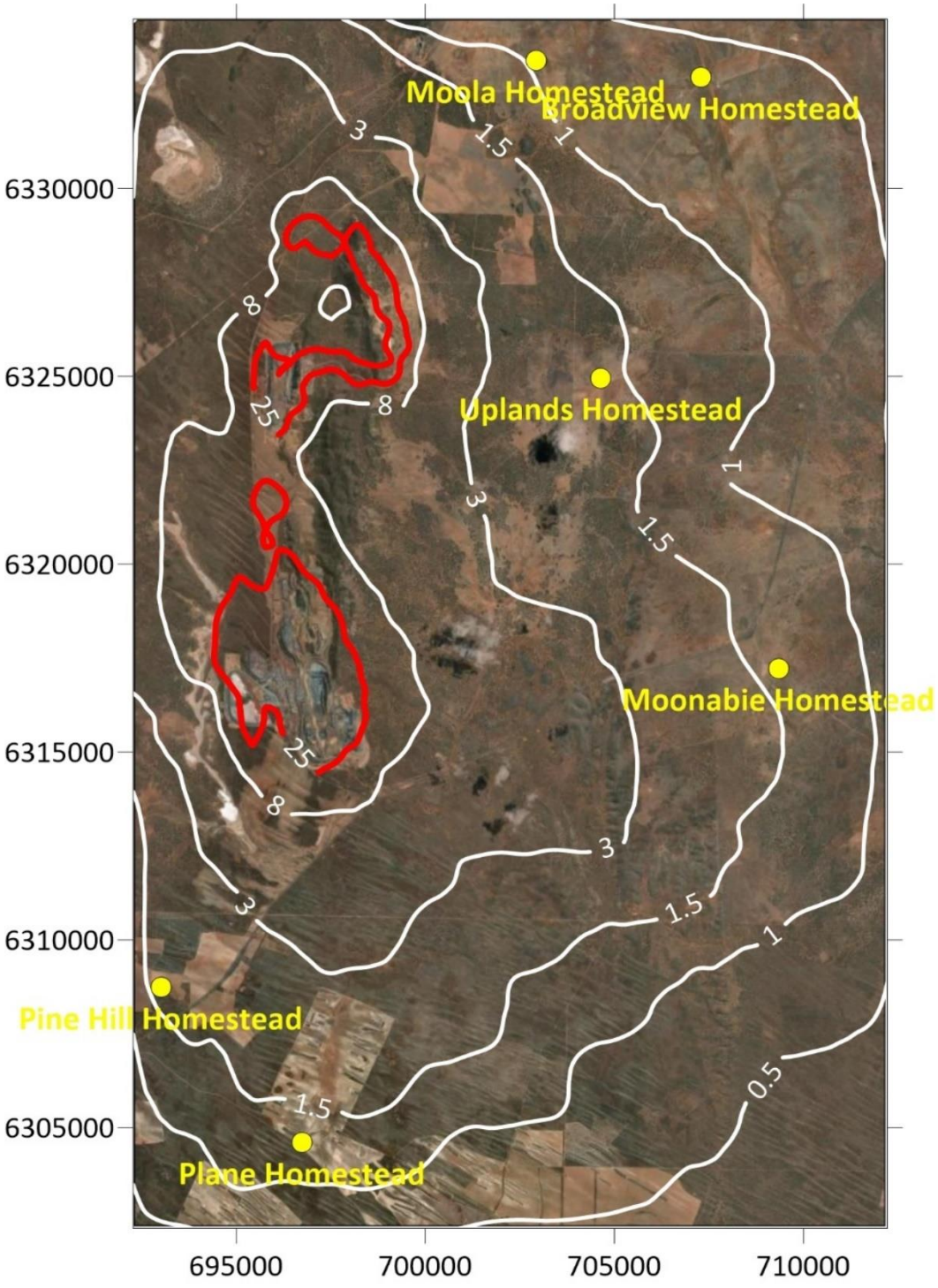


Figure 23: Annual Average PM_{10} GLC (µg/m³) Contour Plot of MEP1 in Isolation – Unmitigated (Guideline: 25 µg/m³)

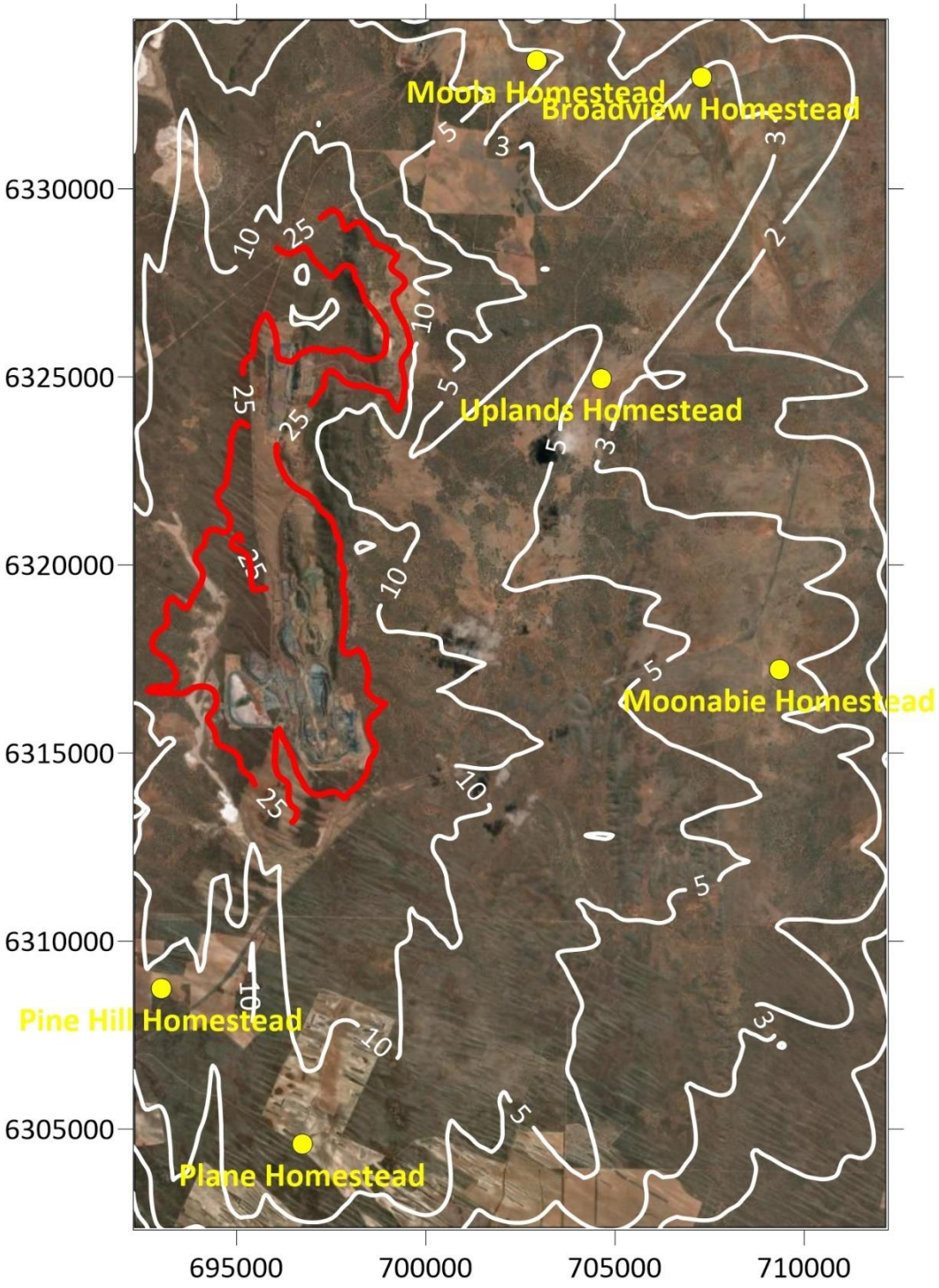


Figure 24: Max 24hr $PM_{2.5}$ GLC (µg/m³) Contour Plot of Current operations at SMR in Isolation (Guideline: 25 µg/m³)

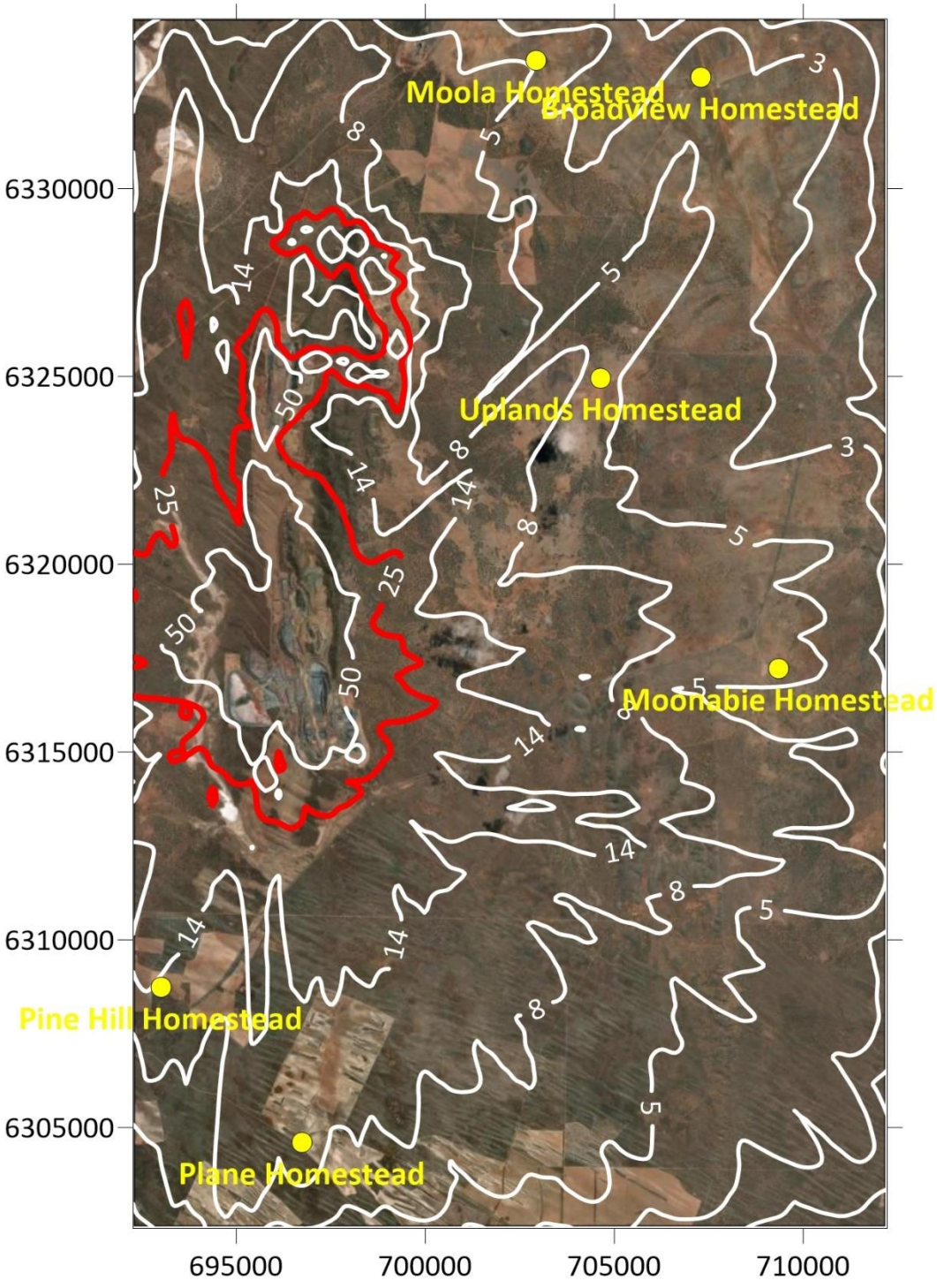


Figure 25: Max 24hr $PM_{2.5}$ GLC (µg/m³) Contour Plot of MEP1 in Isolation – Mitigated (Guideline: 25 µg/m³)

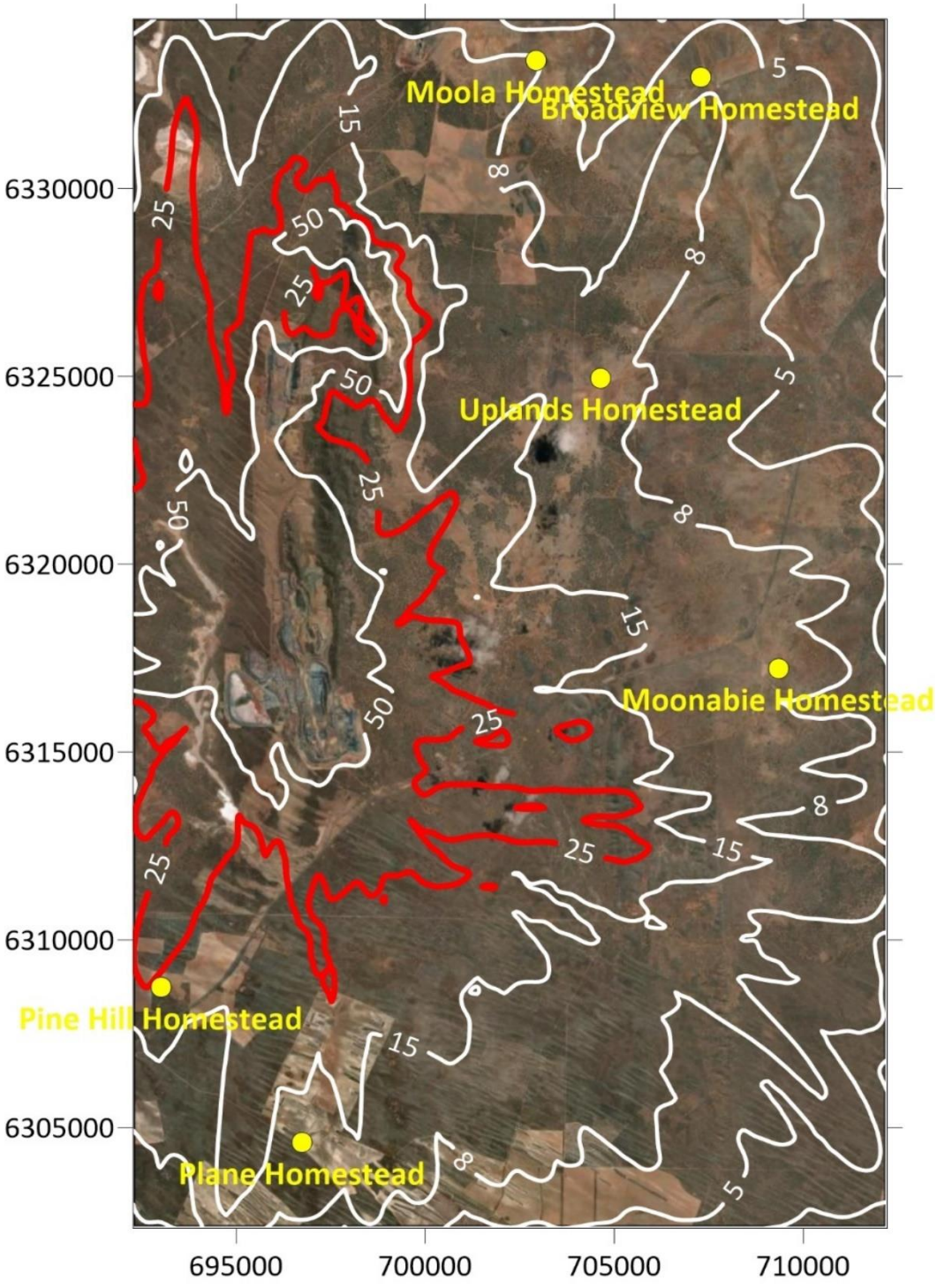


Figure 26: Max 24hr $PM_{2.5}$ GLC (µg/m³) Contour Plot of MEP1 in Isolation – Unmitigated (Guideline: 25 µg/m³)

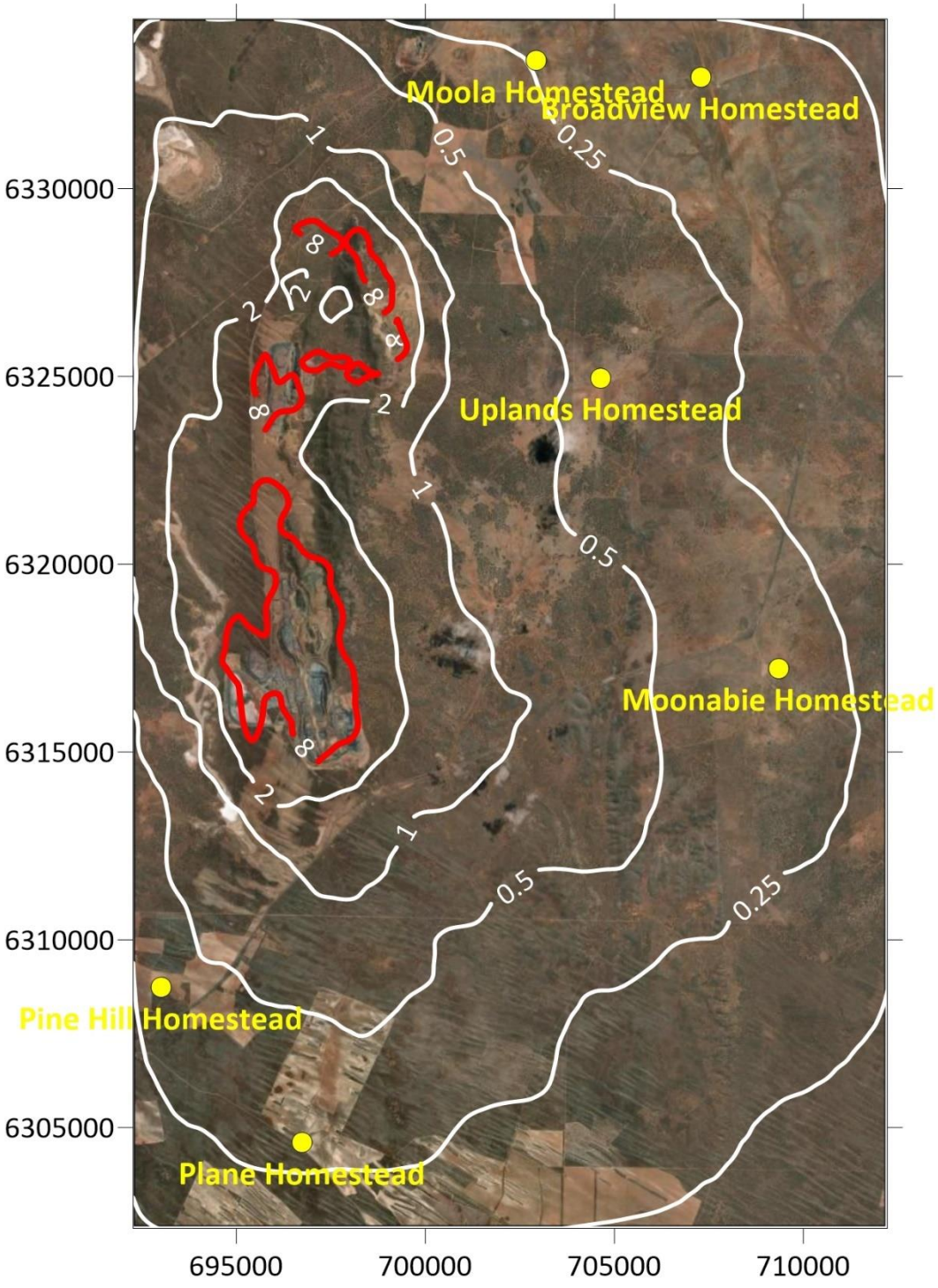


Figure 27: Annual Average $PM_{2.5}$ GLC (µg/m³) Contour Plot of Current Operations at SMR in Isolation (Guideline: 8 µg/m³)

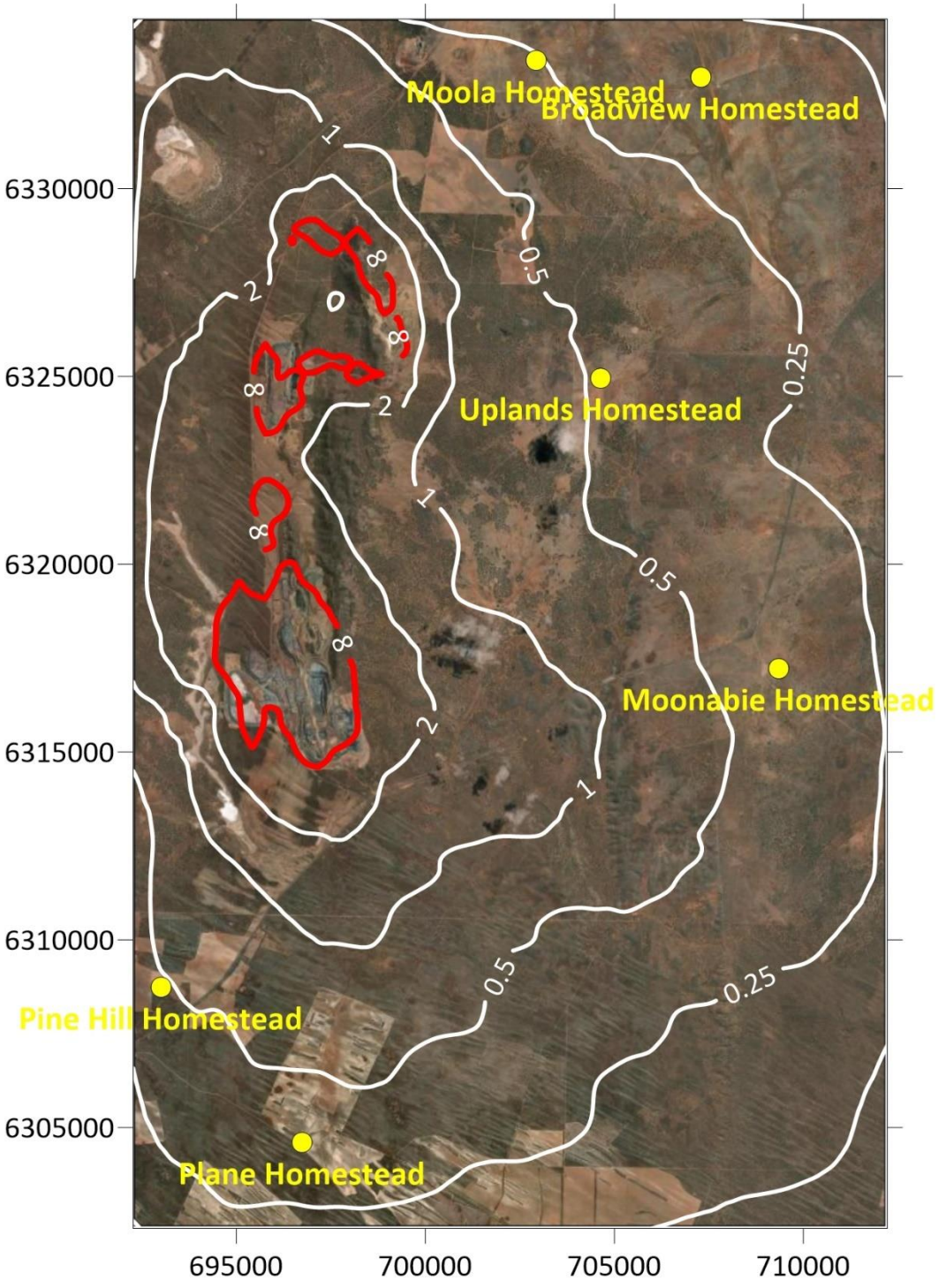


Figure 28: Annual Average $PM_{2.5}$ GLC (µg/m³) Contour Plot of MEP1 in Isolation – Mitigated (Guideline: 8 µg/m³)

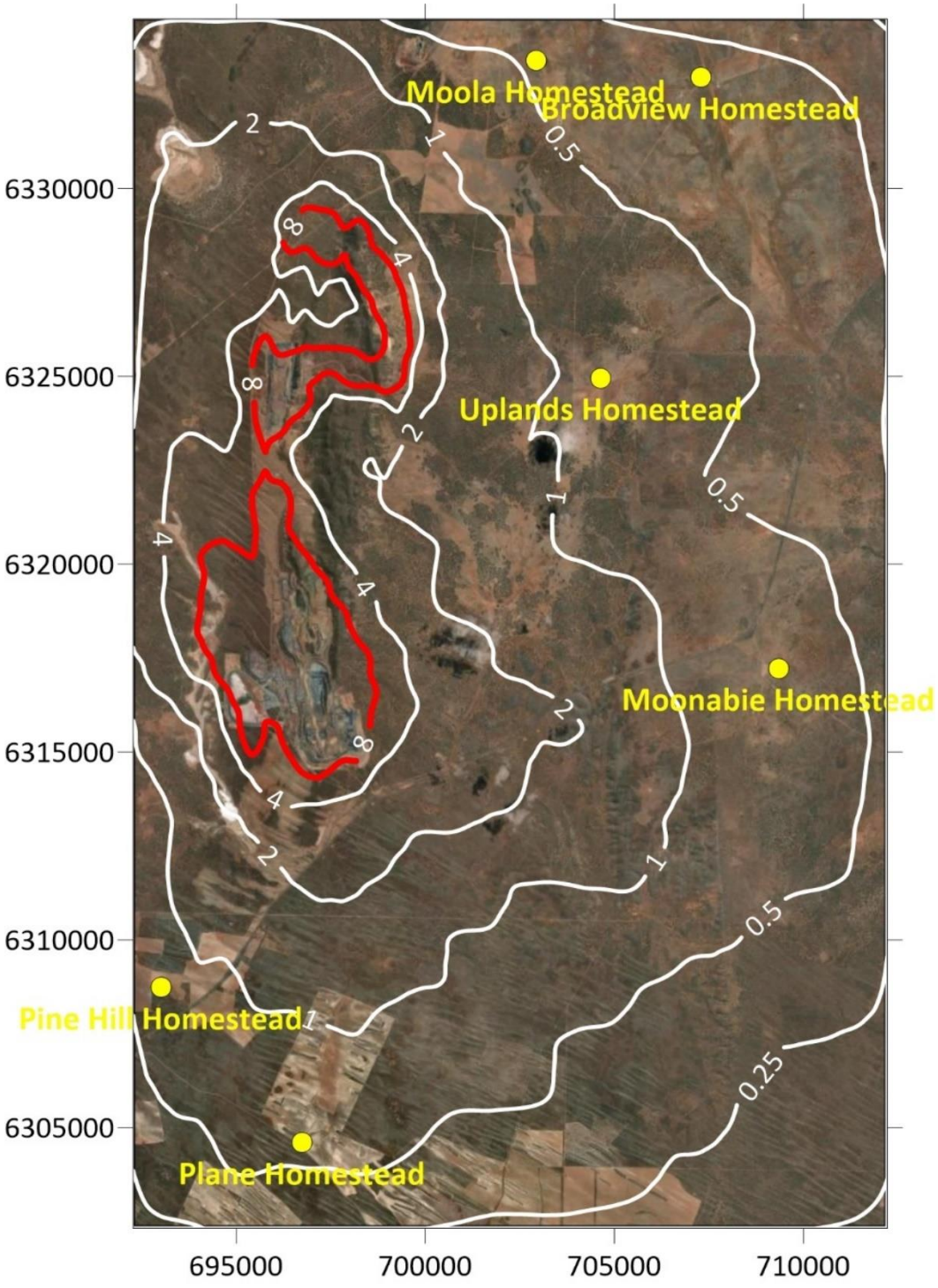


Figure 29: Annual Average $PM_{2.5}$ GLC (µg/m³) Contour Plot of MEP1 in Isolation – Unmitigated (Guideline: 8 µg/m³)

APPENDIX 5

CONTOUR PLOTS – Cumulative

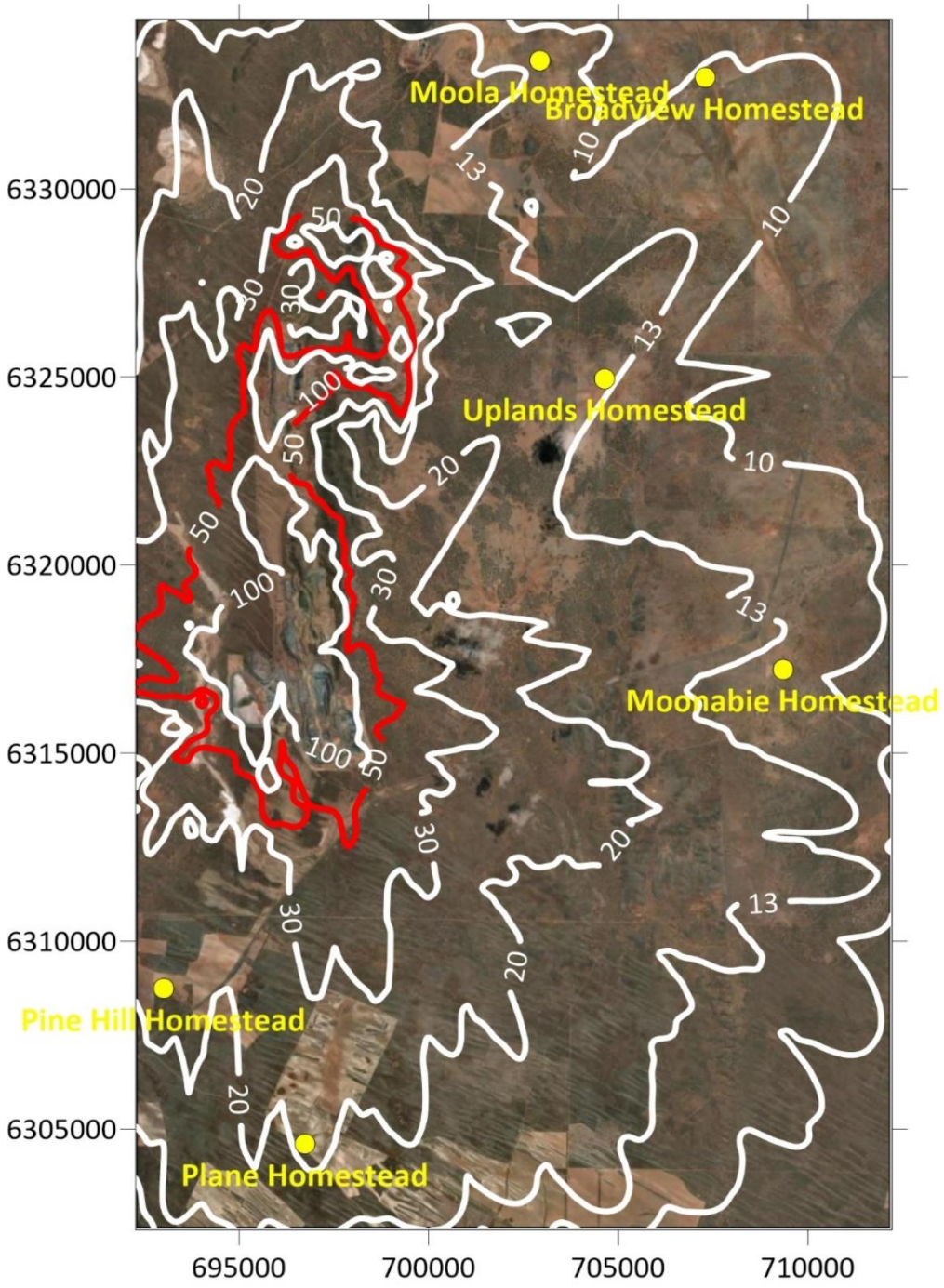


Figure 30: Cumulative 24hr Max Average PM_{10} GLC (µg/m^3) Contour Plot of Current Operations at SMR (Guideline: 50 µg/m^3)

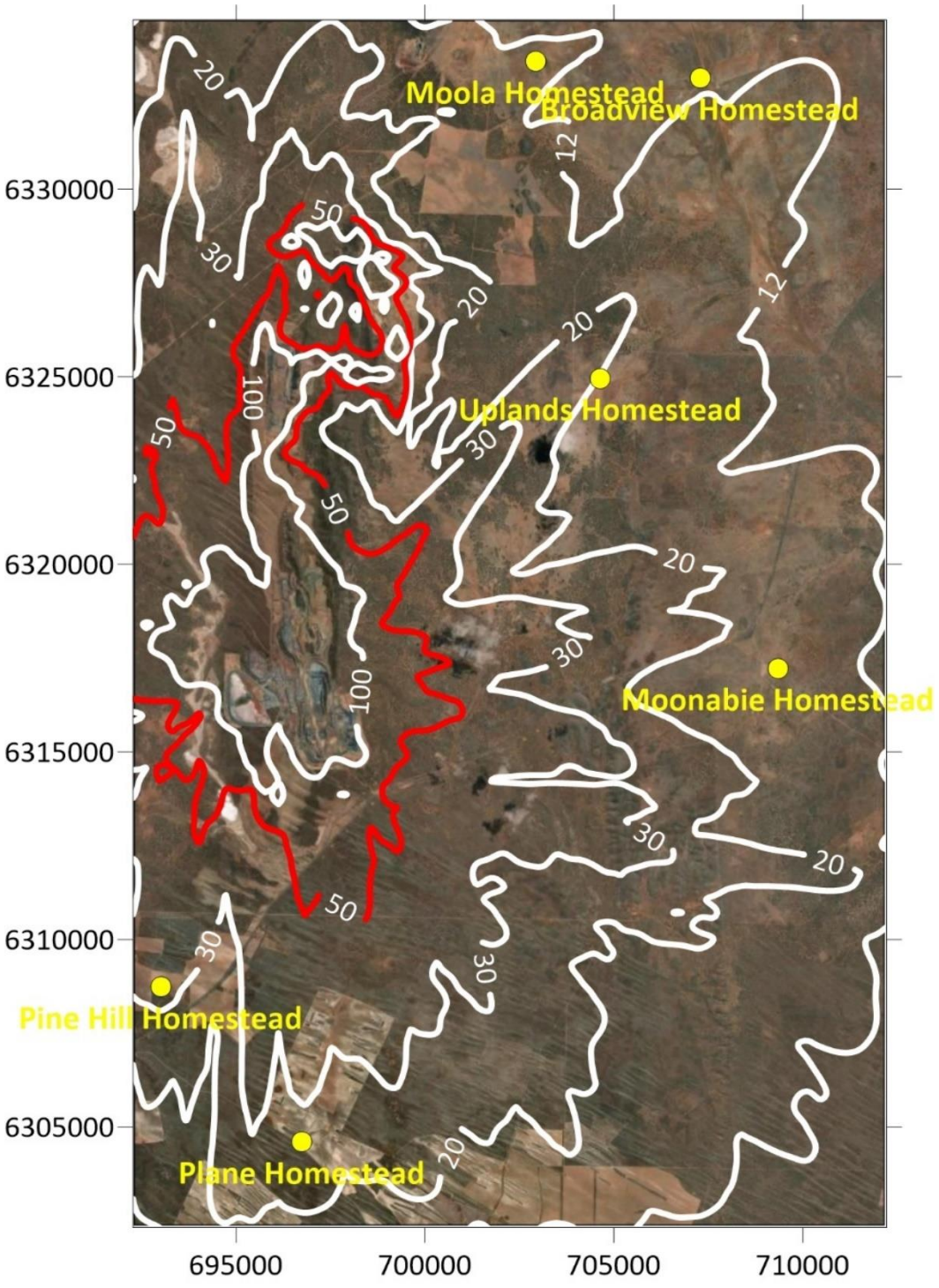


Figure 31: Cumulative 24hr Max Average PM_{10} GLC (µg/m^3) Contour Plot of MEP1 – Mitigated (Guideline: 50 µg/m^3)

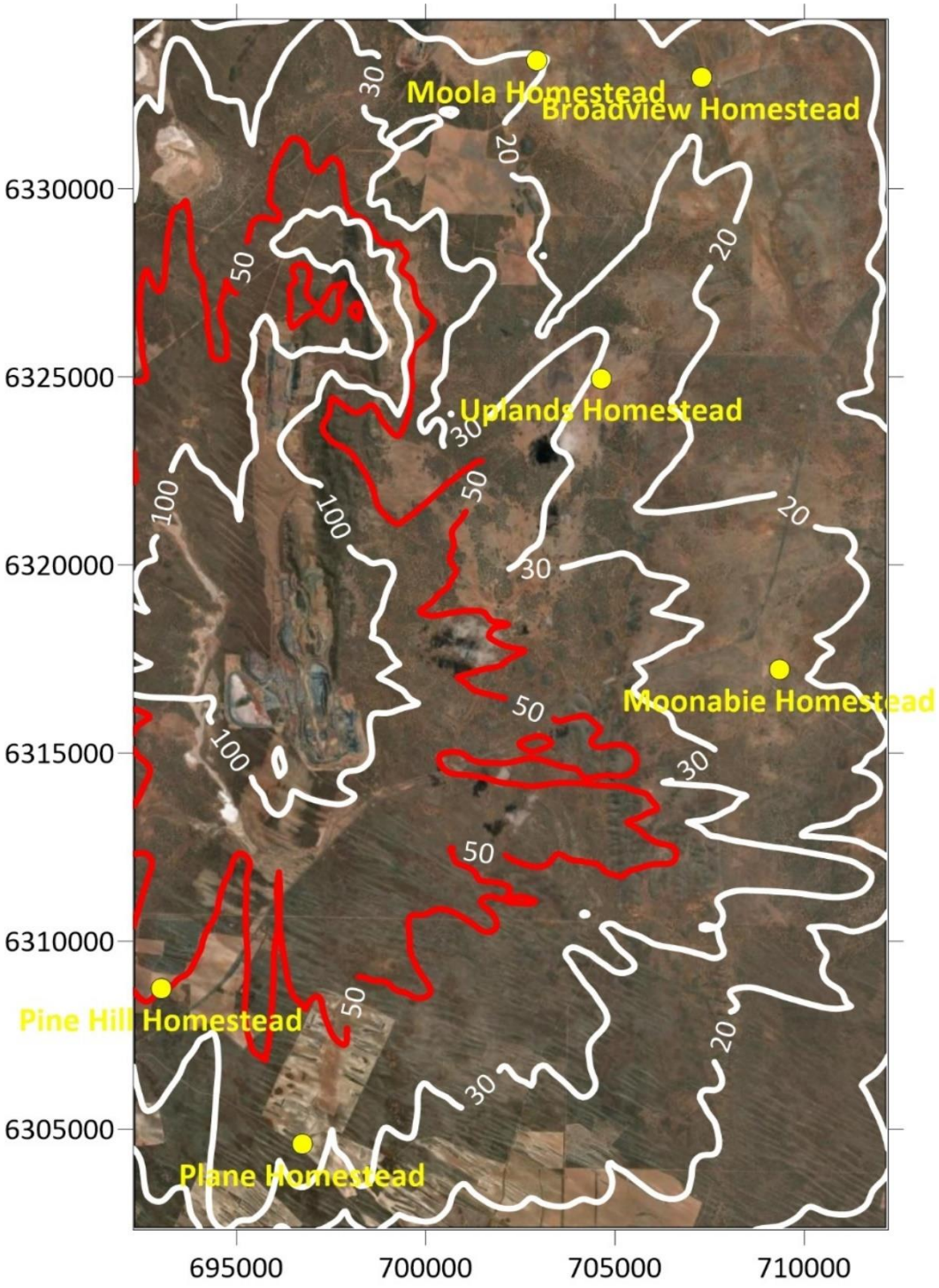


Figure 32: Cumulative 24hr Max Average PM_{10} GLC (µg/m³) Contour Plot of MEP1 - Unmitigated (Guideline: 50 µg/m³)

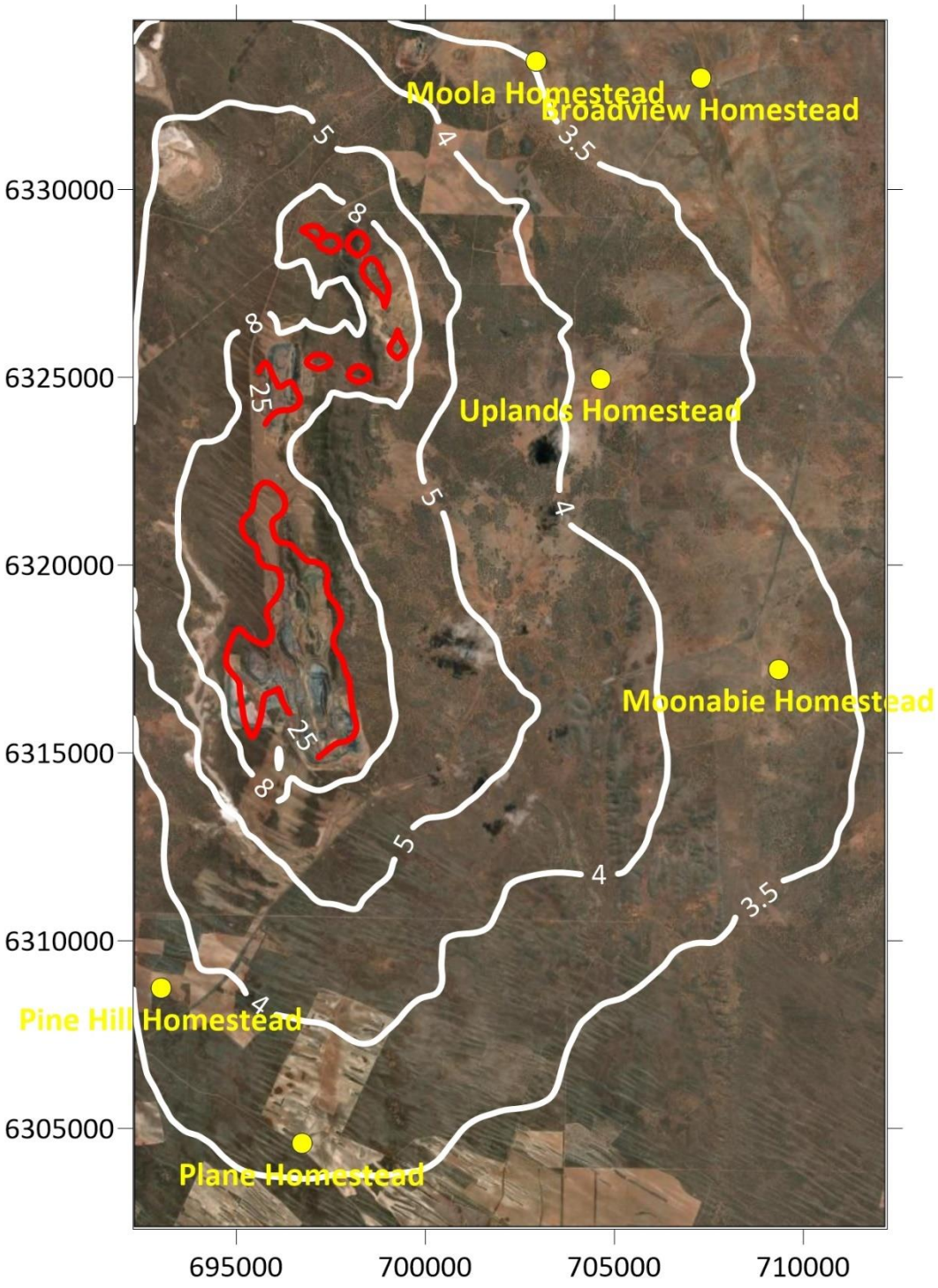


Figure 33: Cumulative Annual Average PM_{10} GLC (µg/m^3) Contour Plot of Current Operations at SMR (Guideline: 25 µg/m^3)

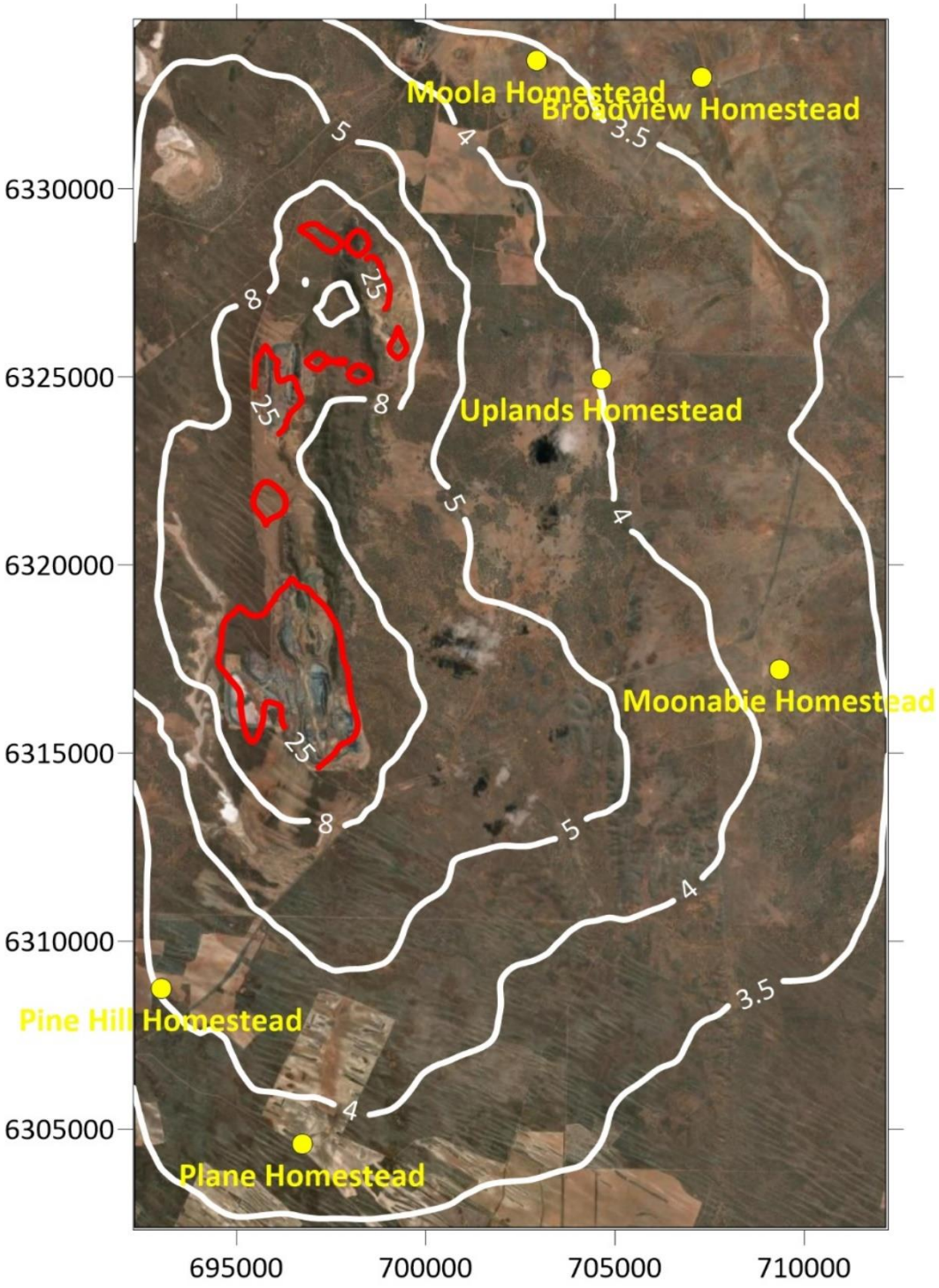


Figure 34: Cumulative Annual Average PM_{10} GLC (µg/m³) Contour Plot of MEP1 – Mitigated (Guideline: 25 µg/m³)

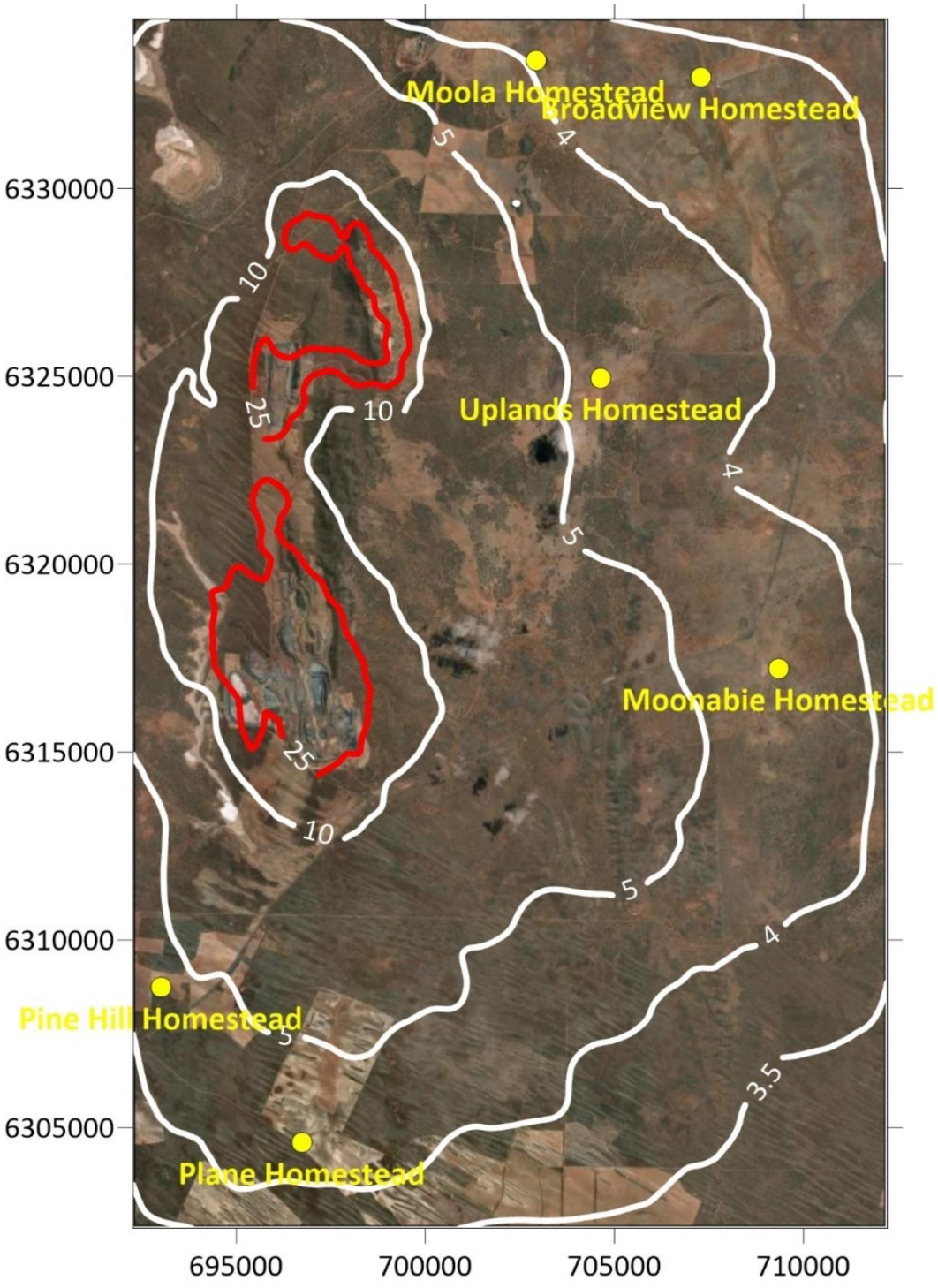


Figure 35: Cumulative Annual Average PM_{10} GLC (µg/m³) Contour Plot of MEP1 – Unmitigated (Guideline: 25 µg/m³)

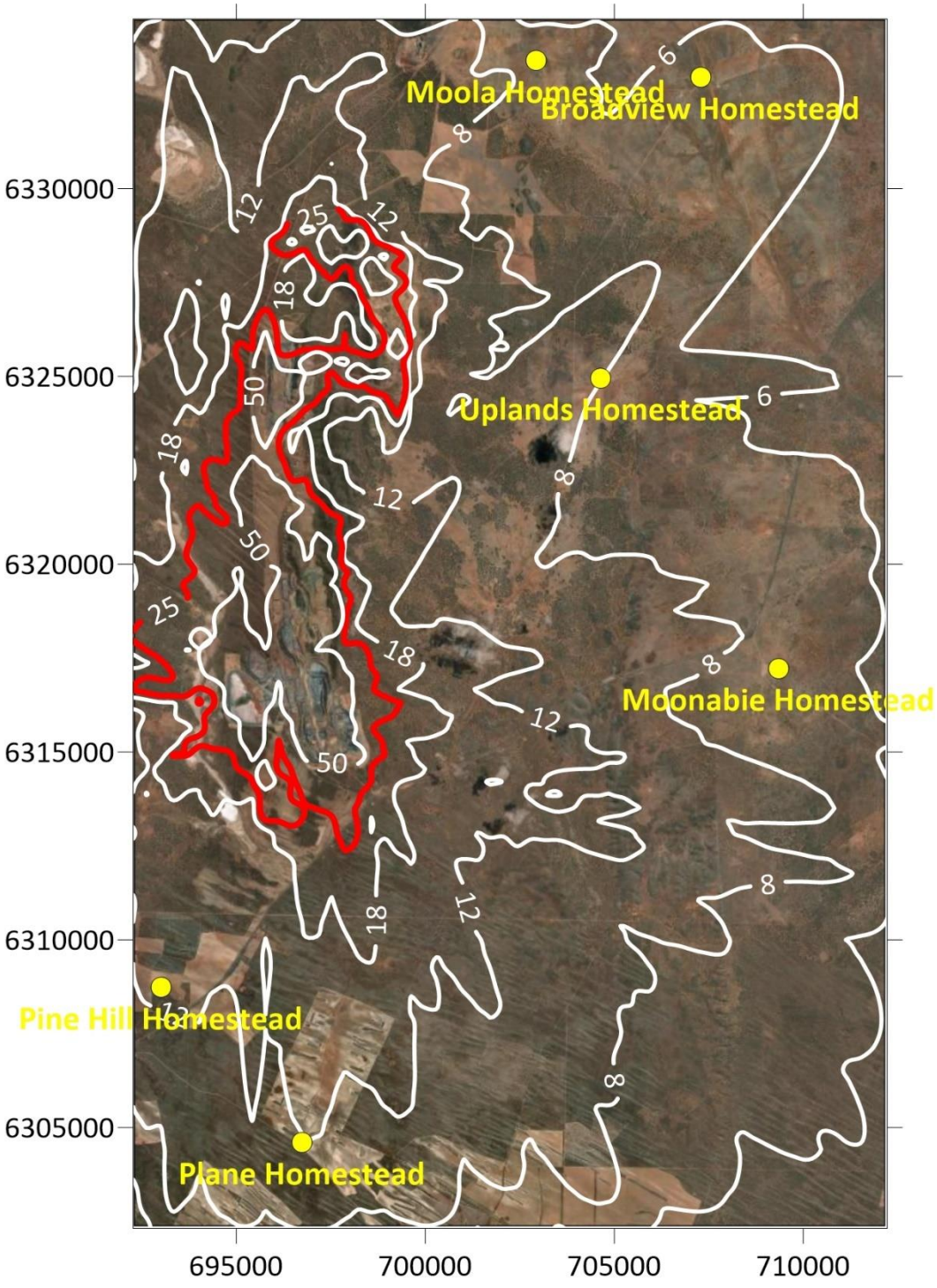


Figure 36: Cumulative Max 24hr $PM_{2.5}$ GLC (µg/m³) Contour Plot of Current Operations at SMR (Guideline: 25 µg/m³)

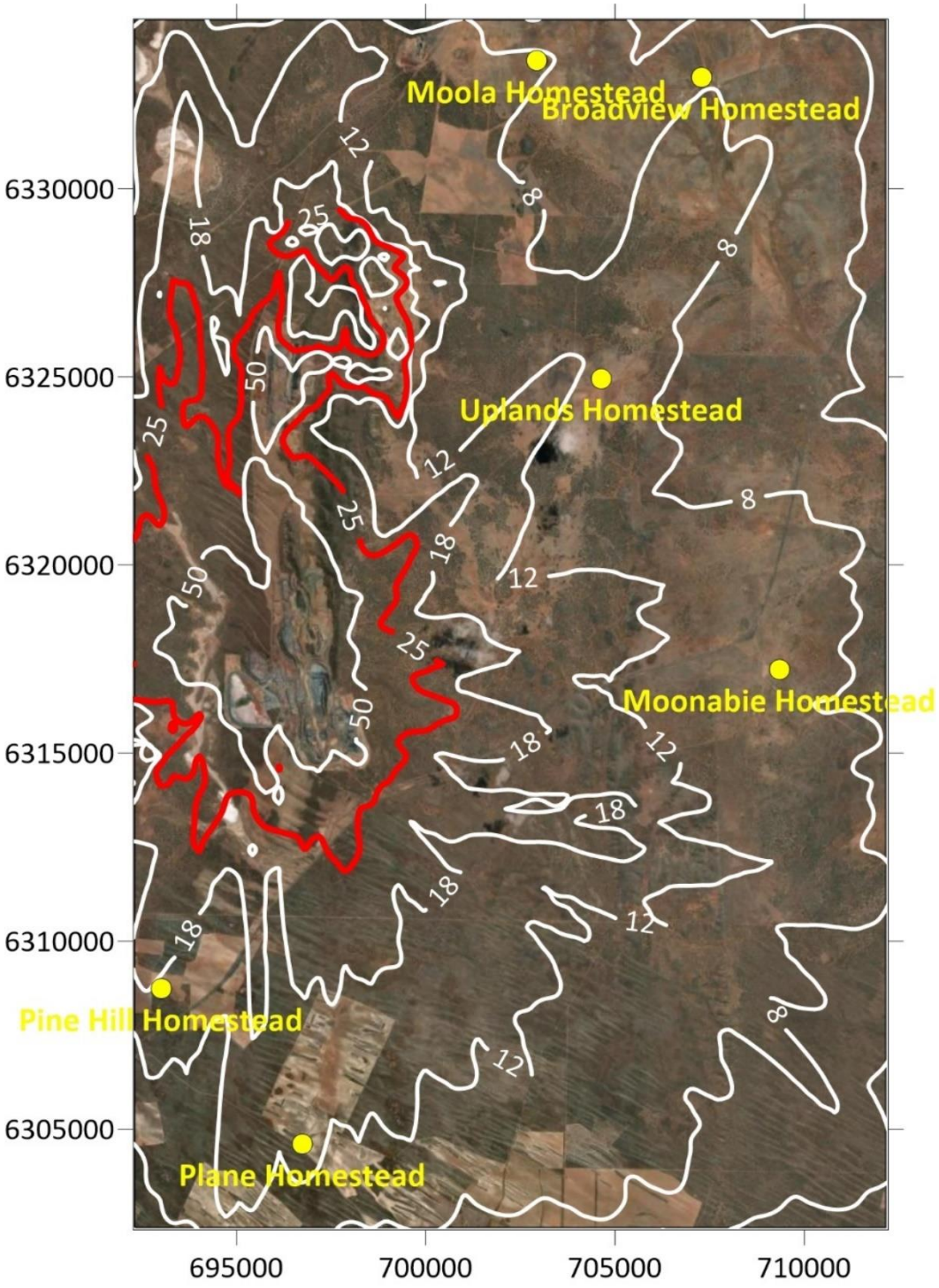


Figure 37: Cumulative Max 24hr $PM_{2.5}$ GLC (µg/m³) Contour Plot of MEP1 – Mitigated (Guideline: 25 µg/m³)

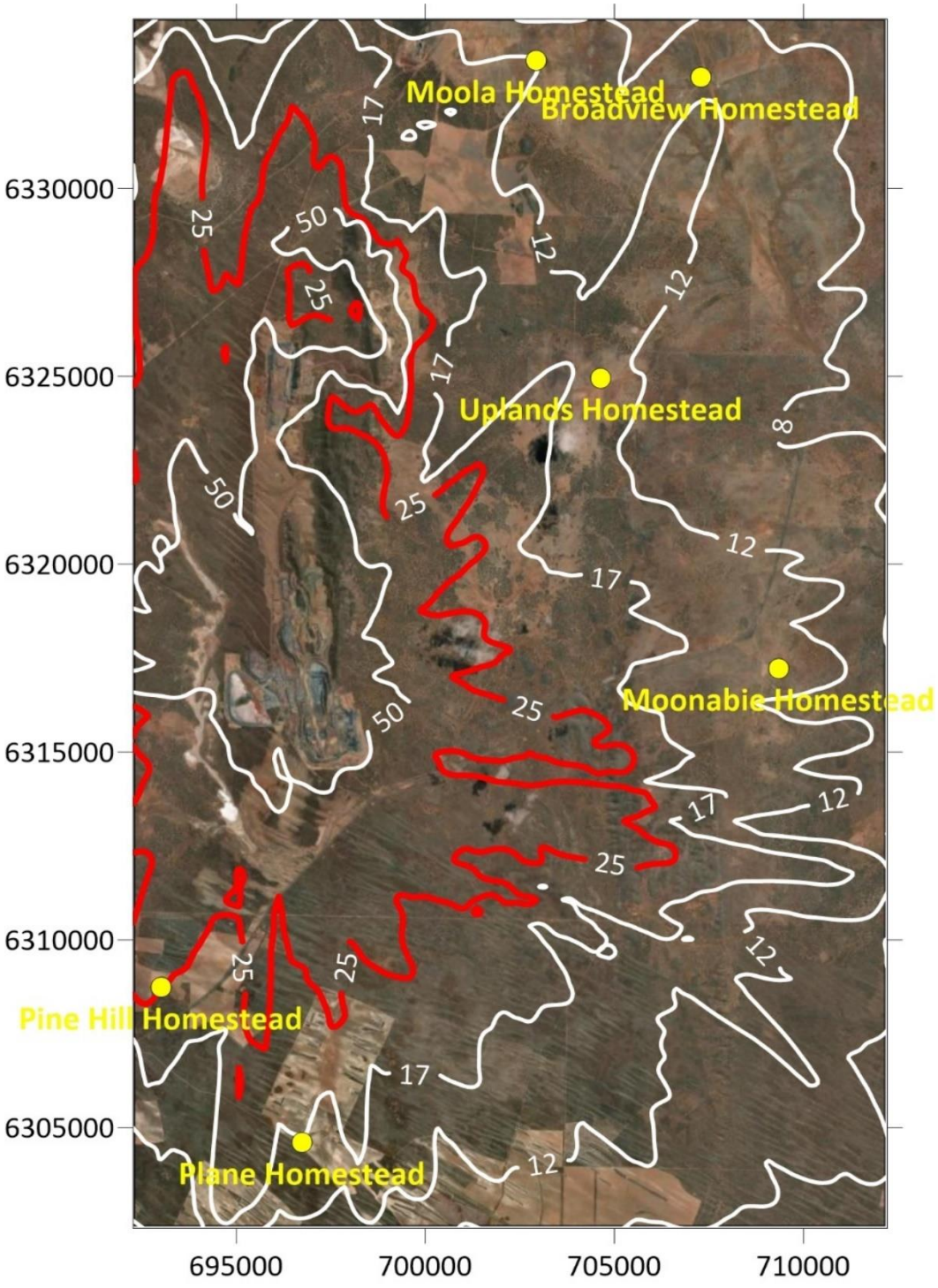


Figure 38: Cumulative Max 24hr $PM_{2.5}$ GLC (µg/m³) Contour Plot of MEP1 – Unmitigated (Guideline: 25 µg/m³)

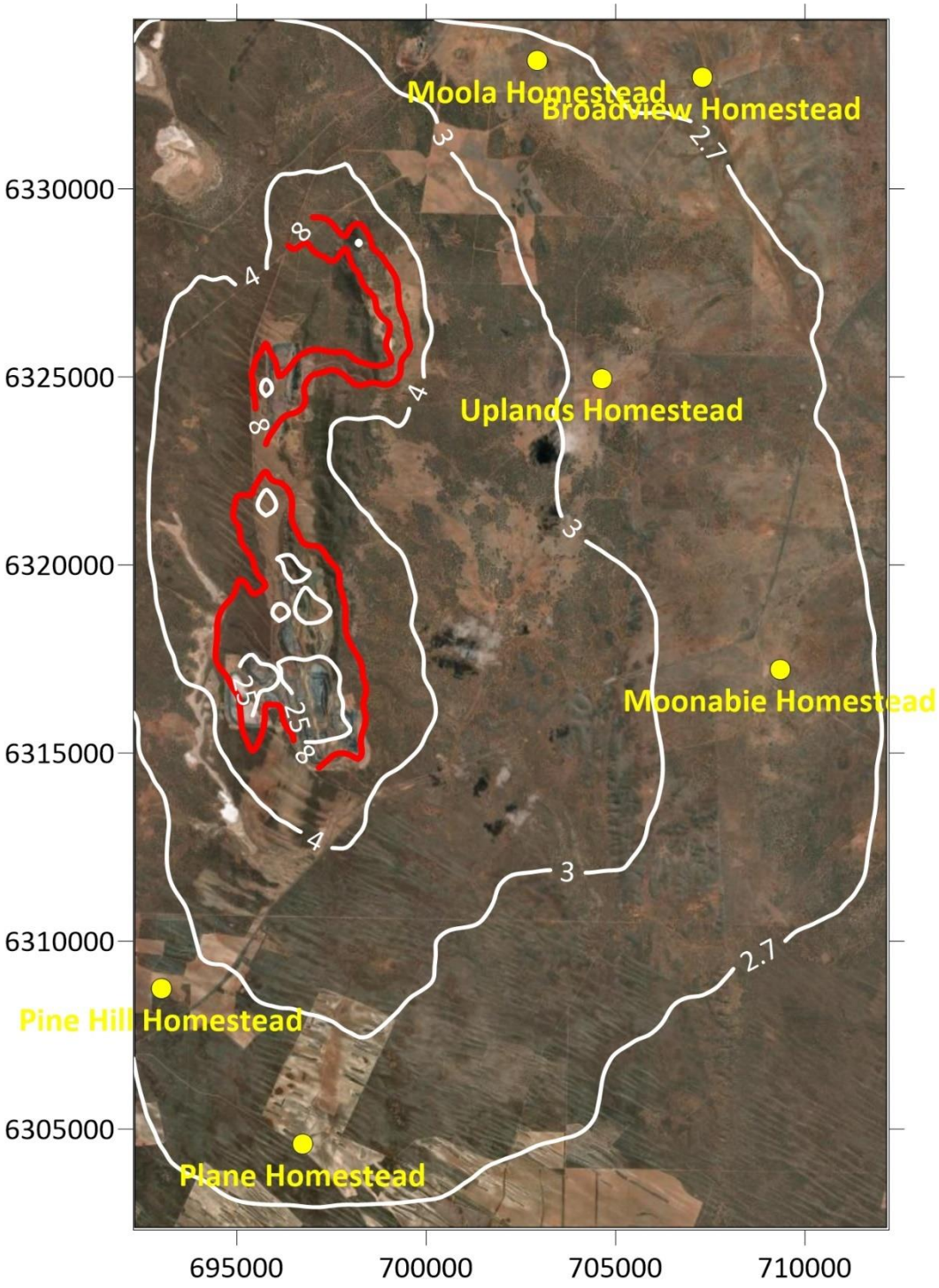


Figure 39: Cumulative Annual Average $PM_{2.5}$ GLC (µg/m³) Contour Plot of SMR (Guideline: 8 µg/m³)

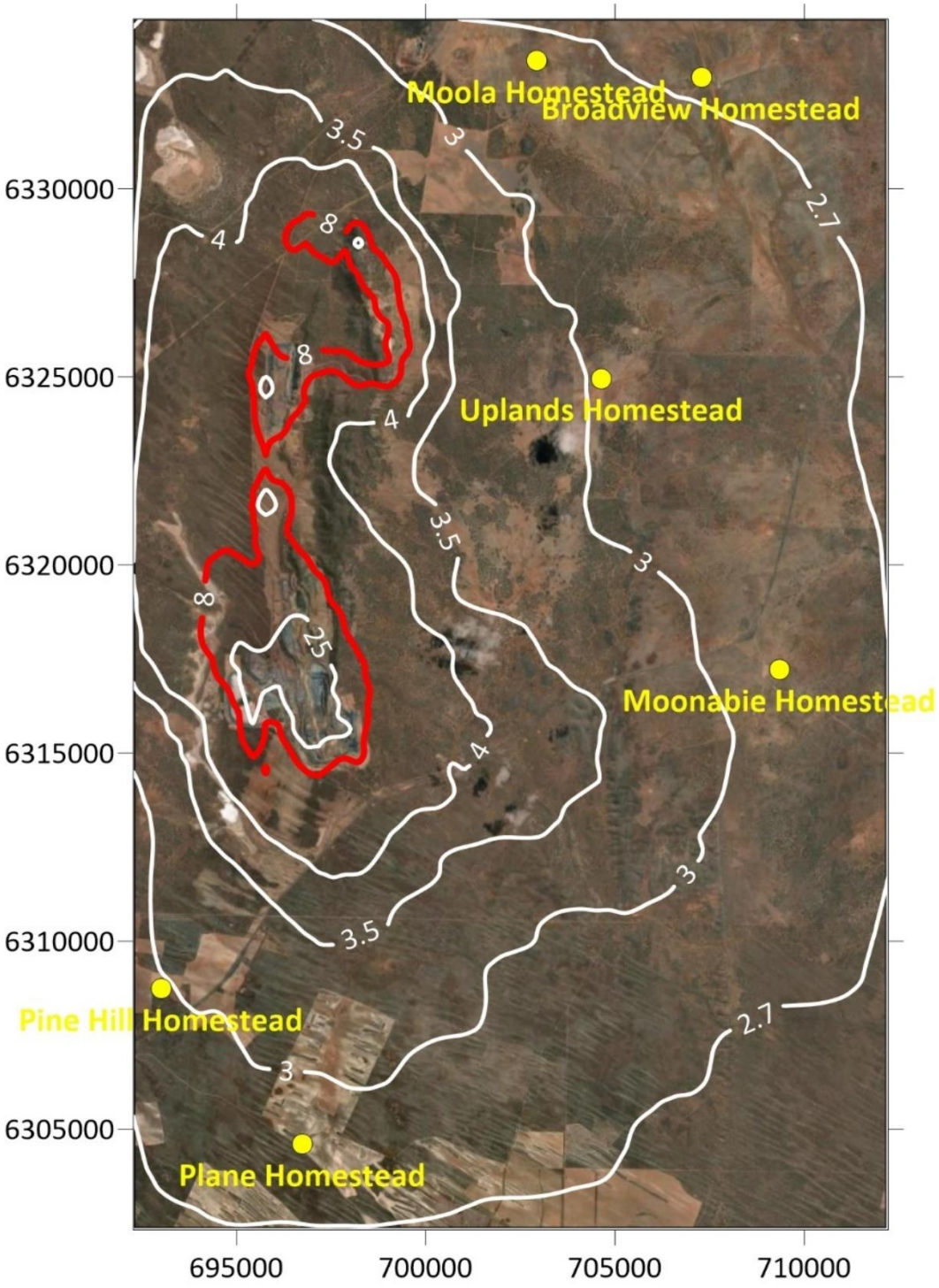


Figure 40: Cumulative Annual Average $PM_{2.5}$ GLC (µg/m³) Contour Plot of MEP1 – Mitigated (Guideline: 8 µg/m³)

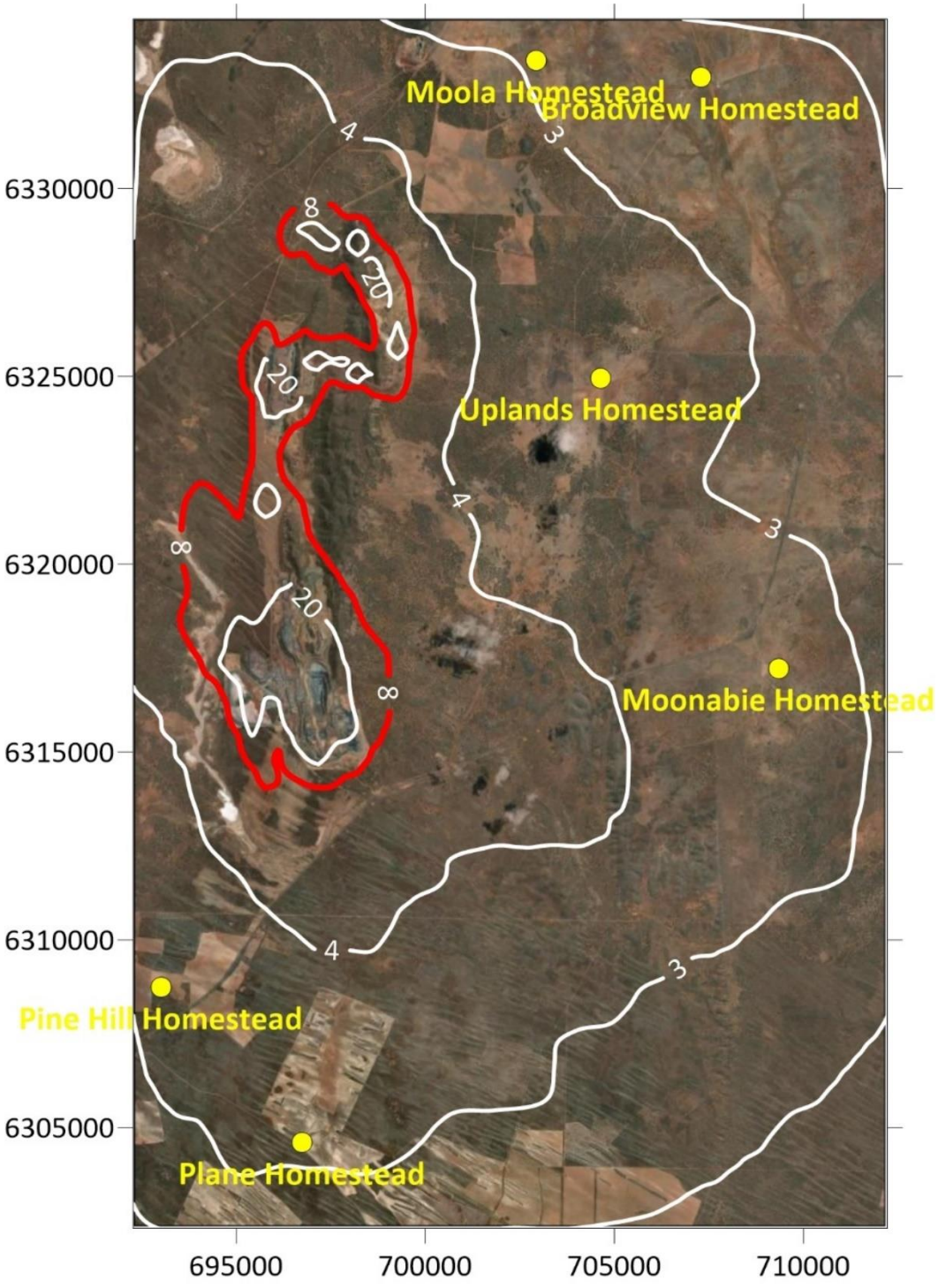


Figure 41: Cumulative Annual Average $PM_{2.5}$ GLC (µg/m³) Contour Plot of MEP1 – Unmitigated (Guideline: 8 µg/m³)

D3 Landscape and Visual Impact: Review of the modifications

MEP1 - Modification

Landscape and Visual Impact: Review of the Modifications

DRAFT

March 2024

L A N D F O R M

ARCHITECTS

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Executive summary

This report has undertaken an assessment of the changes proposed to the approved Development under the Endorsed Plans.

The assessment included:

- A review of the changes between the Endorsed Plans and the Modifications.
- Examination of comparative photomontages to consider the change in views brought about by the proposed changes in the Modifications compared to the Endorsed Plans and
- The assessment of the Modifications through viewpoints selected from locations along the Lincoln Highway

The overall visual impact resulting from the proposed Modifications will be negligible. The photomontages show that there would be a noticeable change in views when the proposed amendments to the approved disturbance areas of MEP1 are compared to the existing view. However, the test is the change to approved views, including the modifications to landforms permitted under the current approvals for MEP1. In this context, the change brought about by the proposed amendments would not be readily discernible.

1. Introduction

SIMEC Mining is seeking to expand its magnetite production in the Middleback Ranges by extending the 'Life of Mine' (LOM) for the approved MEP1 mining lease.

This is to be achieved by modifying the permitted mining area allowed under the currently approved magnet pit. The addition of MEP 1 would increase production from the current ~2.2 Million tonnes per annum (Mtpa) to ~2.35 Mtpa, and extend production by approximately 20 years. Ore will be processed utilising existing plant, equipment and concentrator facilities located at Iron Duchess A and Iron Duchess B.

This report assesses the potential landscape and visual impacts associated with proposed changes ('the Modifications') to the approvals currently held for MEP1.

1.1 Report Structure

This report will:

- Review features and landforms permitted under the current approvals for MEP1,
- Summarise the work changes between the current approvals and the proposed amendments.
- Review the proposed amendments through views and photomontages from publicly accessible locations along the Lincoln Highway.

1.2 Site Visit

A site visit was undertaken in early 2023, partly informing the assessment and findings of this review.

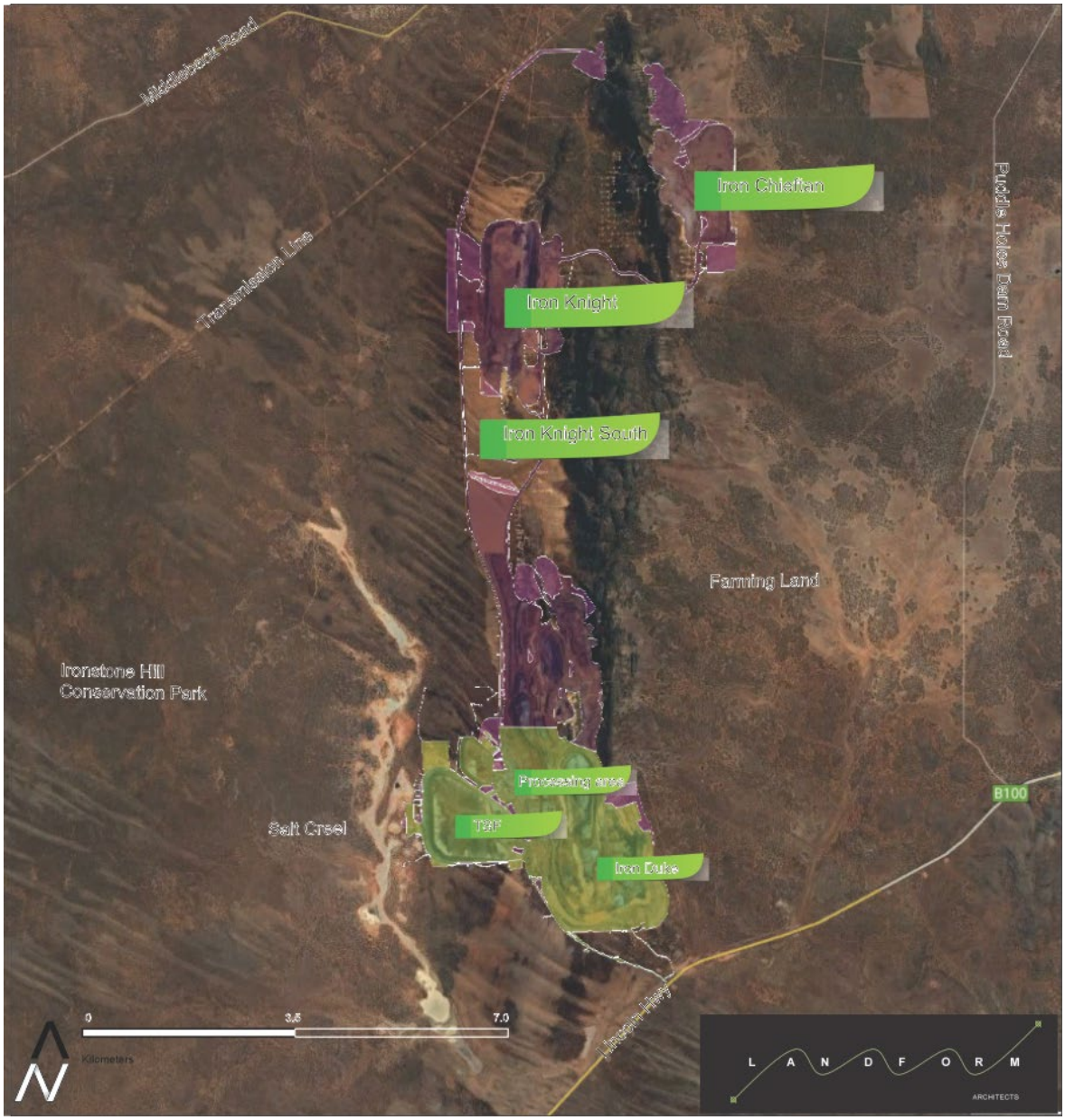
2. Description of the proposed amendments

The Proposal seeks to expand upon existing mining areas along the South Middle Back Range (SMR) and mining areas that have been approved but not yet undertaken.

2.1 Existing and approved mining areas

The location and extent of these areas area shown in Figure 2-1 below.

Figure 2-1 Existing and approved mining on the SMR *(Placeholder)*



The areas of existing and approved mining are shaded. Existing processing areas and the Tailings Storage Facility are located toward the southern end of the facility and the Lincoln Highway. Existing rail connections heading to Whyalla and the Port are to the north near Middleback Road.

There are few road users along Middleback Road to the north, and access along Puddly Holes Dam Road to the east is dry weather access only, with limited users. There is also limited access to Iron Hill Conservation Park to west. Limited locations to the west, north and east are publicly accessible.

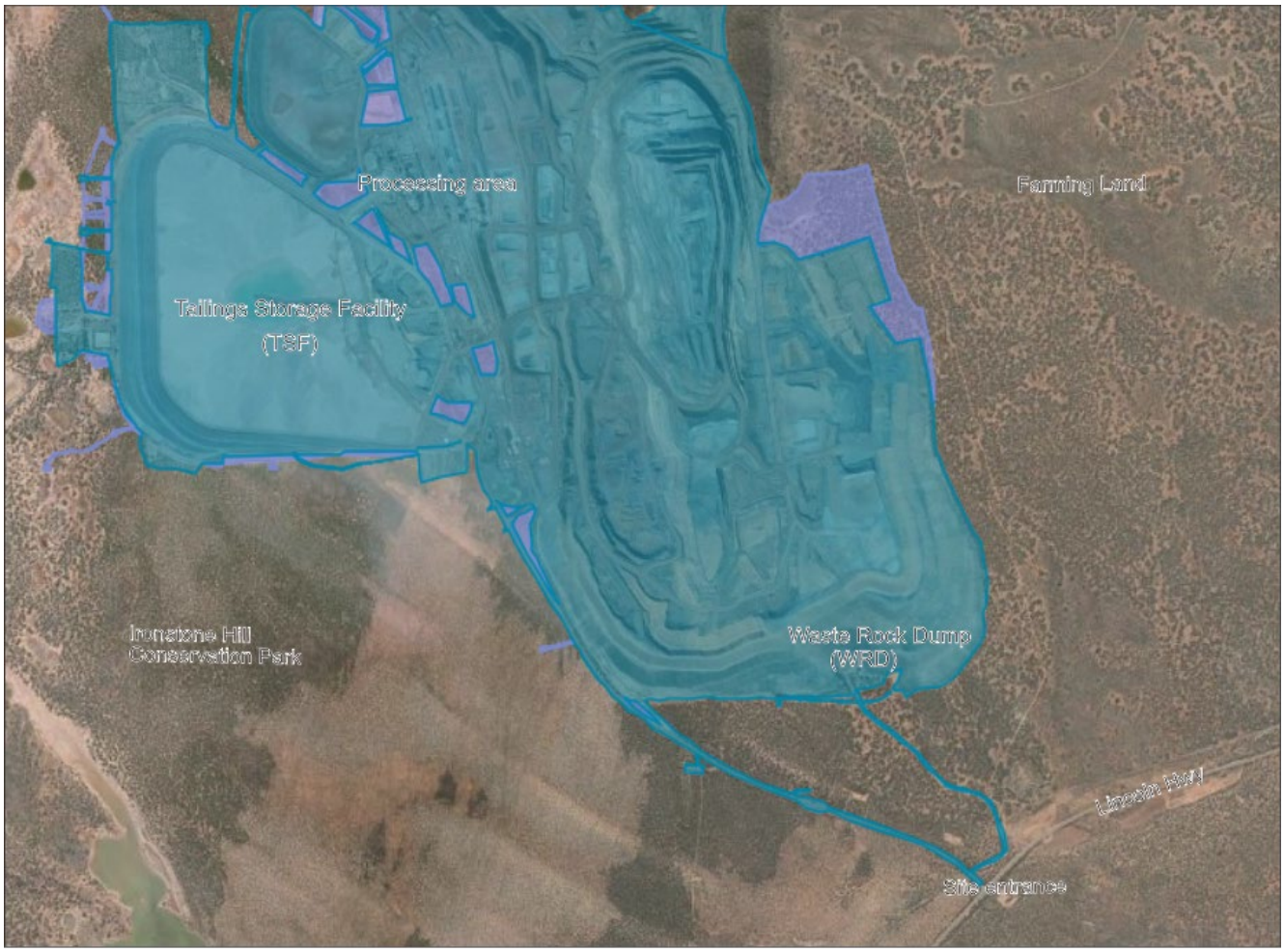
The Lincoln Highway to the south is the closest all weather road and publicly accessible location where most people view existing mine features. This area is also where most of the MEP1 are approved but not yet executed works and the area to be modified by the proposed amendments.

2.2 MEP1 - Approved

As noted previously, the existing Processing areas, and the location of the TSF are proposed to be retained by MEP1 and the modifications which are the focus of this review. Therefore, changes that would be most noticeable by the local community, visitors to the region and road users will be limited to any changes to the southern extent of the mining areas adjacent to the Lincoln Highway.

Figure 2-2 shows an enlargement of the mining areas toward the southern end of the SMR and near the Lincoln Highway.

Figure 2-2 Southern extent *(Placeholder)*



The following section will briefly review the proposed amendments to the existing MEP1 approvals relevant to assessing the potential visual impact in the public realm.

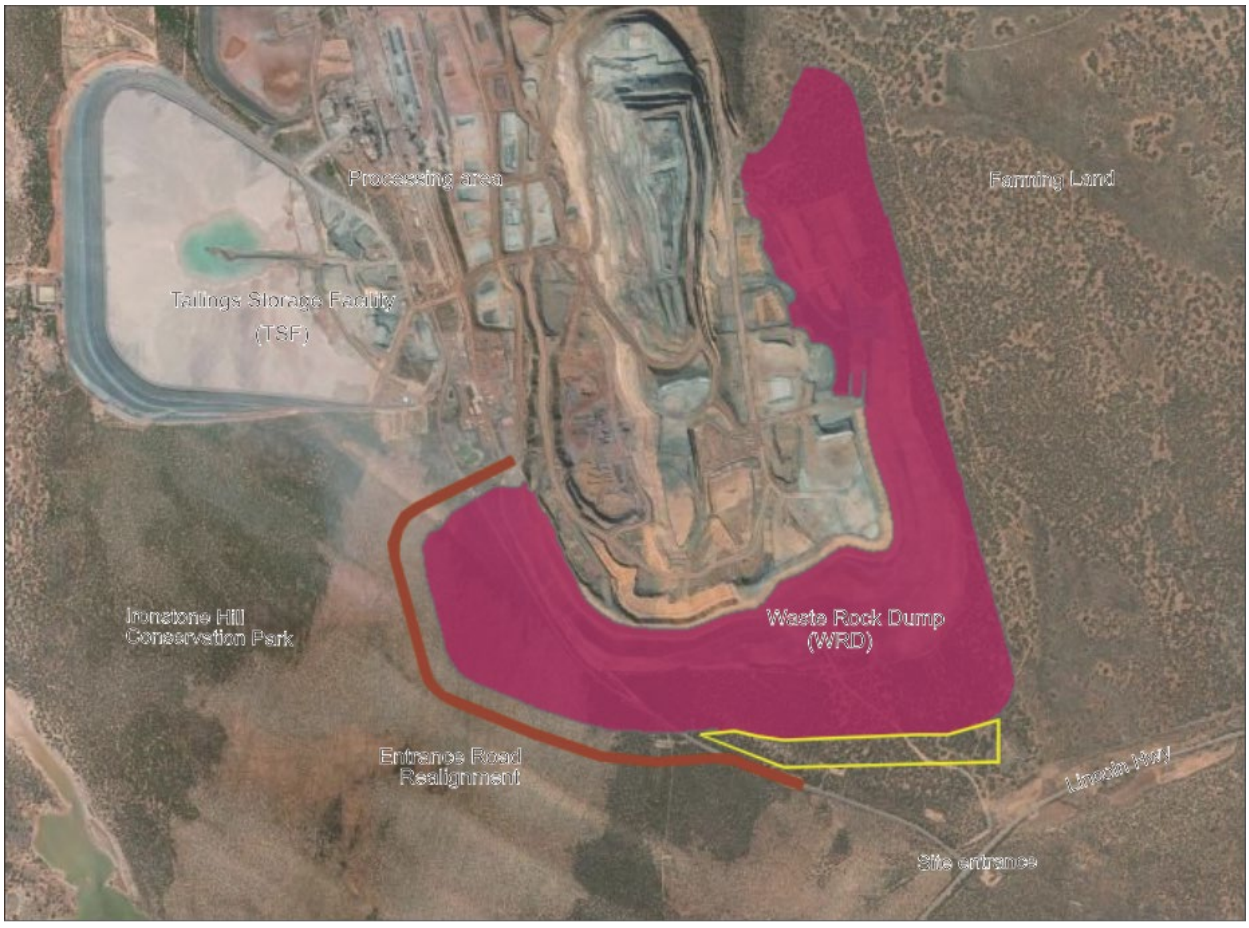
2.3 MEP1 – Modifications

The Magnetite Expansion Stage 1 will continue the mining method of conventional open-cut mining using drill and blast. Ore and waste rock will be removed from the pit with excavators, loaders and haul trucks. Existing features such as haul roads and run-of-mine (ROM) pads, stockpiles and waste rock dumps (WRDs) will be retained and re-used where required.

Ore will transported from the existing processing plant and concentrator to Port via the existing pipeline pair (slurry delivery and water return). Excess material not able to be transported via the existing pipeline will transported to Whyalla via the existing rail facility.

Waste rock produced by MEP 1 project will be partly accommodated in the existing and approved WRDs. The southern WRD adjacent to the Lincoln Highway will be enlarged to accommodate additional spoil material generated by the proposed MEP1 expansion. Figure 2-3 shows the anticipated WRD footprint required to accommodate waste material generated by the approved MEP mining area, and the proposed expansion.

Figure 2-3 MEP1 WRD Footprint *(Placeholder)*



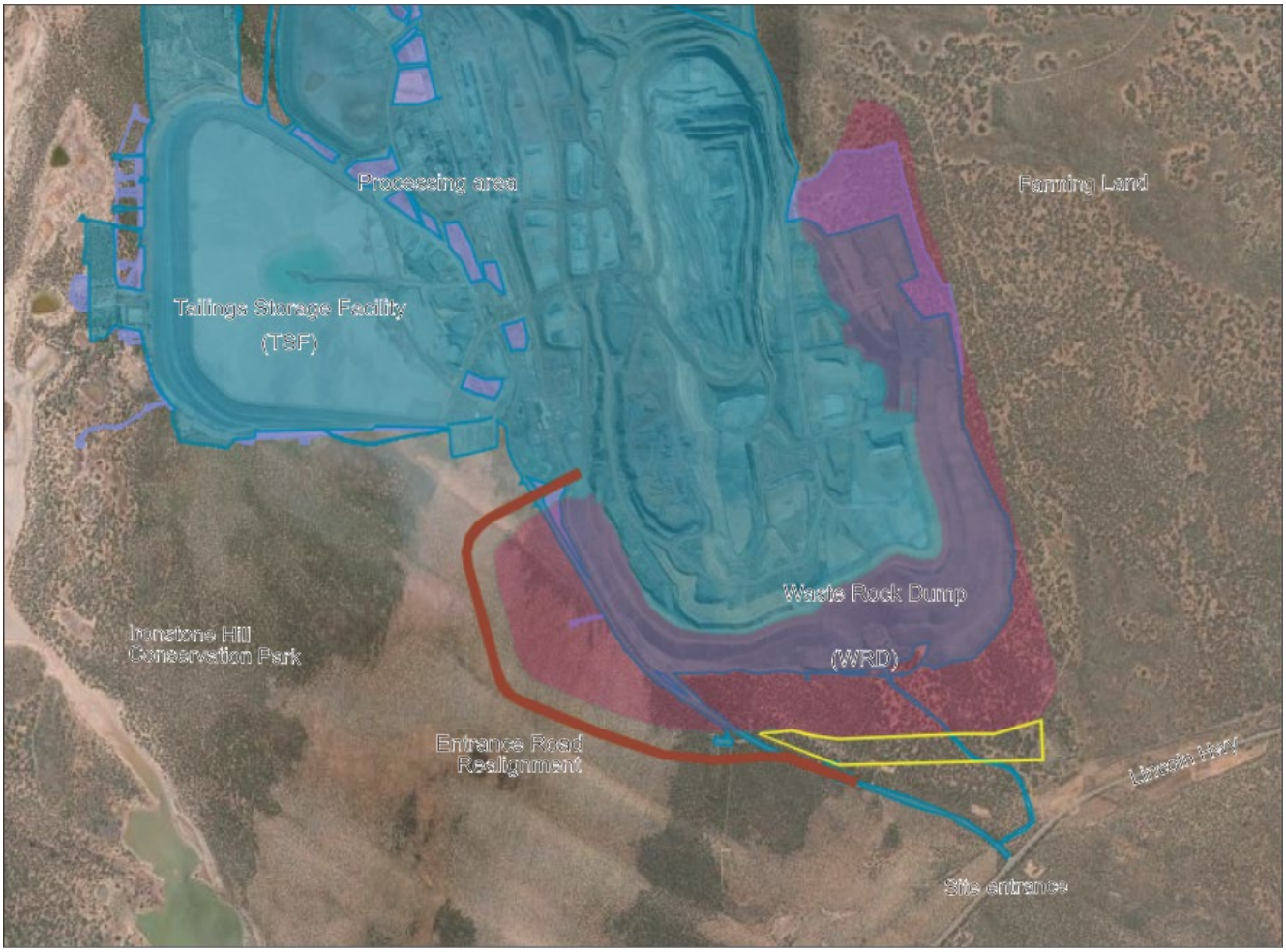
The expansion of the southern WRD would reduce the setback to the Lincoln Highway by approximately 370m and require the entrance road to be realigned to the west.

The existing tailings storage facility (TSF) is proposed to be retained for use in the early phases of MEP1. Excess tailings material is proposed to be disposed of in a mined-out pit located in Iron Knight North and in an area that will not be visible.

2.4 Summary of Proposed Changes

Figure 2-4 shows the extent of the approved footprint for MEP1, superimposed over the footprint of the WRD required to accommodate excess material generated by the MEP1 expansion, allowing a direct comparison of mining features in both layouts

Figure 2-4 Comparison



The extent and location of ancillary features and associated buildings remain unchanged between the two layouts. internal access roads and access locations are also unchanged.

Based on the above project summary, it is evident that the most noticeable change in views will be associated with the proposed expansion of the approved southern WRD.

3. Impact assessment

Three viewing locations have been selected from locations along the Lincoln Highway to assess the change in views and visual impact of the Project. The selected locations demonstrate the range of views that are likely to be affected by the Project. The viewpoints' location and proximity to the Project are shown in Figure 3-1 below.

Photomontages have been prepared from each location which show the final landform proposed by the MEP1 Expansion Project. The methodology used to prepare the photomontages is set out in Appendix B. This includes a description of how imagery should be used to support the interpretation and assessment of the Development in views from the surrounding landscape. An important point of reference in all views is the high-voltage transmission towers that bisect the Site.

For each viewpoint, the overall visual impact is assessed based on the six criteria which include Landscape change, visibility, distance, duration, viewer numbers and the qualitative aspects of the View. A summary table (distance, viewer numbers, and landscape sensitivity) is provided at the conclusion of each viewpoint.

The levels of assessed impact from each viewpoint will be rated from Neglible to High. A definition of each scale is provided in Table 1 below.

Table 1 Scale of effects

Overall visual impact	Definition
Nil visual impact	An overall assessment of **Nil** will be arrived at where the Project will be screened by topography, vegetation, buildings and other structures or project features are at such a distance that they will no longer be a readily discernible feature in views.
Negligible visual impact	An overall assessment of **Negligible** is a minute effect barely discernible over ordinary day-to-day views. A 'negligible' level of visual impact would typically occur where the Project will be at a distance that would be a minute element in views, filtered by vegetation, or partially screened by features such as topography or buildings. An overall assessment of negligible may also be where the Project is added to views that already include many similar features.
Low visual impact	An overall assessment of **Low** will be arrived at where the Project is noticeable but will not cause significant adverse impacts. For example, a "low" level of visual impact will be assessed if the rating of several, but not all, assessment criteria (visibility, distance, viewer numbers and landscape sensitivity) is assessed as low. Examples of a low level of visual impact are where the Project is visible in a highly modified landscape, few people will see the Project, or where views are transient rather than stationary.
Moderate visual impact	An overall assessment of **Moderate** may occur where several criteria are higher than "low", or the visual effects would be mitigated/remedied from an initial rating of High.
High visual impact	An overall assessment of **High** will be arrived at where significant adverse effects cannot be avoided, remedied, or mitigated. For example, a highly sensitive landscape, viewed by many people, with the Project in close proximity and largely visible, will lead to an assessment of a high level of visual impact.

The location of each publicly assessable viewpoint and its proximity to the Project are shown in

Figure 3-1 Viewpoint Locations



NTS
GDA2020 Vicgrid

3.1 Photomontages

3.2 Viewpoint 1 – Lincoln Highway #1 - (GPS 53H, 695991.98 m E, 6311045.16 m S)

Viewpoint 1 is from a roadside stop along the Lincoln Highway, approximately 3.3km west of the WRD.

Figure 3-2 shows the existing view looking north from the northern end of the roadside stop in the direction of the existing mining operation.

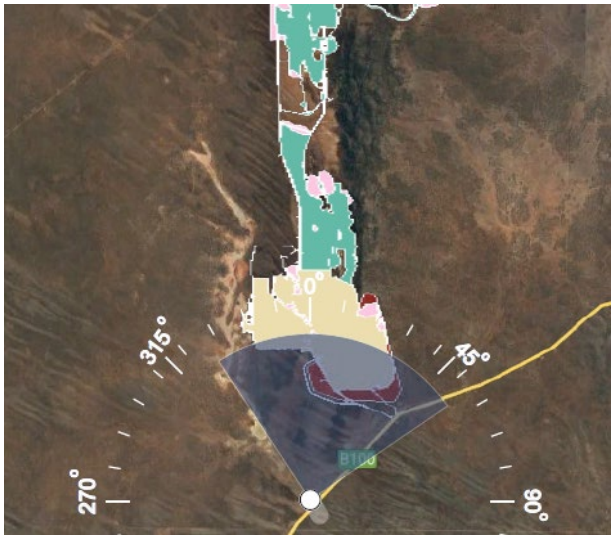


Figure 3-2 Viewpoint 1 – Existing View looking northeast

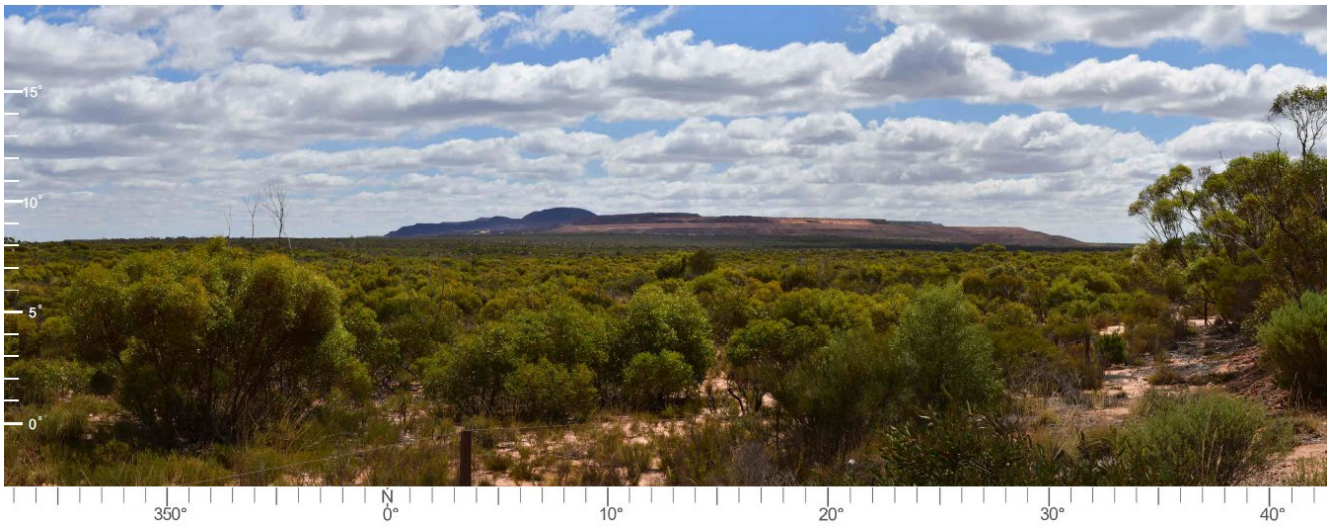
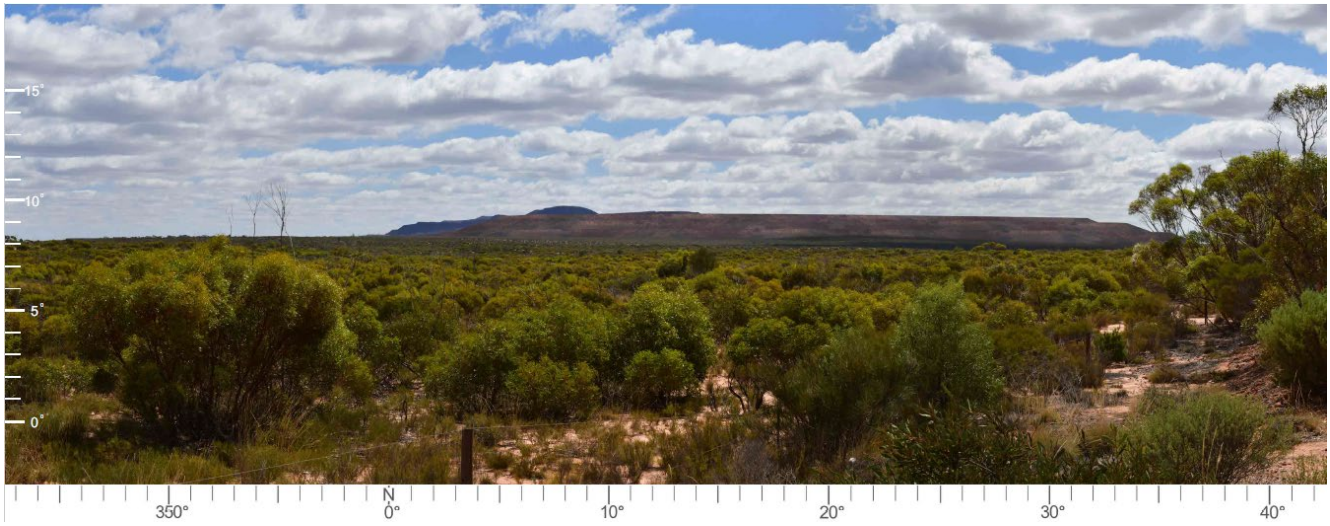


Figure 3-3 shows a photomontage of the same view with the anticipated profile of the southern WRD and mining areas proposed by the modification to MEP1.

Figure 3-3 Viewpoint 1 – Photomontage of amended layout



3.3 Assessment

The visual impact of the changes proposed by the Modifications would be negligible. Although the proposed modifications to the southern WRD would be noticeable when compared to the existing view, for most viewers, these changes would be added to a view that includes similar landforms and features.

When compared to the landforms contemplated by the existing approvals for MEP1, the changes between the approved landforms and these proposed amendments would not be discernible.

3.4 Viewpoint 2 – Lincoln Highway #2 - (GPS 53H, 698647.06 m E, 6313793.33 m S)

Viewpoint 2 is from the Lincoln Highway, approximately 270m east of the existing site entrance and 500m south of the WRD.

This location is not a formal roadside stop, lookout or vantage point. Views of this nature will be short in duration and generally oblique to the direction of travel in both directions.

Figure 3-4 shows the existing view looking northwest from the northern end of the roadside stop in the direction of the existing mining operation.

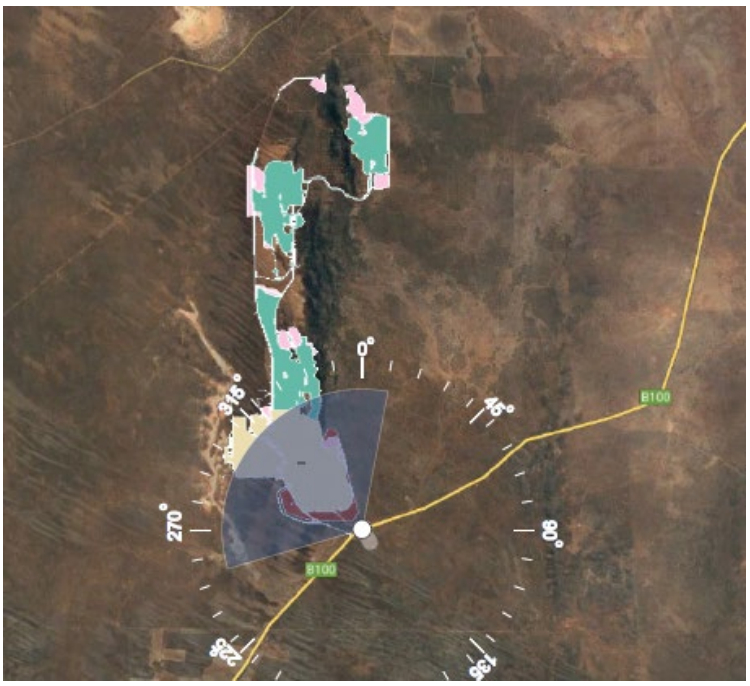


Figure 3-4 Viewpoint 2 – Existing View looking northeast

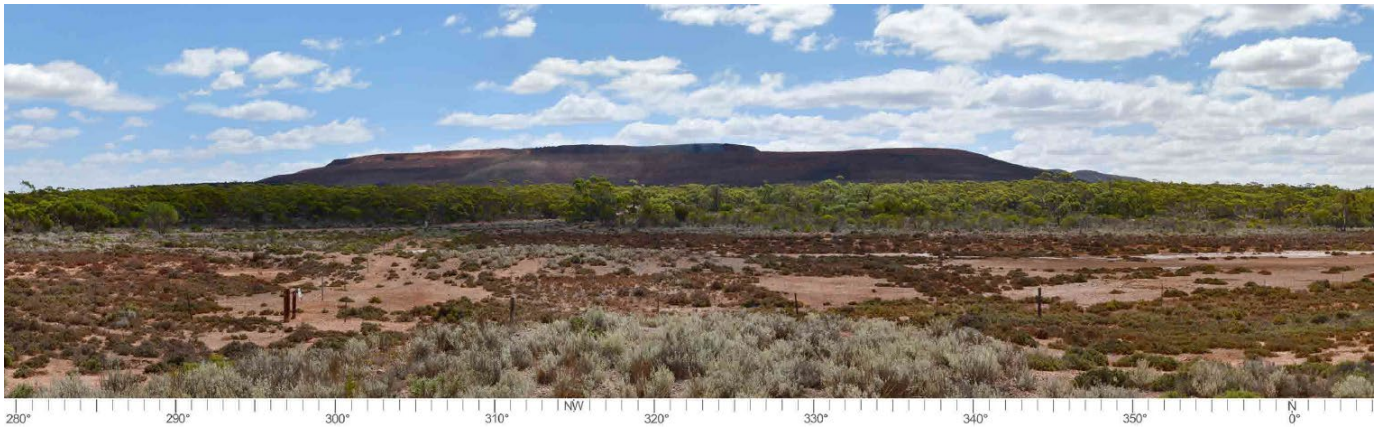


Figure 3-5 shows a photomontage of the same view with the anticipated profile of the southern WRD and mining areas proposed by the modification to MEP1.

Figure 3-5 Viewpoint 2 – Photomontage of amended layout



3.5 Assessment

The visual impact of the changes proposed by the Modifications would be negligible. Although the proposed modifications to the southern WRD would be noticeable when compared to the existing view, for most viewers, views would be short, oblique to the direction of travel and added to a view that includes similar landforms and features. Further, material would deposited incrementally and over timeframes such that, for most regular viewers, the change would also not be discernible.

When compared to the landforms contemplated by the existing approvals for MEP1, the changes between the approved landforms and these proposed amendments would not be discernible.

3.7 Viewpoint 3 – Lincoln Highway #3 - (GPS 53H, 695991.98 m E, 6311045.16 m S)

Viewpoint 3 is from the intersection of Puddle Holes Dam Road and the Lincoln Highway, approximately 5.8km east of the WRD.

This location is not a formal roadside stop, lookout or vantage point. Views of this nature will be short in duration and generally oblique to the direction of travel in both directions.

Figure 3-6 shows the existing view looking north from the northern end of the roadside stop in the direction of the existing mining operation.

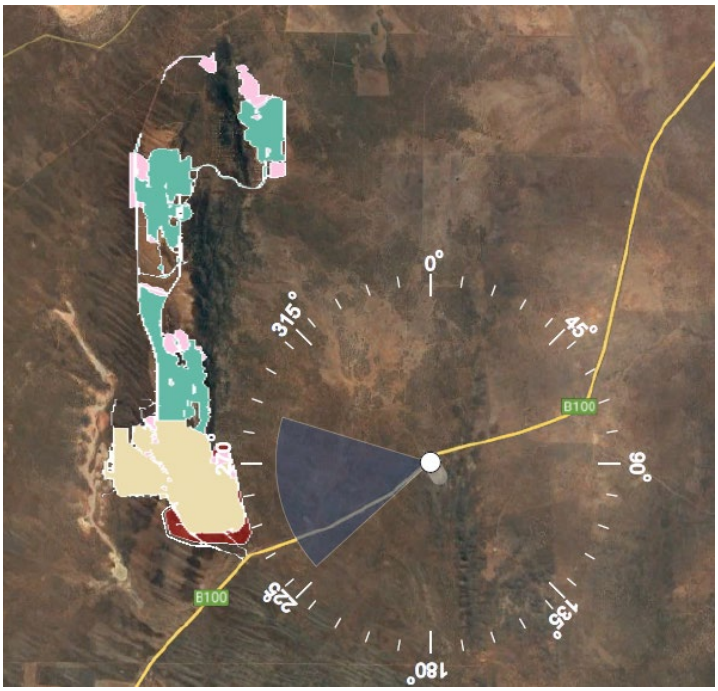


Figure 3-6 Viewpoint 3 – Existing View looking northeast

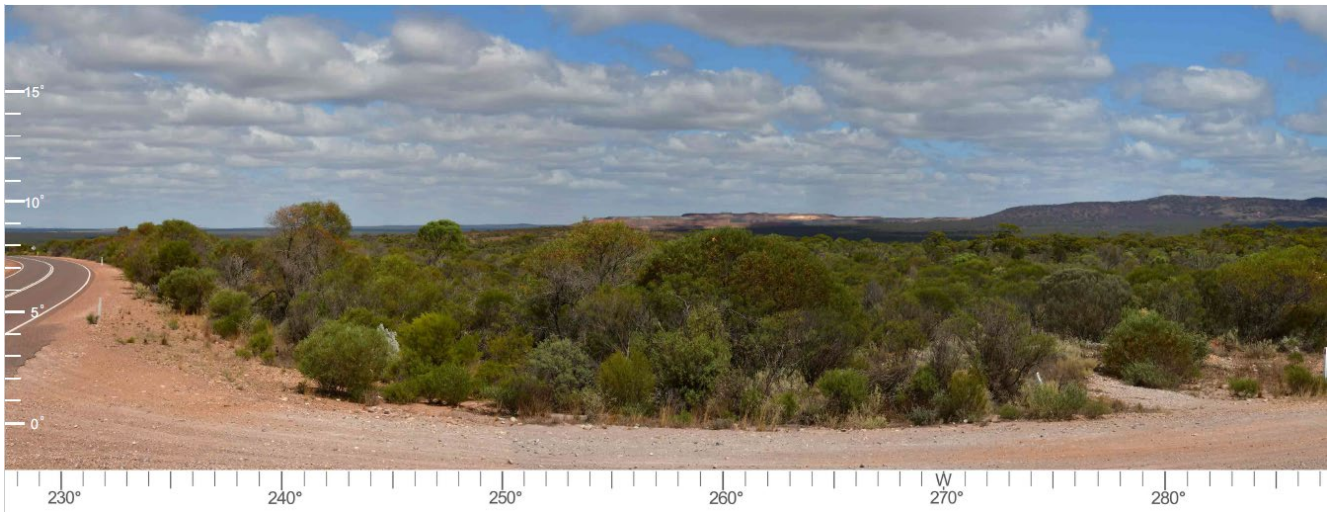
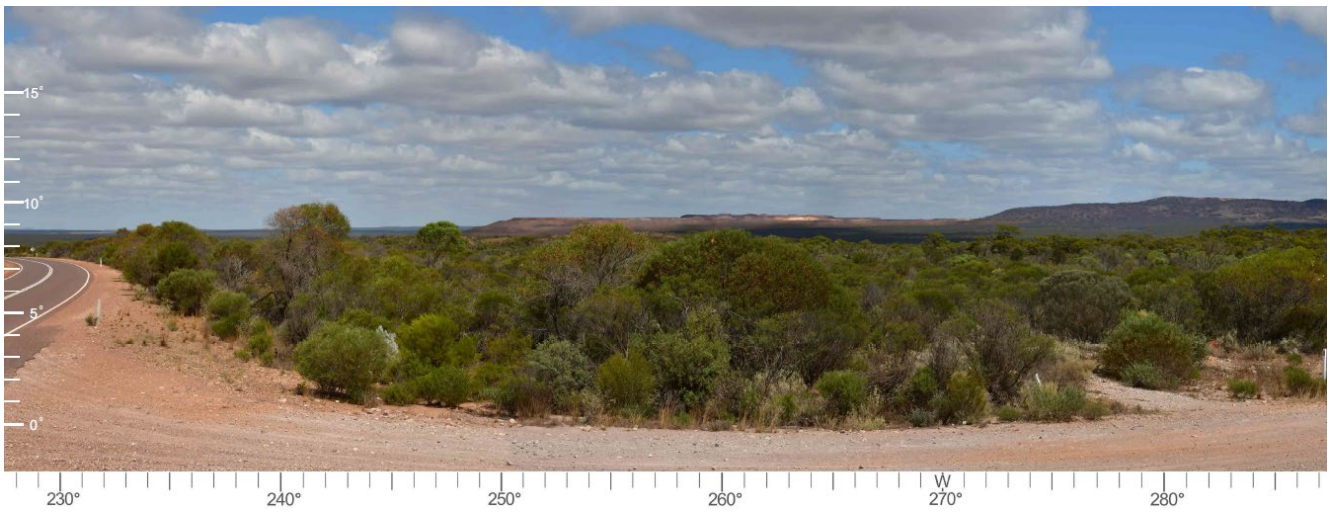


Figure 3-7 shows a photomontage of the same view with the anticipated profile of the southern WRD and mining areas proposed by the modification to MEP1.

Figure 3-7 Viewpoint 3 – Photomontage of amended layout



3.8 Assessment

The visual impact of the changes proposed by the Modifications would be negligible. Although the proposed modifications to the southern WRD would be noticeable when compared to the existing view, for most viewers, these changes would be added to a view that includes similar landforms and features.

When compared to the landforms contemplated by the existing approvals for MEP1, the changes between the approved landforms and these proposed amendments would not be discernible.

4. Conclusion

This report has reviewed the potential for changes in the impact to views, amenity and landscape character brought about by the changes proposed in the Modifications to the Approved mining operation under MEP1.

The assessment of the Modifications has determined that there would be no discernible change in the visibility of the Development between the Approved mining operation and the Modifications.

For this reason, the change in visual impact between the mining operations and disturbance areas already approved by MEP1 and the proposed Modifications would be negligible.

Appendix A. Plans

Appendix B. Photomontages

Photomontage preparation

Photomontages are used within the report to show the anticipated change to the existing landscape created by the Development of the solar farm.

Lens size and photos used within the photomontages

Photomontages typically show the changes in a 60º horizontal field of view. The 60º horizontal field of view represents the central cone of view in which symbol recognition and colour discrimination can occur. When defining vertical field of view, either 10º or 15º can represent the central field of view of human vision as shown in Figure 4-1.

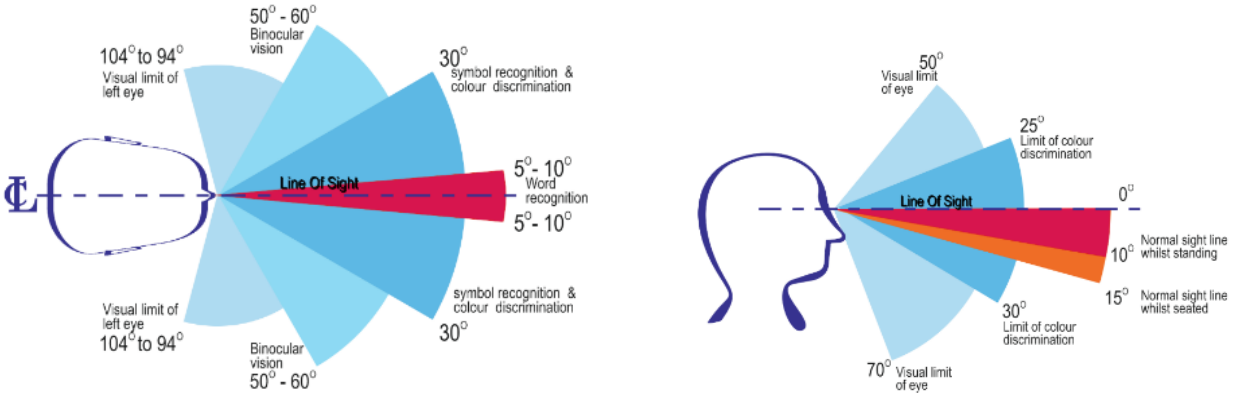


Figure 4-1 Horizontal and Vertical field of view (*Human Dimension and Interior Space, Julius Panero & Martin Zellnik, Witney Library of Design,1979)*

Similar data can be found in the more recent publication entitled 'The Measure of Man and Woman, Revised Edition', Henry Dreyfuss Associates, John Wiley, and Sons, 2012.

The 60º horizontal field of view is important if the photomontage images represent the change in the landscape. The A3 photomontages included in this appendix, include a 60º horizontal field of view. One of the sheets within the photomontage set shows a wireframe view of the computer model to illustrate how the photomontages were derived. Vertical 'poles' within this wireframe are merely points on the landscape such as a group of trees, a corner of an existing building etc. which allow the computer model (prepared in 3D StudioMax) and the photograph to be accurately aligned. This ensures that the proposed facility is accurately located within the photograph and then the rest of the model is removed, and the solar farm and the proposed landscape are rendered into the image.

Photographs

A 70mm lens on a Nikon D850 digital camera has a picture angle of 26.5º and a horizontal angle of view of approximately 21.3o. https://imaging.nikon.com/lineup/dslr/basics/19/01.htm.

Four photographs overlapped 1/3 to create an image approximately the same as the central cone of view of human vision, i.e., 50-60º and 15º vertical. Figure 4-2 demonstrates this theory.

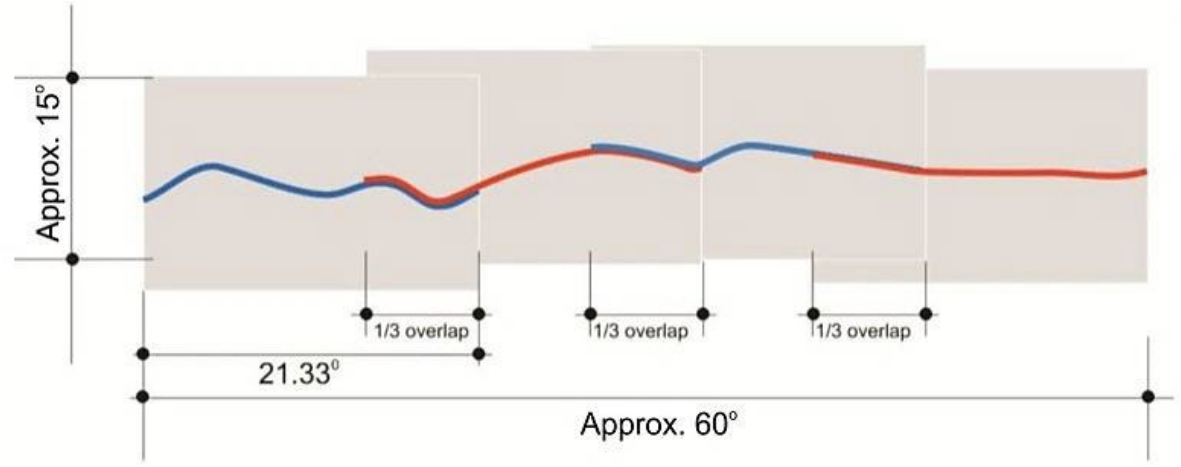


Figure 4-2 Photomontage layout

Computer modelling and the wireframe model

Cadastral data as well as the proposed Development are modelled within a computer program (3D Studio Max). A virtual camera is set up in the model at the GPS coordinates for each of the photographs that are being used within the panorama.

The digital model or wireframe view is then overlaid on the photographic panorama. Known points within survey information such as topography, building locations or other infrastructure are registered into the vase photographs (or other predetermined points). For technical accuracy, these points must align. This verifies the Location and apparent height and scale of the proposed Development.

After the background reference points have been aligned, the wireframe is removed, leaving only the proposed solar farm facilities, which are rendered, either to match the lighting conditions at the time the photographs were taken or, more typically to maximise their visibility by increasing their contrast against the background sky.

Photomontages are prepared with a 60° field of view, which follows the parameters of human vision. Wider panoramas are also used to indicate the full extent of the proposed solar farm facilities where appropriate.

GPS Coordinates and distance to the solar farm

The Nikon D850 camera also records the GPS coordinates as part of the metadata. GPS coordinates are also taken based on a separate hand-held GPS and the locations from which the photographs were taken is also marked on a digital map at the location of each photograph.

Photomontages

Two photomontages have been prepared from public viewpoints VP01 and VP07.

It is recognised that the small photographs and the A3 photomontages included within this assessment are not indicative of actual visual impact. The A3 images, which are included within this Appendix are clearer than the smaller images within the text.

However, to view the photomontages in a way that they appear perceptually accurate, they need to be printed and viewed on A0 sized sheets and held at arms' length. When viewed at A0 the photomontages are representative of the level of visual alteration.

D4 Environmental Noise Assessment

Magnetite Expansion Phase 1 Project

PEPR Environmental Noise Assessment

A240188RP2 Revision 0

Wednesday, 29 May 2024

Document Information

Project	Magnetite Expansion Phase 1 Project
Client	JBS&G Pty Ltd
Report title	PEPR Environmental Noise Assessment
Project Number	A240188

Revision Table

Report revision	Date	Description	Author	Reviewer
0	29 May 2024	First Issue	Nick Henrys	Darren Jurevicius

Glossary

A-weighting	A spectrum adaption that is applied to measured noise levels to represent human hearing. A-weighted levels are used as human hearing does not respond equally at all frequencies.
Characteristic	Associated with a noise source, means a tonal, impulsive, low frequency or modulating characteristic of the noise that is determined in accordance with the Guidelines for the use of the Environment Protection (Noise) Policy (Noise Policy) to be fundamental to the nature and impact of the noise.
Continuous noise level	A-weighted noise level of a continuous steady sound that, for the period over which the measurement is taken using fast time weighting, has the same mean square sound pressure as the noise level which varies over time when measured in relation to a noise source and noise-affected premises in accordance with the Noise Policy
Day	Between 7 am and 10 pm as defined in the Noise Policy
dB	Decibel—a unit of measurement used to express sound level. It is based on a logarithmic scale which means a sound that is 3 dB higher has twice as much energy. We typically perceive a 10 dB increase in sound as a doubling of loudness.
dB(A)	Units of the A-weighted sound level.
Frequency (Hz)	The number of times a vibrating object oscillates (moves back and forth) in one second. Fast movements produce high frequency sound (high pitch/tone), but slow movements mean the frequency (pitch/tone) is low. 1 Hz is equal to 1 cycle per second.
Indicative noise level	Indicative noise level determined under clause 5 of the Noise Policy.
L_{90}	Noise level exceeded for 90 % of the measurement time. The L_{90} level is commonly referred to as the background noise level.
L_{eq}	Equivalent Noise Level—Energy averaged noise level over the measurement time.
L_{max}	The maximum instantaneous noise level.
Night	Between 10.00 p.m. on one day and 7.00 a.m. on the following day as defined in the Noise Policy
Noise source	Premises or a place at which an activity is undertaken, or a machine or device is operated, resulting in the emission of noise
Quiet locality	A locality is a quiet locality if the Planning & Design Code provisions that make land use rules for the locality principally promote land uses that all fall within either or both of the following land use categories: (a) Residential; (b) Rural Living;

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1 Introduction

This report outlines the environmental noise assessment for the proposed Magnetite Expansion Phase 1 Project (the **Project**) at SIMEC Mining's Southern Middleback Ranges (SMR). The noise assessment has been undertaken to support development of the program for environment protection and rehabilitation (PEPR) for the Project.

The principal noise sources associated with the proposal are mobile plant associated with open pit mining activities, blasting, and processing activities. The closest noise affected receptors are various homesteads located a minimum of 5 km from the proposed mine site.

The potential noise emissions from the development have been assessed against the requirements of the Mining Act 1971, Planning & Design Code, and the South Australian Environment Protection (Commercial & Industrial Noise) Policy 2023 (the **Noise Policy**).

2 Proposed development

SIMEC is seeking to expand its magnetite production in the Middleback Ranges. Magnetite Expansion Phase 1 (MEP1) is the optimisation and de-bottlenecking of production and involved relatively minor changes of existing infrastructure entirely on the existing footprint of the SMR Mining Area. New and expanded processing facilities will be required to support the proposed operations, including an expanded mine pit and associated new tailings and waste rock management facilities.

The addition of MEP 1 would increase production from the current ~2.2 Million tonnes per annum (Mtpa) to ~2.5 Mtpa.

MEP1 will maintain the current mining method, employing conventional open cut mining using drill and blast methods, with ore and waste rock removed from the pit with excavators, loaders and haul trucks. The site has a network of haul roads and run of mine (ROM) pads, stockpiles and waste rock dumps (WRDs). Product will continue to be transported from the existing concentrator via existing pipelines. Specifically, MEP1 will comprise of:

- An extension to 'Life of Mine' (LOM) magnetite mining beyond the current magnet pit is proposed. This would use the current concentrator facilities, and is designated as Iron Duchess A and Iron Duchess B, adding approximately 20 years to LOM;
- Some waste rock produced during the MEP1 project will be accommodated in the existing waste rock dumps, however it is expected that some additional vegetation clearance would be required by approximately mid-2025 in order to accommodate further waste rock disposal;
- The existing tailings storage facility (TSF) is also proposed to be used in the early years of MEP1, with additional tailings disposal in a mined-out pit (Iron Knight North), not requiring additional vegetation clearance;
- Duchess South water storage moved to Duchess North;
- Diversion of mine access track around the new WRD;
- New topsoil stockpile area;
- Upgrades to the Direct Reduction (DR) Flotation Plant to enable the processing of high silica ore; and
- Repurposing of equipment from OBP to dewater concentrate to enable rail transport to Whyalla to supplement the existing slurry pipeline.

The Project will operate on a 24/7 basis, consistent with existing SMR operations.

Figure 1 and Figure 2 overleaf present the location and layout of the site and nearest noise sensitive receptors considered in the noise assessment. Sensitive receptors where baseline noise monitoring was undertaken are also indicated.

It is understood that there is potential for MEP1 operation to commence while the existing Cooks North mine remains in operation (although the period of overlap is expected to be relatively short).

There is also potential for re-opening of the Iron Knight South pit, for a nominal period of approximately November 2024 to February 2025, during operation of MEP1.

For the purpose of this PEPR noise assessment, cumulative noise emissions from mining of Cooks North, Iron Knight South, and MEP1 have been considered and assessed.

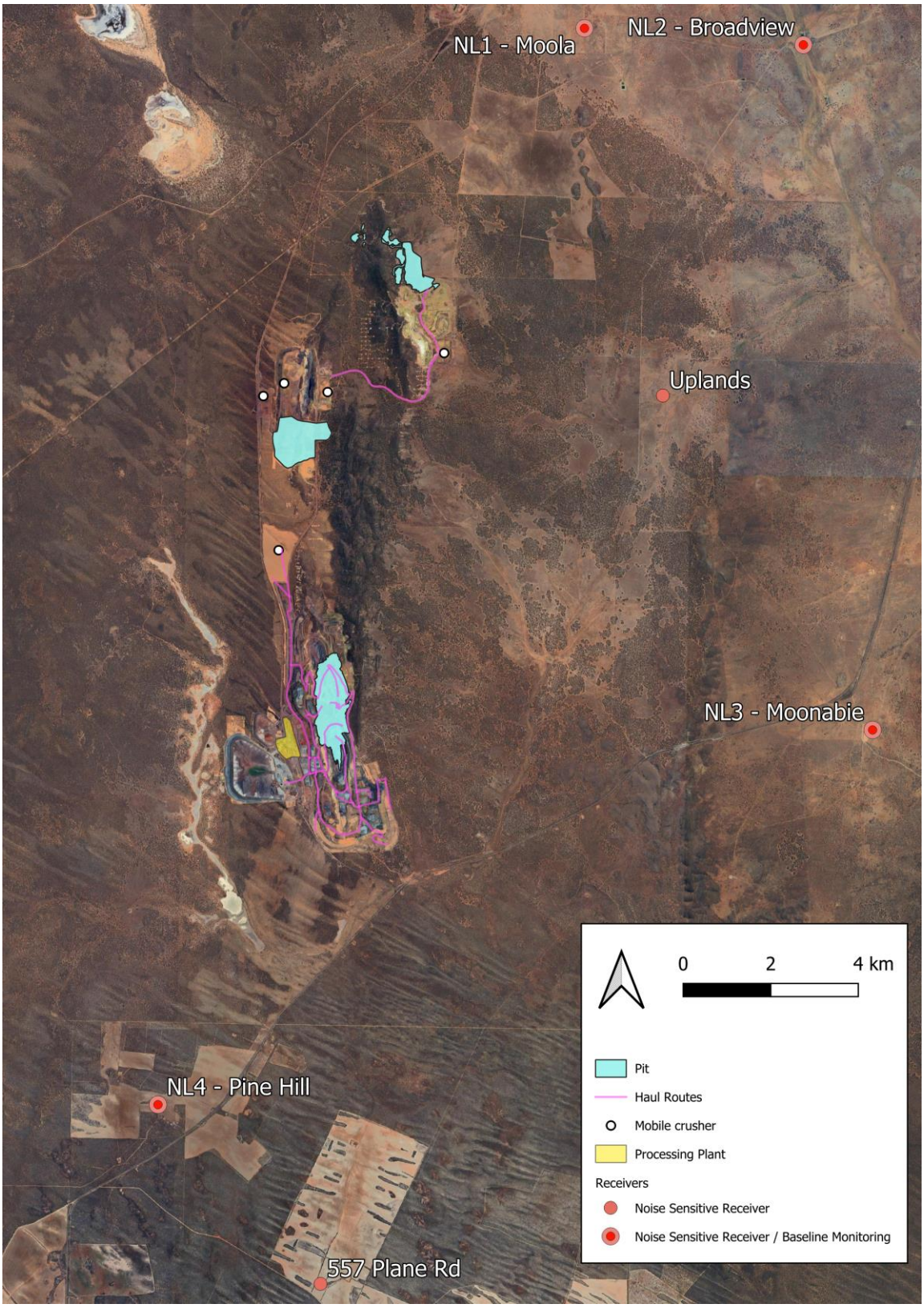


Figure 1: Proposed MEP 1 development (including existing Cooks North and IK South), showing noise sensitive receptors and baseline monitoring locations

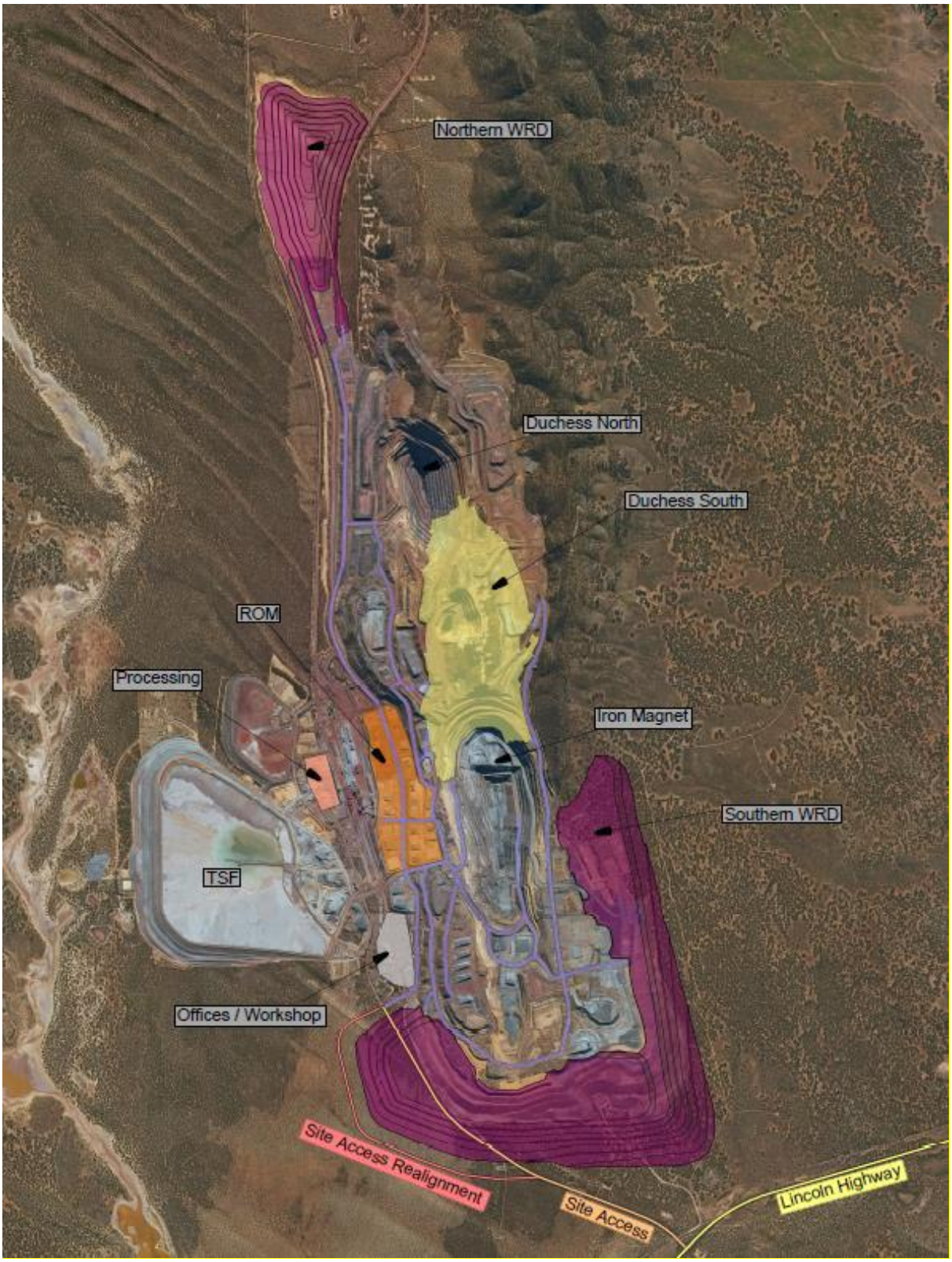


Figure 2: Proposed MEP 1 development, mine layout and operations

3 Noise criteria

3.1 Legislation

3.1.1 Environment Protection Act 1993

The general environmental duty in section 25 of the *Environment Protection Act 1993* (EP Act) states that:

> *A person must not undertake an activity that pollutes, or might pollute, the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm*.

Under the EP Act, pollution includes the emission of noise.

3.1.2 Mining Act 1971

The Terms of Reference for Metallic and industrial mineral PEPRs (TOR 005), which apply under the Mining Act 1971, include the following relevant provisions in relation to assessment of noise emissions:

> ***1. DESCRIPTION OF THE EXISTING ENVIRONMENT***
>
> ***1.17 Noise***
>
> *Provide a description and measurement data of the existing levels of noise and contributors to noise (both natural and anthropogenic).*
>
> …
>
> ***4.1.2 Potential Impact Events***
>
> *Describe potential impact events associated with each phase of the proposed operations (construction, operation and post completion) and relevant to each element of the environment.*
>
> *For the purpose of the impact assessment, a potential impact event is the combination of a source, a pathway and an environmental receptor.*
>
> *The source, pathway and environmental receptor of each potential impact event must be described prior to the implementation of engineering or administrative control measures.*

3.2 Environmental noise policy

Part 4, Clause 17(1) of the *Environment Protection (Commercial & Industrial Noise) Policy* 2023 (the Noise Policy) states that:

> *The general environmental duty under section 25 of the Act is satisfied in relation to noise from a noise source, insofar as the noise affects particular noise-affected premises, if the noise complies with the noise goals.*

The noise goals in the Noise Policy are based on the zoning of the development and the closest noise affected premises. The land uses primarily promoted by the zones are used to determine the environmental noise criteria with the indicative noise factors shown in Table 1 and Table 2. Note that the indicative noise factors in Table 1 are used where the noise source and noise affected premises falls within the same land use category (being only General Industry and Special Industry). In all other cases the indicative noise factors in Table 2 are to be used.

Table 1 Excerpt from Noise Policy—Table 1(subclause(1)(a))

Land use category	Indicative noise factor dB(A)	
	Day (7 am to 10 pm)	Night (10 pm to 7 am)
General industry	65	65
Special industry	70	70

Table 2 Excerpt from Noise Policy—Table 2(subclause(1)(b))

Land use category	Indicative noise factor dB(A)	
	Day (7 am to 10 pm)	Night (10 pm to 7 am)
Rural living	47	40
Residential	52	45
Rural industry	57	50
Light industry	57	50
Commercial	62	55
General industry	65	55
Special industry	70	60

Based on the zoning and the relevant Noise Policy Criteria for the zones of the subject site and the adjacent receptors, the primarily promoted land uses and the relevant criteria for the receptors in each zone are outlined in Table 3. In accordance with the Noise Policy, the relevant criteria are the average of the relevant indicative noise factors.

Table 3 Summary of zones, land uses, and Noise Policy criteria

Site	Zone	Land use(s)	Criteria	
			Day (7 am to 10 pm)	Night (10 pm to 7 am)
Subject site	Remote Areas	Rural Living, Residential, Rural Industry, Commercial, General Industry	57	49
Receptors to the east and north-east	Remote Areas	Rural Living, Residential, Rural Industry, Commercial, General Industry	57	49
Receptors to the south	Rural	Rural Industry	57	50

4 Existing environment

Noise monitoring was carried out at the locations shown in Figure 1 during the following periods:

- Thursday 12 August – Tuesday 24 August 2021 at NL1 and NL2;
- Tuesday March 7 – Thursday March 16 2023 at NL4; and
- Thursday April 13 – Thursday April 27 2023 at NL3.

The principal purpose of noise monitoring was to quantify the existing noise levels at representative sensitive receptors in the vicinity of the project site.

Rion NL-42 / NL-42A noise loggers were deployed, which are Class 2 instruments meeting the requirements of the Noise Policy. All noise loggers were calibrated before and after the measurements using a Type 1 Brüel & Kjær 4231 sound level calibrator and the calibration was confirmed to have not drifted. The noise logger and calibrator carry current calibration certificates from a NATA accredited laboratory.

The results of the noise logging during the day (7:00 am – 10:00 pm) and night periods (10:00 pm – 7:00 am) at the four logging locations are presented in Table 4 and Table 5 for the day and night periods respectively. Complete noise plots showing all results in 15-minute intervals is presented in Appendix A.

Table 4 Noise monitoring results summary – Day

Location	Type/SN	Date period	Average measured noise level dB(A)		Maximum noise level dB(A)
			$L_{eq,\ 15min}$	$L_{90,\ 15\ min}$	L_{Fmax}
NL1 – Moola	NL-42 01000248	12/08/2021 – 24/08/2021	39.7	19.3	97.6
NL2 – Broadview	NL-42 01000321	12/08/2021 – 24/08/2021	38.4	18.1	81.1
NL3 – Moonabie	NL-42A 00623378	13/04/2023 – 27/04/2023	45.6	23.6	87.6
NL4 – Pine Hill	NL-42A 00322763	7/03/2023 – 16/03/2023	42.2	25.4	89.9

Table 5 Noise monitoring results summary – Night

Location	Type/SN	Date period	Average measured noise level dB(A)		Maximum noise level dB(A)
			$L_{eq,\ 15min}$	$L_{90,\ 15\ min}$	L_{Fmax}
NL1 – Moola	NL-42 01000248	12/08/2021 – 24/08/2021	38.1	18.1	88.2
NL2 – Broadview	NL-42 01000321	12/08/2021 – 24/08/2021	31.9	16.9	71.0
NL3 – Moonabie	NL-42A 00623378	13/04/2023 – 27/04/2023	37.7	17.9	80.0
NL4 – Pine Hill	NL-42A 00322763	7/03/2023 – 16/03/2023	33.7	20.7	63.2

During some periods (at all locations), the measured noise level was equal to the instrumentation noise floor of approximately 14 dB(A) during both day and night-time periods. Actual noise levels at these times may have been lower than the instrument noise floor.

We note that measurement results were affected by high wind speeds and rainfall for significant periods of the monitoring duration, based on weather data from the nearest BOM station (Whyalla). Noise data for periods when wind speeds exceeded 5 m/s and rainfall above 0.2 mm/hr have been excluded from the summary of results in accordance the *Environment Protection (Commercial & Industrial Noise) Policy* 2023 (Noise Policy).

Measured noise levels were within the range expected for a remote area. Noise sources that were observed during deployment of noise loggers included wind-induced noise, fauna (birds and insects), and distant construction noise. We note that ambient noise levels at NL1 and NL2 may have been higher than usual as a result of the construction of a high voltage power line within 2 kilometers of the noise logging locations during the period of monitoring.

SMR operation was not audible during noise logger deployment at any of the locations, although it is expected to be audible under some meteorological conditions and during periods of low noise from other sources (particularly at night, for example). The measured data is therefore likely to include contribution from existing SMR mining occurring during the monitoring periods, although the relative contribution (i.e. relative to other ambient sources) is not able to be determined from the available data.

5 Assessment

5.1 Noise modelling

5.1.1 Modelling parameters

The *Guidelines for use of the Environment Protection (Commercial & Industrial Noise) Policy 2023* recommend that Predictions of the source noise levels for distances over 100 metres should be made using worst-case weather conditions that are equivalent to CONCAWE[1] meteorological category 6 at night, and CONCAWE meteorological category 5 for the day period.

However, we note that the CONCAWE algorithm is only valid for distances of up to 2 km from the noise source. In this case all receivers are located further than 2 km from the proposed mining activities. The ISO 9613-2[2] model is able to provide noise level predictions over long distances under conditions which are favourable for the propagation of sound. These conditions are for downwind propagation, or propagation under a well-developed moderate ground-based temperature inversion, such as that which commonly occurs at night.

CONCAWE Category 6, on the other hand, assumes weather conditions in which *both* downwind conditions and a temperature inversion occur in parallel, leading to noise levels which are generally higher than those predicted by ISO 9613-2.

Additional modelling was undertaken to determine the difference between the weather conditions assumed by the ISO 9613-2 algorithm, and nominally 'worst-case' weather conditions for the propagation of sound to the receivers assumed in CONCAWE category 5 and 6). The greatest difference in noise levels between the two models was found to be 5 dB(A), which occurs for all distances of greater than 1 km, for both category 5 and 6.

On this basis a 5 dB(A) increase has been applied to the ISO 9613-2 predictions to provide worst case noise levels at noise sensitive receiver locations, for both day and night-time periods. Note that since the Project will operate on a 24/7 basis there is no meaningful difference between worst-case daytime and night-time noise emissions for the purpose of this assessment.

Noise emissions from site have been modelled in SoundPLAN Environmental Software v8.2 program, using the ISO 9613 algorithm (with correction for nominal 'worst case' meteorological conditions as described above).

Specific terms are provided in the algorithm for the following physical effects:

- geometrical divergence
- atmospheric absorption
- ground effect
- reflection from surfaces
- screening by obstacles.

5.1.2 Equipment sound power levels

The sound power levels for the proposed noise sources are based on data provided by the manufacturer and Resonate's database of mining equipment. The equipment lists used for both existing and proposed SMR / MEP1

[1] Conservation of Clean Air and Water Europe (CONCAWE) report '*The propagation of noise from petrochemical complexes to neighbouring communities*' C.J. Manning 1981.

[2] *International Standard ISO 9613-2 Acoustics—Attenuation of sound during propagation outdoors—Part 2: General method of calculation*.

operational scenarios has been provided by SIMEC and are presented in Appendix B including the quantities and sound power levels used in modelling.

Original Equipment Manufacturers (OEM) design mining equipment to meet required industry standards to reduce or eliminate noise and vibration to protect the environment and operators as far as practicable. All equipment used on site is required to meet mine specification standards.

The sources of operational noise and vibration from the equipment includes, but is not limited to:

- engine operation
- operational alarms and warning systems including tramming or reversing alarms (it is understood that broadband 'squawkers' (i.e. not tonal 'beepers') are used
- loading noise in truck bodies
- track noise from tramming tracked equipment
- hammer noise from drilling rigs
- noise associated with crushers, screens and other processing plant equipment

5.1.3 Modelling scenarios

Noise emissions have been modelled for the simultaneous and continuous operation of the equipment in Appendix B in the following two scenarios:

- Existing operation: mining in Cooks North, Duchess South Pit, and Duchess North Pit D. Note that this scenario was assessed by Resonate as part of the Cooks North Mineral Lease Application[3]
- Proposed operation: continuation of mining in Cooks North, along with mining in the 'MEP 1' pit (i.e. between the existing Iron Magnet and Iron Duchess pits)

Haul routes, mobile crushers and processing plant operation are also included in both scenarios.

The modelled scenarios are representative of nominal 'worst-case' operation, based on simultaneous operation of all equipment for the assessment period.

For the proposed operation scenario, the open pit mining plant has been modelled at the existing ground level. Noise levels are expected to decrease to some extent as the pit is developed to design depth, providing additional 'shielding' between noise sources and the nearest noise sensitive receivers.

5.2 Characteristic noise penalties

Penalties to the source level should be applied in accordance with the Noise Policy to recognise annoyance associated with noise that is dominated by tonal, modulating, intermittent, low frequency, or impulsive characteristics. A 5 dB(A) penalty is applied for one characteristic, an 8 dB(A) penalty is applied for two characteristics, and a 10 dB(A) penalty is applied for three or more characteristics.

For a characteristic penalty to be applied to a noise source, it must be fundamental to the impact of the noise and dominate the overall noise impact. Noise from the proposed development received at noise sensitive locations is not expected to contain any characteristic as defined in the *Guidelines for the use of the Environment Protection (Commercial and Industrial Noise) Policy 2023*, on the basis that:

- Broadband reversing alarms will be used for all mobile plant
- Noise emissions include contribution from a large number of items, with no single item dominating the overall noise when received at noise sensitive premises. The noise is therefore expected to be broadband and generally continuous in nature (i.e. without modulating, impulsive, or intermittent character)

[3] Described in full in Resonate report A210480RP1

- Worst-case predicted noise levels are in the same order of magnitude as existing ambient noise levels, therefore any audible character is expected to be 'masked' to some extent by ambient noise, such that it is not expected to be 'fundamental to the impact of the noise' or 'dominate the overall noise impact'.

No penalty for characteristics has been applied to predicted noise levels, although it is noted that worst-case predicted noise levels remain below the relevant daytime and night-time Noise Policy criteria, even in the event that characteristic penalties were found to be applicable.

5.3 Predicted noise levels

The worst-case predicted noise levels from existing and proposed operation of the mine are shown in Table 5 and Table 6 below.

Predicted noise levels are less the relevant Noise Policy criteria at all noise sensitive receiver locations in both assessment scenarios.

Table 5 Predicted noise levels at sensitive receivers – Existing (baseline) operation

Prediction location	Predicted noise level, L_{eq} dB(A)	Noise Policy daytime criteria, dB(A)	Noise Policy night-time criteria, dB(A)
Moola (NL1)	35	57	50
Broadview (NL2)	31		
Moonabie (NL3)	28		
Pine Hill (NL4)	31		
Uplands	38		
557 Plane Road	23		

(1) Reference location presented for information only – not a noise sensitive receiver

Table 6 Predicted noise levels at sensitive receivers – Proposed operation

Prediction location	Predicted noise level, L_{eq} dB(A)	Noise Policy daytime criteria, dB(A)	Noise Policy night-time criteria, dB(A)
Moola (NL1)	35	57	50
Broadview (NL2)	31		
Moonabie (NL3)	33		
Pine Hill (NL4)	37		
Uplands	40		
557 Plane Road	33		

(1) Reference location presented for information only – not a noise sensitive receiver

6 Blasting noise and vibration assessment

Blasting activities within the SMR mining areas are managed in accordance with SIMEC Mining's Blasting Management Protocol

The Protocol is intended to ensure that:

- there are no risks to public safety on or off the mining lease areas, as a result of blasting activities
- private and public property will not be adversely affected by blasting activities
- blasting techniques and protocols minimise dust generated during blast events
- blasting only occurs in daylight hours.

Blast management procedures address the potential impacts of vibration, overpressure, fly-rock, dust and noise on the environment, personnel, equipment and surrounding land and facilities. Blasts are managed in accordance with industry best practice for explosives handling, blast design, initiation systems and impact controls. All blasts are designed and supervised by qualified, trained and experienced personnel.

Specific controls within the blast management procedures include:

- an exclusion zone of 500 m from the blast for personnel
- an exclusion zone of 300 m from the blast for equipment
- notifications prior to blasting
- clearance activities before the blast
- an allocated blasting controller (i.e. responsible shot-firer)
- emergency preparedness during the blast
- standard communication methods during the blast
- post-blast checks
- clearance at the conclusion of blasting

Blast management procedures are followed in accordance with AS 2187.2:2006 '*Explosives—Storage and use - Part 2: Use of explosives'*. These address the potential impacts of vibration, overpressure, and noise on the environment, personnel, equipment and surrounding land and facilities. All blasts are designed and supervised by qualified, trained, and experienced personnel.

Blast notices are placed on the mine site noticeboards at the mine site entry points, generally at least 24 hours before an event. Broadview Station or Moonabie Station is also notified by phone when blast impact zones marginally encroach on their properties, noting this occurs at locations within 500 m of the mine, and at a substantial distance (of several kilometres) from the respective residences/homesteads.

Overall there is a negligible risk of unreasonable adverse noise and vibration impacts on sensitive receivers as a result of blasting activities, provided the above protocols are followed.

7 Noise impact assessment

7.1 Potential impacts

To meet the requirements of TOR 005, the environmental impact of the proposed mine is assessed as shown below in Table 6.

Table 6 Environmental noise impact assessment for the proposed mines

Source	Pathway	Receptor	Likely Impact	Uncertainty
Mobile mining plant	Airborne noise	Residential noise sensitive receptors	Worst case noise levels of up to 39 dB(A) predicted at the nearest receiver Predicted noise levels are in the range of existing ambient noise levels at the nearest receiver locations, indicating that noise from the proposal may be audible. However, they are significantly below the Noise Policy criteria which are intended to prevent unreasonable adverse impacts on amenity and sleep	Accuracy of noise source data, modelling uncertainty, assumptions in relation to noise source locations and operation. Conservative assumptions have been made which are expected to overpredict actual noise emissions for the majority of the time.
Blasting activities	Shock wave overpressure via atmosphere, airborne noise, ground-borne vibration	Residential noise and vibration sensitive receptors	Low intensity impacts with insignificant harm expected providing AS 2187.2:2006 procedures are followed, considering large separation distances between pit and sensitive receptors.	N/A

7.2 Control measures and environmental outcomes

Proposed control measures and environmental outcomes for each source are presented below in Table 8.

Table 7 Environmental noise control and outcomes proposed mines

Source	Control measures	Outcomes
Blasting activities	Use appropriate charge mass, Implement blasting management procedures in accordance with AS 2187.2:2006.	Blasting overpressure and vibration compliant with the limits in AS 2187.2:2006. No significant adverse impacts on noise and vibration sensitive receivers.

8 Conclusion

An environmental noise impact assessment has been undertaken for the proposed MEP 1 project located in the South Middleback Range (SMR).

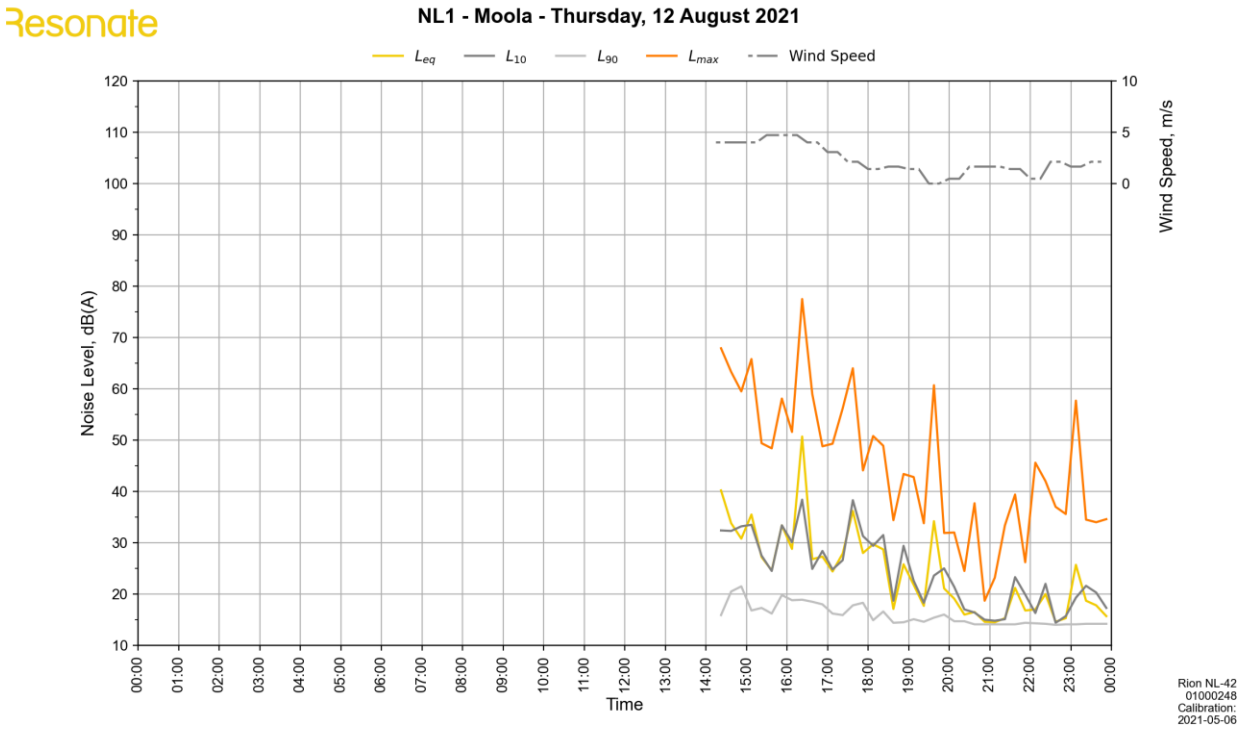
This assessment has demonstrated that noise and vibration emissions from the proposed Project will be able to comply with the relevant requirements of:

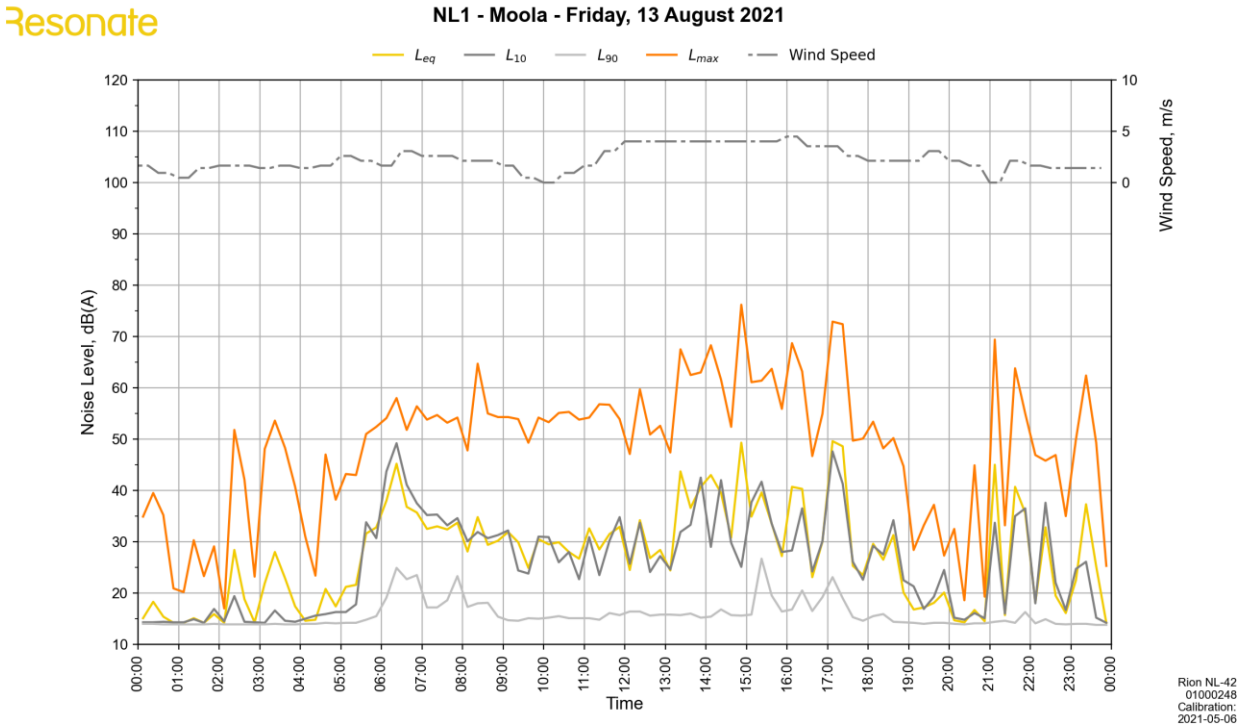
- TOR 006 *Metallic and industrial mineral PEPRs*
- *Environment Protection (Commercial & Industrial Noise) Policy* 2023 (Noise Policy)

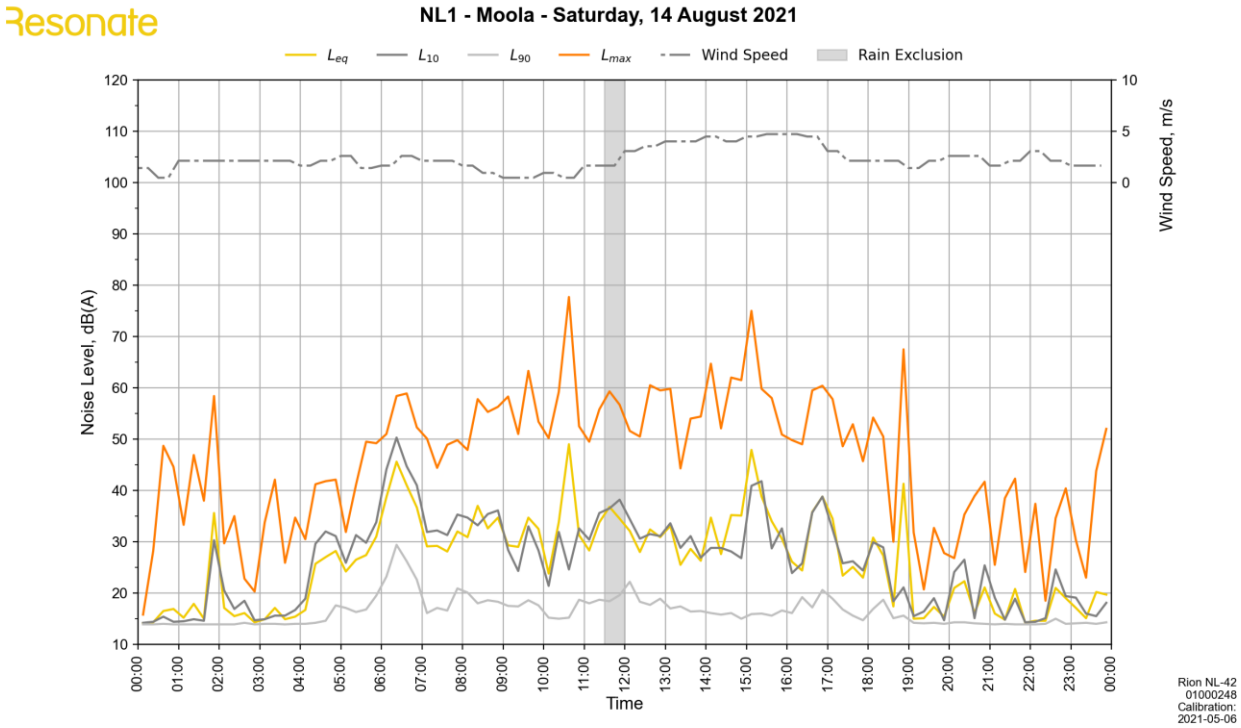
No specific control measures are required beyond the standard procedures and blasting protocols already implemented by SIMEC for existing SMR operations.

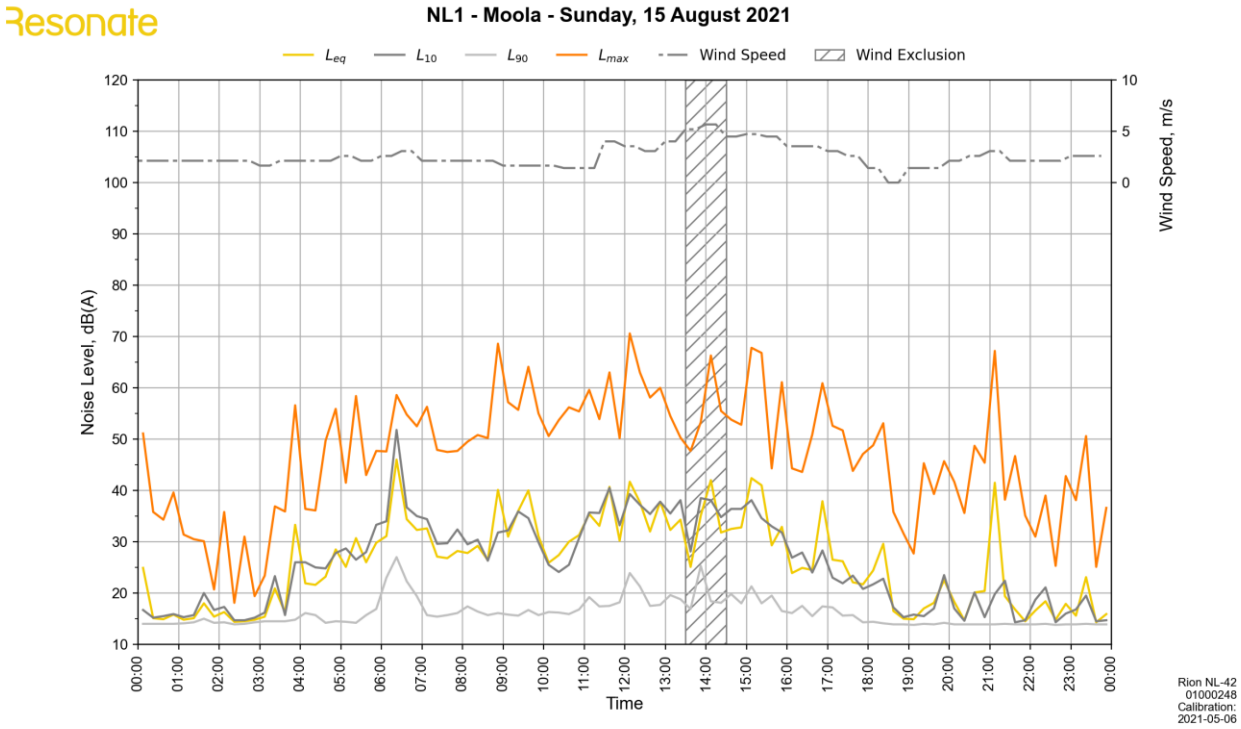
Appendix A – Daily Noise Monitoring Plots

NL1 – Moola

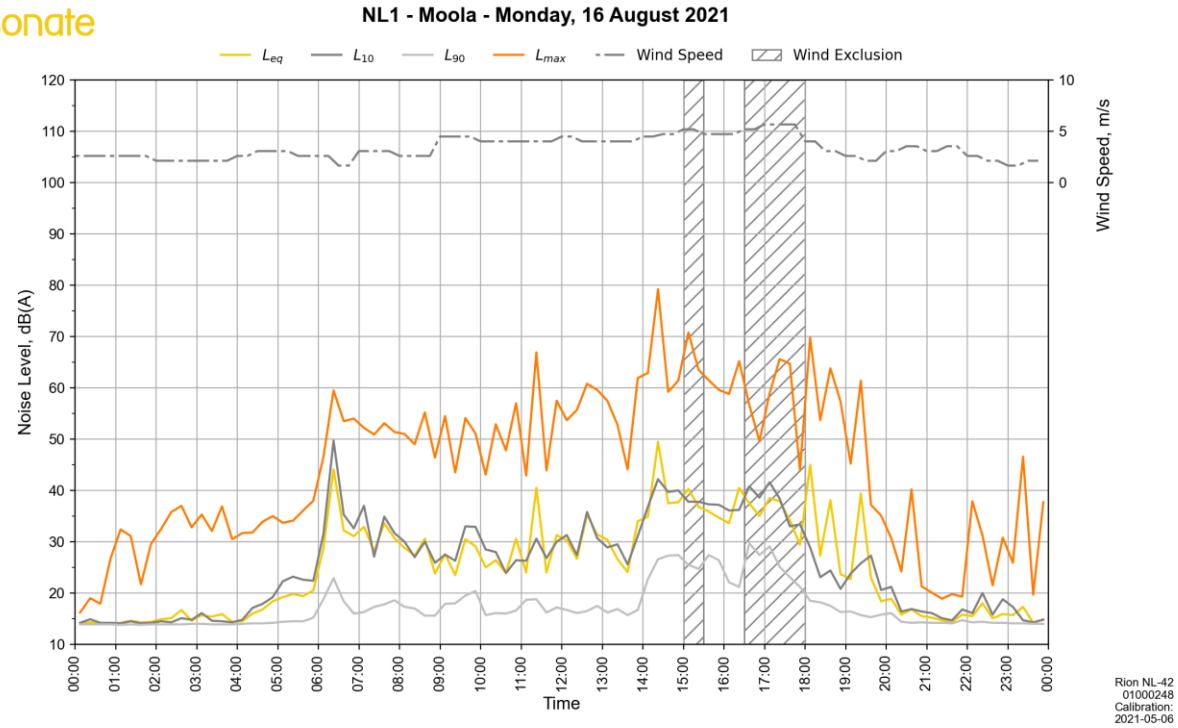

Resonate
NL1 - Moola - Thursday, 12 August 2021
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000248
Calibration:
2021-05-06


Resonate
NL1 - Moola - Friday, 13 August 2021
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000248
Calibration:
2021-05-06

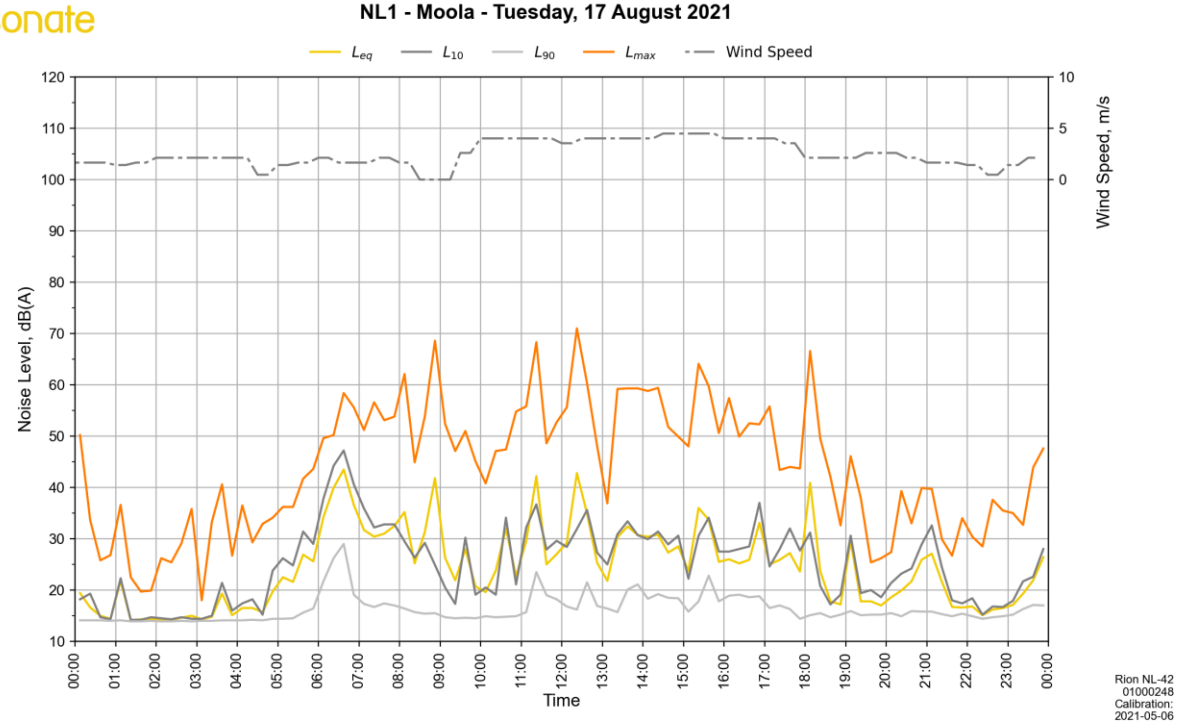

Resonate
NL1 - Moola - Saturday, 14 August 2021
L_{eq} L_{10} L_{90} L_{max} Wind Speed Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000248
Calibration:
2021-05-06


Resonate
NL1 - Moola - Sunday, 15 August 2021
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000248
Calibration:
2021-05-06

Resonate

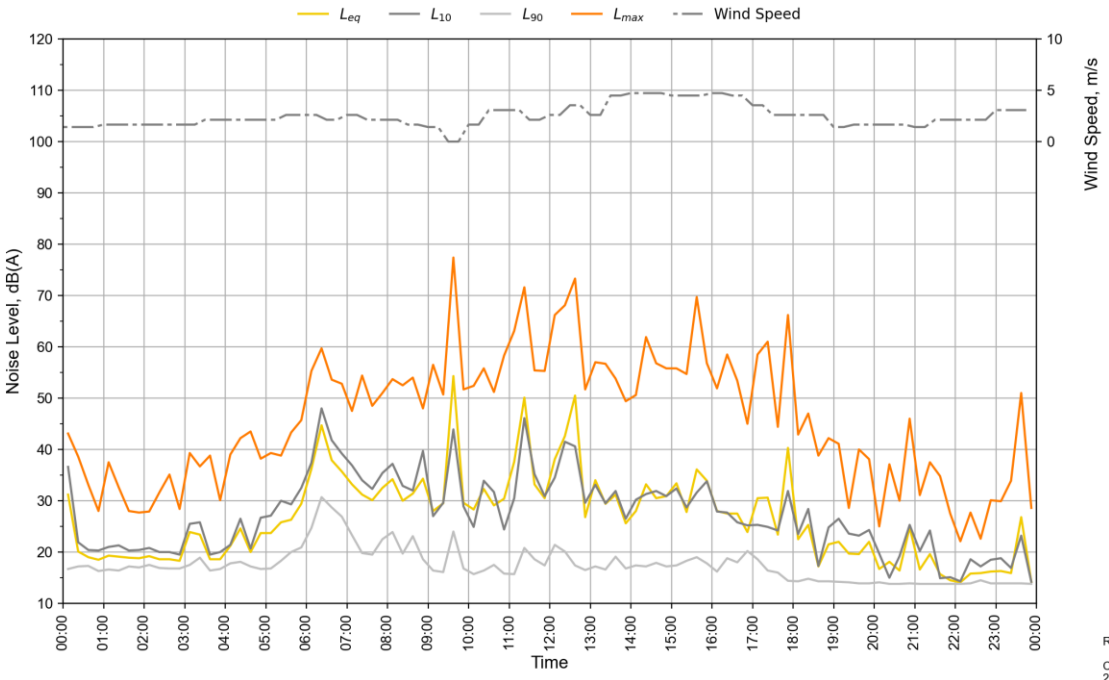


Resonate



Resonate

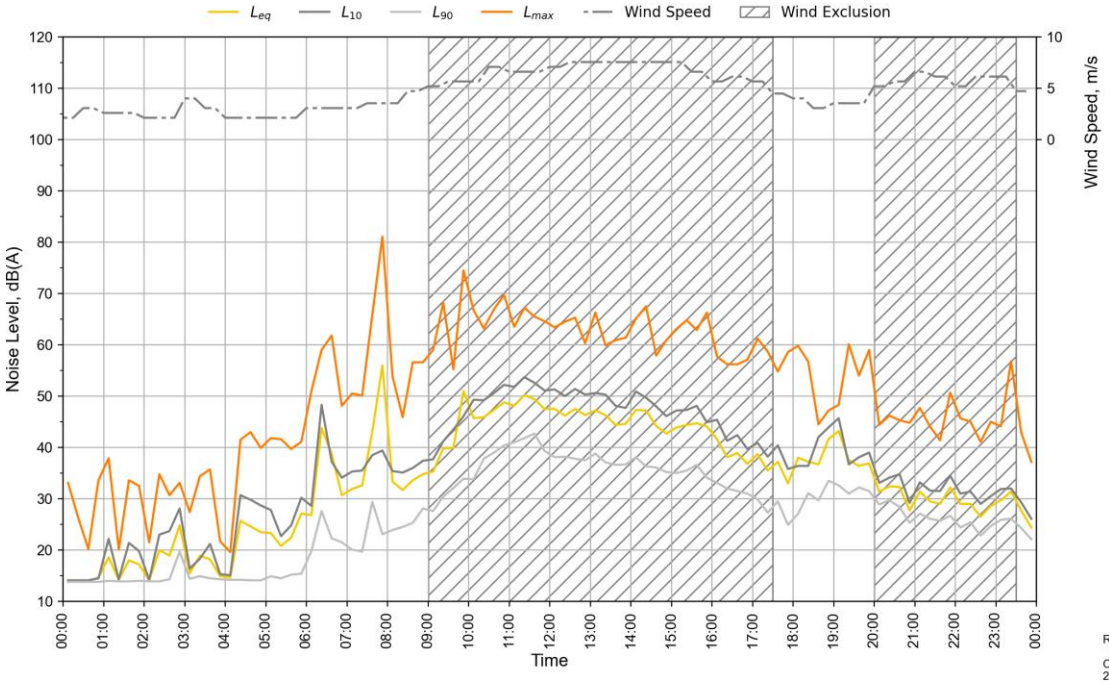
NL1 - Moola - Wednesday, 18 August 2021



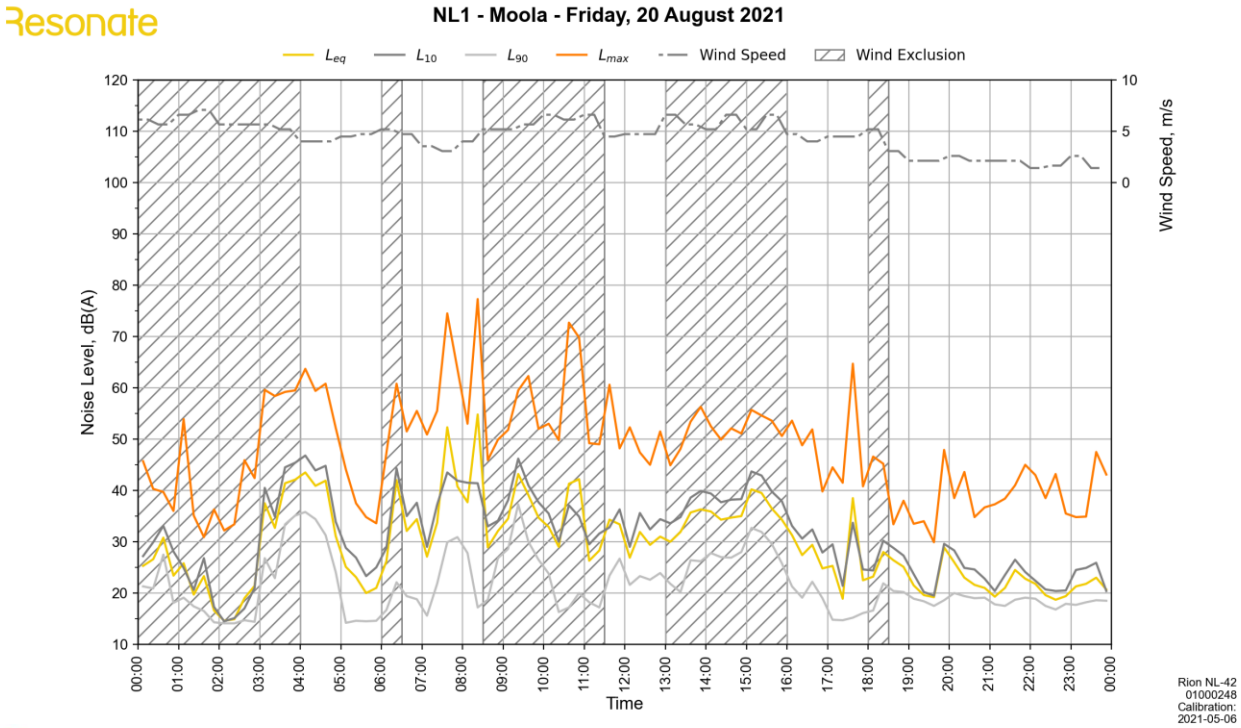
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Calibration:
2021-05-06

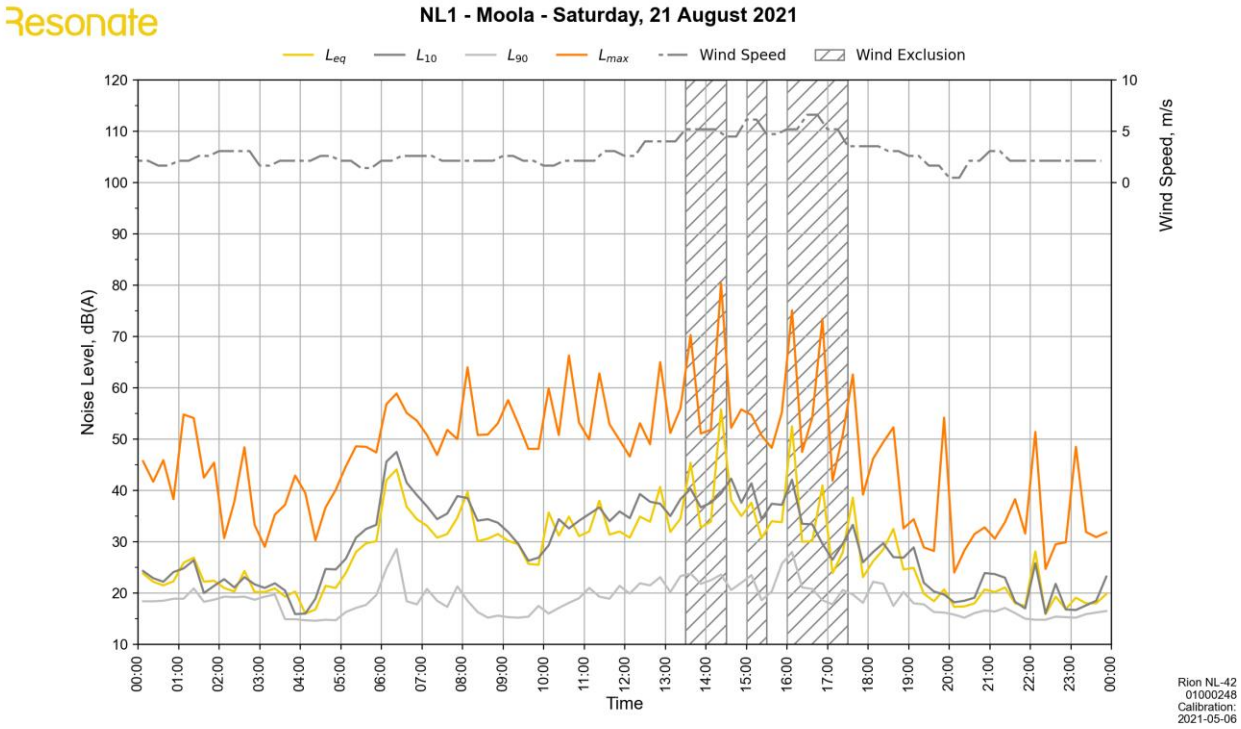
Resonate

NL1 - Moola - Thursday, 19 August 2021

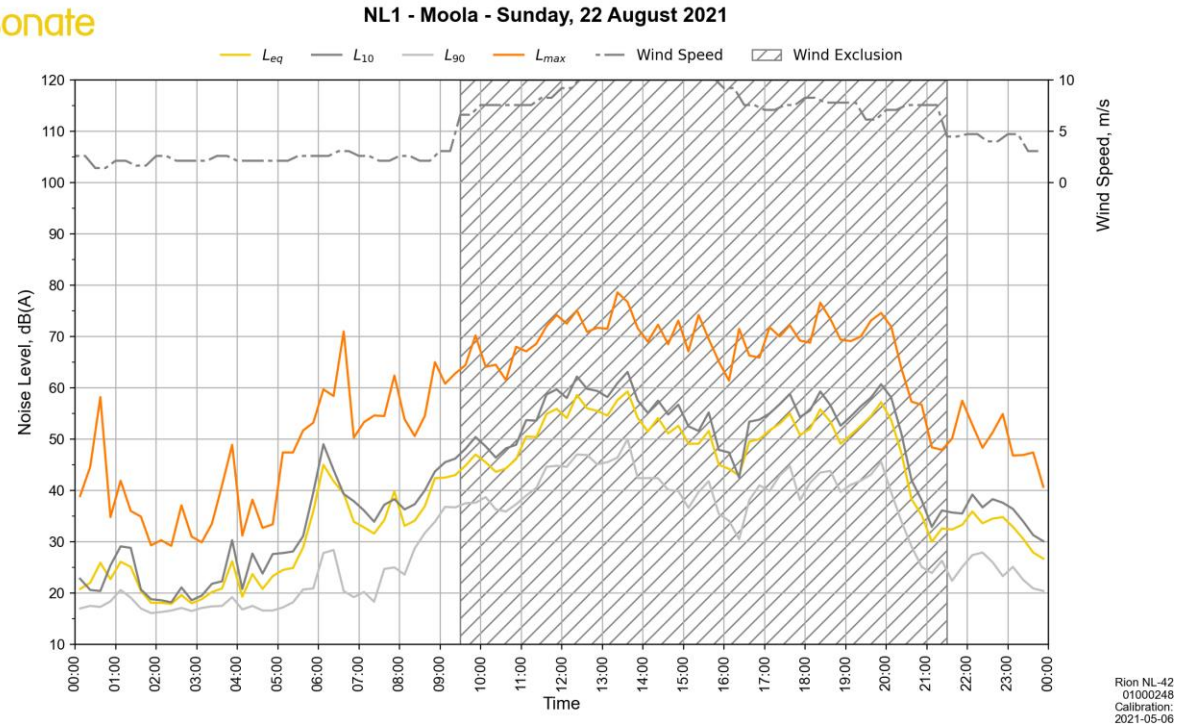


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Calibration:
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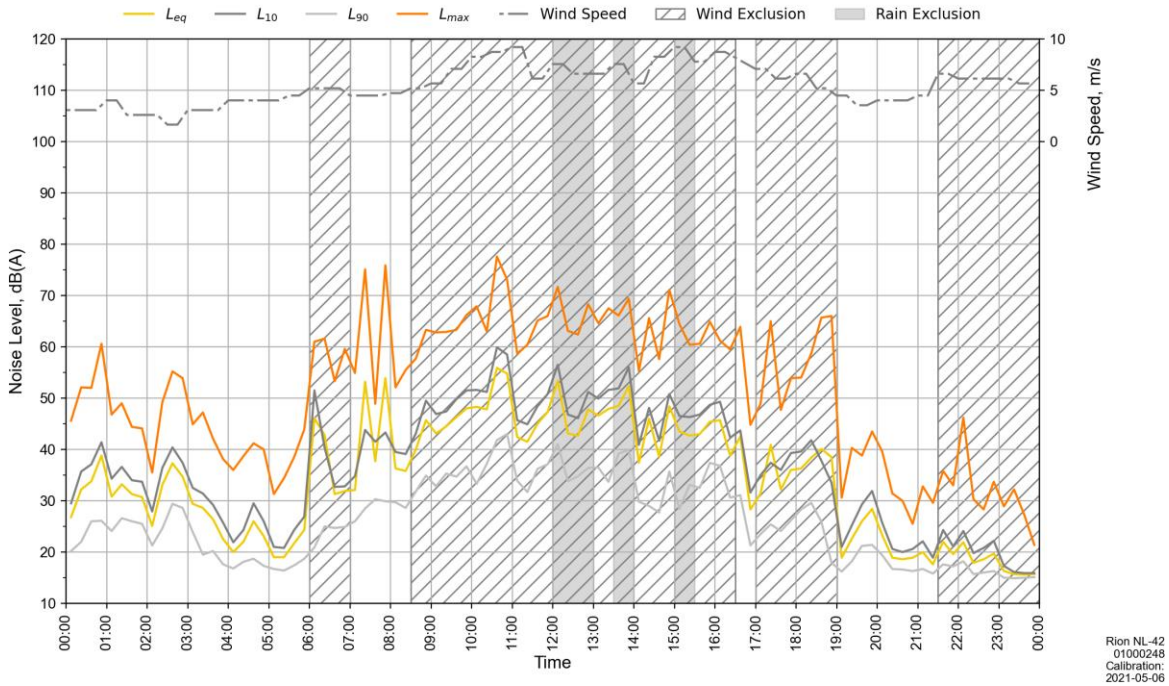

Resonate
NL1 - Moola - Friday, 20 August 2021
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000248
Calibration:
2021-05-06


Resonate
NL1 - Moola - Saturday, 21 August 2021
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
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Rion NL-42
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Calibration:
2021-05-06

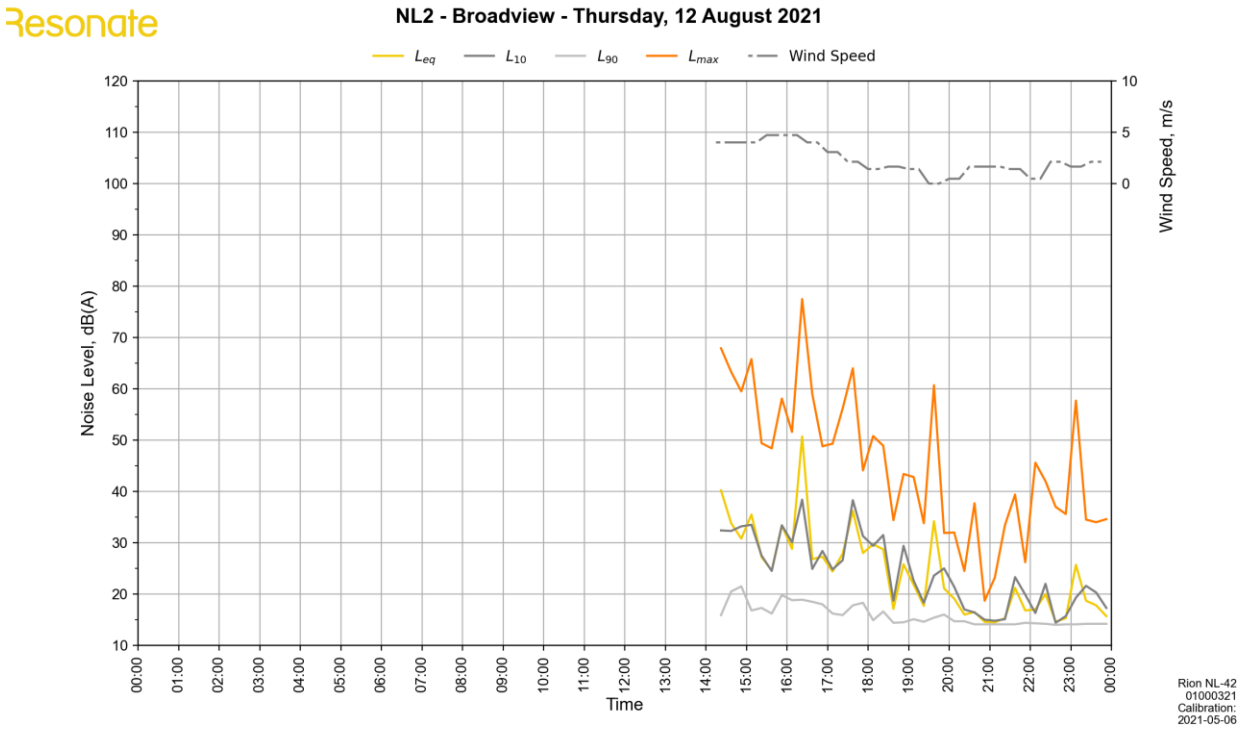
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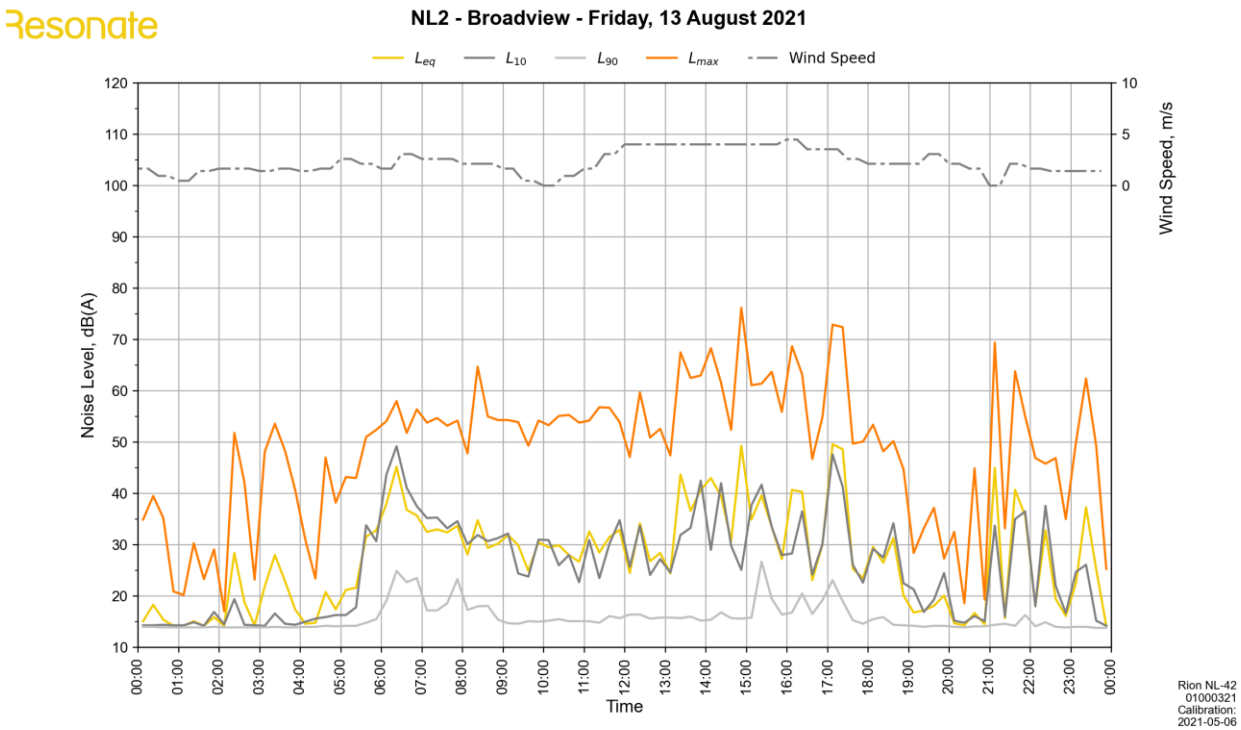


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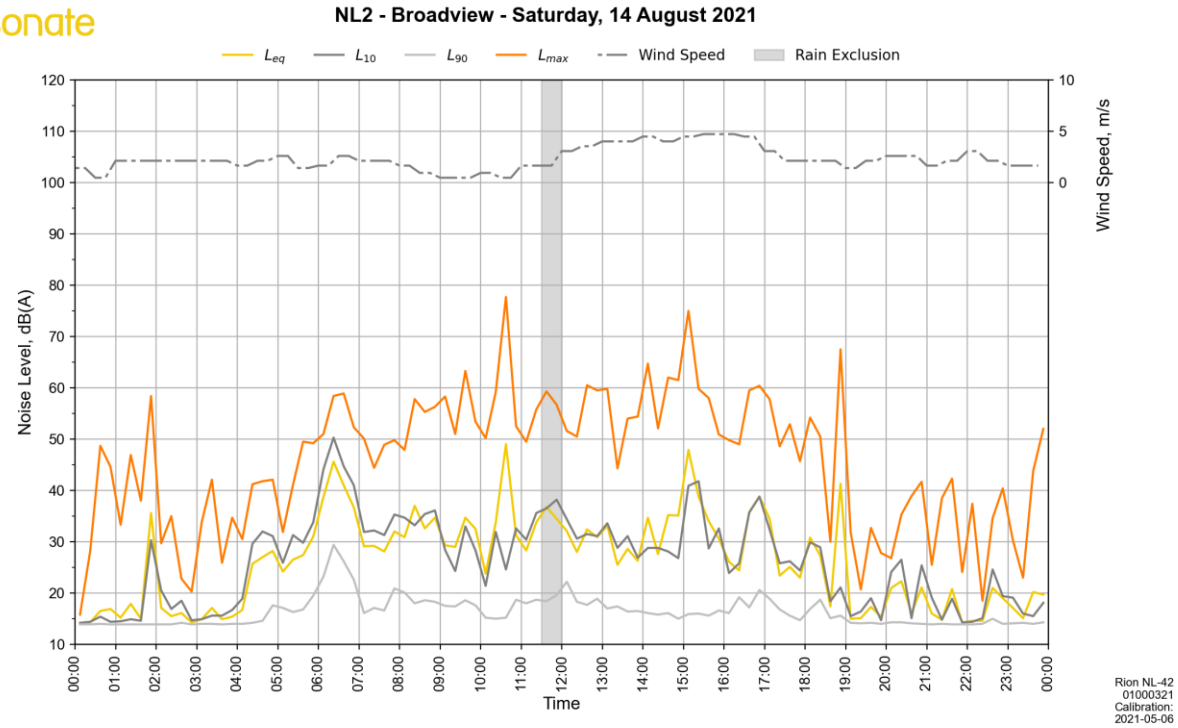


NL2 – Broadview

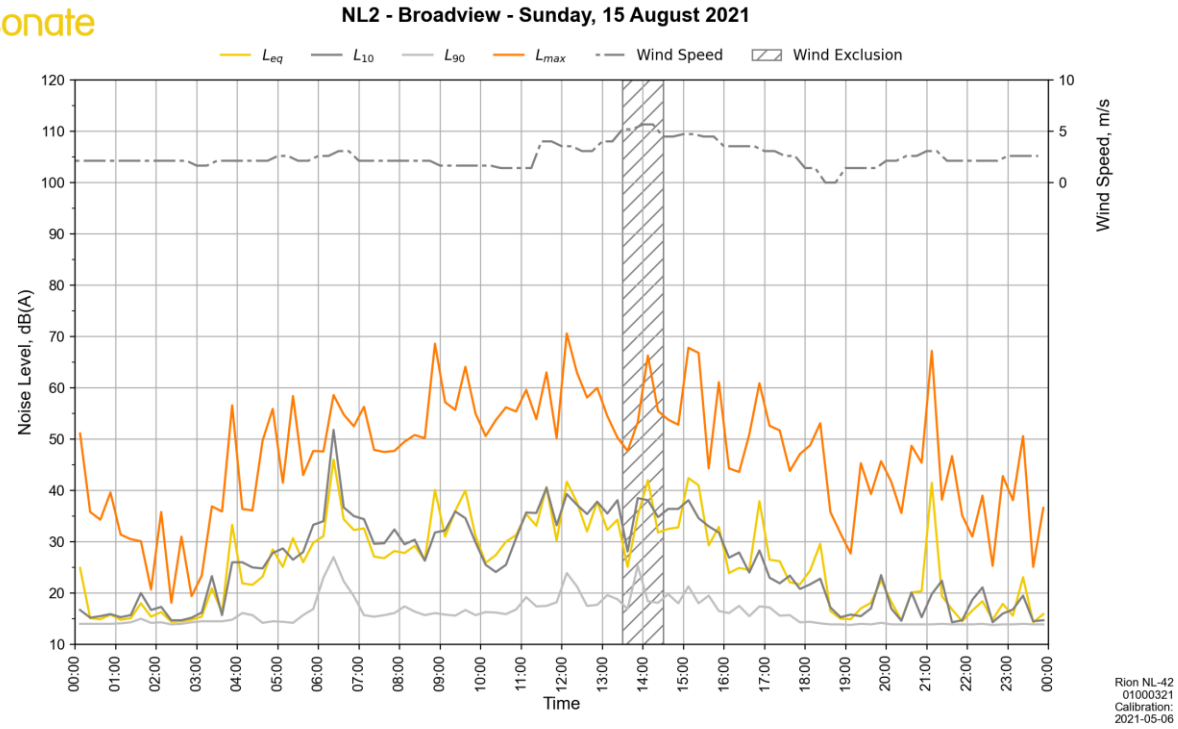


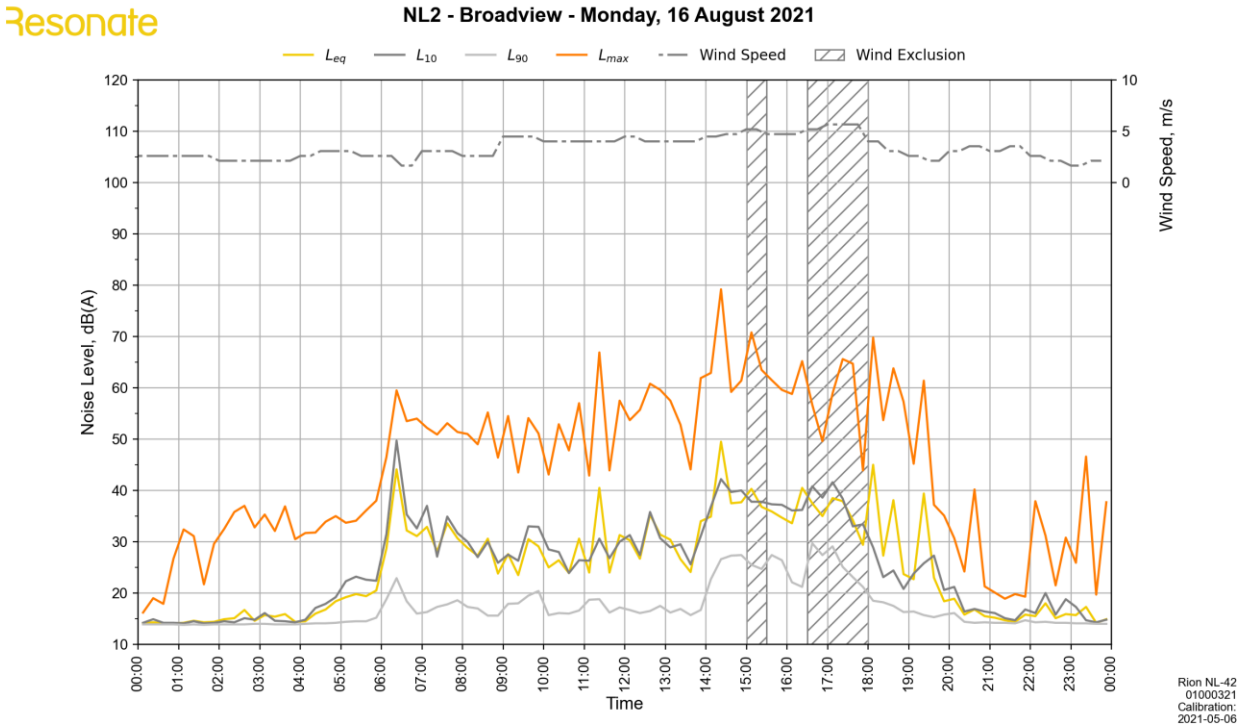


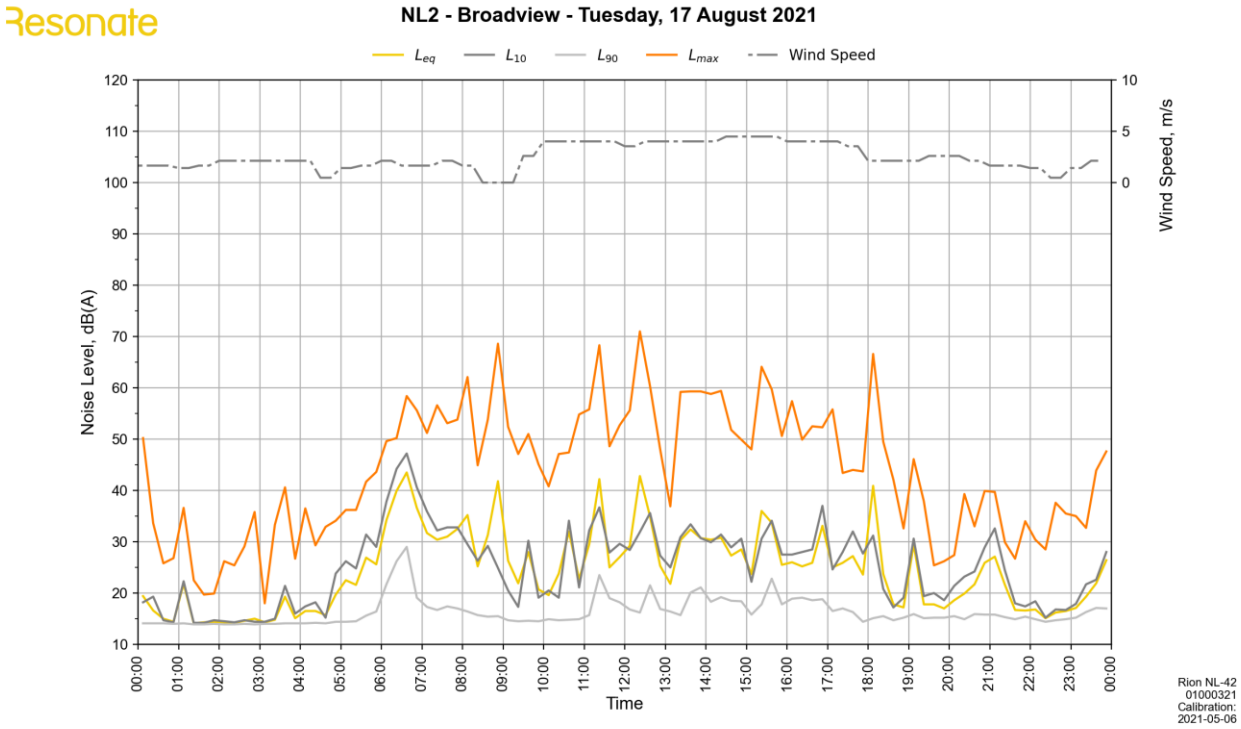
Resonate



Resonate

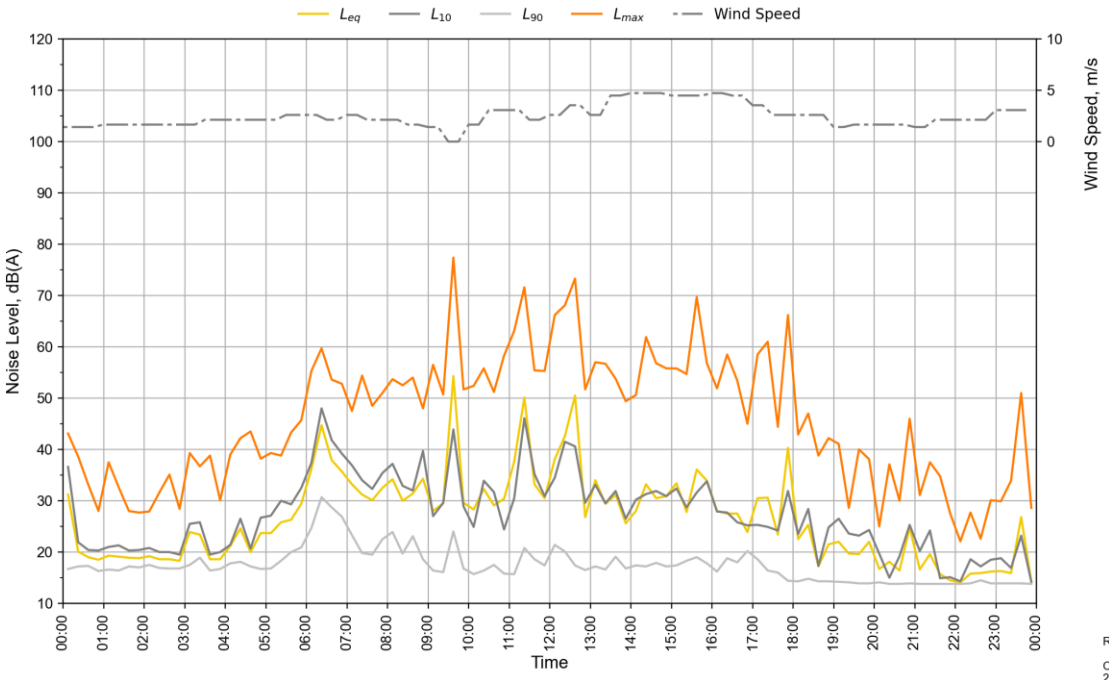



Resonate
NL2 - Broadview - Monday, 16 August 2021
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2021-05-06


Resonate
NL2 - Broadview - Tuesday, 17 August 2021
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2021-05-06

Resonate

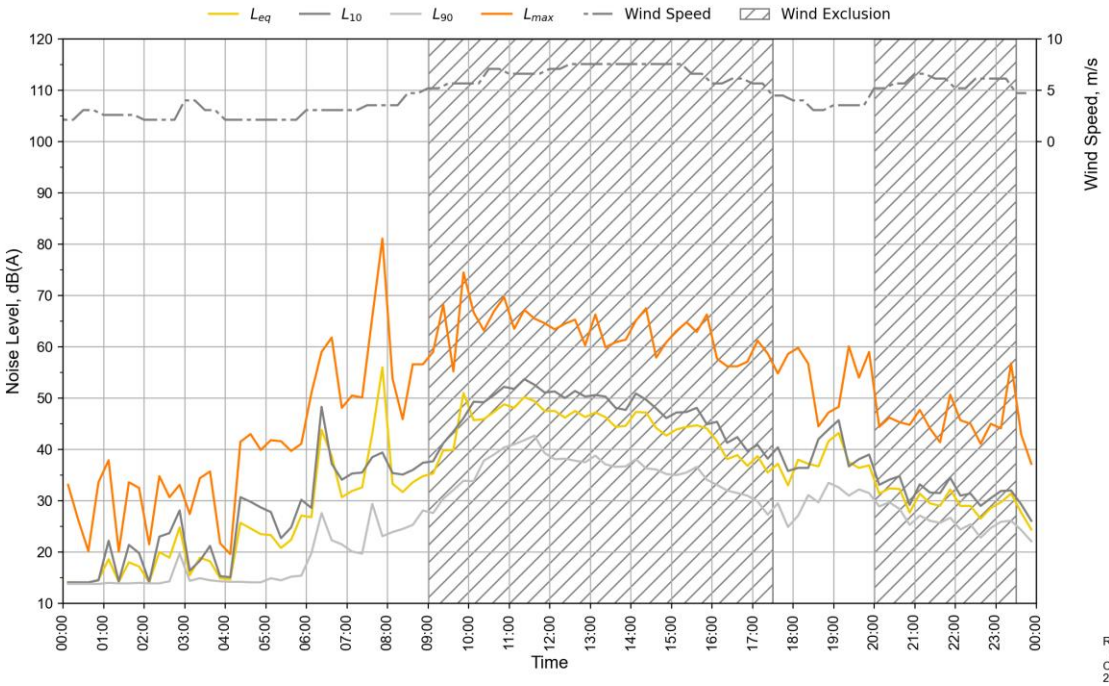
NL2 - Broadview - Wednesday, 18 August 2021



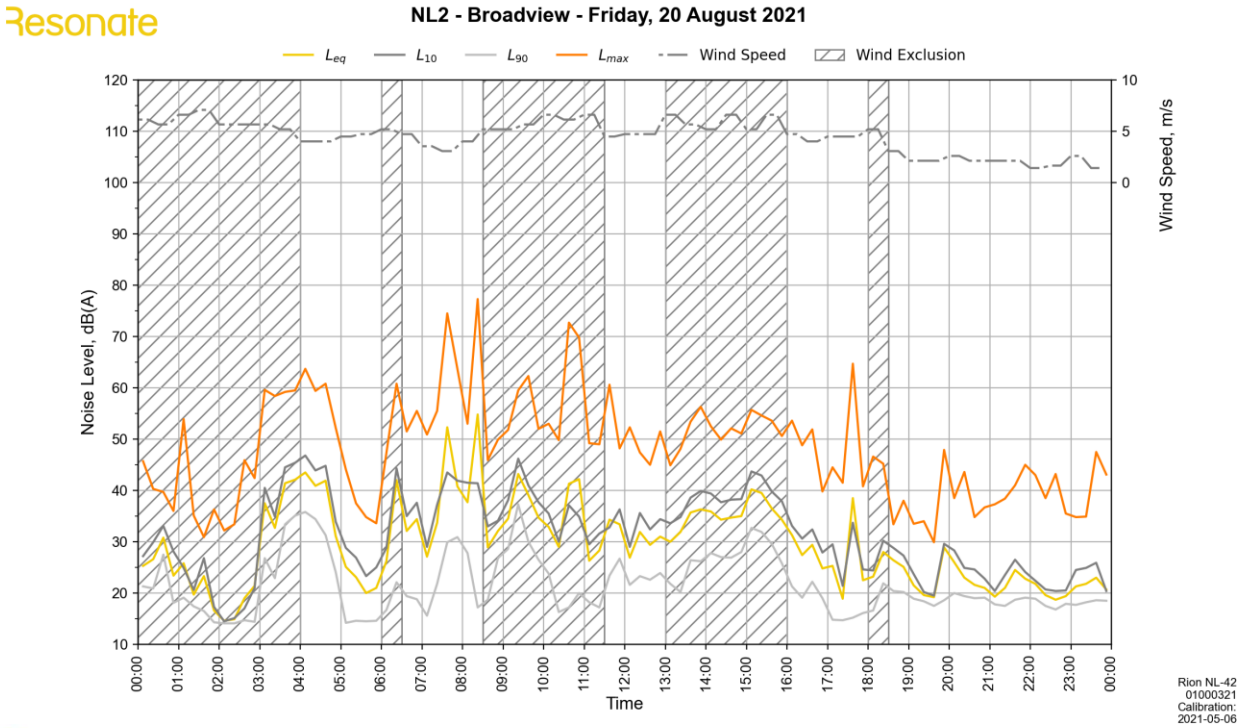
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Calibration:
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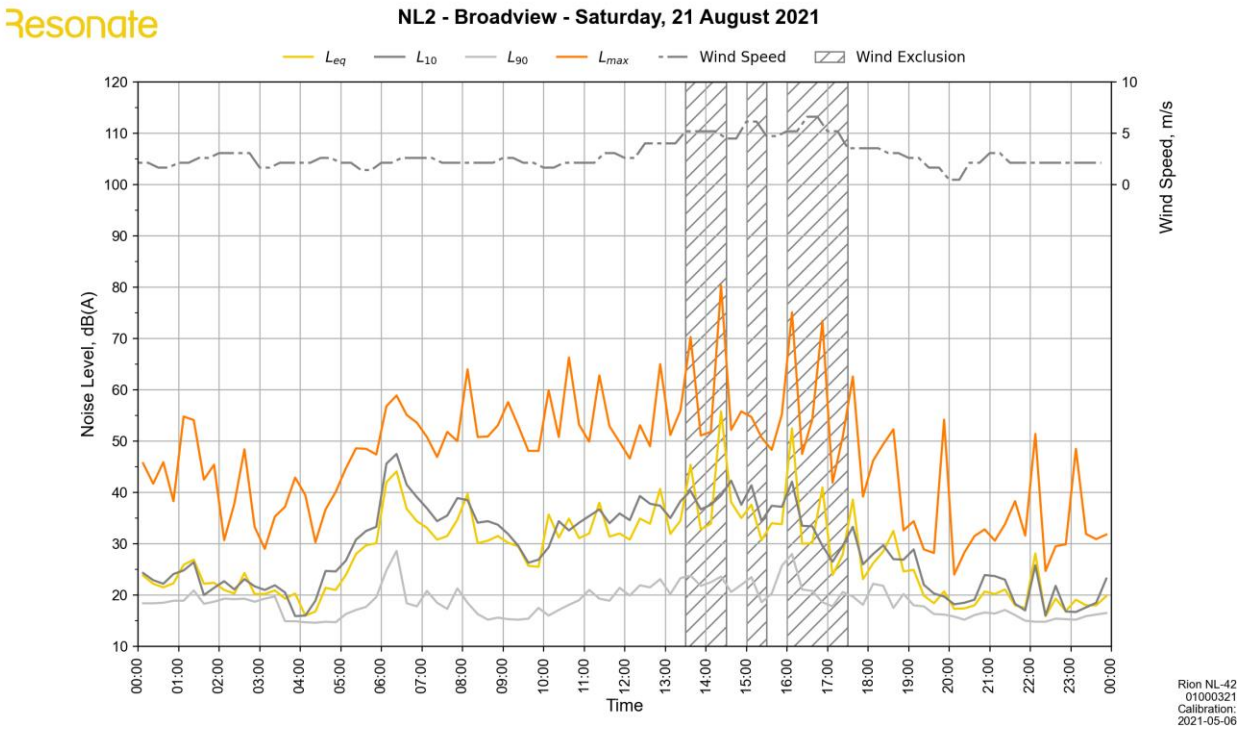
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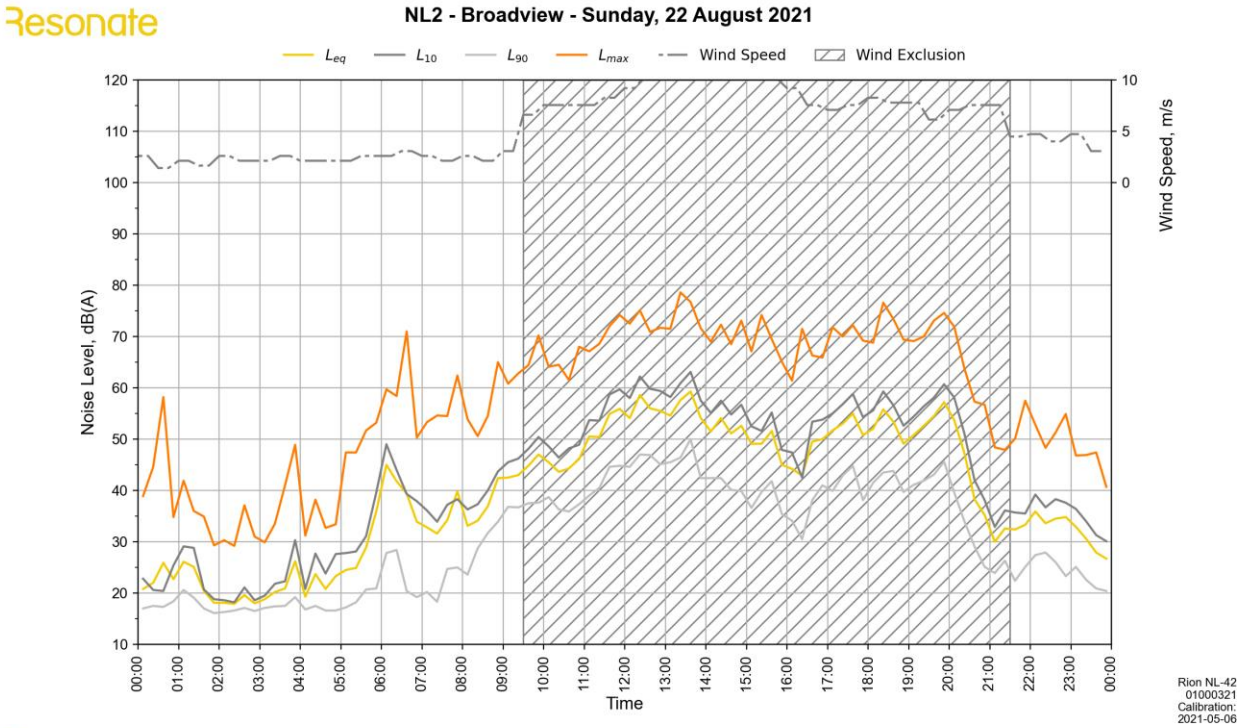
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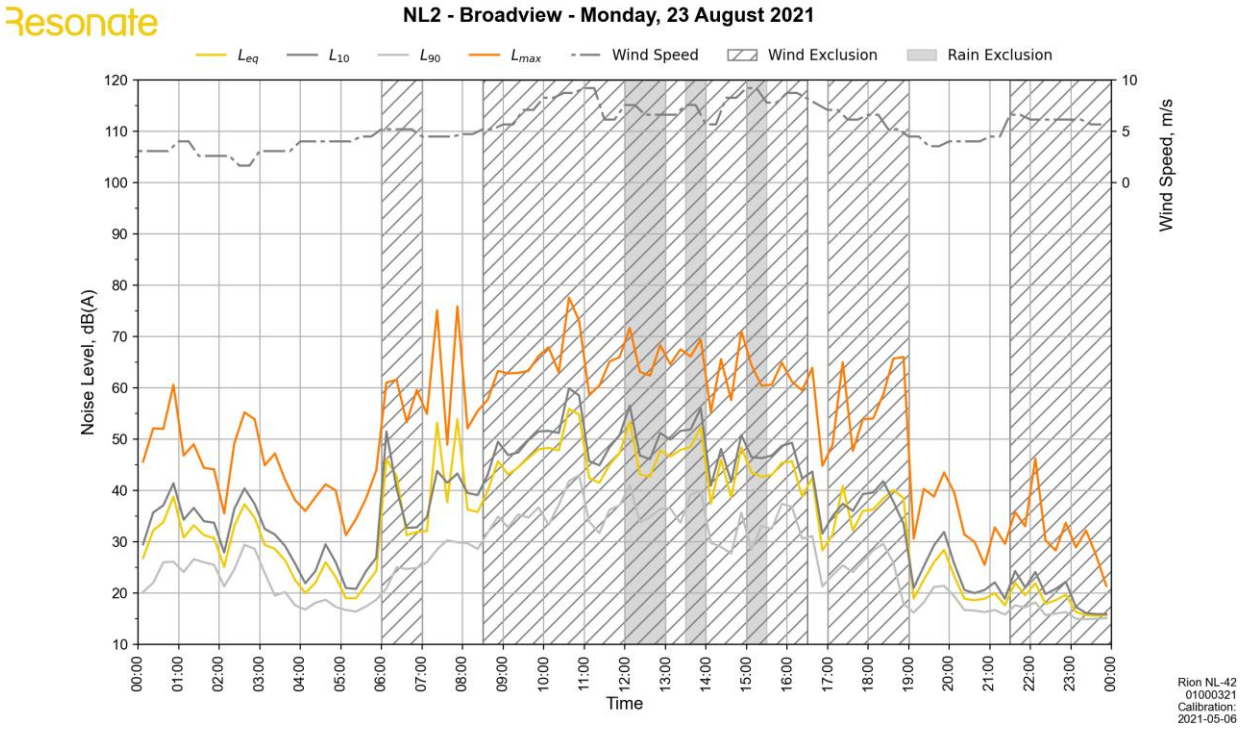


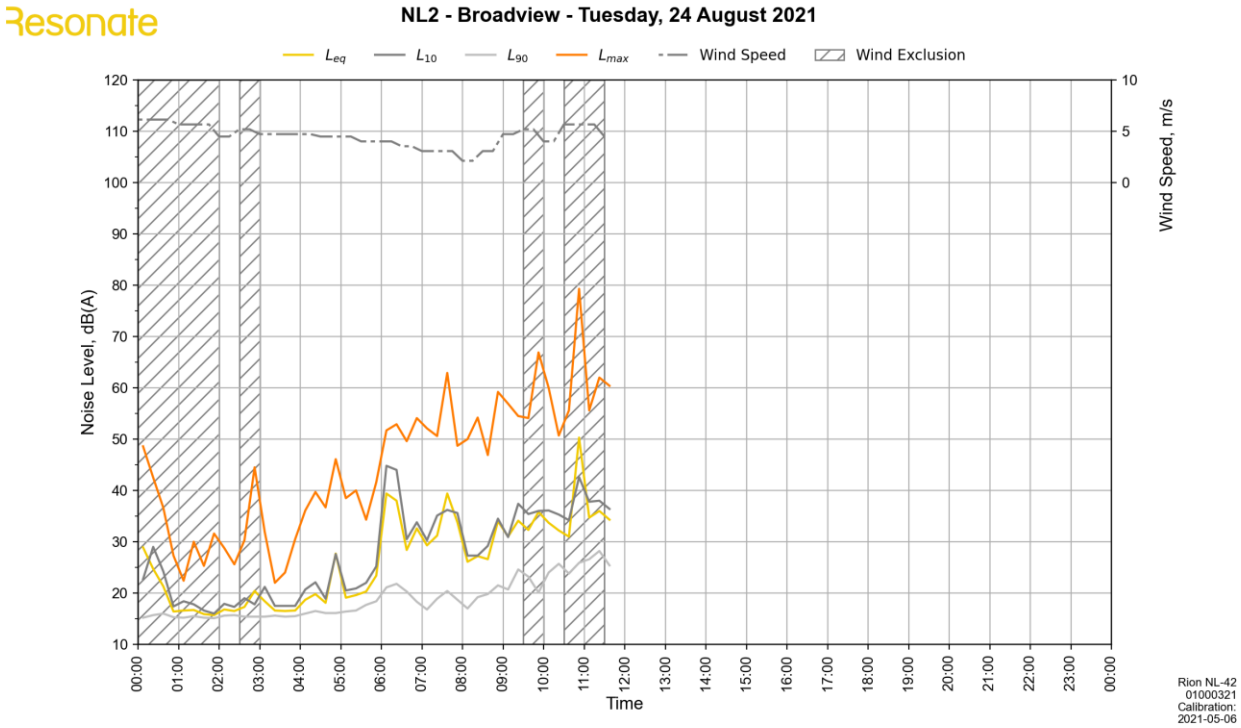
Rion NL-42
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Calibration:
2021-05-06


Resonate
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Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2021-05-06

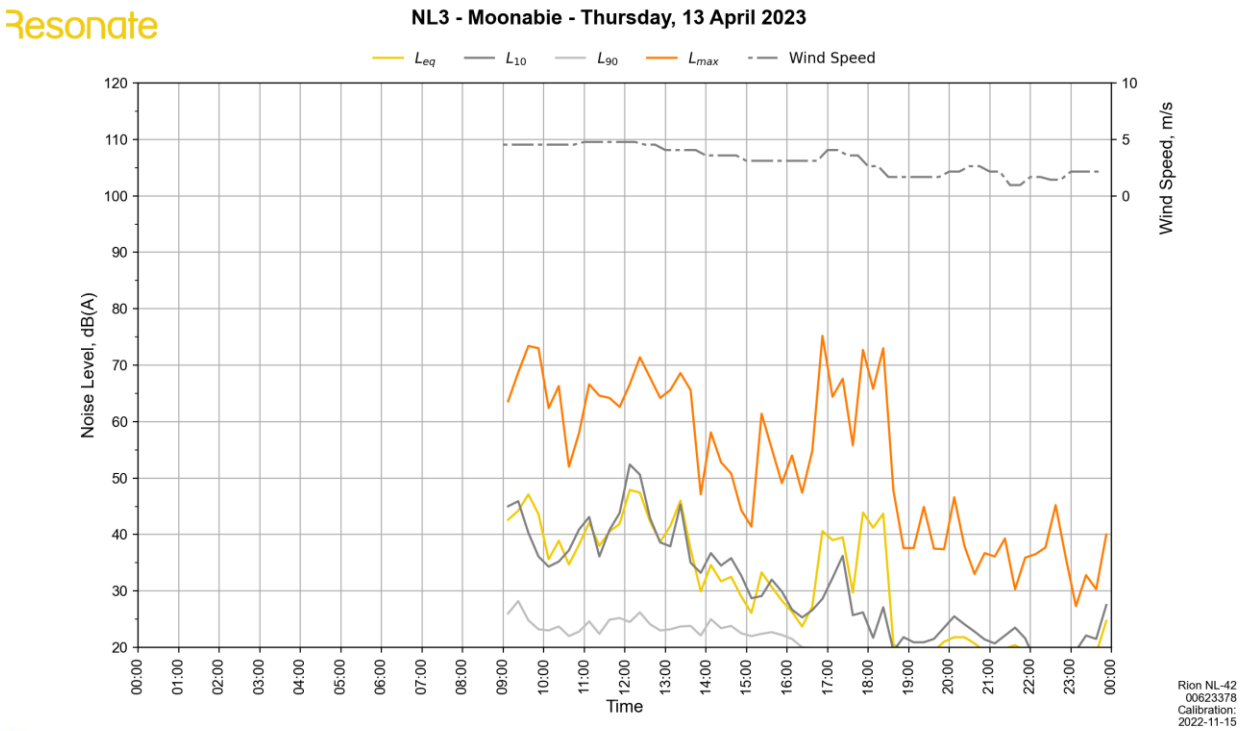

Resonate
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L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2021-05-06

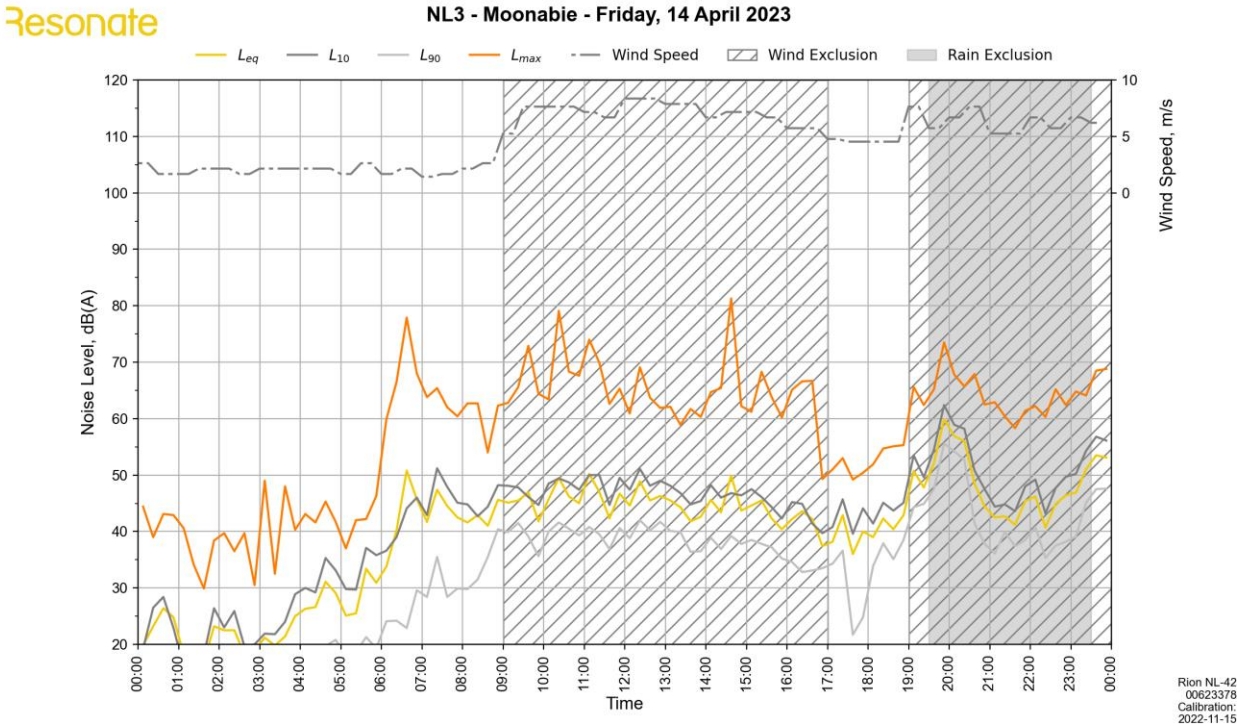

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Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2021-05-06

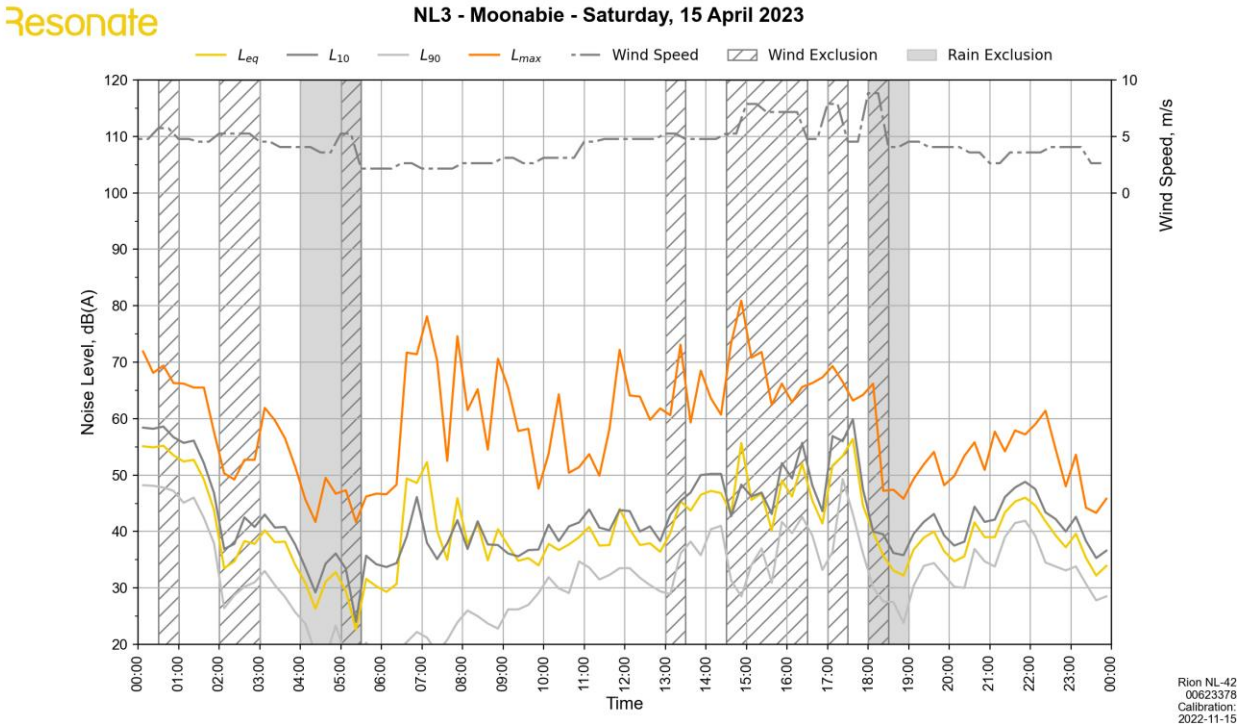

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NL2 - Broadview - Monday, 23 August 2021
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2021-05-06

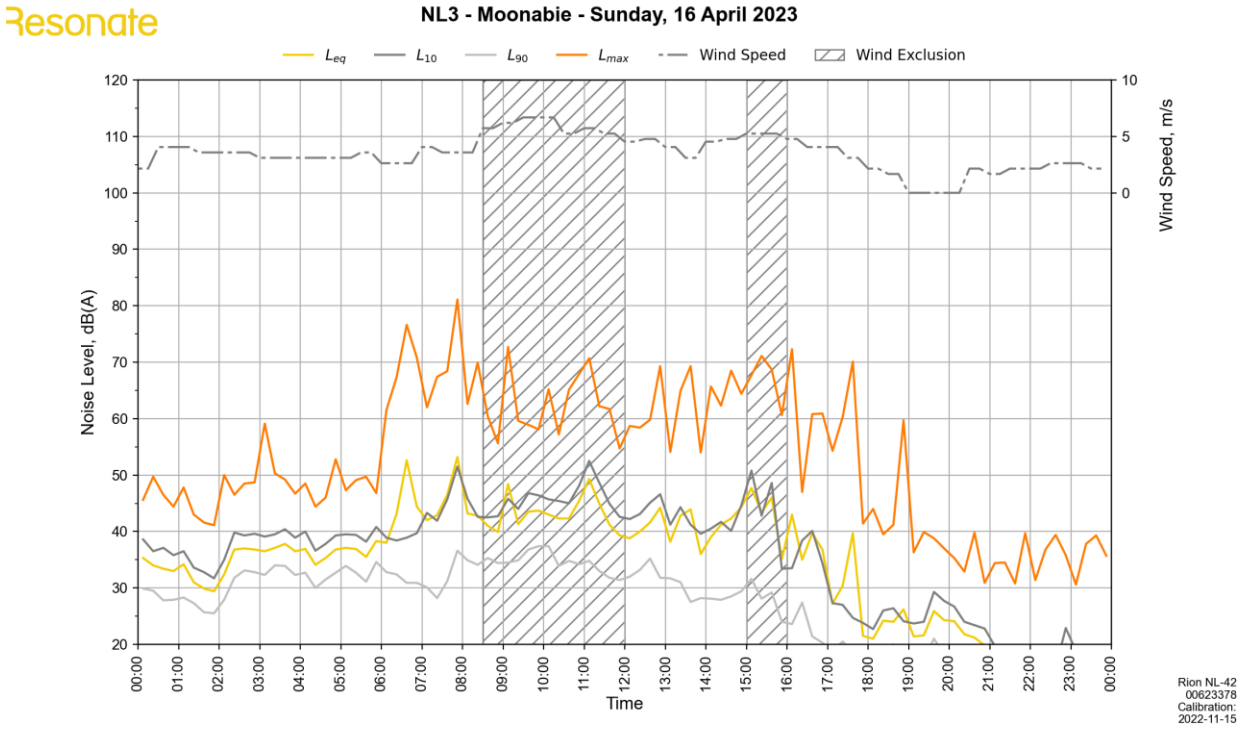

Resonate
NL2 - Broadview - Tuesday, 24 August 2021
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2021-05-06

NL3 – Moonabie

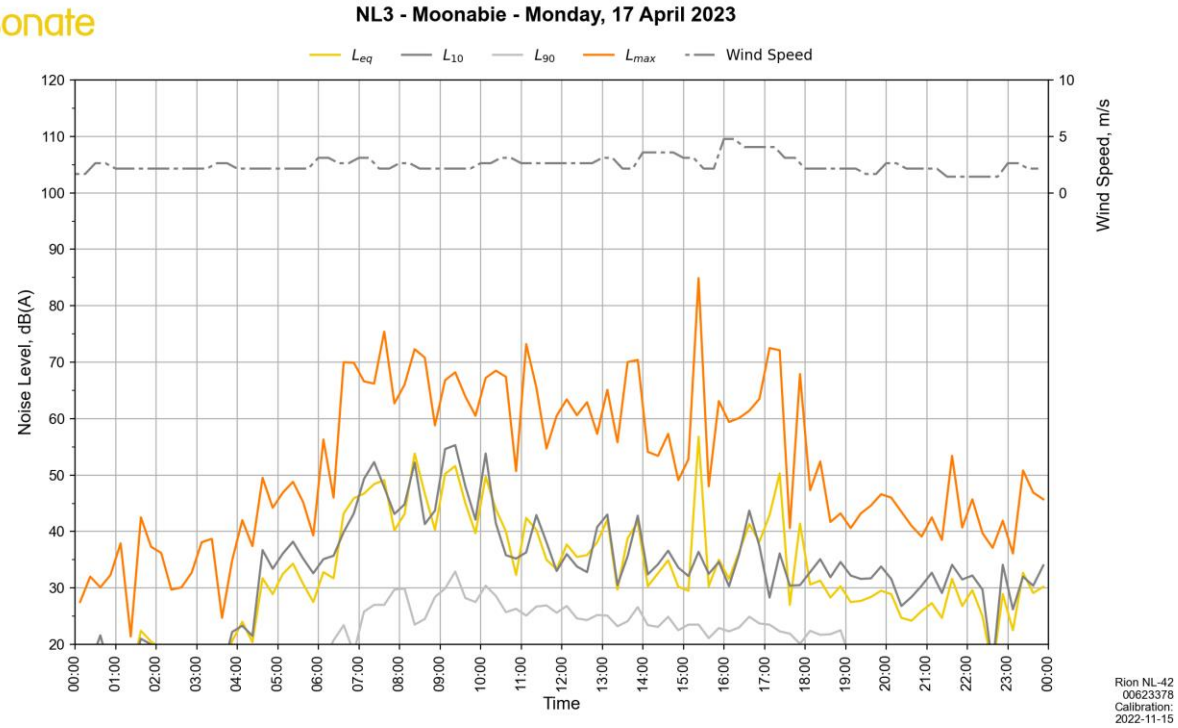




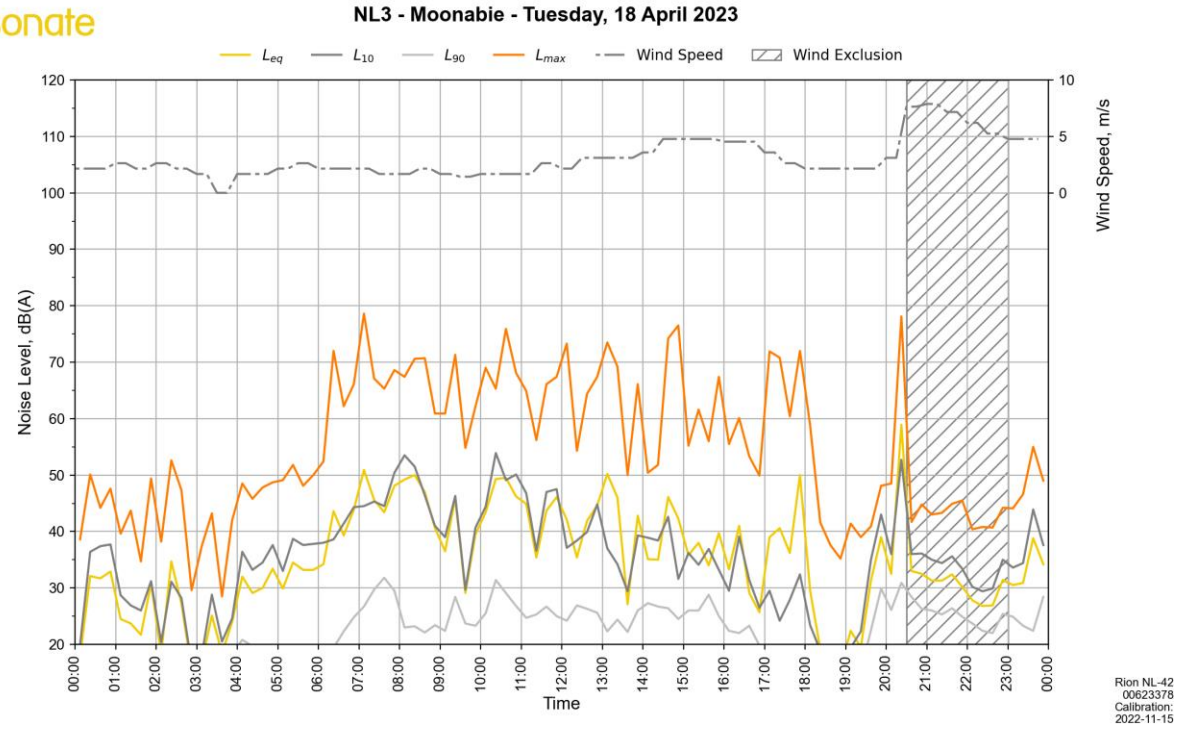

Resonate
NL3 - Moonabie - Saturday, 15 April 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00623378
Calibration:
2022-11-15

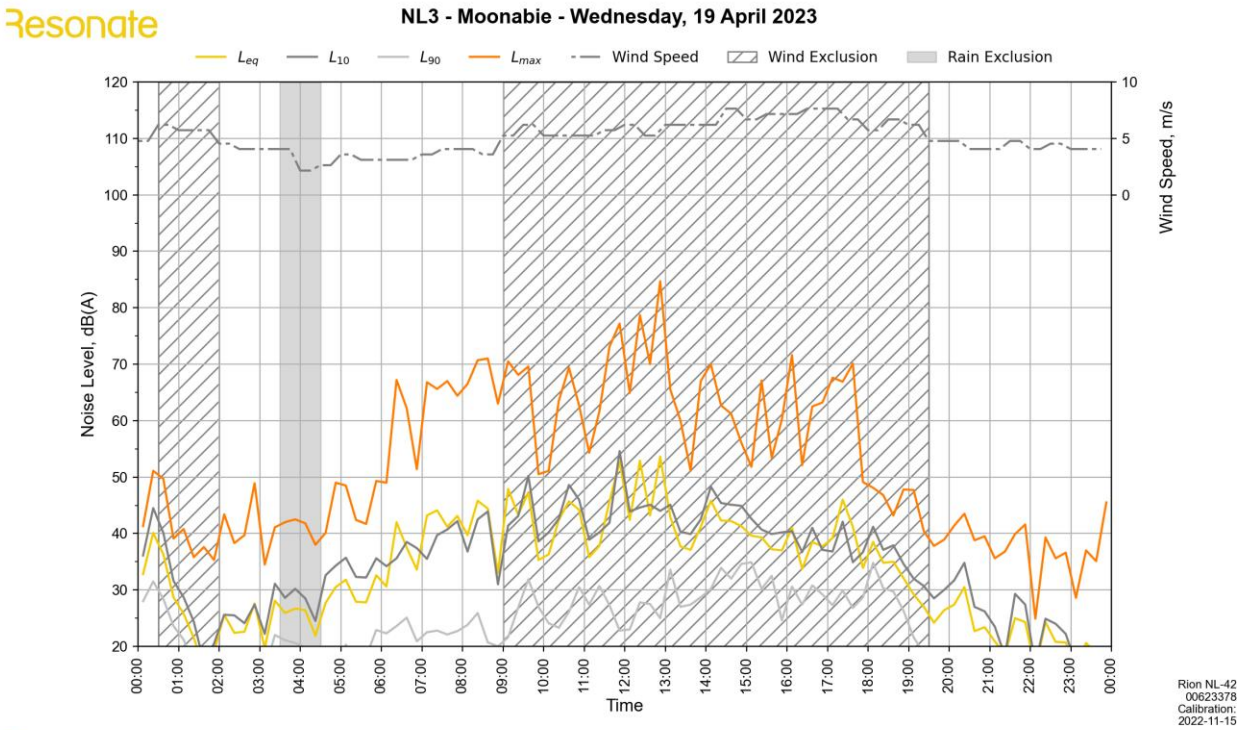

Resonate
NL3 - Moonabie - Sunday, 16 April 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00623378
Calibration:
2022-11-15

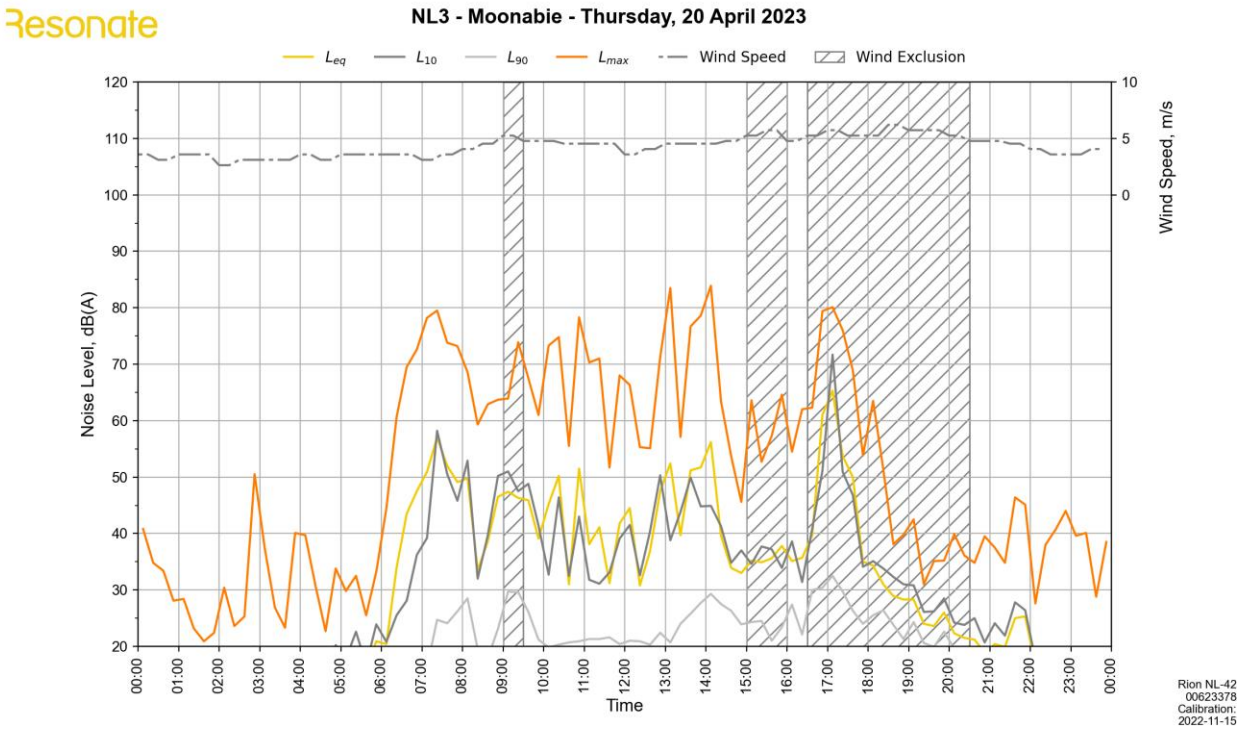
Resonate



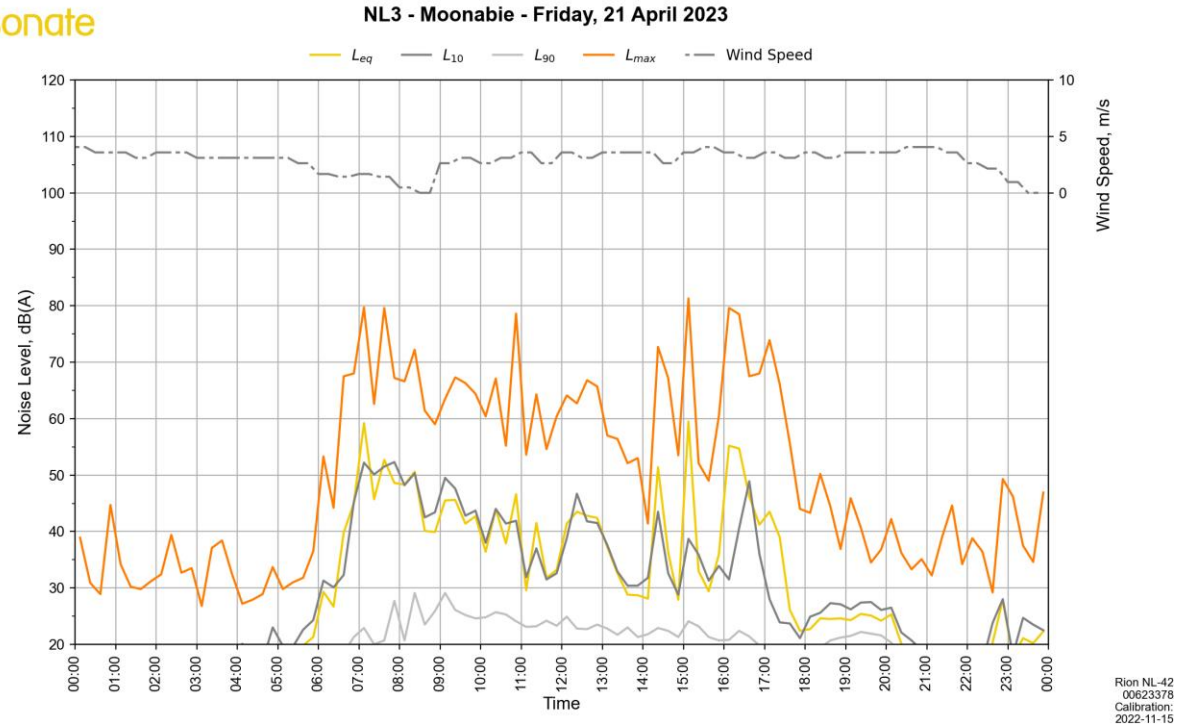
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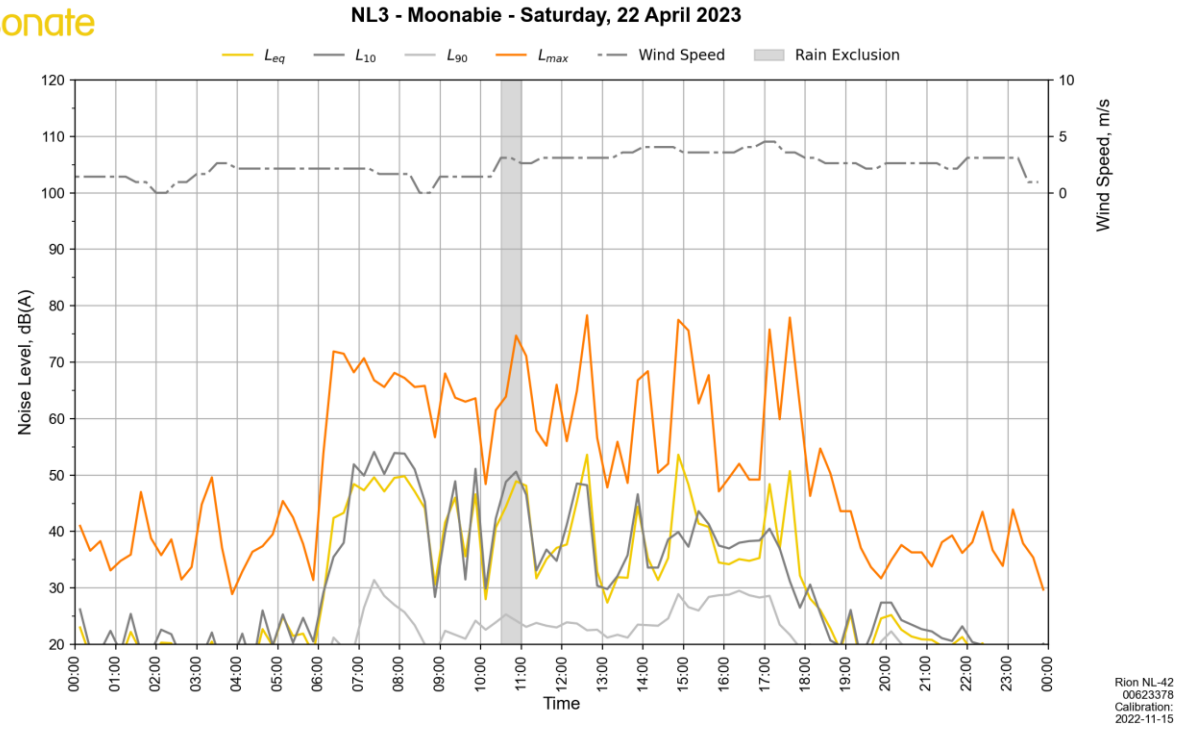

Resonate
NL3 - Moonabie - Wednesday, 19 April 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00623378
Calibration:
2022-11-15


Resonate
NL3 - Moonabie - Thursday, 20 April 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00623378
Calibration:
2022-11-15

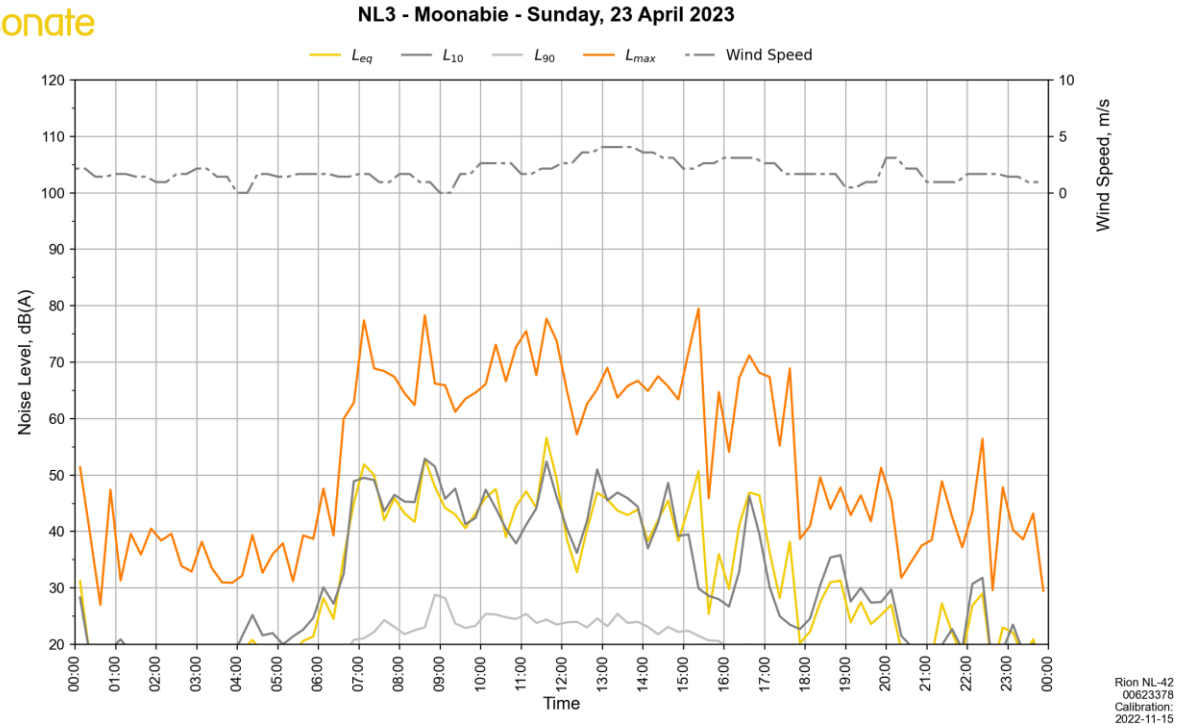
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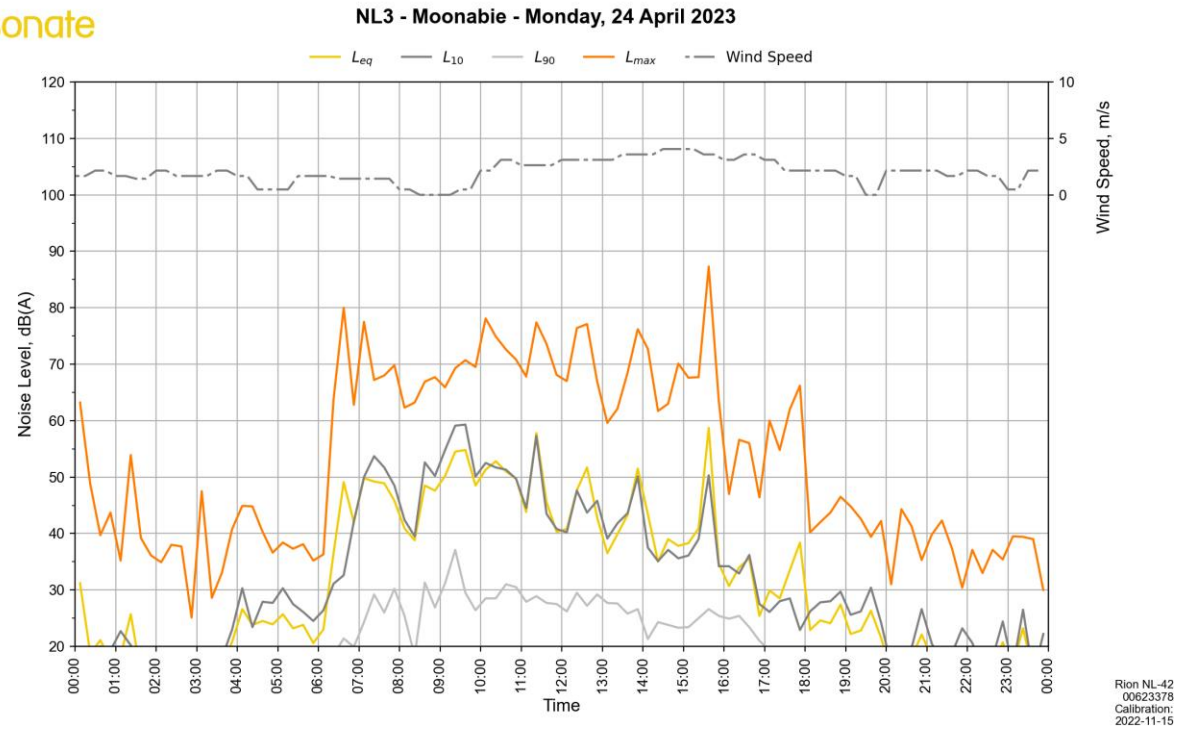
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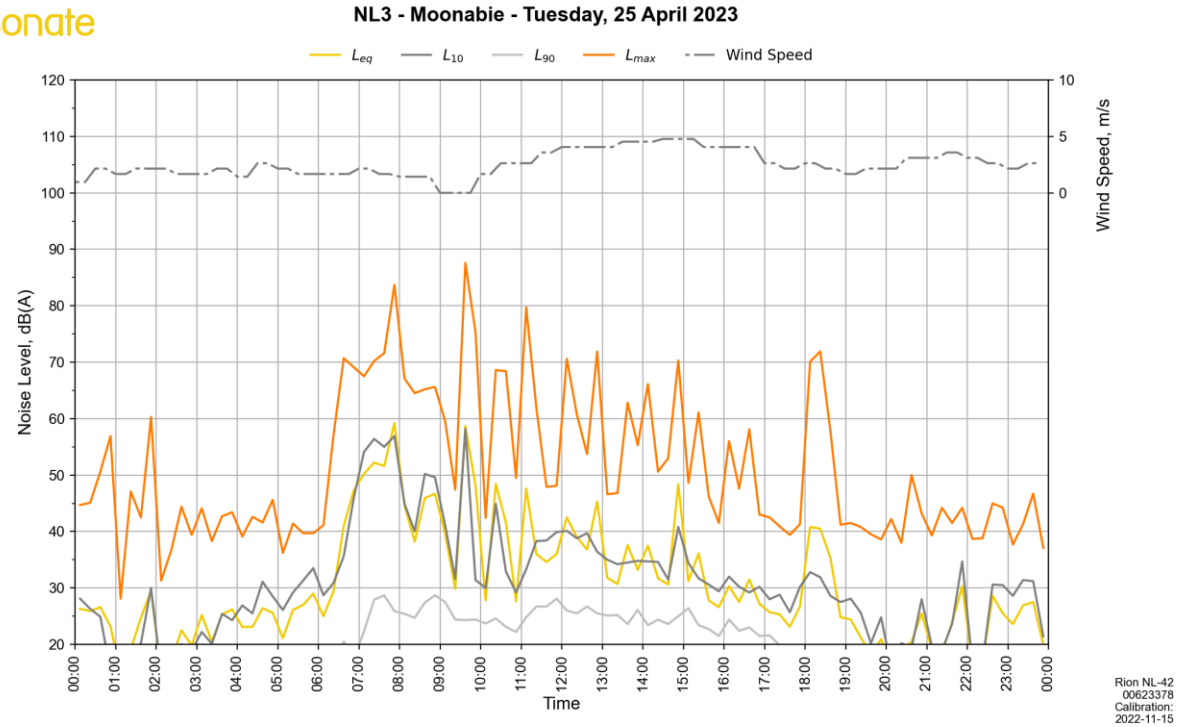
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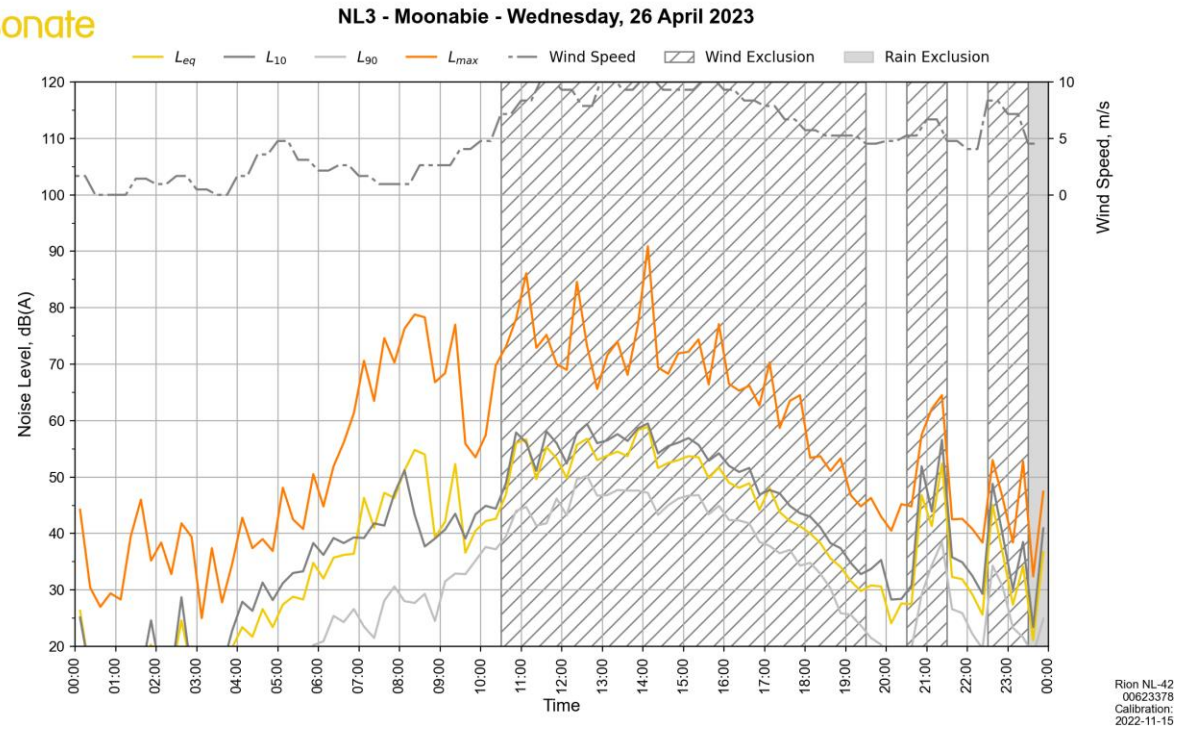
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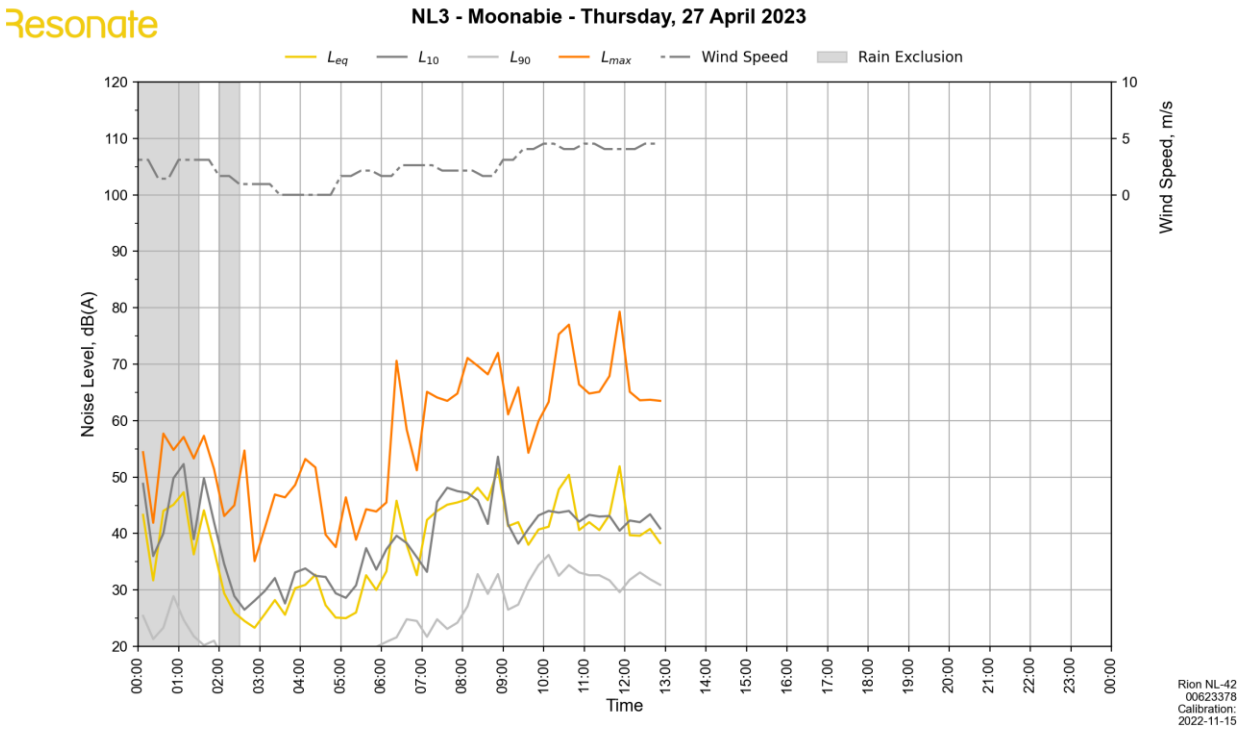


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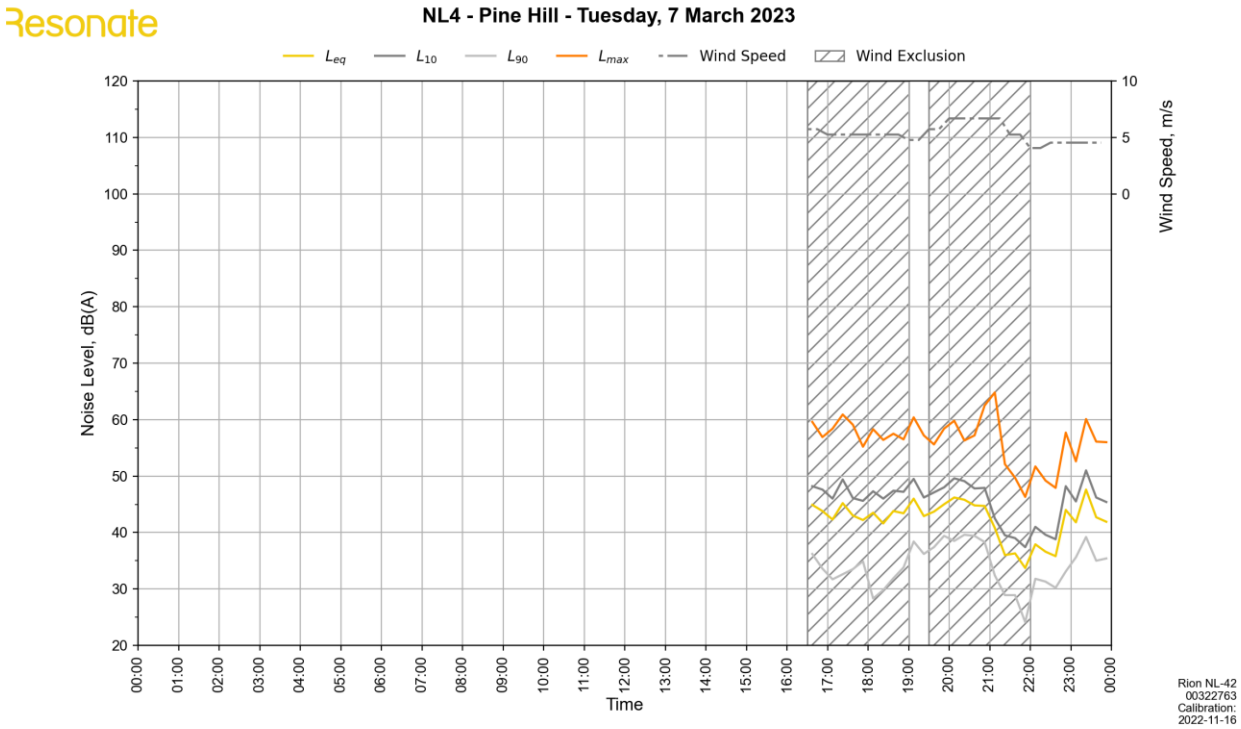


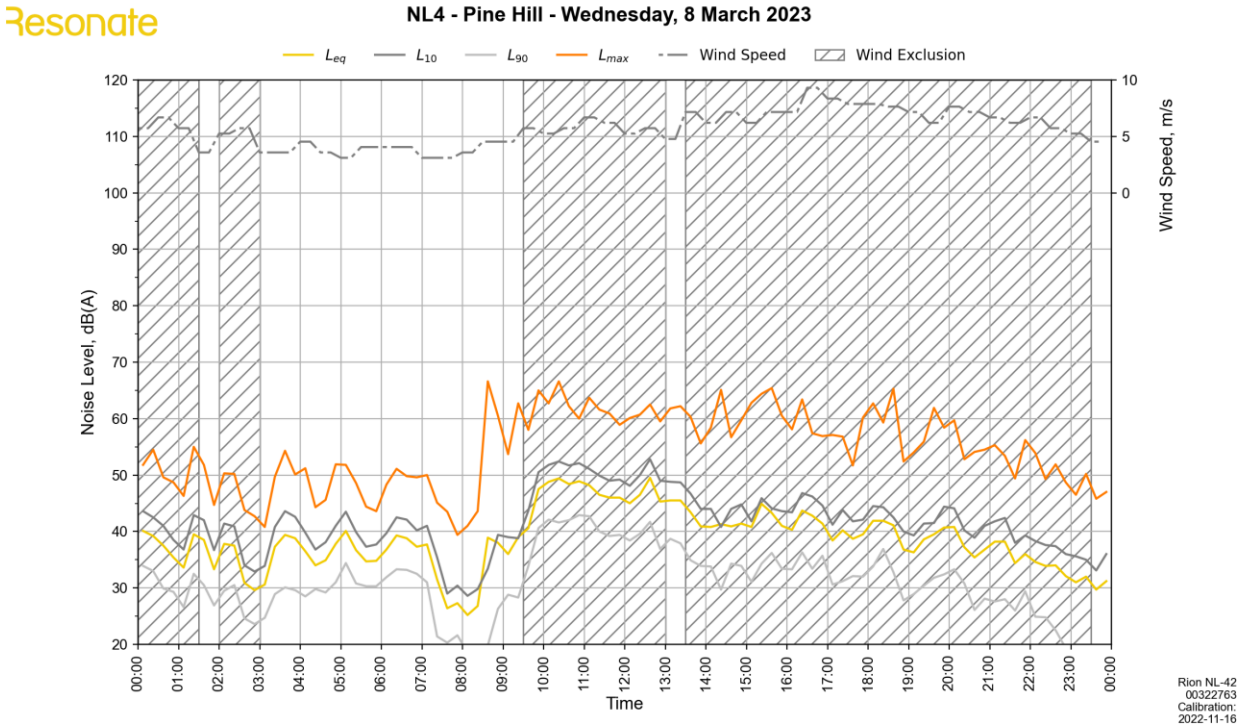
Resonate




Resonate
NL3 - Moonabie - Thursday, 27 April 2023
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00623378
Calibration:
2022-11-15

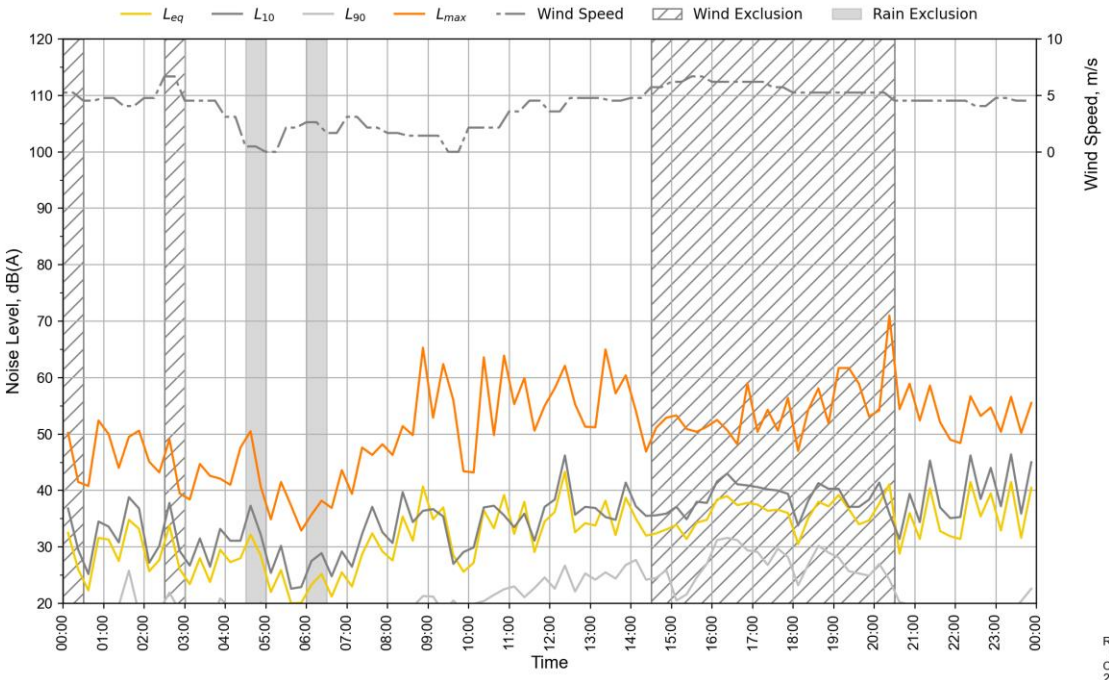
NL4 - Pine Hill





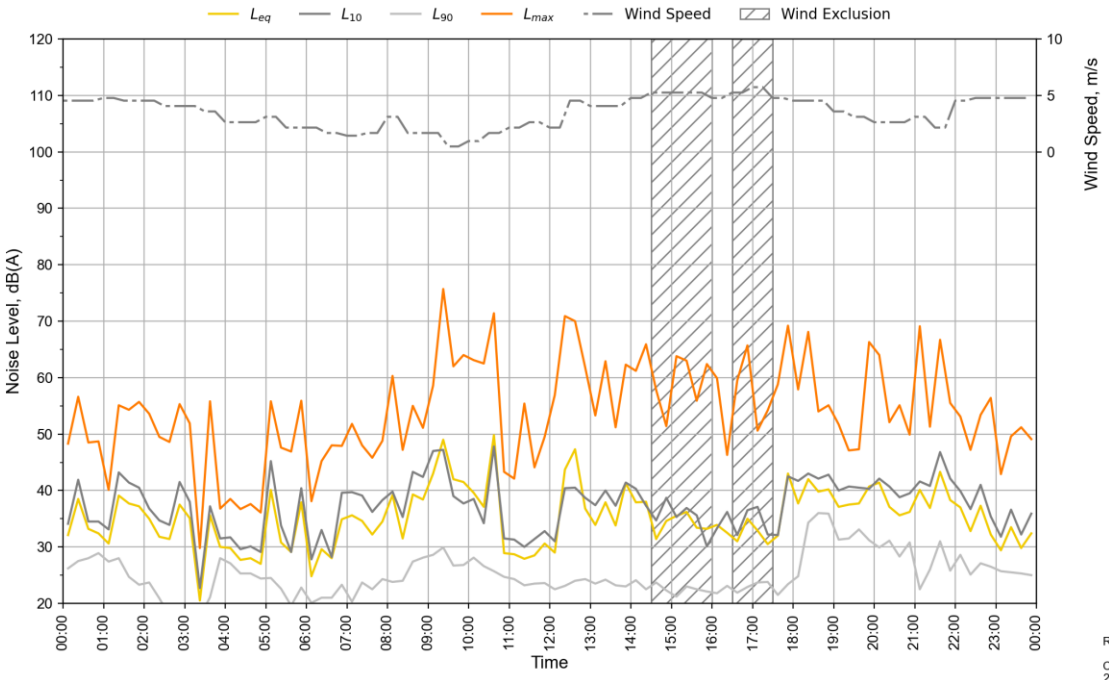
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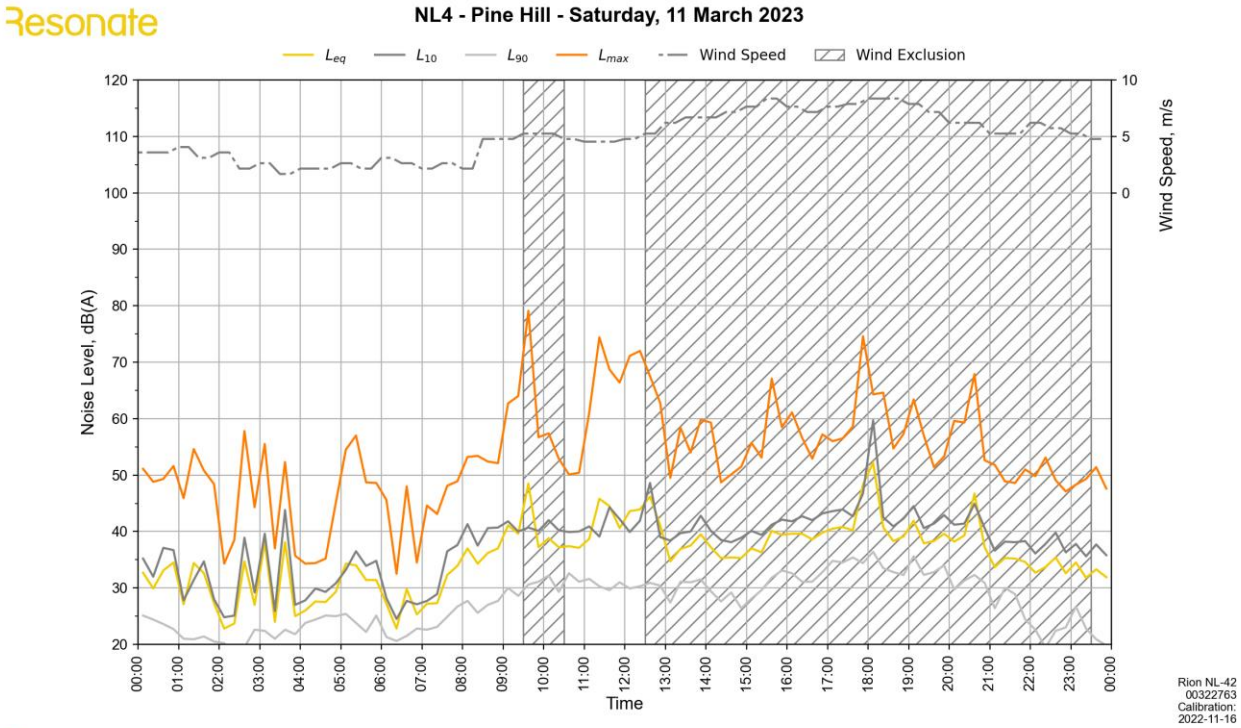
NL4 - Pine Hill - Thursday, 9 March 2023

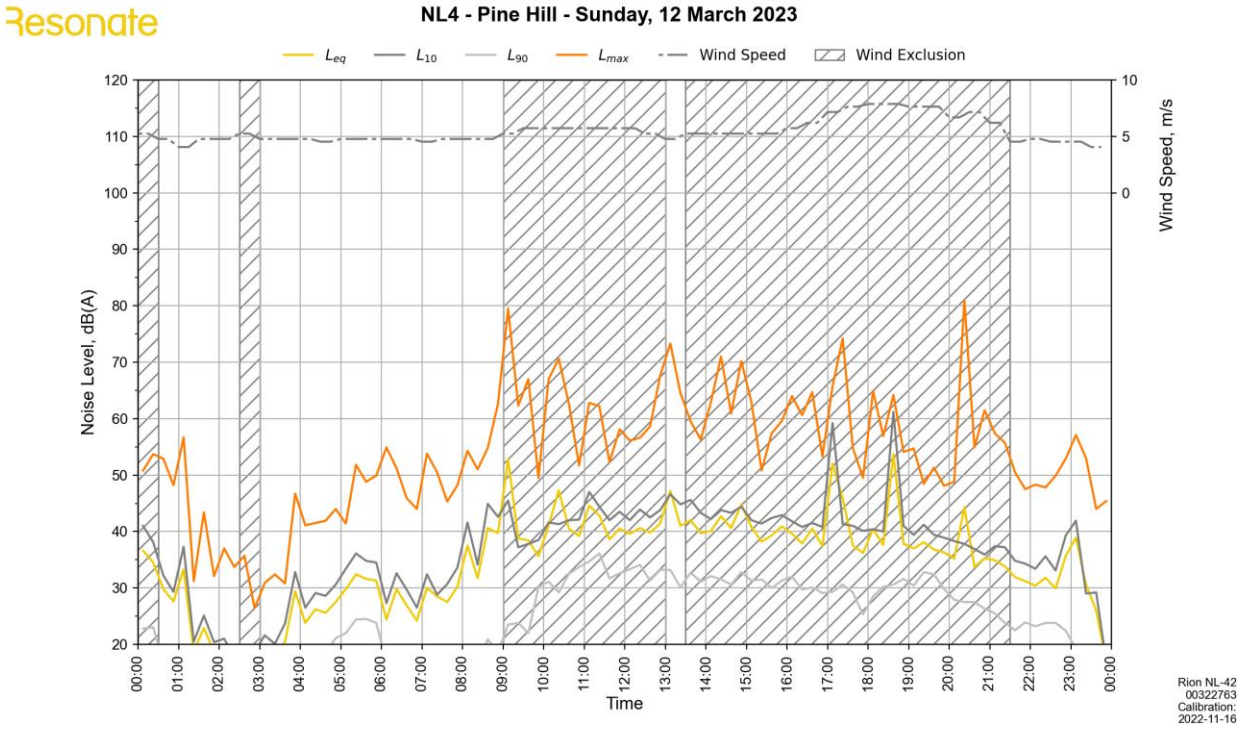


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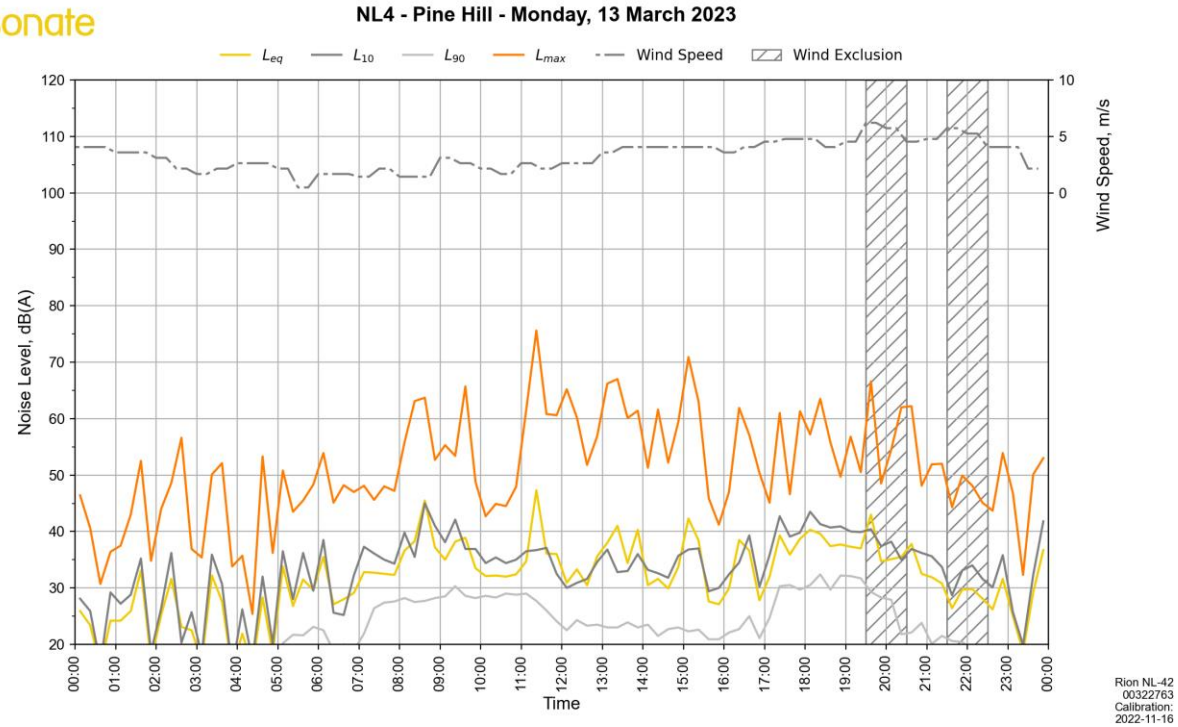
NL4 - Pine Hill - Friday, 10 March 2023



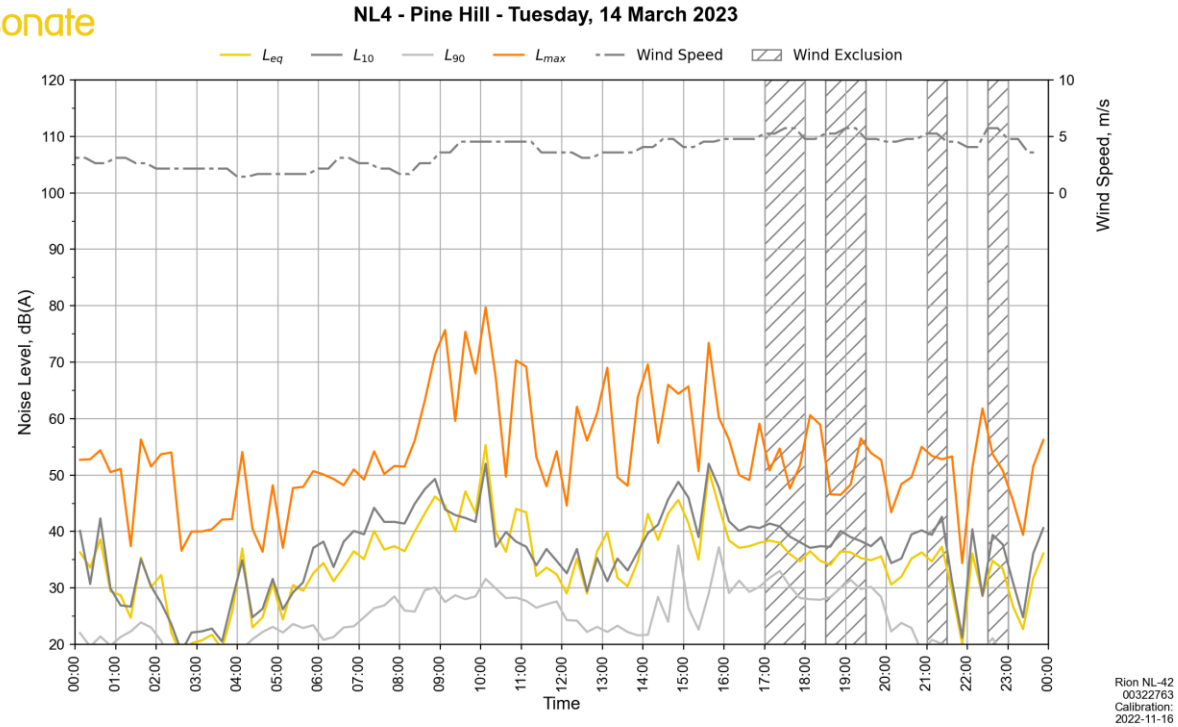

Resonate
NL4 - Pine Hill - Saturday, 11 March 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00322763
Calibration:
2022-11-16

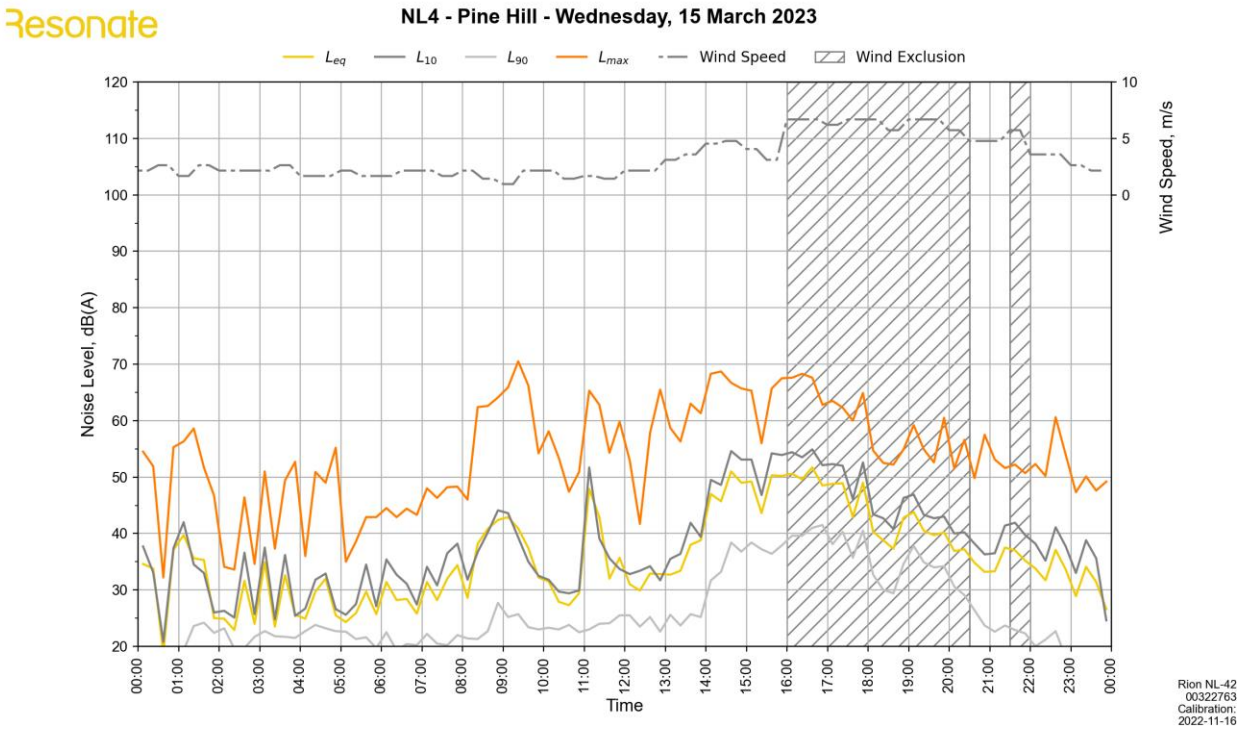

Resonate
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Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00322763
Calibration:
2022-11-16

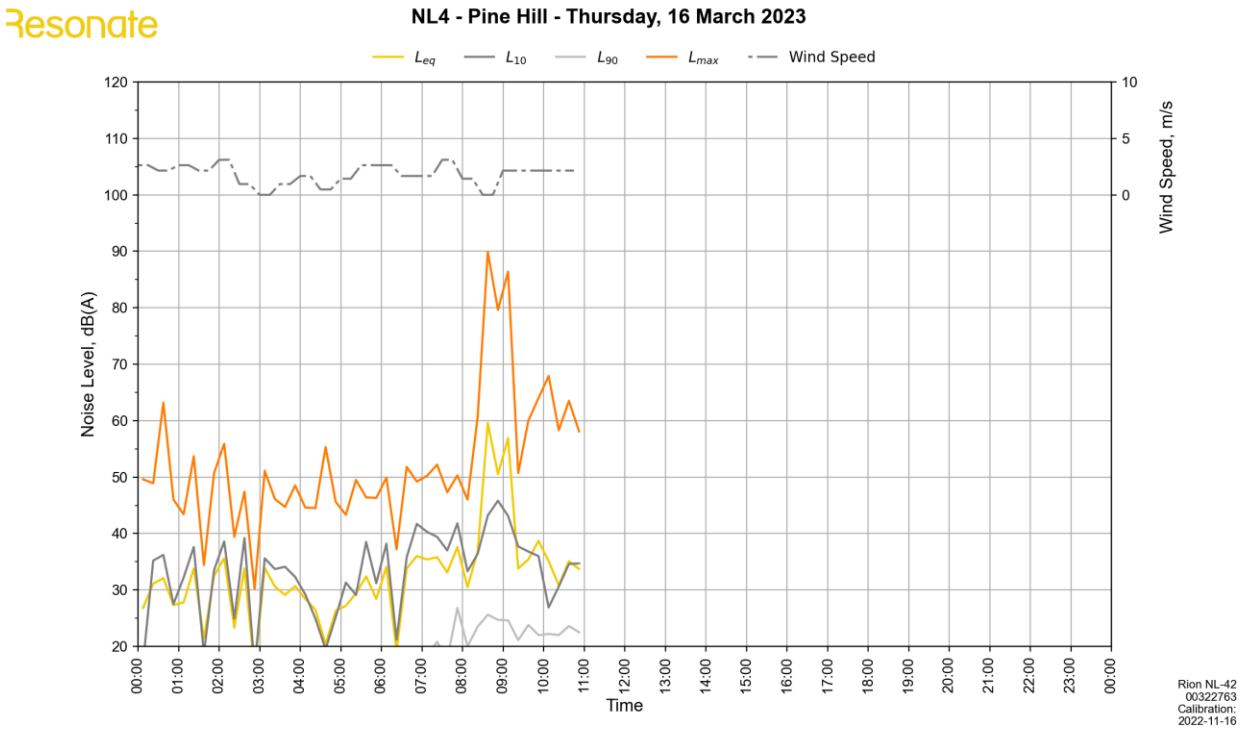
Resonate



Resonate




Resonate
NL4 - Pine Hill - Wednesday, 15 March 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00322763
Calibration:
2022-11-16


Resonate
NL4 - Pine Hill - Thursday, 16 March 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00322763
Calibration:
2022-11-16

Appendix B – Noise Sources

Table B1: Existing SMR equipment and overall Sound Power Level used in Noise Modelling

Nominal quantity	Type	Make	Model	Size	Overall Sound Power Level, dB(A)
2	Excavator	Hitachi	EX2600	260 tonne	117
1	Excavator	Komatsu	PC4000	392 tonne	117
10	Haul truck	Cat	785	250 tonne gross	119
3	Haul truck	Komatsu	HD785	250 tonne	119
8	Haul truck	Komatsu	HD1500	250 tonne	119
1	Haul truck	Cat	777	165 tonne	119
1	Haul truck	Cat	769	71 tonne	119
1	Road train	Kenworth	C510	300 tonne	108
1	Rock breakers	Komatsu	PC300		119
4	Track dozer	Cat	D9	48/62 tonne	112
1	Track dozer	Cat	D10	D10	112
2	Grader	Cat	16H	26 tonne, 16 ft blade	116
1	Grader	Komatsu	GD825	GD825	116
5	Wheel loaders	Komatsu	WA900	WA900	119
1	Wheel loader	Komatsu	WA600	WA600	119
1	Wheel loader	Komatsu	WA500	WA500	119
1	Wheel loader	Cat	993	993	119
1	Wheel loader	Cat	992	992	119
1	Wheel loader	Cat	990	990	119
1	Wheel loader	Cat	988	988	119
3	Drill	Cubex/Sandvik	QXR1120/DR580	DR580	102
1	Drill	Gardner Denver	GD5000	GD5000	102
1	Drill	Atlas Copco	D65	D65	102
1	Bulk explosives truck	Orica	MMU	E51	108
1	Bobcat/Stemming loader	Cat	T590	E42	119
1	Water truck	Komatsu	HD785	365 tonne gross	108

Nominal quantity	Type	Make	Model	Size	Overall Sound Power Level, dB(A)
1	Water truck	Komatsu	HD405		108
1	Water truck	Cat	785-C		108

Table B2: Proposed MEP1 equipment and overall Sound Power Level used in Noise Modelling

Nominal quantity	Type	Make	Model	Size	Overall Sound Power Level, dB(A)
20	Rear Dump Truck	Caterpillar	785D	135 t	121
2	Hydraulic Excavator	Hitachi	EW2600	250 t	117
3	Grader	Caterpillar	16M	221 kW	116
2	Tracked Dozer	Caterpillar	D9	325 kW	112
1	Tracked Dozer	Caterpillar	D10	447 kW	112
1	Rotary Drill (Rotary)	Epiroc	PV271HP	311 kN	125
1	Surface Drill (DTH)	Epiroc	SmartROC D65 XLF	24900 kg	124
2	Water Truck	Caterpillar	777WT	80 kl	112
2	Front End Loader	Caterpillar	992	638 kW	119
6	Rear Dump Truck	Caterpillar	777	97 t	112
1	Hydraulic Excavator	Komatsu	PC850SE-8E0	79.9 t	117
1	Hydraulic Excavator	Komatsu	PC300LC-8	30 t	117
1	Tyre Handler	Komatsu	WA500-8 TH	263 kW	112
1	Service Truck	Komatsu	HD785-7 ST	95 t	112
1	Fuel Truck	Komatsu	HD785-7 FT	80 kl	108
1	Compactor - Vibratory Roller	Caterpillar	CS78B	18.7 t	110
6	Pit Pump	Pioneer	PP86C21	250 kW	104
1	IT Tool Carrier	Komatsu	WA380-8 ITC	142 kW	107

Appendix C – Noise Contours

Figure C1: Predicted noise levels - Existing operation

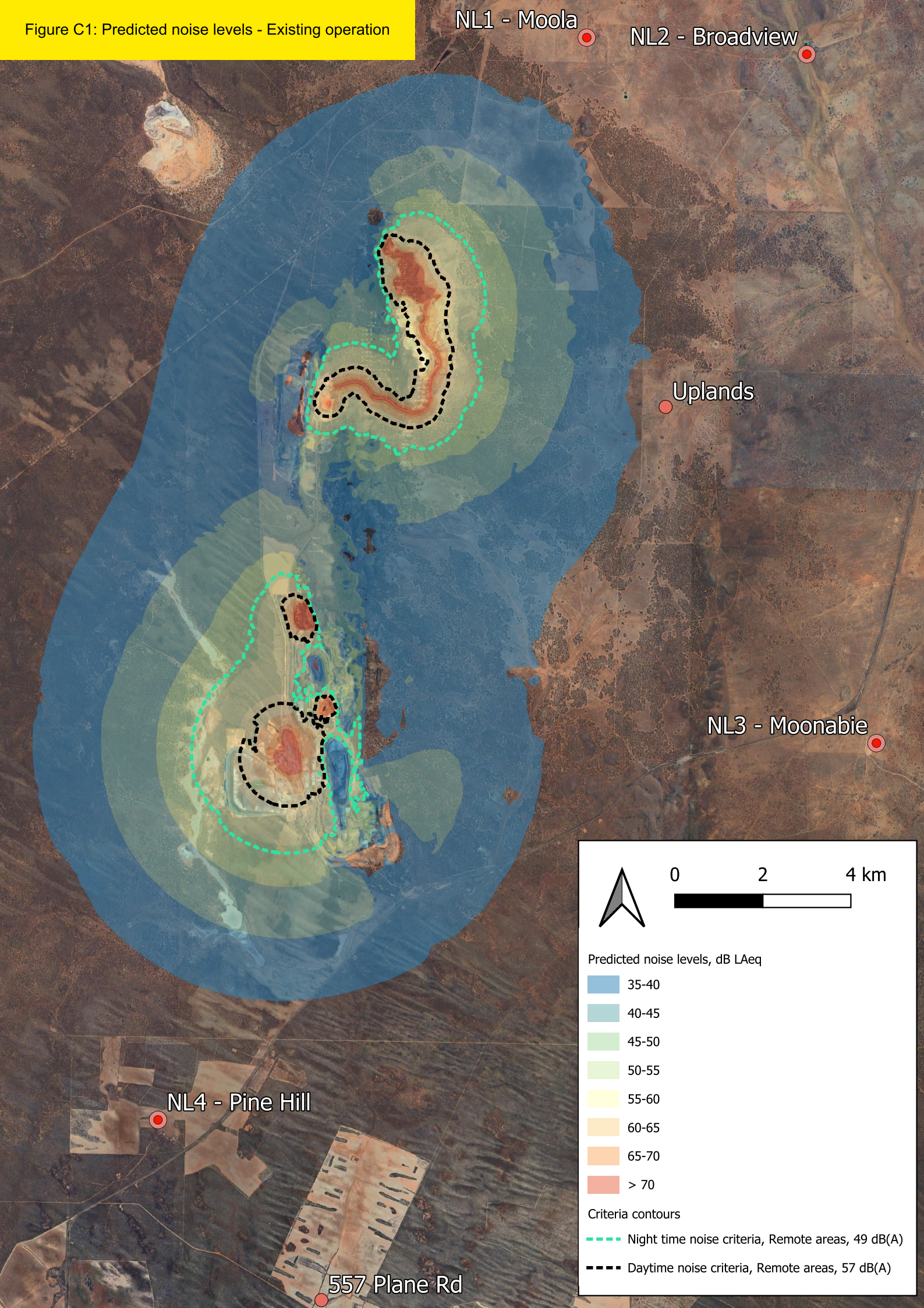
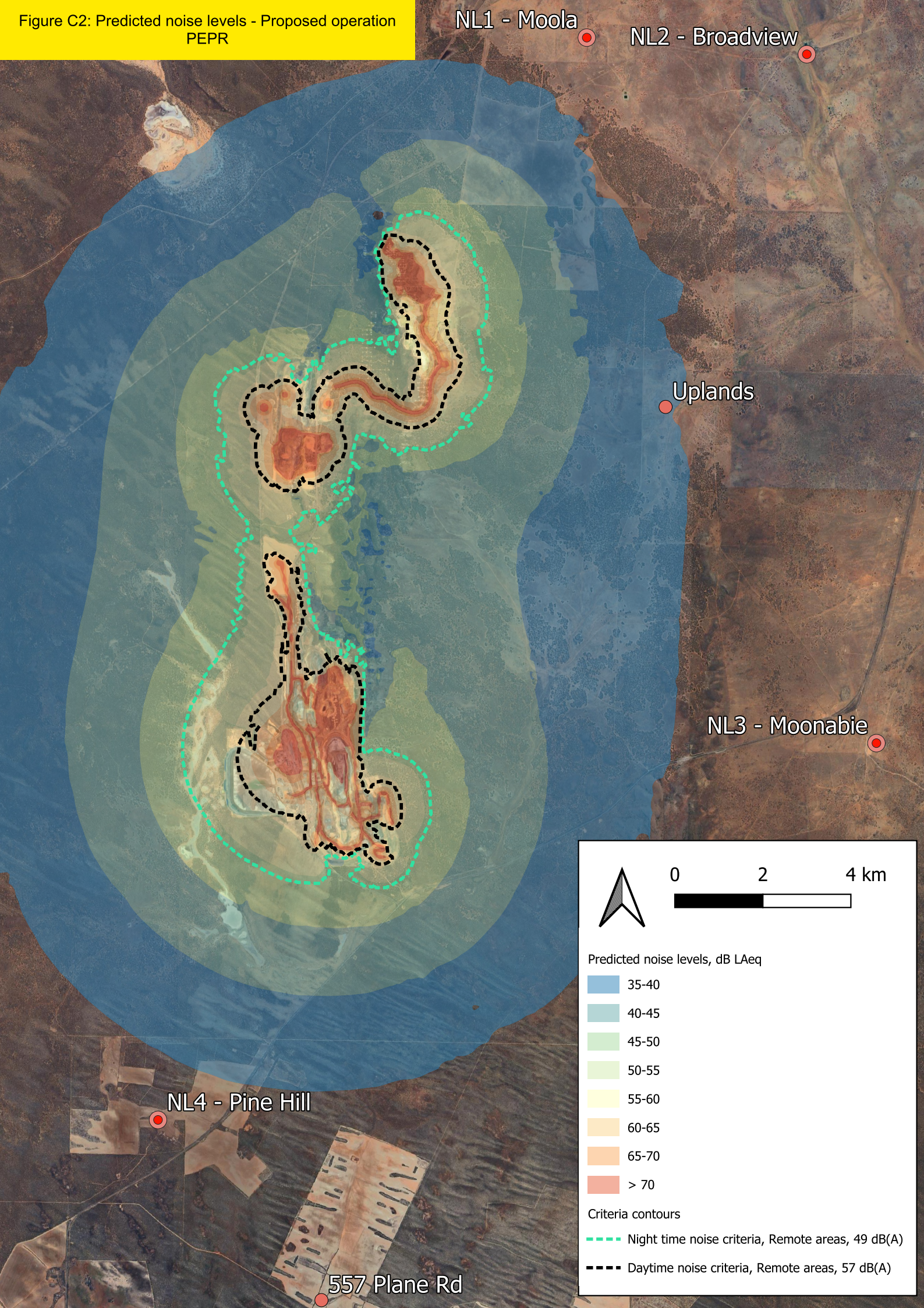


Figure C2: Predicted noise levels - Proposed operation
PEPR



D5 Seepage Assessment

australia@cdmsmith.com
cdmsmith.com/en-AU/

Memorandum

To: Dr Karen Mackenzie (Land and Water Consulting (WA) Pty Ltd)

From: Mori Javidi

Date: 13 March 2024

Subject: MEP1 WRDs Seepage assessment

1 Introduction

Land and Water Consulting (WA) Pty Ltd (LWC) has engaged CDM Smith Australia Pty Ltd (CDM Smith) to assess the seepage potential of several waste rock dumps (WRDs) being built for the Magnetite Expansion Project Phase 1 (MEP1). MEP1 is being carried out in the Southern Middleback Range (SMR) area, which is owned and operated by SIMEC Mining (SIMEC). The expansion aims to shift the current hematite operation to magnetite, a vital step towards achieving carbon-neutral steel production. MEP1 will expand mining activities in the Magnet, Duke, Duchess South, and Duchess North mine pits, as well as the associated processing infrastructure and tailings management systems.

This memorandum informs the geochemical study that is being undertaken to fulfil the requirements of the Department for Energy and Mining's (DEM) Terms of Reference (TOR) 006 for a Mineral Mine Lease/License Application. SIMEC is obligated to update the Program for Environmental Protection and Rehabilitation (PEPR) to construct the WRDs as part of the proposed magnetite expansion. This memorandum aims to assess the potential for seepage from the MEP1 WRDs.

2 Objective and Approach

The objectives of the seepage assessment are to:

- Investigate the seepage potential from the planned WRDs, specifically whether seepage is likely to present as surface expressions of groundwater (i.e., seepage induced mounding that results in daylighting at surface).
- Understand the fate of seepage (if it occurs) on the local aquifers.

A groundwater model has been developed to assess the movement of water in the planned WRDs and the surrounding hydrostratigraphic units (HSUs). This model is based on the data and assumptions from the recent hydrogeological impact assessments carried out by Jacobs in 2023 for the Magnetite Expansion Project Phase 2 (MEP2). The MEP2 hydrogeological impact assessments involved the use of a calibrated groundwater model, which has been used as the basis for the MEP1 seepage modelling for consistency.

listen. think. deliver.

3 Site Description

SIMEC Mining is actively working to increase its magnetite production in the Middleback Ranges, South Australia, through a strategic mining expansion project to extend its mines' operational life. This initiative, divided into two phases (MEP1 and MEP2), seeks to enhance the sustainability and longevity of the mining operations. The initial phase (MEP1) focuses on expanding mining activities north of the Iron Magnet pit, targeting areas rich in iron ore, such as Iron Magnet, Iron Duchess, and Iron Duchess North.

MEP1 involves constructing WRDs for the disposal of waste materials. The Southern WRD will be located to the south of the Iron Magnet pit, and the Northern WRD will be located to the north of the Iron Duchess pits. Figure 1 illustrates the location of the designed WRDs and planned expansions in mining activities as part of MEP1.

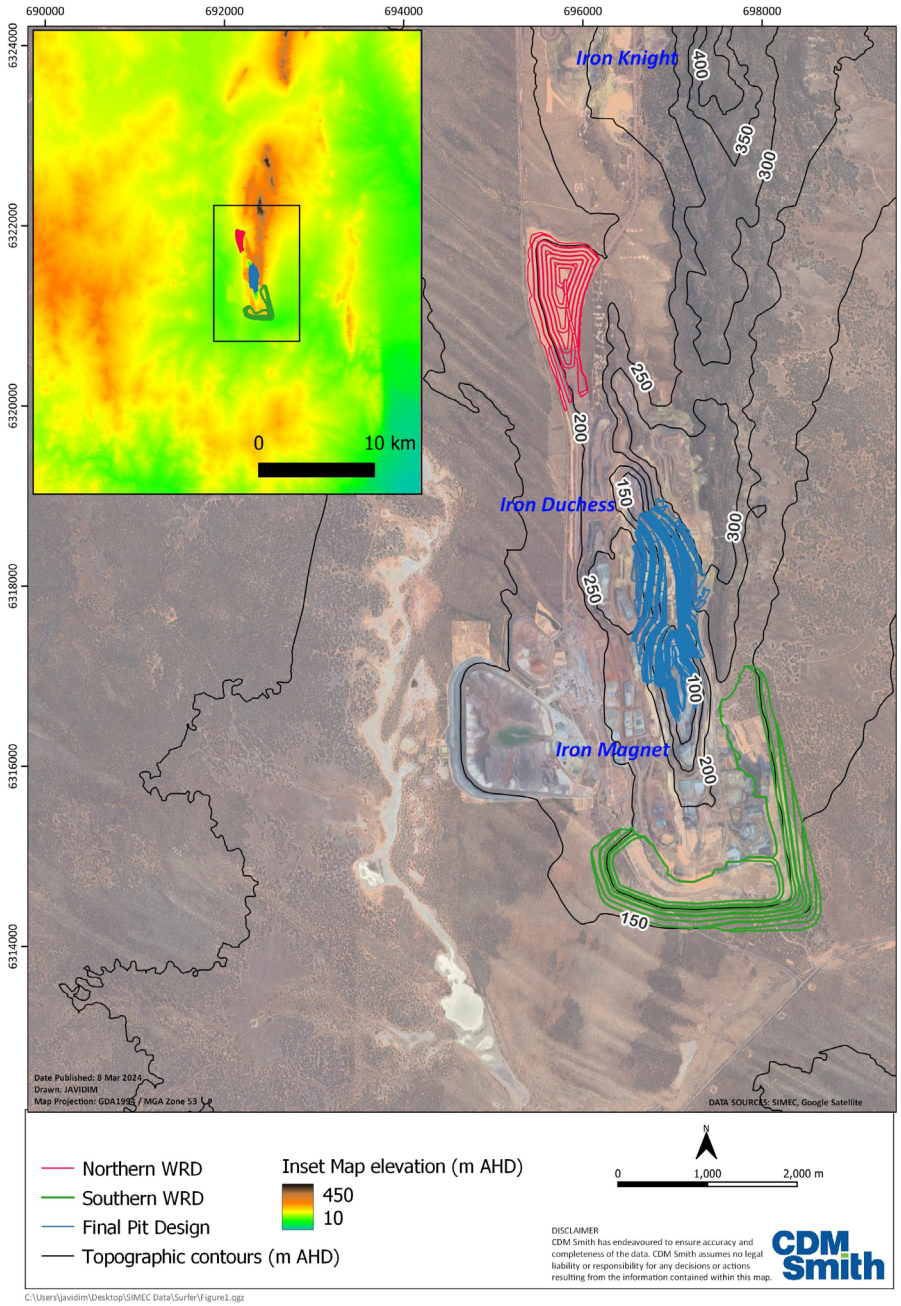


Figure 1 Site locality

3.1 Climate

The SILO climate database of the Queensland Government has been used to inform the site climate conditions (Queensland Department of Environment and Science, 2023). Figure 2 Shows the mean monthly variations in rainfall and evaporation, which are based on the data from BOM weather station 18120 rainfall and evaporation averaged from 2000 to 2023. According to the data from the same period, the average yearly rainfall is 280mm, while the pan evaporation is 2240mm/year. Based on these data, the site is considered arid, with the annual evaporation rate significantly exceeding the annual rainfall.

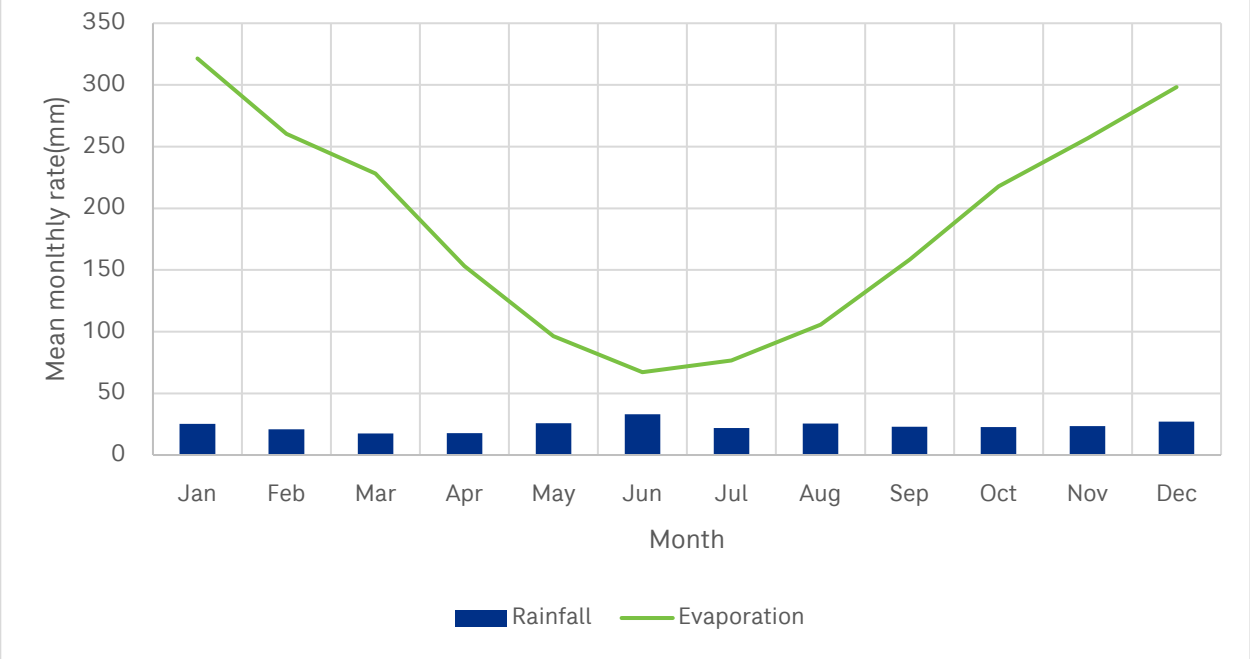


Figure 2 Mean rainfall and evaporation at station 18120 (Whyalla Aero)

3.2 Topography

The SMR area comprises steep ranges surrounded by broad sloping plains to the east and west. Generally, the ranges are steepest in the north near Iron Knight (up to 435 m AHD) and decline towards the south (Iron Duke). Ephemeral stream channels are incised in the steep slopes of the ranges and drain towards the surrounding plains (Groundwater Science, 2021). The final topography of the site, using the design data provided by SIMEC combined with regional SRTM DEM data (ICMS, 2024), is shown in Figure 1.

3.3 Geology

The SMR area, located in the central-eastern Gawler Craton, has a complex geological history that has led to the formation of significant iron ore deposits essential for the local mining industry. These deposits are mainly found within the Early Proterozoic Hutchison Group metasediments, which have undergone extensive geological processes, notably during the Kimban Orogeny around 1.73 to 1.69 billion years ago. This geological event, the most widespread in the craton's history, has resulted in various metamorphic facies across the region.

The iron ore deposits, consisting of magnetite and hematite types, are associated with a broader magnetic anomaly linked to ancient Mesoarchaean units, indicating a prolonged and intricate geological evolution. Iron ore formation in the Middleback Ranges occurred through a supergene enrichment process, where waste minerals were dissolved, and iron ore minerals replaced them selectively. This process, particularly noticeable at the base of the geological sequence and along faults, fractures, and dyke contacts, has led to the development of hematite mineralisation up-dip from the carbonate and silica-rich Banded Iron Formation (BIF) (Parker, 2012).

3.4 Hydrogeology

The SMR hydrogeology has been discussed by Groundwater Science (2021) and Jacobs (2023). Groundwater is primarily located within Paleoproterozoic metasediments, including banded iron formations (Lower and Upper Middleback Iron Formations), Katunga dolomite, Cook Gap Schist, and amphibolite dykes, as well as the regional granitic basement. Fractures within these formations serve as pathways for groundwater movement, collectively forming the regional unconfined Fractured Rock Aquifer.

The heavily folded and faulted metasediments in the SMR area exhibit slightly higher permeability than the regional granitic basement. Permeability is notably enhanced along north-south trending fold axes. This is evident by the seepage patterns in the existing pits, which generally align with shear/fracture zones oriented in a north-south fashion.

In addition to the fractured rock aquifer, there is a shallow, unconfined aquifer consisting of Tertiary and Quaternary sediments (including clays, silts, and sands) in the plains to the west and east of the SMR area. These sediments are saturated in the lower-lying regions, particularly to the west of the Iron Duchess, Iron Magnet, and Iron Knight mines, which are centred along Salt Creek. These sediments overlay the regional fractured rock aquifer with a maximum saturated thickness of approximately 10 meters.

The key HSUs in the SMR area include:

- **Quaternary/Tertiary Sediments and Aeolian Sand:** Groundwater occurrence in these sediments is generally low in upland and intermediate elevation areas but increases in low-lying areas below the regional groundwater table.
- **Fracture and Shear Zones:** While some sheared/fractured/fault zones exist, they are unlikely to enhance groundwater flow significantly compared to Duchess North and Duchess South pits. No significant high hydraulic conductivity water-bearing geological structures have been encountered to date.
- **Orebody Zone:** Groundwater presence is observed in the orebody zone but is not characterised by high hydraulic conductivity. Low groundwater inflow rates are typical in current pits.
- **Banded Iron Formation (BIF):** Groundwater is predominantly found in fractured BIF, primarily unconfined to semi-confined. Groundwater occurrence in the Upper Middleback Formation is limited due to its position above the regional Groundwater.
- **Cook Group Schist:** Groundwater mainly occurs within fractures of the Cook Group Schist, with a faulted, steeply dipping contact inferred between the Cook Group Schist and rocks of the Lower Middleback Iron Formation.
- **Amphibolite/Dolerite Dykes:** These structures are cross-cutting within Middleback Subgroup and Basement rocks. Varying thicknesses of amphibolite intrusions are found, with significant bodies located west of Duchess North Pit.
- **Basement Rocks:** Granites and metamorphosed rocks form the basement, hosting groundwater systems in fractured conditions. Groundwater systems are generally unconfined to semi-confined in upland areas, while in low-lying areas overlain by Quaternary/Tertiary sediments, they tend to be semi-confined to confined.

3.5 Groundwater Elevations

At the regional level, groundwater elevation typically reflects the area's topography. Jacobs (2023) indicates that groundwater flows eastward towards the Spencer Gulf and westward towards the Salt Creek paleochannel and surrounding plains. The groundwater levels near the project site before mining are believed to be mainly influenced by the topography of the SMR area and discharge via evapotranspiration (ET) at Salt Creek. The groundwater head contours (shown in Figure 3) show groundwater moves to the east and west from a groundwater divide beneath the SMR to the south. Hydraulic gradients near the proposed MEP1 area are minimal, approximately 0.005m/m with the gradient steepening towards the north, particularly near Iron Knight. As of late 2021/early 2022, the water table contours align with the interpreted pre-mining contours, except for changes due to the Iron Magnet pit and other mining structures. Figure 3 suggests the expansion of mining activities will reduce groundwater levels in the areas near the pits.

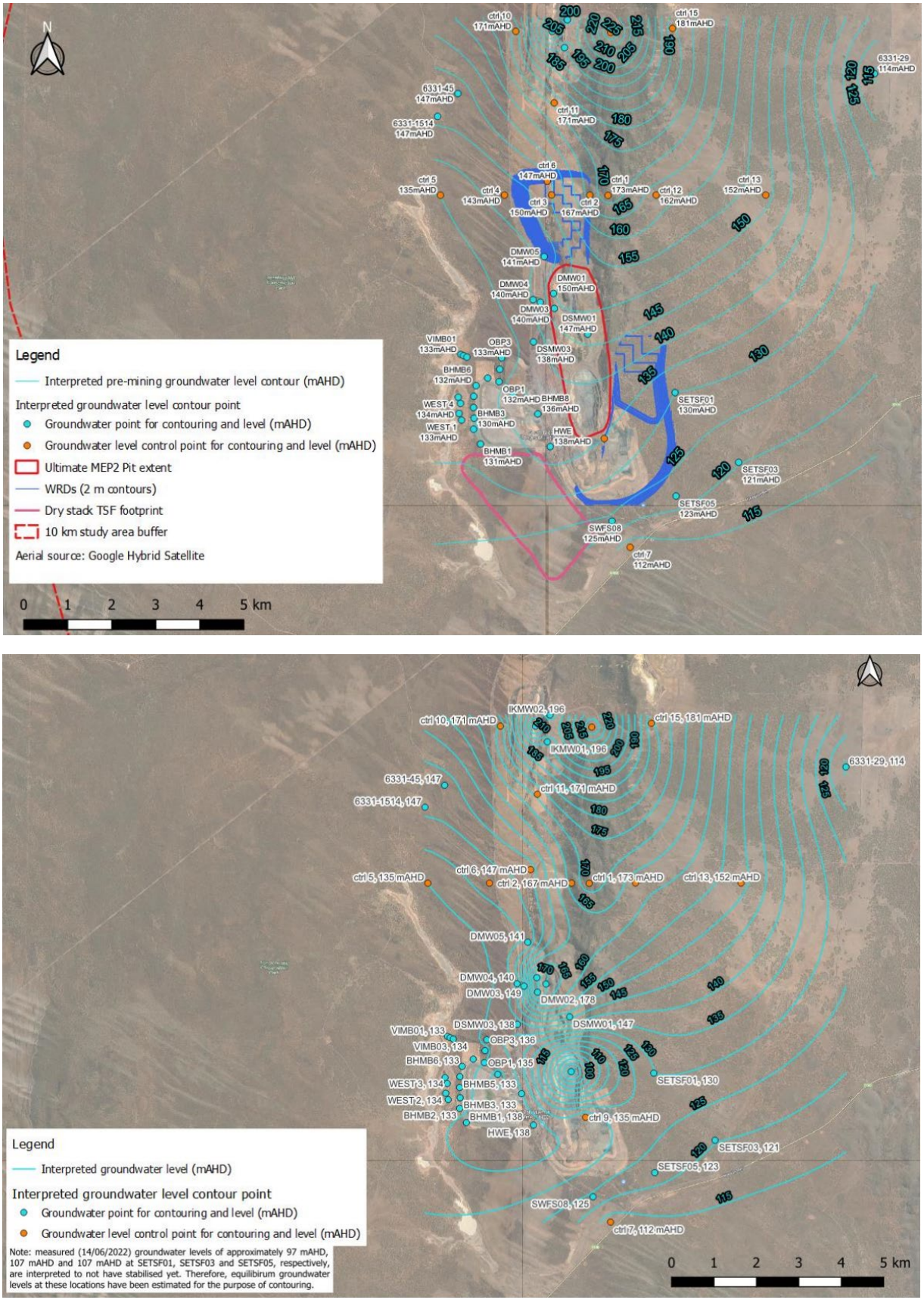


Figure 3 **Interpreted pre mining (late 2020) groundwater contours (top) and interpreted post mining (early 2021) groundwater contours (bottom)(Jacobs, 2023)**

4 Groundwater Seepage Model

4.1 Model Development

4.1.1 Modelling Approach

A groundwater model has been developed to investigate the seepage potential from the planned WRDs, specifically whether seepage is likely to present as surface expressions of groundwater (i.e., seepage induced mounding that results in daylighting at surface). For this purpose, a transient groundwater model has been developed to provide predictions of changes to the groundwater system over 200 years. The life of mine (LoM) period is represented by a steady state model to provide stable initial conditions for the subsequent transient simulation.

Jacobs (2023) developed a numerical groundwater model for impact assessment purposes with the intention of predicting the impacts of the MEP2 expansion stage on groundwater resources. This model has been calibrated against groundwater head observations and was used to inform various aspects of the MEP1 seepage modelling, including the setup of the model domain, boundary conditions (including rainfall recharge), model layers and hydraulic properties. These model settings have been adjusted and refined for the purpose of this seepage assessment, with the following noteworthy points:

- The WRD and mining design in the mining area are based on the most current MEP1 WRD designs provided by SIMEC.
- The current conditions are represented in the model as a steady-state period, a model simplification aiming to provide stable initial conditions for the subsequent transient periods. For the purposes of maintaining a simplistic and conservative seepage model, pit dewatering effects have not been simulated. Therefore, the model is not suitable for providing predictions of groundwater drawdown, however, is considered suitable for providing predictions of groundwater mounding.
- To allow for conservative predictions of WRD seepage, a higher recharge rate than what was used by Jacobs (2023) has been applied to the MEP1 WRDs (described in more detail in subsequent text).

4.1.2 Model Code, Discretisation and Boundary Conditions

The groundwater model has been developed using MODFLOW-USG (Panday et al., 2013) and the graphical user interface Groundwater Vistas (ESI, 2020). The calibrated hydraulic parameters from Jacobs (2023) were adopted in this study. While no additional calibration has been undertaken as part of this study, the uncertainty associated with these parameters was assessed through a risk-oriented uncertainty analysis (i.e. considering the worst combination of plausible hydraulic parameters that would lead to the largest impact).

The model comprises six model layers and two hydrogeological domains, a Plains Domain and an MBR Domain, to represent the areas separately. The Plains Domain and MBR Domain are shown in Figure 4, and the model layering is summarised in Table 1. All layers, except for Layer 1, which represents the WRDs, have been defined in accordance with Jacobs (2023). The hydraulic properties of WRDs have been defined based on previous seepage studies for SIMEC by CDM Smith (2022 and 2023).

Table 1 Model Layers

Layer	Plain Domains	MBR Domain	Surface/Thickness
1	WRDs		The geometry of WRDs based on designed DXF files provided by SIMEC
2	Quaternary/Tertiary sediment	Weathered Middleback Group	Top elevation: The design files provided with SIMEC are in the mining area, and they are derived from 1sec SRTM DEM data (ICMS, 2024) outside the mining area. Thickness: Thickness 10m
3	Weathered granite basement		Top: Layer 1 base Thickness: 10 m
4	Fresh granite basement		Top: Layer 2 base Bottom: 125 mAHD (except in low-lying regions, where it is assigned to be 1 m thick). Represents the base of weathered material.
5		Fresh Middleback Group	Top: Layer 3 base Bottom: -76 mAHD. Established to be just below the lowest mining level to facilitate the setting up of pit boundary conditions.
6	Fresh granite basement		Top: Layer 4 base Bottom: -150 mAHD. It affords about 50 m of model thickness below the base of mine at maximum extent. Such a layer thickness is considered adequate to represent the interaction of proposed mining with the underlying groundwater system.

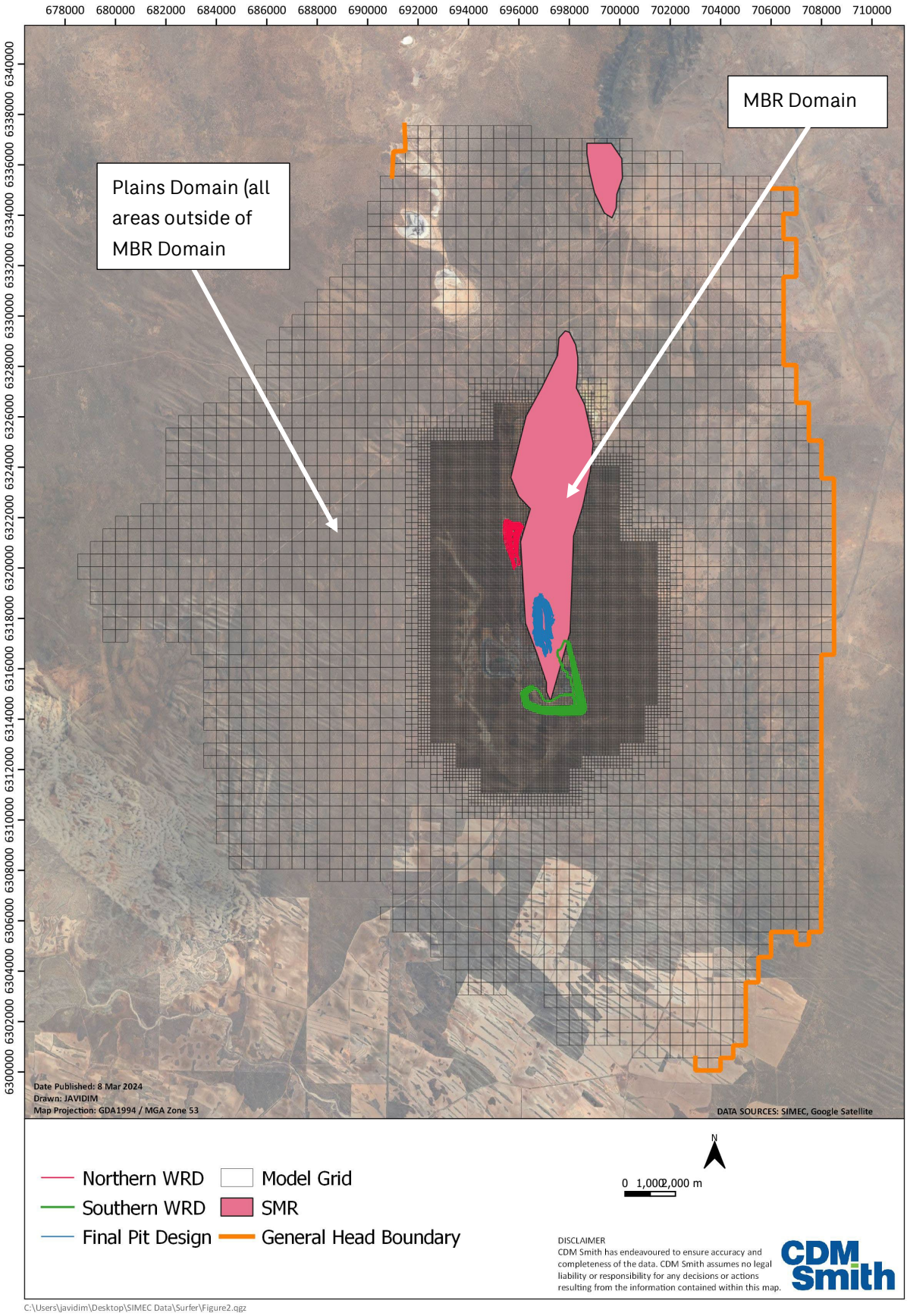


Figure 4 **Model boundary conditions**

4.1.3 Model Parameterisation and Assumptions

The model characteristics have been summarised below:

- The model domain has been selected based on the Jacobs (2023) model domain. It covers the regional groundwater levels, with a centre on the expansion area to cover all the potential impacts (refer Figure 4).
- Cell size ranges between 31.25m near the expansion areas to 500m away from mine. The Quadtree method has been used to refine the model grid. These cell sizes are suitable for covering the effect of regional groundwater movement and impacts from WRD recharge in the mining area.
- A general head boundary has been applied along the eastern edge of the active model area and in the northwest corner of the model. No flow boundaries are applied elsewhere. Based on regional heads, the head on the western boundary has been assigned an elevation of 48m AHD, and the northern-western boundary an elevation of 148 mAHD.
- The conductance term which controls the magnitude of flux across boundary conditions, is consistent with the value used by Jacobs (2023) at 100 m^2/day in the eastern boundary and 1,250 m^2/d in the northwest.
- The transient period, for which seepage is estimated to occur over, has been designed to continue for 200 years. This timeframe has been selected to test the plausibility of seepage to daylight from the MEP1 WRDs. It is understood, however, that in reality, the planned expansion of MEP2 will likely occur before long term effects of this magnitude can be predicted from the MEP1 WRDs. The seepage model will, therefore, require updating to quantify the mounding effects associated with the planned MEP2 expansion (if the WRD designs differ to what has already been assessed as part of Jacobs (2023) groundwater model).
- The baseline recharge rate (outside WRDs) varies between the Plains and MBR Domains. The values are based on the calibrated recharge rates from Jacobs (2023), at 0.7 and 1.05 mm/year, for the Plain and MBR domains respectively.
- The entire area of the model domain has been assigned the long-term average of FAO56 evapotranspiration (ET) values of 1,401 mm/y (SILO, 2023) from station 01820 post-1970, with an extinction depth of 2m. FAO56 evaporation rates were utilised instead of pan evaporation rates (as employed in Jacobs (2023) model) to allow for a more conservative approach noting no further calibration has been completed for the seepage model.
- Boundary condition effects have been designed to cease following mining operations to simulate the absence of dewatering activities following mining. Groundwater discharge within the pit lakes is instead simulated through groundwater ET here near the void base is accounted for through groundwater ET as described above.
- The WRD recharge rates were calculated by subtracting the daily FAO56 from the daily rainfall (Station No. 18120), over a rolling seven-day period. If the evaporation rate was higher than the rainfall rate for seven consecutive days, the recharge rate was set to zero. This assumption is conservative by assuming the infiltrated water only spends seven days in the waste rock before reaching the water table (in reality it is likely to take longer). The net recharge rates of the seven-day periods were then averaged over the past 50 years (1973 to 2023) and applied to the WRD areas for the transient model simulation. According to the calculations, the recharge over WRDs is considered to be 48.40mm/year (or 18% of mean annual rainfall).
- Two scenarios were defined for prediction of WRD seepage:
    1. A base-case (most likely) scenario based on the calibrated model parameters of Jacobs (2023).
    2. A worst-case scenario was defined to evaluate the model's sensitivity to changes in hydraulic parameters. This scenario uses hydraulic properties reduced by 50% compared to the standard (most likely) scenario. Hydraulic parameters for the WRDs remain the same for both scenarios to maintain a consistent recharge rate.

The hydraulic parameters assigned to each scenario are displayed in the Table 2.

Table 2 Defined Hydraulic Properties in Most-likely scenario and worst-case scenario

Hydrostratigraphic unit or area	Most likely scenario				Worst case scenario			
	Kx, Ky	Kz	Sy	Ss	Kx, Ky	Kz	Sy	Ss
Waste rock dump material	4	4	1.00E-01	1 x 10-4	4	4	1.00E-01	1 x 10-4
Quaternary/Tertiary sediment	5.00E-01	5.00E-02	2.00E-01	5 x 10-6	2.50E-01	2.50E-02	1.00E-01	2.5 x 10-6
Weathered granite basement	2.00E-01	2.00E-01	1.00E-02	5 x 10-6	1.00E-01	1.00E-01	5.00E-03	2.5 x 10-6
Fresh granite basement	2.80E-03	2.80E-03	1.00E-02	5 x 10-6	1.40E-03	1.40E-03	5.00E-03	2.5 x 10-6
Weathered Middleback Group	1.00E-02	1.00E-02	1.00E-02	5 x 10-6	5.00E-03	5.00E-03	5.00E-03	2.5 x 10-6
Fresh Middleback Group	2.80E-03	2.80E-03	1.00E-02	5 x 10-6	1.40E-03	1.40E-03	5.00E-03	2.5 x 10-6
Iron Knight	2.00E-05	2.00E-05	1.00E-02	5 x 10-6	1.00E-05	1.00E-05	5.00E-03	2.5 x 10-6
Small area near Duchess North	1.00E-01	1.00E-01	1.00E-02	5 x 10-6	5.00E-02	5.00E-02	5.00E-03	2.5 x 10-6

Kx, Ky = Horizontal hydraulic conductivity (m/day)

Kz = Vertical hydraulic conductivity (m/day)

Sy = Specific yield (-)

Ss = Specific storage (m^{-1})

4.2 Results

A summary of the modelling results for the base-case and worst-case scenarios is presented in Table 3. The predicted groundwater heads at the conclusion of the 200-year simulation period is presented in Figure 5, while the change in groundwater head after this period is presented in Figure 6.

Under the most-likely scenario, the modelling predicts a rise in groundwater head of between 10m (52m bgl) and 12 m (48m bgl) under the Northern and Southern WRDs, respectively. The impact of the recharge is predicted to extend up to 2.2km from east to west and around 2.7km from north to south surrounding the Northern WRD and around 4km radially surrounding the Southern WRD (Figure 6). Even still, groundwater flow from beneath the WRDs is predicted to occur towards the Iron Magnet pit.

Under the worst-case scenario, mounding is predicted to reach up to 12m (33m bgl) under the Northern WRD and 18m (40m bgl) under the Southern WRD. Under this scenario, the impact of recharge is predicted to extend up to 3km from east to west and 2.8km from north to south surrounding the Northern WRD and up to 5km east-west and around 4.4km north-south surrounding the Southern WRD (Figure 6). Similar to the most-likely scenario, groundwater flow beneath the WRDs is predicted to occur towards Iron Magnet pit with a small component flowing to a groundwater sink feature located directly southeast of the Southern WRD. This feature is still within the broader drawdown zone of influence surrounding Iron Magnet pit meaning the fate of such seepage is not expected to interact with regional aquifers.

Table 3 Model predictions at the end of the simulation period (200 years)

Location	Most likely scenario		Worst case scenario	
	Rise in groundwater head (m)	Depth to groundwater at end of simulation period (mbgl)	Rise in groundwater head (m)	Depth to groundwater at end of simulation period (mbgl)
Northern WRD	10	52	12	33
Southern WRD	12	48	18	40

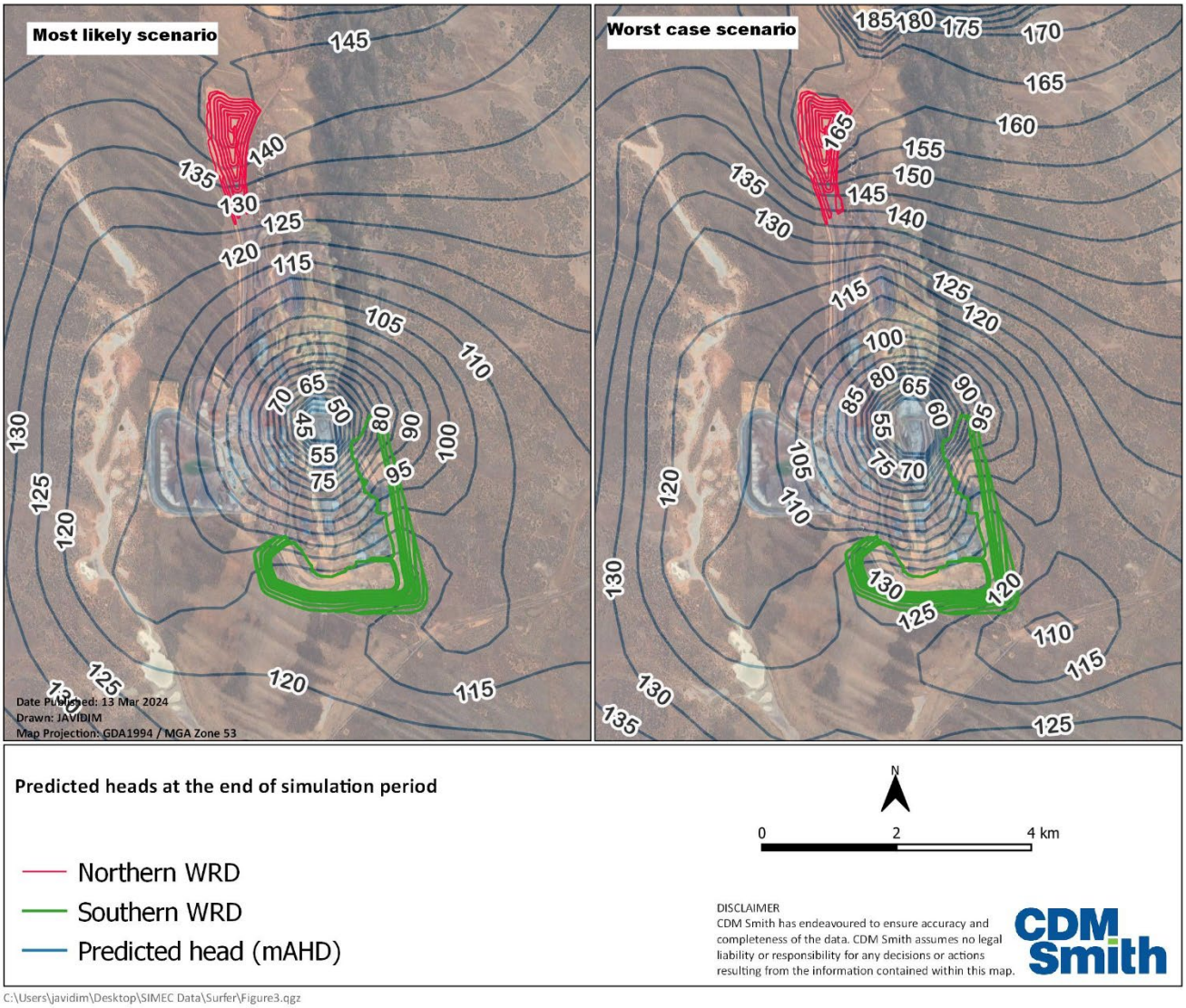


Figure 5 Predicted groundwater heads following 200-year simulation period (m AHD)

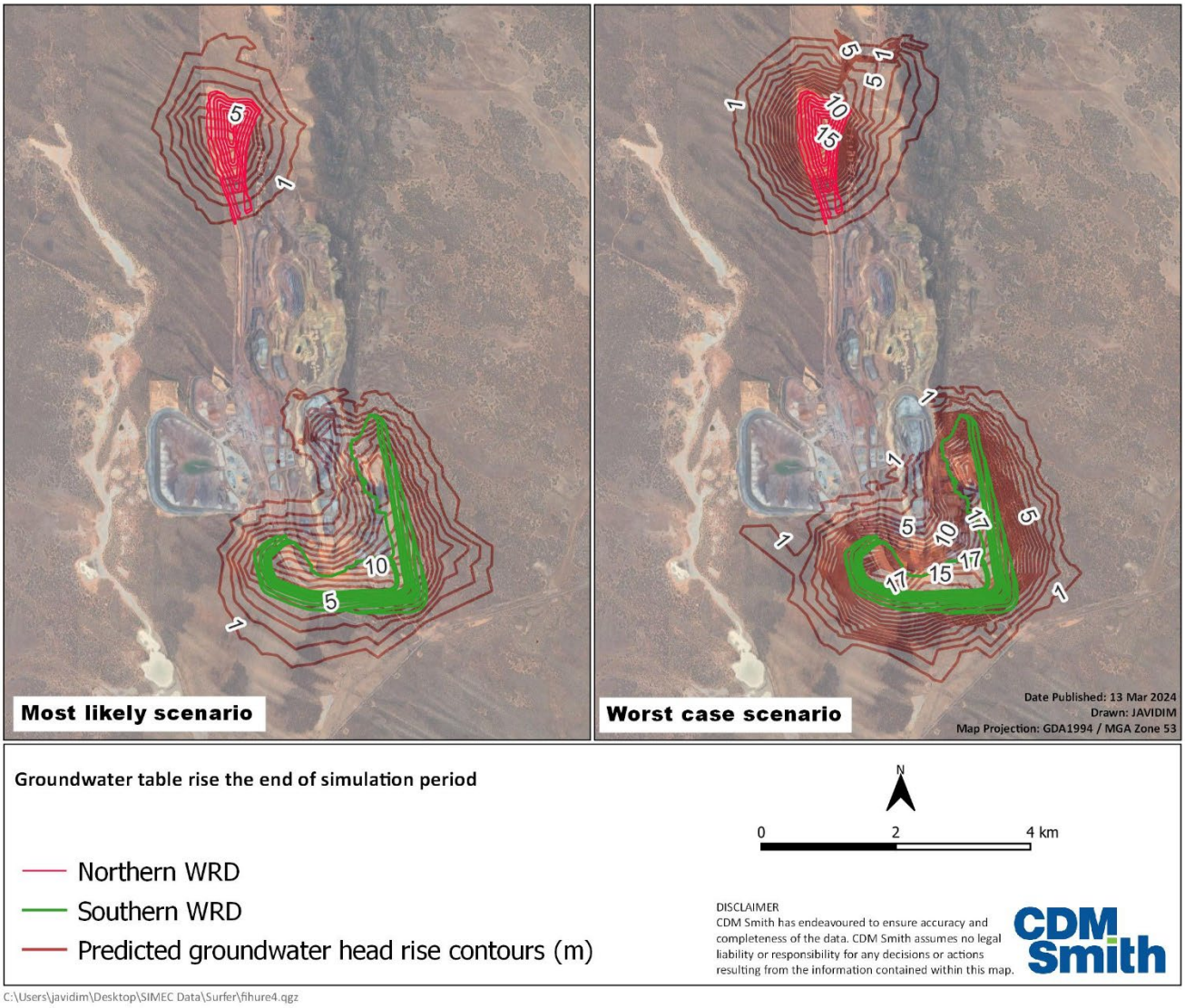
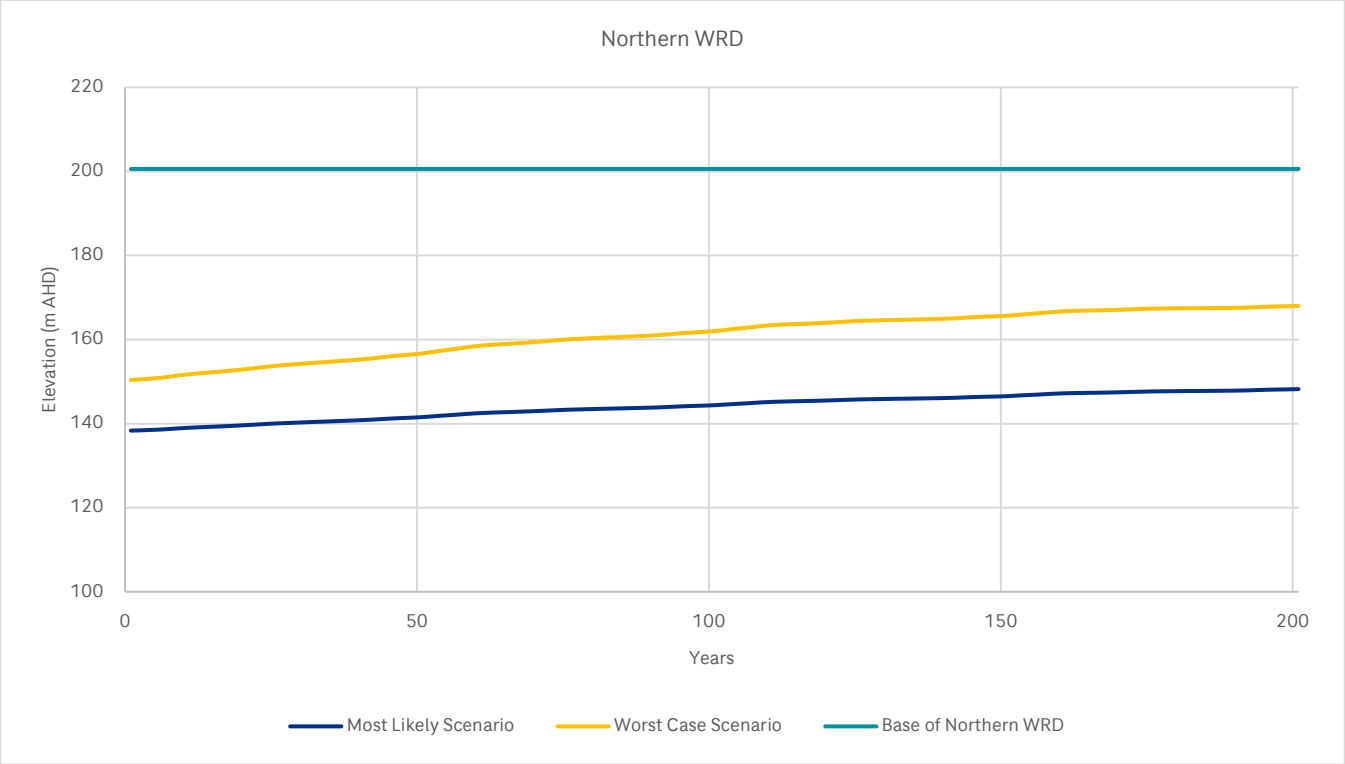


Figure 6 Predicted groundwater head increase following 200-year simulation period

To assist in understanding the potential for seepage induced mounding to daylight at surface, hydrographs showing the predicted groundwater heads over the 200-year simulation period beneath the Northern and Southern WRDs have been presented in Figure 7. These charts illustrate that although the recharge from WRDs has the potential to increase groundwater heads beneath the WRDs, the predicted increase in groundwater heads under both scenarios is insufficient to cause surface expressions of groundwater beneath the WRDs. It is worth noting due to the different hydraulic properties of the most likely and worst-case scenarios the predicted groundwater heads result in different starting equilibrium conditions for each scenario. It is also worth noting the model simulation period runs for 200 years, however, in reality, the planned expansion of MEP2 will likely occur before long term effects of this magnitude can be predicted from the MEP1 WRDs. Therefore, the quantity of seepage induced mounding attributed with construction of the MEP1 WRDs should be viewed with respect to the earlier simulation periods (i.e. years 0 – 5) prior to the construction of MEP2 WRDs.

As the model does not explicitly simulate groundwater abstractions, groundwater heads both regionally and beneath the MEP1 WRDs are expected to be lower than what has been predicted. This adds further confidence to the model predictions which suggest that daylighting of groundwater beneath the MEP1 WRDs is unlikely.



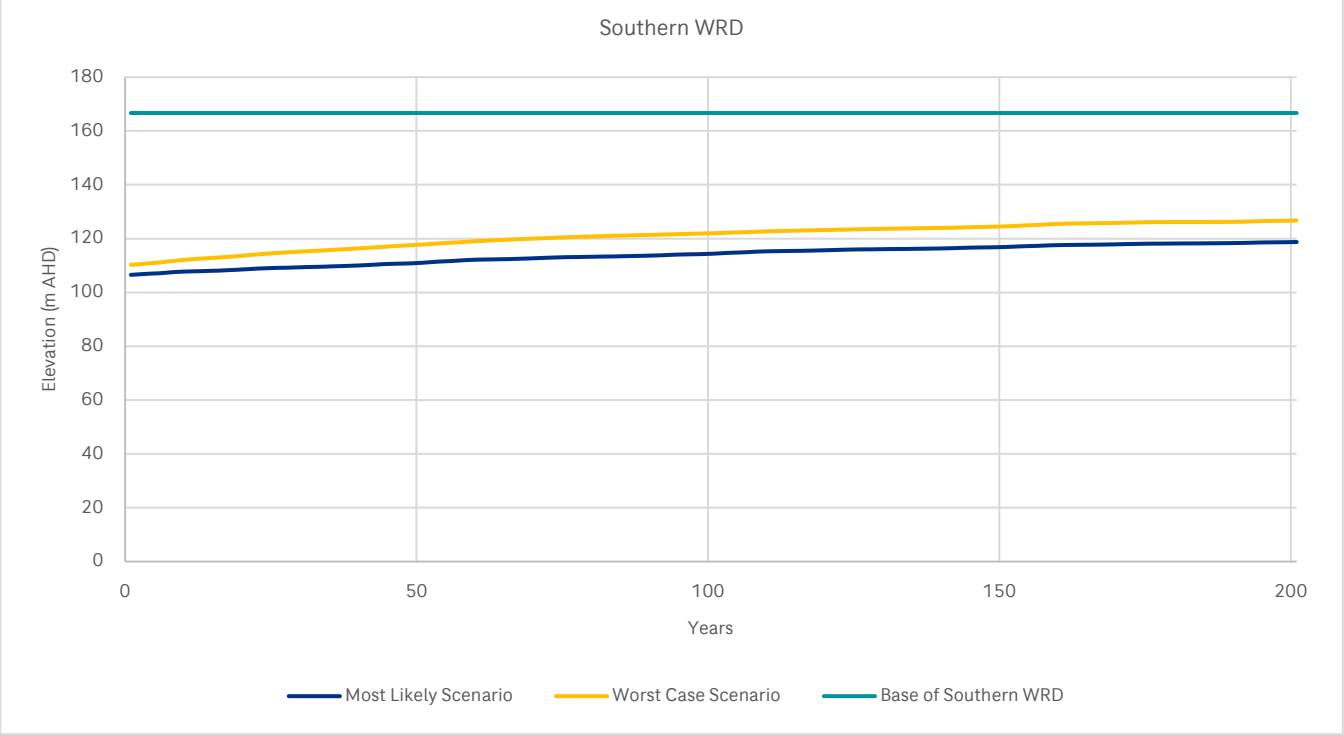


Figure 7 Predicted groundwater hydrographs for MEP1 WRDs

A model mass balance for the most likely scenario is presented in Table 4. The mass balance indicates the majority of groundwater inflows are attributed to WRD seepage, while only a minor component occurs through regional groundwater flow (general head boundary). Groundwater outflows are largely driven by groundwater ET with a lesser component associated with the general head boundary. A large component of groundwater recharge from the WRDs is predicted to be accommodated by aquifer storage which enables the localised rise in the groundwater heads shown in prior figures.

Table 4 Most-likely scenario mass balance (KL/d)

DESCRIPTION	Steady-state		End of simulation		Change	
	Inflow	Outflow	Inflow	Outflow	Inflow	Outflow
Recharge	1,490.86	0.00	1,957.17	0.00	466.31	0.00
ET	0.00	1,018.30	0.00	997.60	0.00	-20.70
GHB	122.20	594.79	122.20	594.79	0.00	0.00
Storage	0.00	0.00	56.80	543.82	56.80	543.82
Total	1,613.06	1,613.09	2,136.17	2,136.21	523.11	523.12

5 Conclusions

A numerical groundwater flow model has been developed to assess the seepage potential from MEP1 WRDs and test the plausibility of seepage to present as surface expressions of groundwater beneath the WRDs. The following key conclusions have been found:

- It is considered highly unlikely that the WRD seepage will cause groundwater to daylight at surface.
- Seepage from WRDs is predicted to cause a localised increase in groundwater heads beneath the WRDs, varying between 10m (52m bgl) and 12m (33m bgl) beneath the Northern WRD and 12m (48m bgl) and 18m (40m bgl) beneath the Southern WRD.
- The extent of the groundwater mounding is precited to be up to 3km (worst-case scenario) surrounding the Northern WRD and up to 5km (worst-case scenario) surrounding the Southern WRD.
- Groundwater flow is not predicted to interact with regional aquifers outside the mining areas, with groundwater flow beneath the WRDs predicted to report to Iron Magnet pit either entirely, or partially (via a groundwater sink feature directly adjacent to the Northern WRD).
- The threat imposed by seepage induced mounding from the MEP1 WRDs is considered low.

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D6 Geochemical Assessment

SIMEC

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MEP1-GEOCHEMICAL MATERIAL CHARACTERISATION

Stage 1

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Abbreviation	Description
ABA	Acid-base accounting
ABCC	Acid buffering characteristic curve
AC	Acid consuming
AP	Acid production
Alkalinity	A measure of the buffering capacity of water and capacity to neutralise acidity ($kgCaCO_3/l$)
AMD	Acid and metalliferous drainage
AMP	Amphibolite dykes
ANC	Acid neutralisation capacity (kg H_2SO_4/t)
ANC_{Lab}	Acid neutralisation capacity measured in the laboratory (kg H_2SO_4/t)
ANC_{Carb}	Acid neutralising capacity estimated from carbonate (total inorganic carbon) (kg H_2SO_4/t)
ANC_{ABCC}	Acid neutralising capacity estimated from ABCC test (kg H_2SO_4/t)
BIF	Banded iron formation
BSQ	Basal sequence
CGS	Cook gap schist
CRS	Chromium reducible sulfur (sulfide)
DOM	Katunga dolomite
EAT	Emerson aggregate test
EC	Electrical conductivity (µS/cm)
$EC_{1:2}$	EC of a sample slurry with a solid to water ratio of 1:2 (µS/cm)
ECEC	Effective cation exchange capacity
ESP	Exchangeable sodium percentage
ESZ	Eastern shear zone
GAI	Geochemical abundance index
GRT	Basement granite
HBF	Haematite banded iron formation
HEO	Hematite
HEC	Hematite carbonate
LoM	Life of mine
MPA	Maximum potential acidity (kg H_2SO_4/t)
MTC	Magnetite carbonate
MTS	Magnetite silica
NAF	Non-acid forming
NAG	Net acid generation
NAG pH	Measured pH of the NAG solution
NAG pH 4.5	NAG acidity to endpoint pH 4.5 (kg H_2SO_4/t)
NAG pH 7.0	NAG acidity to endpoint pH 7.0 (kg H_2SO_4/t)
NAPP	Net acid producing potential (MPA-ANC)(kg H_2SO_4/t)
NPR	Net potential ratio (ANC/MPA) (kg H_2SO_4/t)
PAF	Potentially acid forming

PAF-LC	PAF-low capacity
$pH_{1:2}$	pH of a sample slurry with a solid to water ratio of 1:2
PSD	Particle size distribution
QXRD	Qualitative X-ray diffraction
SAQP	Sampling, analysis and quality program
SCH	Internal schist
SD	Saline drainage
S_{HCl}	Sulfate fraction
Total-C	Total carbon (%).
TIC	Total inorganic carbon
TOC	Total organic carbon
Total-S	Total sulfur (%)
UC	Uncertain
WRD	Waste rock dump

1 Introduction

SIMEC Mining (SIMEC) has identified the 673 Mt Iron Duchess South Magnetite Resource within its existing Southern Middleback Ranges Operations (SMR). This resource is predominantly magnetite silica mineralisation high in quartz. The Magnetite Expansion Project Stage 1 (MEP1) will produce ~2.5 Mtpa of high-grade direct reduction iron (DRI) capable magnetite concentrate and has an expected mine life of ~20 years to 2046. Over the life of mine (LOM), 161 Mt of magnetite ore and 182 Mt of waste rock will be extracted from the Iron Duchess South Resource.

SIMEC has completed over 300,000 m of resource and exploration drilling at Duchess South with routine analysis of major bulk rock elements. This data has been reviewed to understand the sulfur distribution across the pit and determine the typical composition of the major rock types. In addition to this, over 1000 drillhole samples have been analysed for acid-base accounting (ABA) parameters including Acid Neutralisation Capacity (ANC), 266 for Net Acid Generation (NAG) and chromium reducible sulfur (CRS) speciation, 538 X-ray diffraction (qXRD) qualitative mineralogy, and 401 for a 37 multi-elements suite.

The purpose of this report is to provide an assessment of the analytical data collected to date, to determine the acid and metalliferous drainage (AMD) potential of the different rock types, leading to the development of a preliminary AMD block model to assist mine planning and waste rock management and placement. The data interpretation is based on industry best practice guidelines and regulatory requirements (AMIRA, 2002; Price, 2009; DFAT, 2016; DMP, 2016; DEM, 2024).

This report is part of the support material prepared for regulatory approvals to facilitate a change in operations application under the South Australian Department for Energy and Mining's Terms of Reference 025 as required to deliver the MEP1 project.

2 Background information

2.1 Historical geochemical assessments

Material geochemical characterisation information for the Iron Duchess and Iron Magnet deposits is available in five reports, with the first study dating back to 2007. Since then, adjustments have been made to the geological models such as the rationalisation of the different lithological codes, which need to be considered when assessing the data.

The outcomes of these reports can be summarised as follows:

- Samples from the Duchess North pit were all classed as non-acid forming (NAF) or Uncertain (UC). No potentially acid forming (PAF) material was recorded.
- PAF material was identified at:
  - Duchess South pit: mostly samples collected from the Amphibolite dykes (AMP) and Magnetite silica (MTS) geozones
  - Iron Magnet Pit: from the internal schist (SCH), MTS and magnetite carbonate (MTC) geozones
- Carbonate-bearing units have been identified in the Iron Magnet pit F footprint with sulfidic material generally constrained to below the base of oxidation.
- High sulfur content was noted in samples localised on fault zones.

2.2 Pit geometry

The MEP1 pit (Figure 1) will join two existing pits, Iron Magnet and Iron Duchess South with the extension progressing from South to North starting with Duchess South-A (intersects MAG-E pit) and finishing with Duchess South-C (intersects Iron Duchess North B4 pit). The key characteristics are:

- Maximum length of 1.90 km.
- Typical pit width of 740 m.
- Maximum pit depth 336 m.
- Total pit area 115 hectares (ha).
- Estimated 343 Mt of material extracted (161 Mt of magnetite ore and 182 Mt of waste rock).

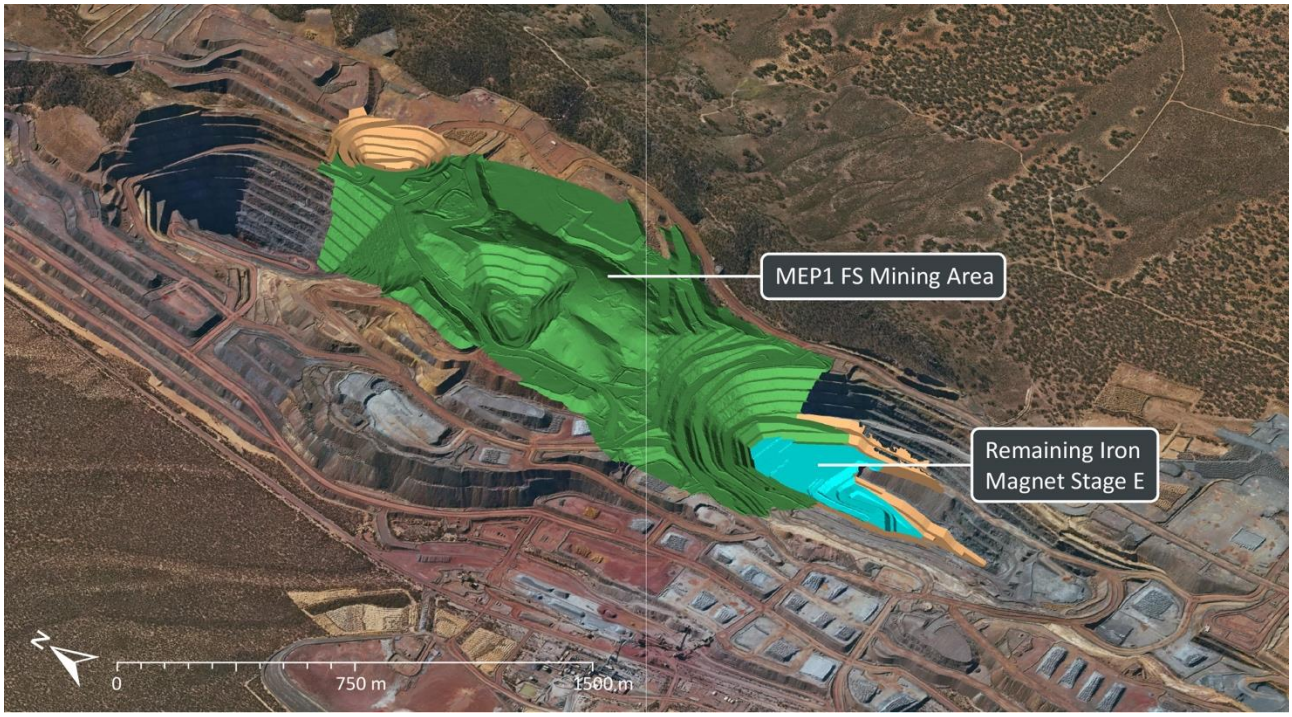


Figure 1 **MEP1 pit design**

2.3 Rock types and estimated waste rock volumes

The geological block model has been constructed using 15 different rock types or geozones (Table 1) derived from the lithological logging of over 300,000 m of resource and exploration drilling (2185 drillholes). The dominant rock types differ for ore and waste as follows:

- Ore: Magnetite silica mineralisation (MTS) with lesser amounts of magnetite-carbonate (MTC).
- Waste rock: Banded iron formation (BIF), amphibolite dykes (AMP), basal sequence (BSQ) and Cook Gap Schist (CGS)

The volume of waste rock was estimated using the block model for the MEP1 resource and resulted in 67,308,190 bcm (182,044,918 tonnes of waste) to be extracted from the pit, for the following cut-off ore/waste values:

- Hematite - head grade > 47% Fe and a SiO_2 head grade < 50%.
- Magnetite - mass recovery > 15% and Fe head grade > 15% and SiO_2 head grade < 70% and SiO_2 concentrate grade < 30%.

The arrangement of the geozones is shown on the pit cross-section presented in Figure 2, with MTS, the dominant rock type in the ore. The proportions of different rock types within the total volume of waste are provided in Table 1, with the dominant rock types (those with a proportion above 5%) highlighted in bold.

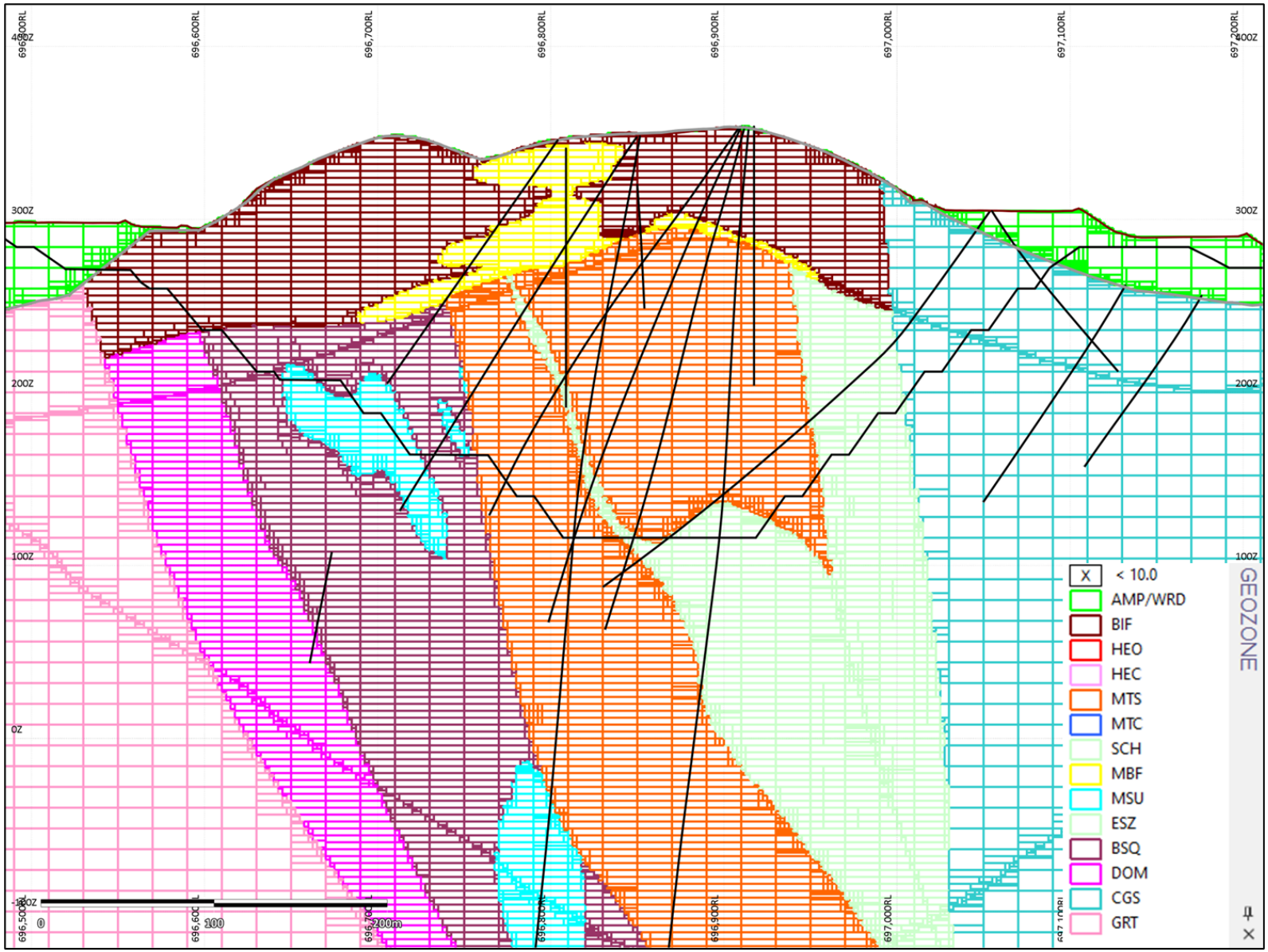


Figure 2 **Representative MEP1 Cross section including MEP1 pit outline (6317650 northing)**

Table 1: MEP1 waste rock (below ore cut-off) volumes and proportions per geozone (dominant rock waste types in bold)

Geozone	Code	Rock type description	Ore/waste	Volume (bcm)	Proportion %
10	**AMP**	**Amphibolite Dykes**	Waste	**10,370,602**	**15.4**
20	**BIF**	**Banded Iron Formation**	Waste	**20,725,756**	**30.8**
30	HEO	Hematite	Waste	102,270	0.2
32	HEC	Hematite Carbonate	Waste	66,978	0.1
37	HBF	Haematite Banded Iron Formation	Waste	371,252	0.6
40	MTS	Magnetite Silica	Ore	1,630,165	2.4
43	MTC	Magnetite Carbonate	Ore	9,556	<0.1
46	SCH	Internal “Schist”	Waste	2,917,918	4.3
47	**MBF**	**Magnetite Banded Iron Formation**	Waste	**4,411,620**	**6.6**
48	MSU	Magnetite Sulfide	Waste	2,685,499	4.0
49	**ESZ**	**Eastern Shear Zone**	Waste	**4,763,844**	**7.1**
70	**BSQ**	**Basal Sequence**	Waste	**9,006,170**	**13.4**
71	DOM	Katunga Dolomite	Waste	2,582,989	3.8
80	**CGS**	**Cook Gap Schist**	Waste	**7,241,058**	**10.8**
90	GRT	Basement Granite	Waste	422,513	0.6
		Total		67,308,190	100

3 Methods

3.1 Sample selection and geochemical program

The geochemical characterisation program was conducted in two stages on samples collected between 2020 and 2023. The objectives of the 2 stages were:

- Stage 1: identify sulfur clusters in the pit and estimate the acid-forming potential of the different rock types using total sulfur (total-S) and ANC.
- Stage 2: confirm the acid potential of select samples by assessing sulfur speciation and quantifying the net acid generation potential.

Stage 1 samples were collected from material remaining from the resource estimation assay program whilst Stage 2 samples were collected from drillcore that targeted the basal sequence (BSQ). All samples were selected to provide a representative spatial distribution of the different materials in the pit including ore by considering rock types, total-S (from the drillcore database) and location. However, some limitations occurred in selecting Stage 1 samples due to the positioning of the drillholes aimed at the reserve rather than at the waste rock. The number of samples per rock type for each stage is provided in Appendix A.

The analyses conducted were selected based on previous geochemical characterisation (Parsons Brinkerhoff, 2007; Golder, 2019; LWC, 2020a; LWC, 2020b). The number of samples and corresponding analysis for each stage are listed in Table 2. All analyses were undertaken by ALS-Environmental (NATA accredited).

Table 2: Geochemical sampling and characterisation program

Stage 1		Stage 2	
Drilling Campaign 2020-21		Drilling Campaign 2023-24	
Samples selected from resource estimation assay program		Combination of fresh samples (99) selected from new drillholes and Stage 1 samples with high sulfur content material (167)	
• ANC • Total-S (drilling database) • Multi-elements	978 978 401	• ANC • Total-S (drilling database) o Sulfur speciation - sulfide (CRS) • Net Acid Generation (NAG)	266 266 265 266

3.2 Geochemical data analysis

The data analysis was conducted in two stages:

- In Stage 1, Total-S and ANC were used to calculate the Net Acid Potential Production (NAPP) and the Net Potential Ratio (NPR) to class the samples as potentially acid-forming (PAF), non-acid forming (NAF) or Uncertain (UC) following the AMIRA classification (AMIRA, 2002) and Price (Price, 2009) systems. These are presented in Table 3.
- In Stage 2, the NAG pH was used in conjunction with NAPP to further assess high sulfur content or uncertain samples, as per the AMIRA classification (AMIRA, 2002), to confirm the Price classification.

Table 3: Preliminary screening criteria based on $pH_{1:2}$Total-S, NAPP and NAG test data (DFAT, 2016)

		Preliminary Classification		AMIRA Classification		Price System
	$pH_{1:2}$	Total-S (%S)	NAPP Value (kg H_2SO_4/t)	NAG pH (pH Unit)	NAPP Value (kg H_2SO_4/t)	NPR
Existing Acidity	<5.5					
Potentially Acid Forming (PAF)			≥ 10	< 4.5	≥ 10	< 1
PAF-Low Capacity (PAF-LC)			< 10	< 4.5	< 10	
Non-Acid Forming (NAF)		< 0.2	< 0 (negative)	≥ 4.5	< 0 (negative)	≥ 2
Acid Consuming (ACM)			< -100	≥ 4.5	< -100	
Uncertain (UC-NAF)				≥ 4.5	≥ 0 (positive)	1 ≤ NPR < 2
Uncertain (UC-PAF)				< 4.5	< 0 (negative)	

3.3 Data analysis

3.3.1 Total sulfur

Total-S is used as an indicator of the AMD potential that can be generated by a sample. It assumes that all sulfur is present as pyrite and can be oxidised into sulfuric acid, where 1% S generates 30.6 kg of H_2SO_4/t. This method overestimates acidity as sulfur can be present in a variety of forms, such as sulfides (including pyrite, pyrrhotite, chalcopyrite etc.), sulfates (including non-acid generating forms such as gypsum and acid-generating forms such as alunite) or organics forms. It is considered conservative.

The exploration drillhole database for the Duchess South Resource model was reviewed and analysed for total-S content to identify which areas of the pit and which rock types had the potential to generate AMD. For each domain, sample numbers inside the pit shells were counted, and a sulfur cut-off of 0.2% was applied to assess the percentage of material presenting an AMD risk.

The data is presented in Table 4 and highlights that, for the waste rock, the schist (SCH), Basal Sequence (BSQ) and eastern shear zone (ESZ) domains contained the highest proportion of samples with a total-S content greater than 0.2%. The ore sample database, magnetite sulfide (MSU), contained up to 2% of samples with a total-S content above 0.2%. This is consistent with geological observations of pyrite and pyrrhotite within these units (cf. section 3.3.7).

Table 4: Total-S drillhole database analysis for waste rock only, dominant waste rock types in bold

Geozone	Code	Sample count	Sample Count >0.2% S	Sample % > 0.2% S
10	**AMP**	**13,235**	**814**	**6.15**
20	**BIF**	**17,754**	**455**	**3.44**
37	HBF	4,151	237	1.79
46	SCH	5,239	1,780	13.45
47	**MBF**	**2,187**	**131**	**0.99**
48	MSU (Ore)	3,521	2,383	18.01
49	**ESZ**	**2,627**	**1,053**	**7.96**
70	**BSQ**	**3,691**	**1,840**	**13.9**
71	DOM	3,407	593	4.48
80	**CGS**	**3,431**	**415**	**3.14**
90	GRT	1,005	23	0.17

3.3.2 Acid-base accounting (ABA)

The Stage 1 acid-base accounting was conducted on a total of 978 samples of ore and waste. This number was later increased to 1085 (1034 analytical results) when Stage 2 samples were added to the program to address gaps. The samples were analysed for total-S and ANC, and the resulting NAPP and NPR values were calculated to estimate the AMD potential (cf. section 3.2). The analytical data is presented as box and whisker plots for total-S, ANC and NAPP for all rock types (Figure 3, Figure 4 and Figure 5).

The rock types can also be classified based on the NPR ratio (Price W. , 2009), which corresponds to ANC divided by total-S. The output of this ABA classification is presented in Figure 6 for the dominant rock types of the waste rock and in Figure 18 in Appendix B for the minor rock types. As the NPR ratio increases, the risk of acid-forming decreases. The classification criteria for the NPR system are provided in Table 3.

Median total-S, ANC, MPA and NAPP values were calculated on Stage 1 and Stage 2 samples for the largest datasets and average values were calculated for sets with less than 10 counts. These values are listed in Table 5.

Key observations for the major geological units are as follows:

- Only three rock types had a total-S content above 0.2%: MSU, BSQ, and DOM. MSU and DOM are minor waste rock types, whilst BSQ is a dominant waste rock type.
- MSU and BSQ are also the rock types with the widest total-S spread with several outliers above 4%S. BSQ is the only rock type that straddles the zero NAPP line.
- DOM and MTC are the rock types with the widest spread of data for ANC, they also have the highest median ANC content, both are minor waste rock types.
- All rock types have a negative median NAPP and can be preliminarily classed as NAF, except BSQ and MSU which are classed UC.
- The NPR AMD classification shows that:
  - out of the 1034 samples tested; 794 (77%) are NAF, 114 (11%) are PAF and 126 (12%) are UC.
  - BSQ is the rock type with the highest number of samples having an NPR<1, this aligns with the higher total-S content.

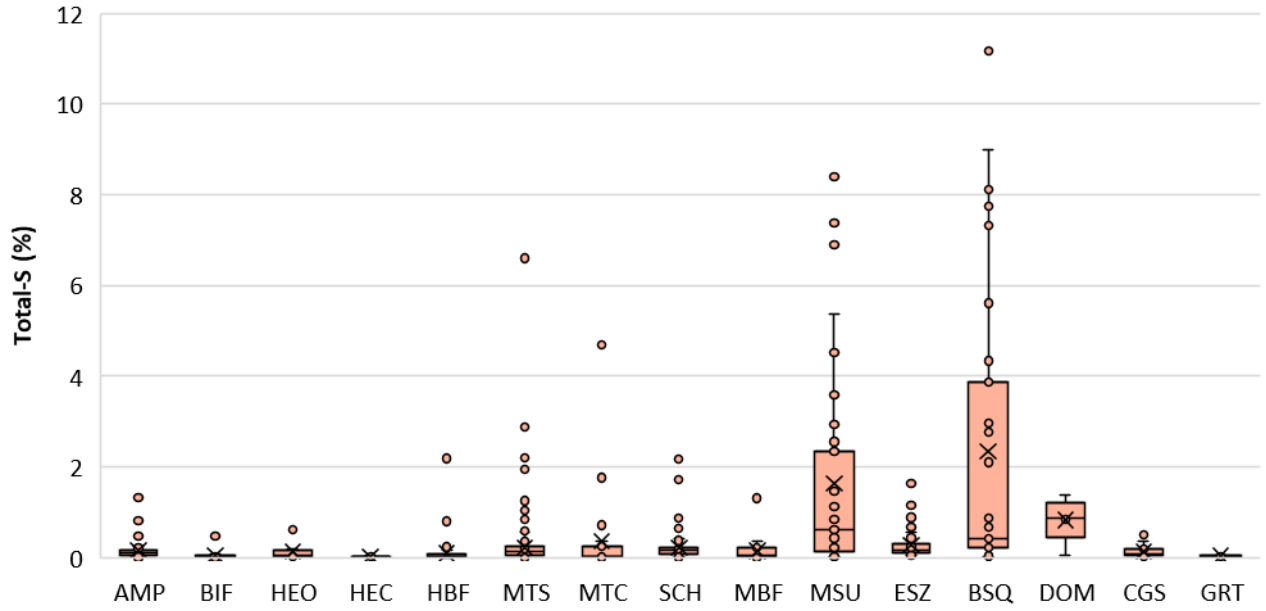


Figure 3 **Total-S Box and Whisker plot for each rock type**

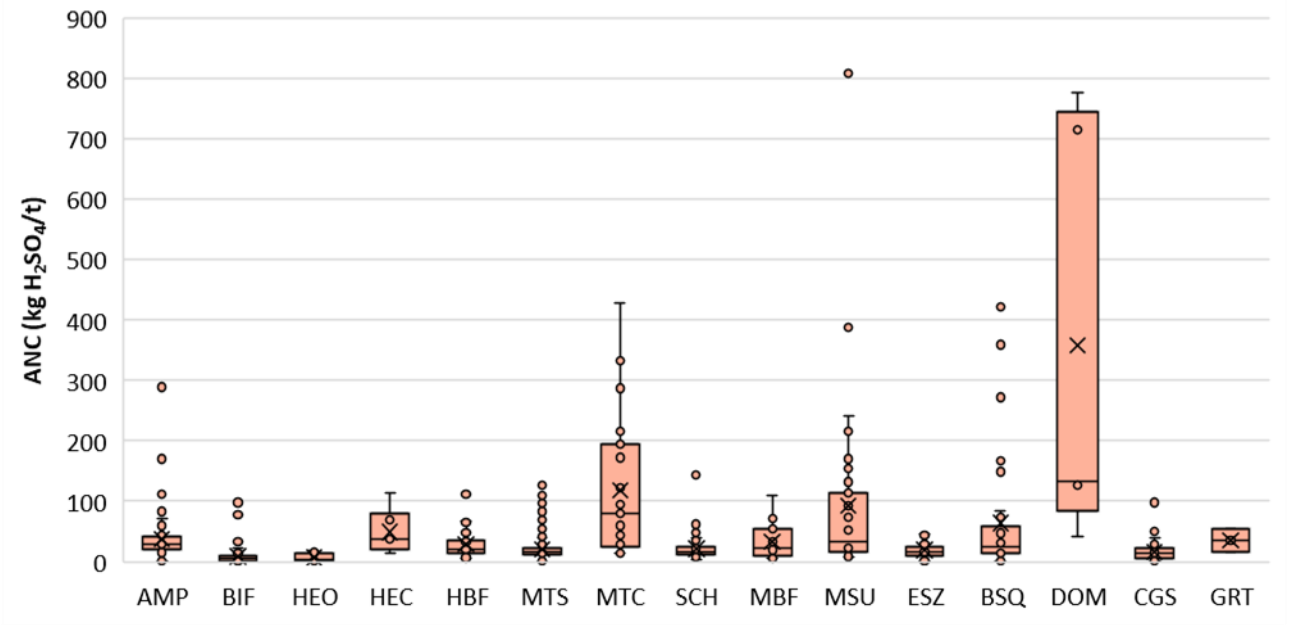


Figure 4 **ANC Box and Whisker plot for each rock type**

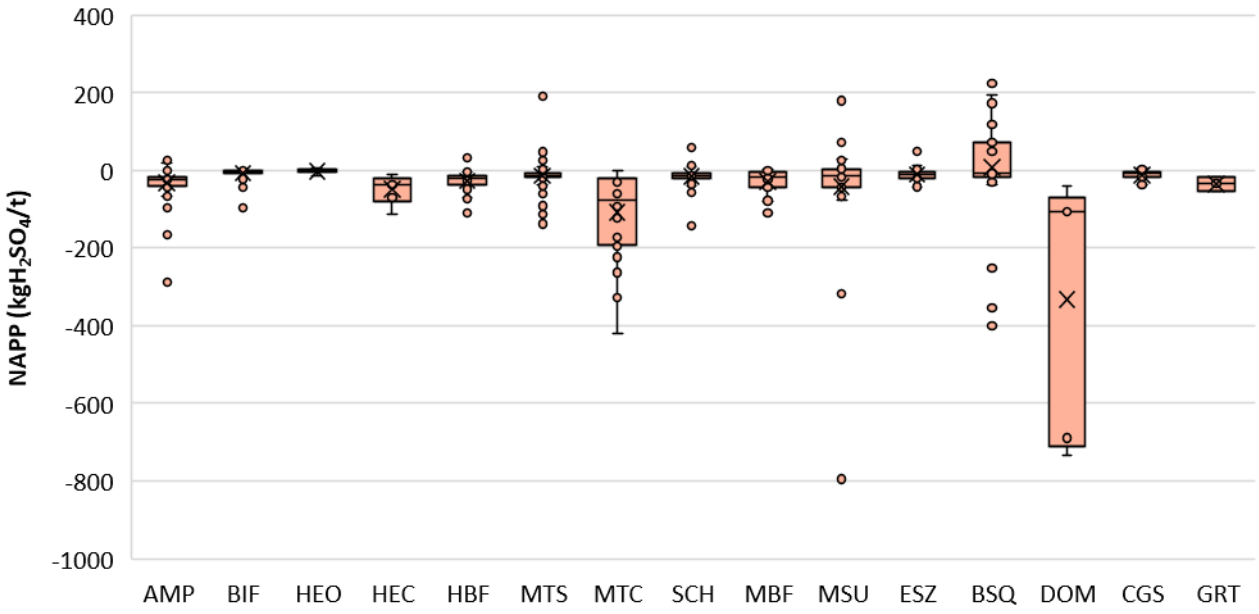


Figure 5 **NAPP Box and Whisker plot for each rock type**

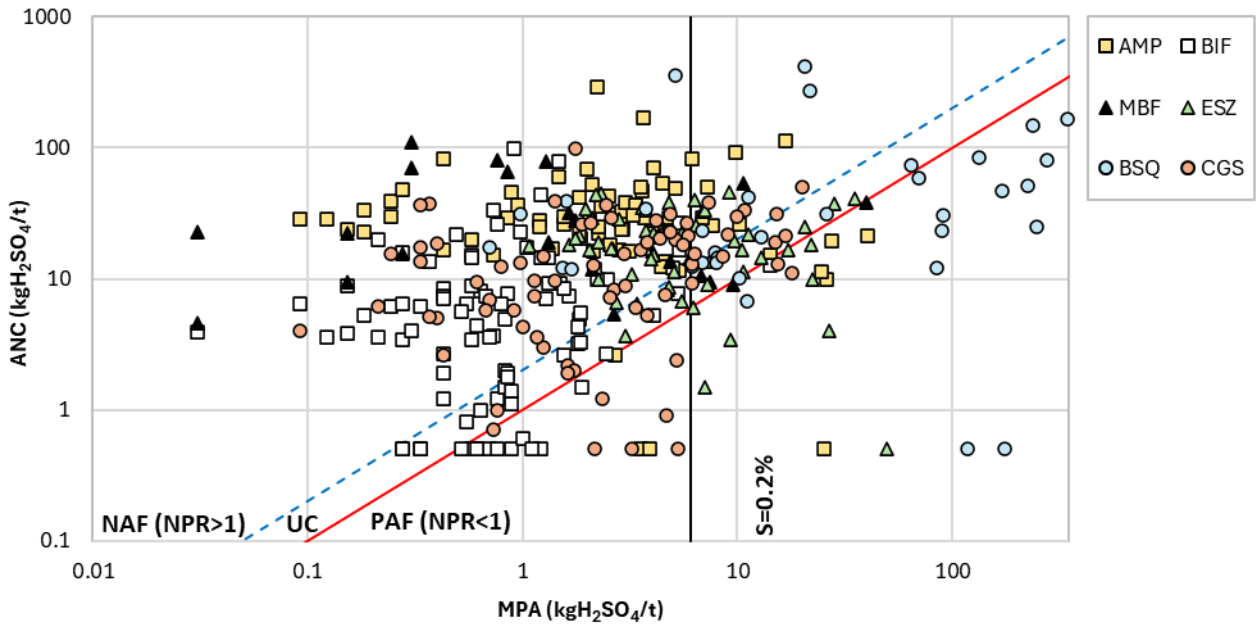


Figure 6 **NPR plot for dominant rock types in the waste (% distribution >5)**

Table 5: Median ANC, total-S, MPA and NAPP for Stage1 and Stage 2 samples with associated NPR NAF/PAF classification, dominant rock types in the waste in bold

	Rock Type	Sample Count	Median total-S (%S)	Median MPA (kgH_2SO_4/t)	Median ANC (kgH_2SO_4/t)	Median NAPP (kgH_2SO_4/t)	NPR Classification
10	**AMP**	**75**	**0.09**	**2.8**	**28**	**-24.4**	**NAF**
20	**BIF**	**93**	**0.02**	**0.7**	**5.3**	**-3.8**	**NAF**
30	HEO	9	0.05#	1.4#	4.15#	-1.8#	NAF
32	HEC	7	0.01#	0.4#	36.7#	-36.1#	NAF
37	HBF	90	0.01	0.4	21.0	-19.9	NAF
40	MTS	426	0.12	3.6	16.4	-12.2	NAF
43	MTC	30	0.02	0.6	80.2	-75.3	NAF
46	SCH	105	0.15	4.4	17.0	-12.2	NAF
47	**MBF**	**23**	**0.05**	**1.6**	**22.5**	**-17.9**	**NAF**
48	MSU	35	0.61	18.6	34.1	-14.2	UC
49	**ESZ**	**58**	**0.16**	**4.9**	**17**	**-9.9**	**NAF**
70	**BSQ**	**37**	**0.56**	**17.3**	**25.2**	**-6.4**	**UC**
71	DOM	6	1.18#	36.1#	358#	-333#	NAF
80	**CGS**	**83**	**0.04**	**1.2**	**13**	**-4.6**	**NAF**
90	GRT	3	0.01#	0.4#	34.4#	-34.1#	NAF

Note: # average calculated due to low sample numbers

3.3.3 Sulfur speciation – chromium reducible sulfur

Sulfur speciation is an important factor when assessing the AMD potential of materials. Differentiating between sulfide and sulfate sulfur forms helps in assessing the AMD risk, with sulfide being the primary source of AMD and sulfate being associated with existing acidity.

Sulfidic forms were quantified by the CRS test and undertaken on 265 samples, including 98 new samples and 167 Stage 1 samples that had been classified as UC or PAF using the NPR classification. The correlation between total-S and CRS for the major waste lithologies is shown in Figure 7 and in Figure 18 in Appendix B for the minor waste rock types. Some discrepancies are observed with CRS greater than total-S for some samples; these is attributed to the heterogeneity of the material between the samples collected for the exploration assays and those for the geochemical characterisation work.

The correlation between total-S and CRS is close to 1 for most of the dominant waste rock types except for samples extracted from the BIF and AMP geozones. This indicates that the BIF and AMP are likely to contain sulfate minerals whilst sulfide in the other rock types. The latter materials may present a potential AMD risk if oxidised and ANC is insufficient to ensure neutralisation. The same correlation was observed for the minor rock types (Figure 18, Appendix B).

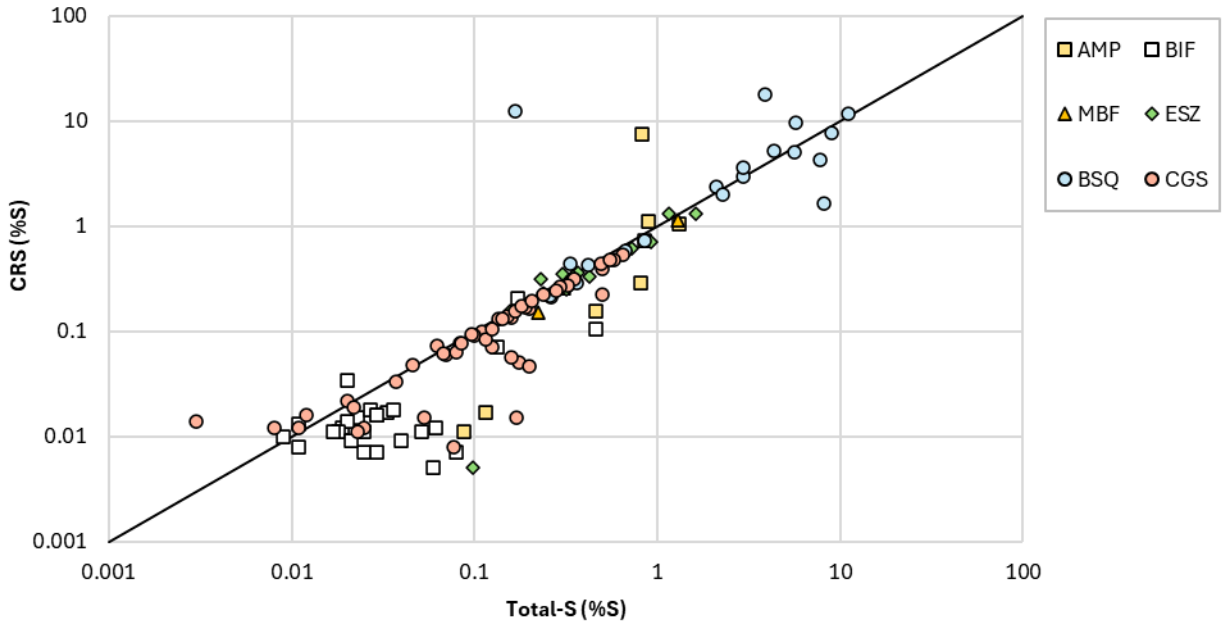


Figure 7 Correlation between total-S and CRS for select samples from major waste rock geological domains (% distribution >5)

3.3.4 Net acid generation - NAG pH and indicative sulfur cut-off value

NAG testing was undertaken on 266 samples (99 new samples and 167 Stage 1 samples). NAG pH provides an indication of the potential of the sample to generate AMD after oxidation, it is linked to sulfidic content in the fresh rock. This can be observed in Figure 8 where NAG pH decreases with increasing sulfur content and therefore sulfide content.

Figure 8 shows that all samples with a NAG pH below 4.5 had a sulfur content above 0.2% except two samples. This indicates that a sulfur cut-off of 0.2% is appropriate to separate NAF and PAF material. This same value has been applied in Section 3.3.1 to quantify the volumes of PAF material from the drilling database.

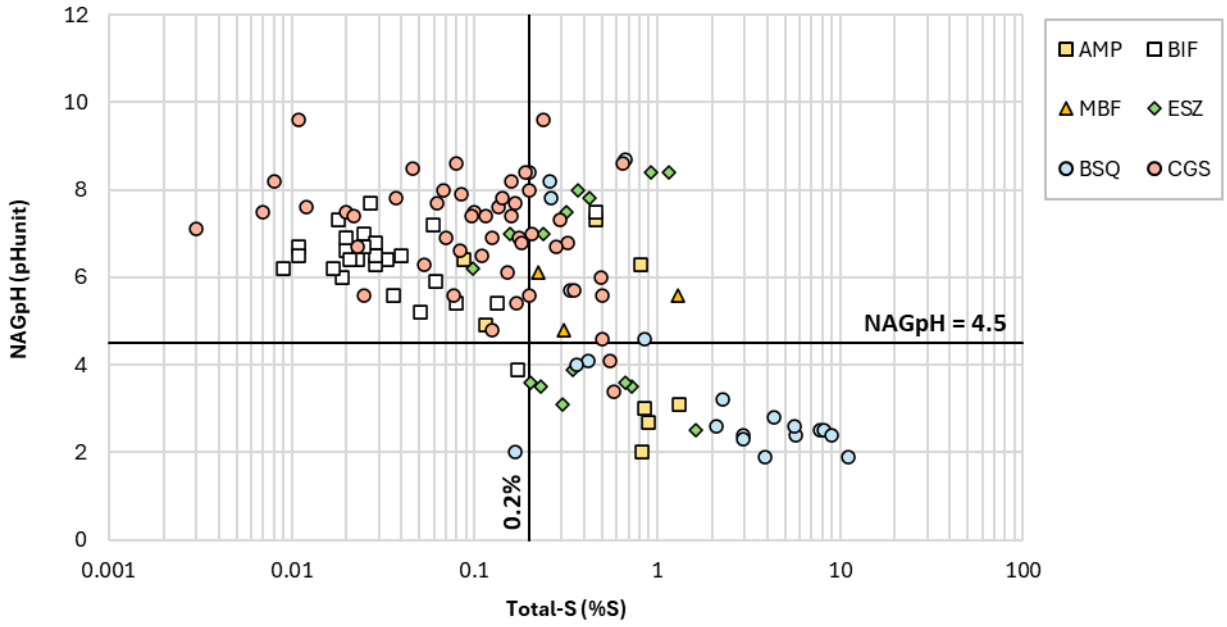


Figure 8 NAG pH against total-S for select samples from the wastes' dominant rock types (% distribution >5)

3.3.5 AMIRA NAF/PAF validation

The ABA assessment and preliminary grouping are refined by considering the $NAPP_{CRS}$ and NAG pH values for each sample and classifying them according to the acid-forming classification scheme provided in Table 3Table 3. The values attributed to $NAPP_{CRS}$ and NAG pH are based on the AMIRA (2002) and DITR (2016) guidance. The graphs corresponding to these geochemical classifications are presented in Figure 9 (full set of $NAPP_{CRS}$ values) and Figure 10 ($NAPP_{CRS}$ values between -50 and 50 kg H_2SO_4/t) for the dominant waste rock types. It includes reference lines for NAG pH (pH 4.5) and NAPP (0 kg H_2SO_4/t) which generates four quadrants used for classification: NAF, UC (NAF), UC (PAF), and PAF. A PAF-low capacity (PAF-LC) section has also been added with $NAPP_{CRS}$ <10 kgH_2SO_4/t.

Results for the samples selected from the dominant waste rock types are presented in Figure 9 and Figure 10. These graphs show that the AMP and BSQ samples selected for the NAG test were mostly PAF. The outcome of the AMIRA classification should not be generalized to the entire pit shell, as NAG pH was used to validate the NPR classification based on a limited number of samples that are neither spatially nor chemically representative of the rock type distribution in the pit.

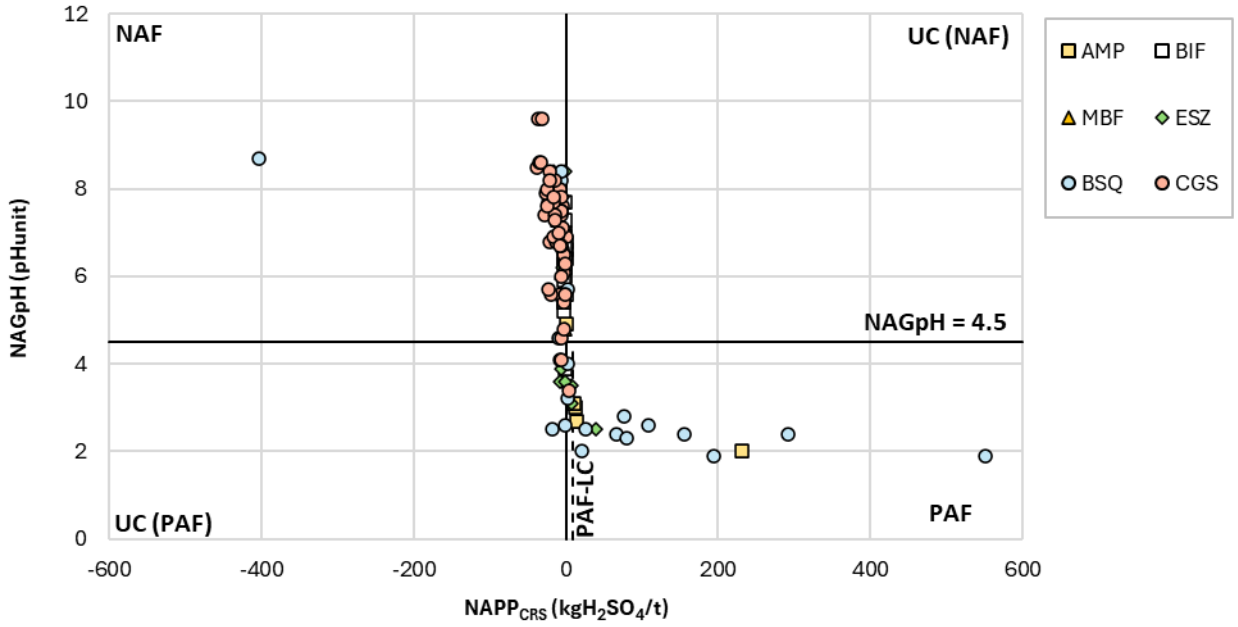


Figure 9 AMIRA classification plot for select samples from the major waste rock types (% distribution >5) full NAPP scale (-600,600)

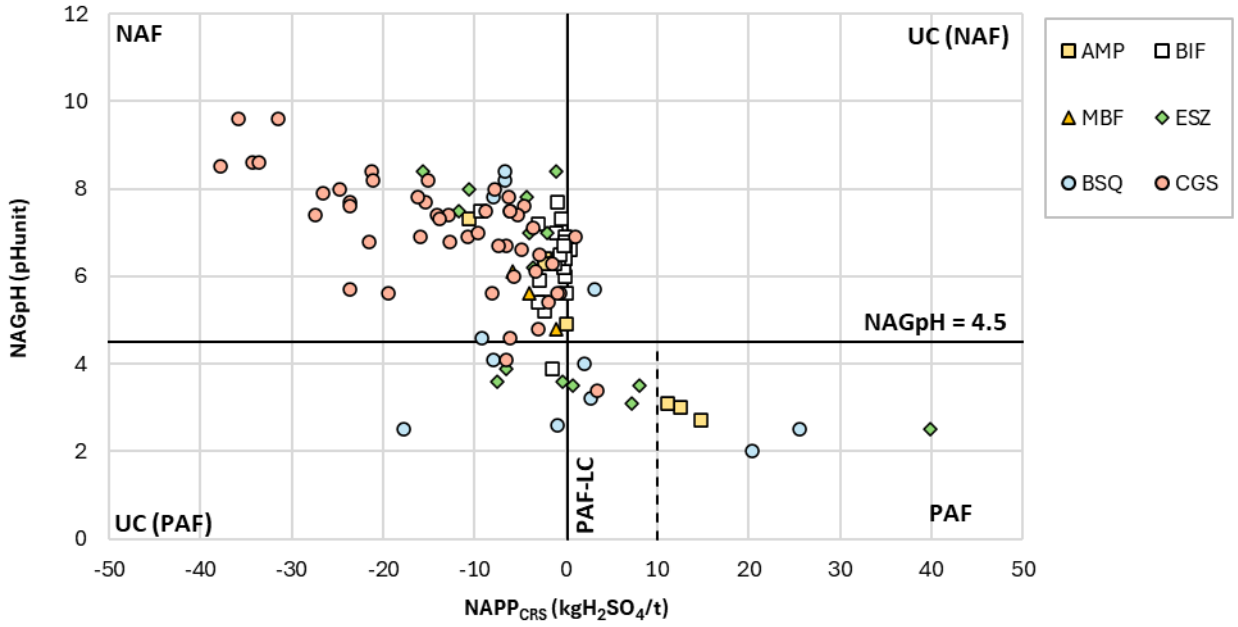


Figure 10 AMIRA classification plot for select samples from the major waste rock types (% distribution >5) short NAPP scale (-50,50)

3.3.6 Multi-element composition

Total metal(loid) concentrations were compared to average crustal concentrations (Smith & Huyck, 1997; AUSIMM, 2001) to calculate Geochemical Abundance Index (GAI) values for each element. The GAI provides a mechanism for identifying geochemically enriched elements, which may be of environmental importance should all metals be fully released. The GAI is based on a log-2 scale and is expressed in integer increments from zero (0) to six (6) (INAP, 2009). A GAI equal to or greater than three (3) is generally considered indicative of geochemical enrichment and may warrant further investigation if the material is at risk of being submitted to highly eroding or corroding conditions.

The multi-element results and calculated GAIs for all metal(loid)s analysed are shown in Appendix C. Out of the 37 elements analysed, only selenium and tellurium were consistently above a GAI of 3 for all rock types. Arsenic was above a GAI of 3 for the BSQ/MSU rock type which is also the richest in sulfidic material.

3.3.7 Mineralogy

Quantitative X-Ray Diffraction mineralogy data was collected from 538 Stage 1 samples covering both ore and waste throughout the Duchess South Resource. The results indicate that pyrite and pyrrhotite are present in BSQ, MSU, MTC and MTS. Calcite and dolomite were present in most rock types with BSQ, MSU and MTC containing the highest proportion of the carbonate minerals.

Table 6: Quantitative X-Ray diffraction (average values)

Domain	AMP	BIF	HEO	HBF	MTS	MTC	SCH	MBF	MSU	BSQ	ESZ	CGS
Sample Count (n)	5	80	27	34	256	13	33	7	9	1	22	51
Quartz (%)	24.7	60.3	4.8	18.1	33.2	2.1	17.0	41.6	28.1	22.0	35.3	61.6
Magnetite (%)	7.2	0.7	2.5	1.4	28.2	36.8	12.8	11.3	16.9	9.0	19.7	1.0
Hematite (%)	7.6	7.3	72.2	39.4	7.4	1.9	3.3	15.0	4.3		0.3	2.4
Goethite (%)	0.0	25.0	8.4		0.7		0.1	8.4				5.4
Chlorite (%)	33.8	0.1	1.8	3.1	2.3	2.9	3.9	2.1	2.2	3.0	2.7	4.2
Smectite (%)	15.2	0.3	0.6	1.2	0.1		0.2					1.5
Talc (%)	3.8	0.6	8.0	33.1	15.5	4.4	25.6	5.3	13.1	13.0	6.6	1.3
Amphibole (%)	10.8	0.9			9.2	9.1	30.6	11.0	12.7	19.0	27.9	0.3
Kaolinite-Serpentinite (%)		4.9	1.0	1.5	2.3	1.2	3.8	0.1	2.3	5.0	3.2	7.1
Mica (%)		0.4			0.1		0.7	0.2		0.0	1.3	10.9
Dolomite (%)	1.4		4.5	3.4	1.6		0.8	1.5	3.1	12.0	0.8	0.2
Calcite (%)	0.2	0.1	0.1		1.2	38.2	0.7	3.1	15.8	8.0	2.4	0.7
Pyrite (%)					0.1	1.2			2.3	8.0		
Pyrrhotite (%)					0.0		0.2		0.3			0.1
Plagioclase (%)	3.6	0.3			0.3		0.2	0.7			0.2	1.5
K-Feldspar (%)					0.1		0.1		1.3			1.1
Anatase (%)	0.8	0.1		0.1								
Garnet (%)				0.3	0.1		0.1		0.3		0.9	1.1
Gypsum (%)										1.0		

Note: dominant rock types in the waste are underlined

4 AMD Block Model Development

4.1 Development of equations

Within the MEP1 project area, acid-base accounting (ABA) test work for Acid Neutralising Capacity (ANC) and Net Acid Production Potential (NAPP) calculations have been completed on 1034 drill hole samples.

The AMD Block Model has been developed by correlating the ABA data collected from the analytical work to the routine XRF analysis for major elements including Fe, SiO_2, Al_2O_3, Mn, TiO_2, CaO, MgO, K_2O, P, S, Na_2O and Loss on ignition (LoI) undertaken on all samples of the drillhole database. Correlations between the two datasets were developed by using multiple linear regression analysis and the geochemical and statistical software, IoGas and Minitab.

Equations defining MPA, ANC and NAPP as a function of the major elements were developed from these correlations. The predicted values were compared to actual measurements, to assess the validity of the equation. An example is provided for NAPP in Figure 11 for BSQ samples where predicted NAPP values are compared to actual NAPP values calculated from total-S and ANC analytical measurements.

The NAPP equations for all rock types are provided in Appendix D. The development of these regressions was applied to the entire drillhole assay database for the Duchess South Resource with calculated NAPP and ANC values estimated into the block model via Ordinary Kriging (OK).

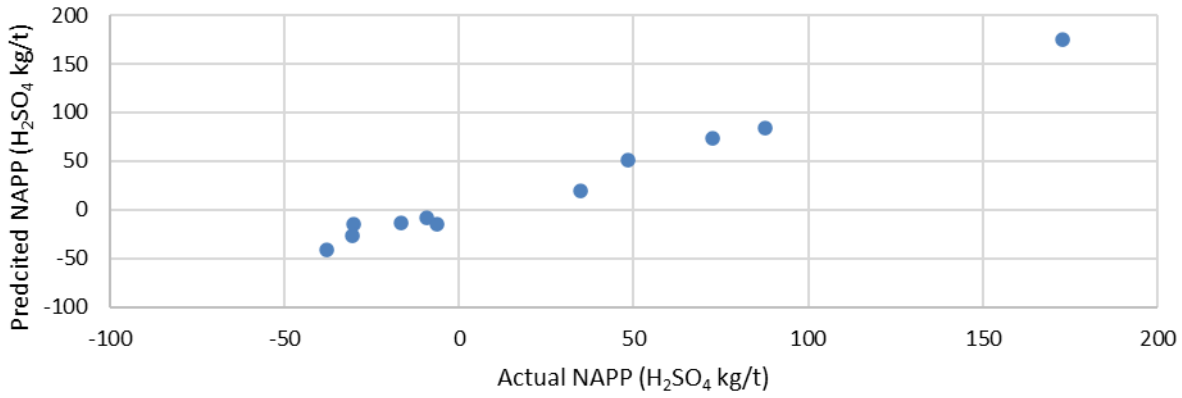


Figure 11 **Multiple linear regression model for NAPP for BSQ samples (n=11, r=0.99)**

4.2 Application to the geological block model

Each block in the geological model was assigned a total-S value based on the rock type and major element XRF analysis (Figure 12) to develop a sulfur block model. This model identifies areas in the pit with the highest sulfur content that will require specific management.

The same approach was followed to develop an AMD block model, every block was assigned an NPR value using the MPA and ANC equations and attributed a PAF, UC or NAF classification in the mine planning/reserve model. This AMD classification scheme was further simplified by treating UC material in the resource as PAF by selecting an NPR cut-off criteria of 2. An example of the AMD cross-section is provided in Figure 13.

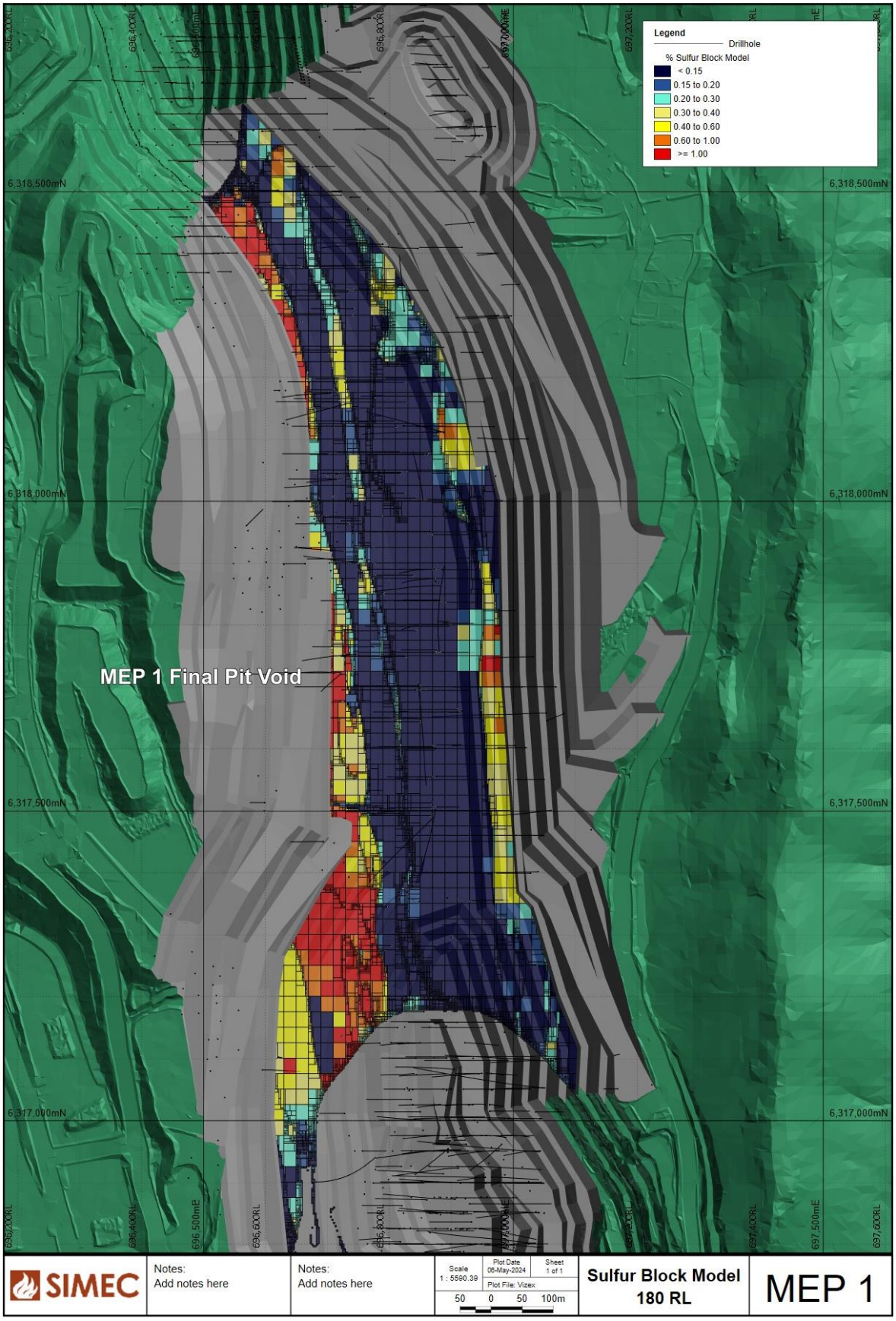


Figure 12 **180 RL Duchess South Sulfur Block Model**

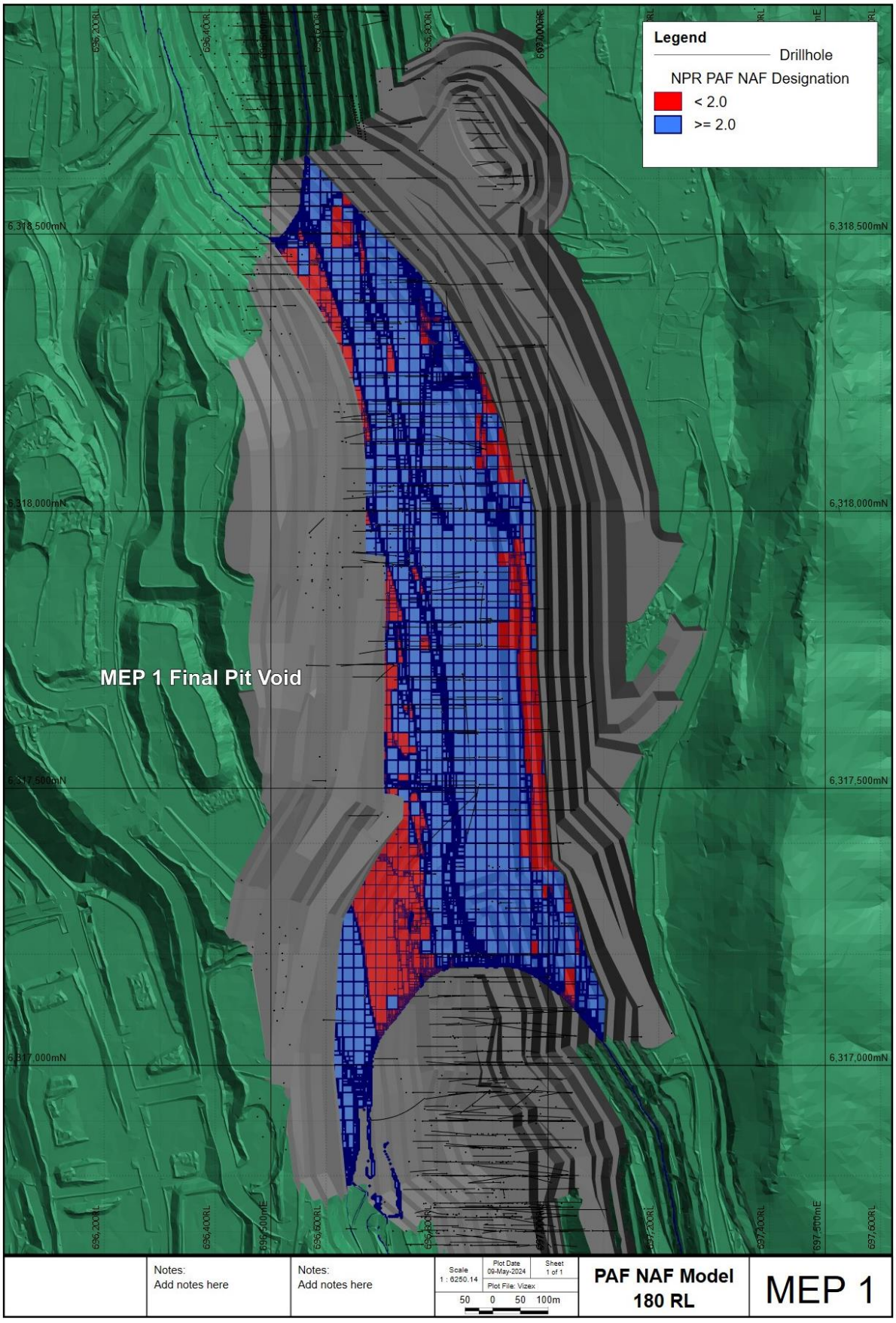


Figure 13 **180 RL Duchess South PAF NAF Block Model. Red = PAF and Blue=NAF**

5 Implications for Material Management

5.1 Waste rock volumes

At this preliminary stage, waste rock management should implement the most conservative acid-forming classification determined from this assessment. The waste rock characterisation program to date has identified that PAF and NAF materials were present within the Duchess South pit shell. The total volumes and tonnages of PAF and NAF waste rock are provided in Table 7 and have been determined from the resource block model and mining schedule for each rock type and their associated domains. A total of 12 million bcm is expected to be classed as PAF waste rock representing 18% of the total volume of waste extracted.

The domains that contribute the largest amounts of PAF waste rock are BSQ, ESZ and MSU.

Table 7: MEP1 waste rock PAF/NAF totals by volume and mass (dominant waste rock type in bold)

		Volume (bcm)		Tonnes (dmt)	
Geozone	code	NAF	PAF	NAF	PAF
10	**AMP**	**10,332,675**	**37,927**	**26,142,897**	**99,984**
20	**BIF**	**20,725,756**		**51,564,683**	
30	HEO	99,118	3,152	338,749	9,377
32	HEC	66,978		246,553	
37	HBF	363,479	7,773	1,424,006	29,381
40	MTS	1,448,615	181,550	4,863,852	608,103
43	MTC	9,556	0	36,230	0
46	SCH	2,342,088	575,830	7,877,109	1,934,754
47	**MBF**	**3,521,253**	**890,367**	**9,305,828**	**2,314,813**
48	MSU	900,220	1,785,279	2,941,241	5,844,338
49	**ESZ**	**2,168,019**	**2,595,825**	**6,814,870**	**8,024,059**
70	**BSQ**	**2,685,338**	**6,320,832**	**7,643,947**	**18,680,104**
71	DOM	2,582,759	230	7,298,672	593
80	**CGS**	**7,241,058**		**17,029,912**	
90	GRT	422,513		970,865	
Grand Total		**54,909,426**	**12,398,766**	**144,499,413**	**37,545,505**
Percentage		**82%**	**18%**	**79%**	**21%**

5.2 Schedule

The AMD block model has been linked to the production schedule to consider NAF and PAF waste material movements through the LoM. Waste movement by NAF and PAF is presented in Figure 14. PAF material is encountered throughout the schedule and will be hauled to the Southern waste rock dump (WRD).

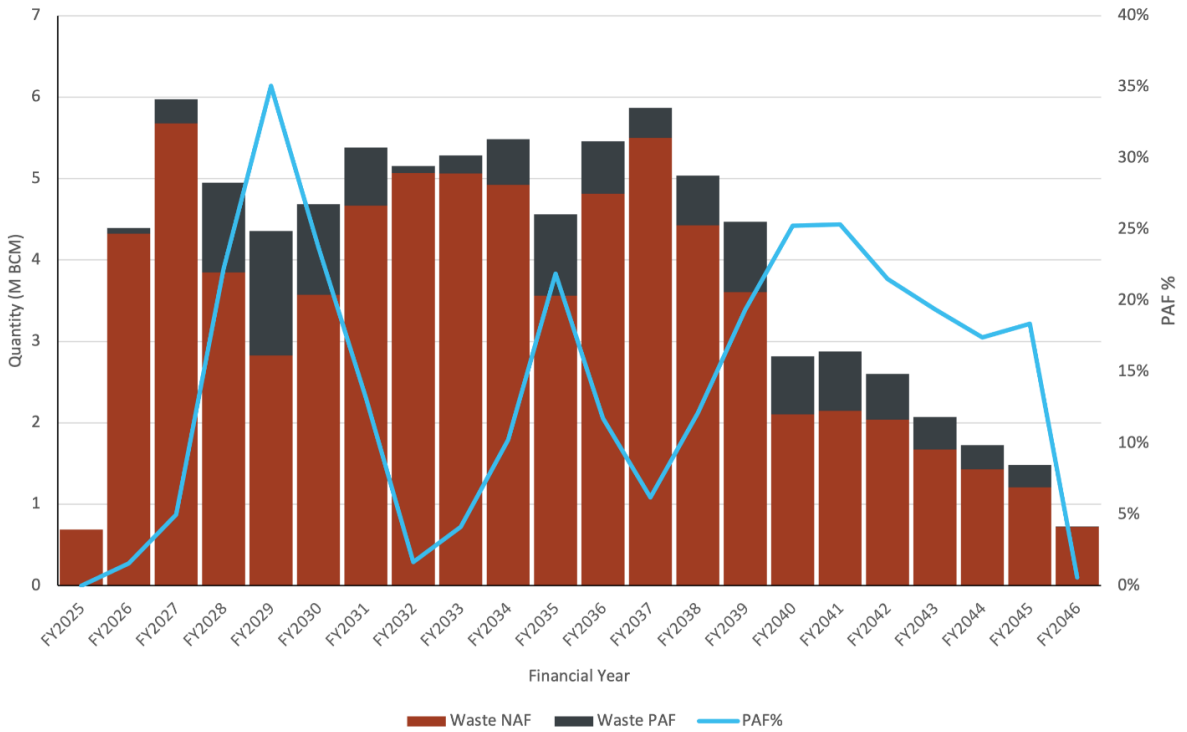


Figure 14 **NAF/PAF waste movement and % PAF through time**

5.3 Waste rock dumps

The PAF material extracted during the Life of Mine will be sent to the Southern WRD **Figure 15**. The Southern WRD has been designed with two dedicated PAF storage areas, one on the Eastern side of the dump and one on the Southern side of the dump. They will be referred to as the Eastern and Southern PAF storage areas and are indicated by the yellow boundaries in Figure 16. All PAF encountered in the LoM is scheduled to a PAF storage area. PAF storage areas can also contain NAF material. PAF storage areas have been designed with the following criteria:

- PAF material will be tipped in 5 m lifts.
- PAF storage areas will be built on a foundation of NAF material that is at least 5 m thick.
- PAF storage areas have been designed to accommodate all PAF material encountered in the LoM.
- After construction, PAF storage areas will be capped with a minimum of 5 m of NAF material on the flat part of the WRD.
- After construction, PAF storage areas will be capped with a minimum of 20 m of NAF material on the sloped part of the WRD.
- Access to PAF storage areas will be designed such that they are separate to NAF storage areas, which will allow for PAF and NAF construction to occur at different rates.

At the end of mine life, all PAF material will be capped with NAF material as per the above thicknesses, such that there is no PAF material exposed. The LoM will be scheduled in such a way that this is achievable. Figure 17 shows cross sections of the PAF storage areas after capping is completed, where PAF material is shown in dark grey and NAF material is shown in blue.



Figure 15 **WRD Designs**

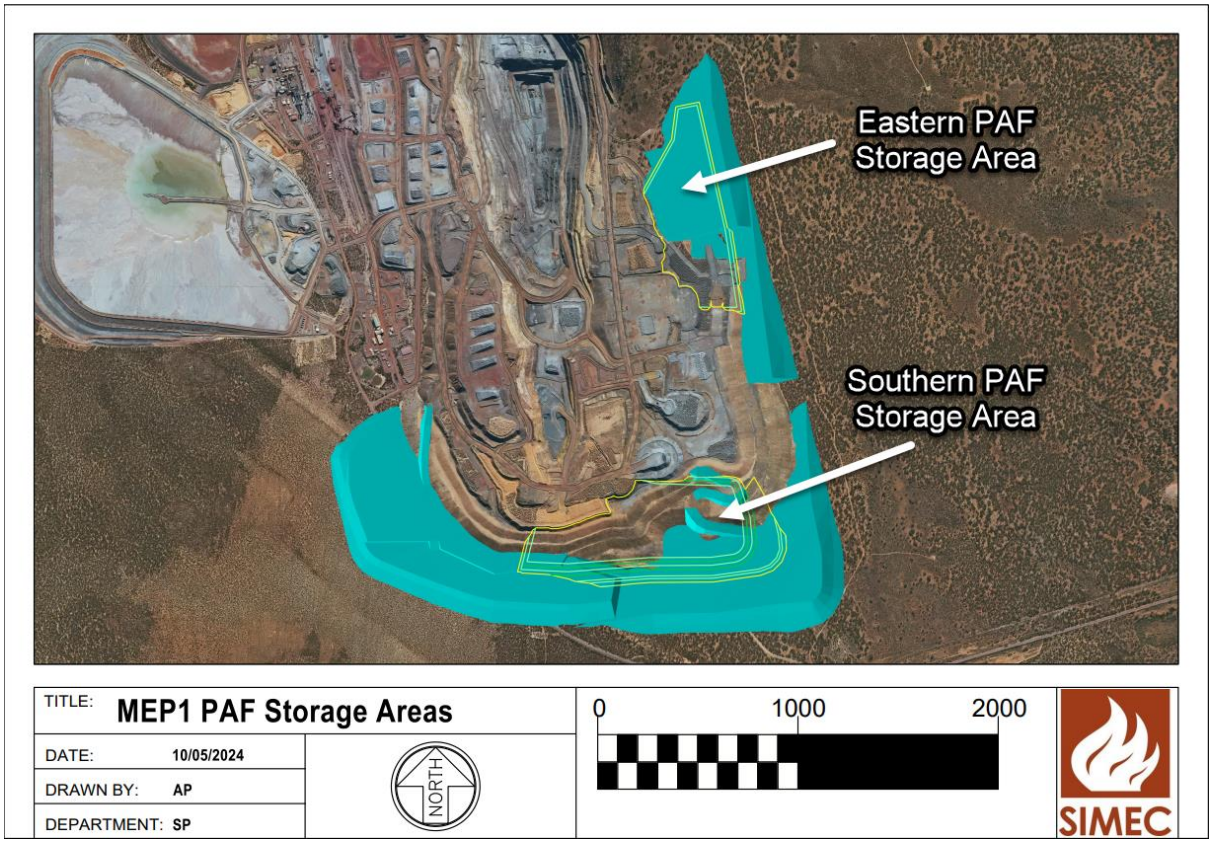


Figure 16 **PAF storage areas**

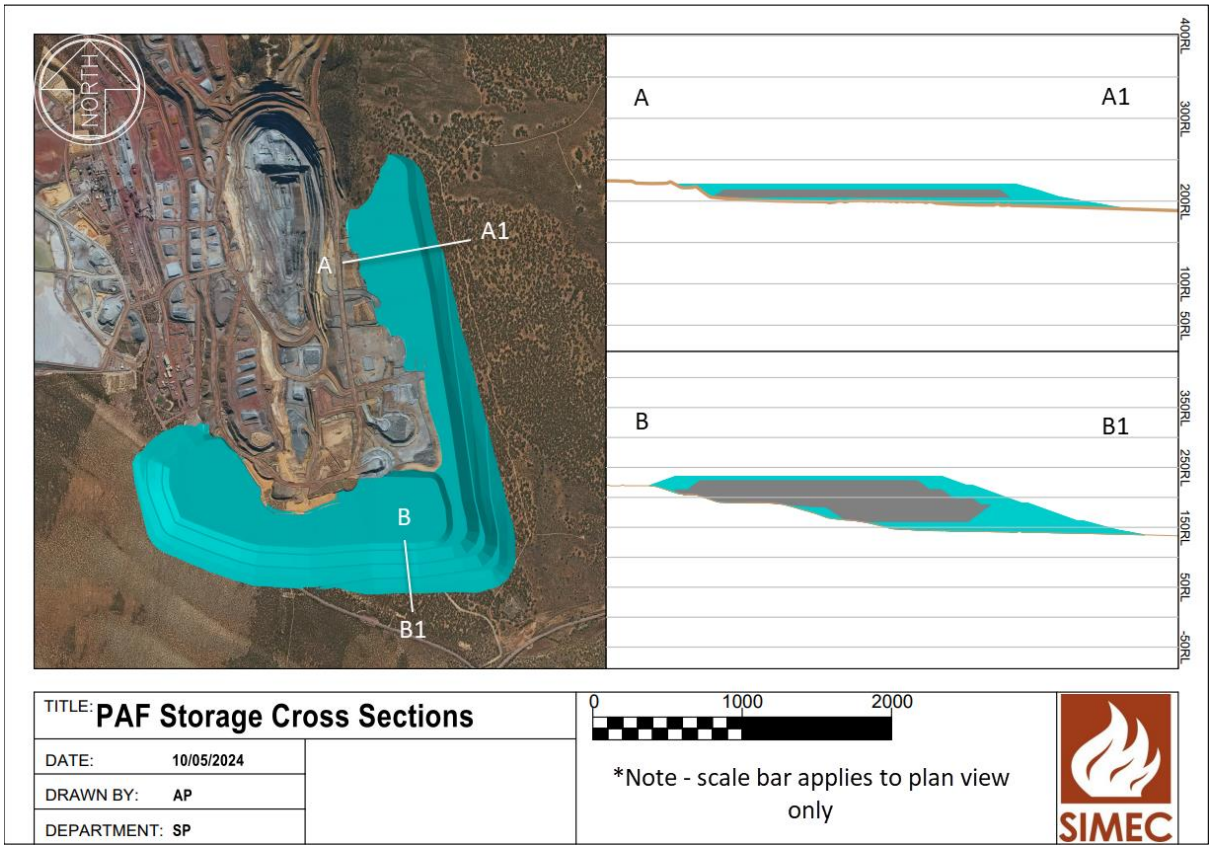


Figure 17 **PAF Storage Cross Sections**

5.4 Ongoing sampling and analysis

Material characterisation will be ongoing until mining operations commence and throughout operation. This information will be used to validate the findings of the geochemical studies and update the block model and the mining schedule. It will also be used to address geochemical characterisation knowledge gaps such as saline and metalliferous drainage and potentially long-term kinetic work to assist in planning for closure.

During operation, the sampling, analysis and quality program (SAQP) should consider:

- Standard sampling frequency of one sample per ~400 m^3.
- Standard analysis to include total-S, ANC and NAG pH.
- Complement the standard analysis with 1:2 solid to liquid extraction and analyse for $pH_{1:2}$, $EC_{1:2,}$ major ions and metalloids to assess saline and metalliferous drainage.

6 Conclusion

The data collected to date for the MEP1 has been reviewed to assess the AMD potential on the waste rock material. The drillhole database was reviewed to assess the distribution and proportion of the different rock types across the pit. This data was combined with the XRF sulfur measurements collected on 60248 waste rock samples. These findings were used to select over 1035 samples for further AMD assessment using a combination of tests including acid-base accounting, CRS, NAGpH and XRD.

The outcome of the review and testing showed the following:

- The dominant (>5% in proportion) waste rock type in the pit shell include Banded Iron Formation-BIF (30.8%), Amphibolite Dykes-AMP (15.4%), Basal Sequence-BSQ (13.4%), Cook Gap Schist-CSG (10.8%), Eastern Shear Zone-ESZ (7.1%) and Magnetite Banded Iron Formation-MBF (6.6%). These lithologies represent over 84 % of the waste material produced.
- The analysis of the sulfur assay data showed that the dominant lithologies with the highest sulfur content included BSQ, ESZ and AMP, whilst the minor lithologies (<5% in proportion) included Magnetite Sulfide-MSU and Schist-SCH. These lithologies contained over 5% of sulfur measurements above a threshold of 0.2%.
- The acid-base accounting assessment was undertaken on 1035 samples and included the measurement of Acid Neutralisation Capacity (ANC) in combination with the XRF data from the sulfur database. The output of the testing was assessed using the Price (2009) classification and showed the following:
    - A distribution ratio between non-acid forming (NAF), potentially acid forming (PAF) and uncertain (UC) material of 77%/11%/12%.
    - the rock type classed as having the highest potential for AMD was BSQ
    - the minor rock type dolomite (DOM) had the highest neutralisation capacity
    - median net acid production potential (NAPP) was below 0 for all waste rock types
- Measurements of NAGpH on selected samples showed that a sulfur cut-off of 0.2% was adequate.
- Mineralogical analysis showed that several rock types have a high dolomite/calcite content which provides neutralisation potential, these include BSQ and MBF for the dominant waste rock types and MTC and MSU for the minor ones. The mineralogy also confirmed the presence of pyrite in BSQ (up to 8%).

An AMD block model was developed by correlating the ABA data to the routine XRF analysis and developing equations using multiple linear regressions. A neutralisation potential ratio (NPR) of 2 was used to differentiate NAF and PAF materials. This AMD block model follows the contour of the sulfur block model and can be used to guide operation to manage the extraction of the PAG waste material and arrange placement in adequately designed PAF cells in the southern WRD.

Continuous sampling and monitoring of the waste material should be undertaken to validate the block model and address gaps relating to saline and metalliferous drainage.

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Appendix A

Rock type distribution across the whole resource

Geozone	Code	Description	Ore/waste	Volume (bcm)	Proportion %	Count
10	AMP	Amphibolite Dykes	Waste	25,408,113	3%	74
20	BIF	Banded Iron Formation	Waste	112,035,569	15%	91
30	HEO	Hematite	Waste	6,357,225	1%	8
32	HEC	Hematite Carbonate	Waste	7,255,638	1%	6
37	HBF	Haematite Banded Iron Formation	Waste	18,804,225	2%	81
40	MTS	Magnetite Silica	Ore	127,748,706	17%	417
43	MTC	Magnetite Carbonate	Ore	19,364,525	3%	27
46	SCH	Internal “Schist”	Waste	27,831,994	4%	100
47	MBF	Magnetite Banded Iron Formation	Waste	5,825,394	1%	23
48	MSU	Magnetite Sulfide	Waste	17,730,838	2%	35
49	ESZ	Eastern Shear Zone	Waste	30,624,844	4%	56
70	BSQ	Basal Sequence	Waste	46,820,319	6%	35
71	DOM	Katunga Dolomite	Waste	64,437,663	8%	5
80	CGS	Cook Gap Schist	Waste	199,559,588	26%	78
90	GRT	Granite	Waste	51,040,031	7%	3
	Total					1039

Appendix B

Figures for minor waste rock types

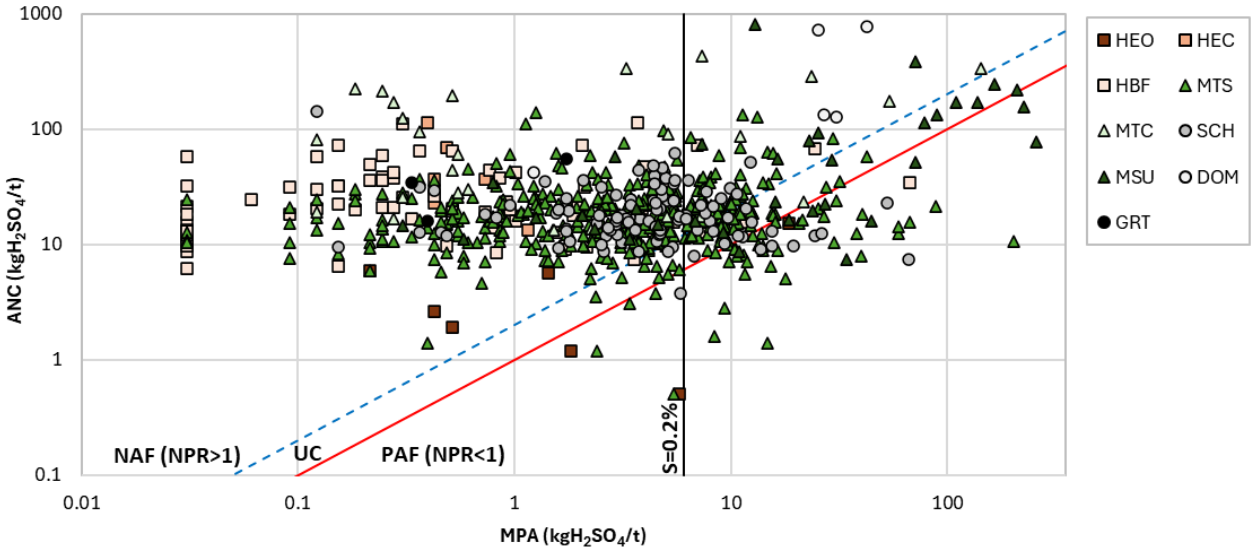


Figure 18 NPR plot of minor waste rock geological domains (% distribution <5)

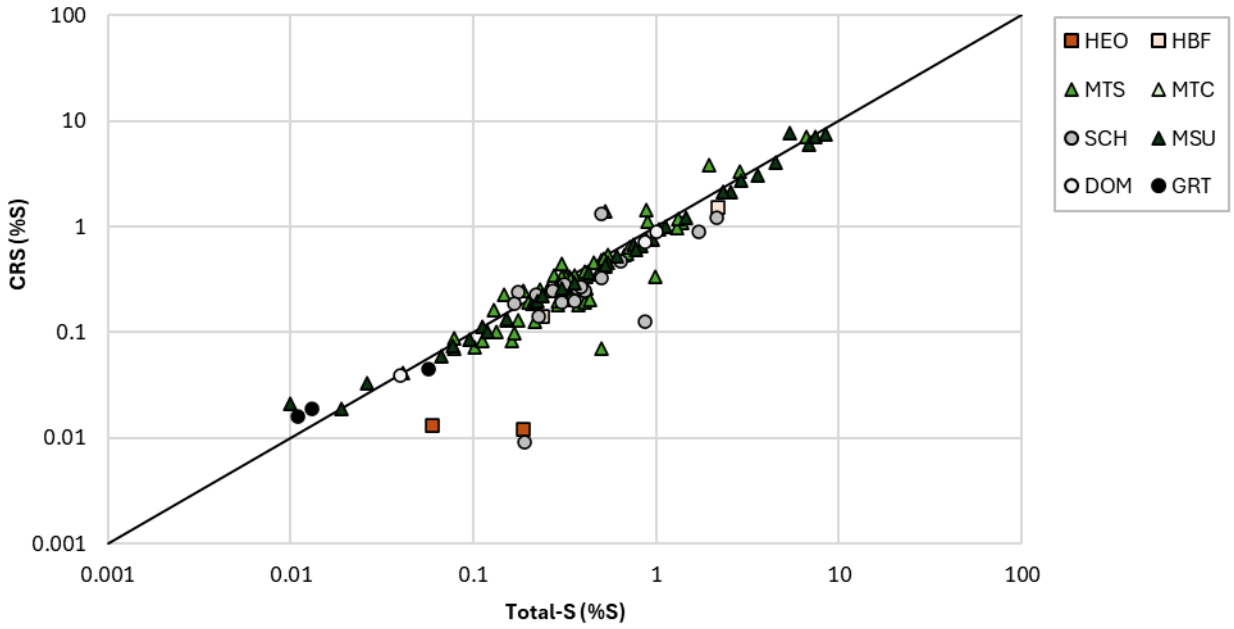
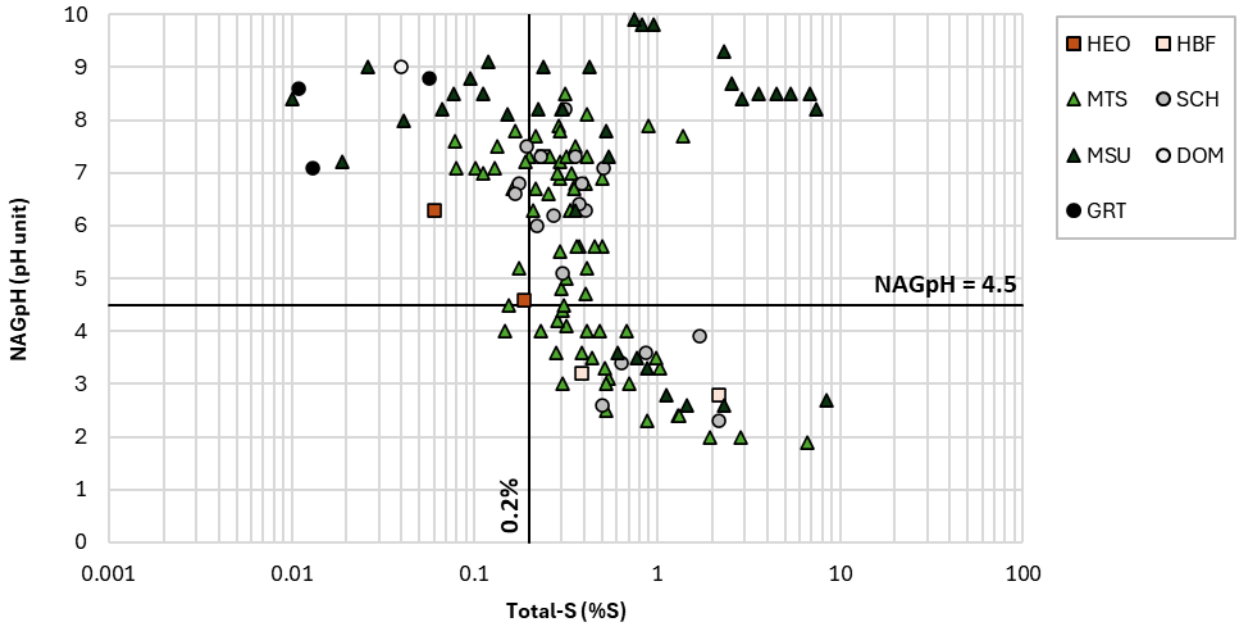


Figure 19 Correlation between total-S and CRS for the minor waste rock geological domains (% distribution <5)


NAGpH (pH unit)
Total-S (%S)
NAGpH = 4.5
0.2%
HEO
HBF
MTS
SCH
MSU
DOM
GRT

Appendix C

GAI enrichment tables

Domain		AMP		BIF		BSQ/MSU		CGS	
SampleCount		28		37		11		10	
Element	Average Crustal Abundance (ppm)	Avg (ppm)	GAI	Avg (ppm)	GAI	Avg (ppm)	GAI	Avg (ppm)	GAI
As_ppm	1.8	7.67	2	4.17	1	15.59	3	6.12	1
Ba_ppm	425	128.57	0	28.92	0	30	0	249	0
Be_ppm	2.8	1.33	0	0.49	0	0.98	0	1.07	0
Bi_ppm	0.17	0.07	0	0.05	0	0.18	0	0.16	0
Cd_ppm	0.2	0.08	0	0.04	0	0.03	0	0.24	0
Co_ppm	25	27.93	0	4.68	0	12.15	0	7.05	0
Ce_ppm	60	27.5	0	9.4	0	8.47	0	52.35	0
Cr_ppm	100	153.07	0	16.43	0	13	0	81.3	0
Cs_ppm	3	0.77	0	0.2	0	0.64	0	0.95	0
Cu_ppm	55	95.54	0	15.39	0	21.38	0	22.57	0
Ga_ppm	15	11.16	0	0.94	0	3.13	0	10.99	0
Ge_ppm	1.5	0.48	0	0.16	0	0.16	0	0.1	0
In_ppm	0.1	0.05	0	0.01	0	0.02	0	0.03	0
La_ppm	30	13.44	0	5.39	0	4.81	0	29.29	0
Li_ppm	20	21.18	0	2.25	0	6.07	0	13.41	0
Tl_ppm	0.45	0.23	0	0.04	0	0.25	0	0.22	0
Mo_ppm	1.5	1.49	0	1.73	0	6.57	2	2.16	0
Se_ppm	0.05	1.32	4	1.03	4	1.09	4	1	4
Th_ppm	10	3.31	0	0.56	0	0.88	0	14.95	0
U_ppm	2.7	2.23	0	0.71	0	0.34	0	3.65	0
Sb_ppm	0.2	0.18	0	0.18	0	0.26	0	0.23	0
Mn_ppm	950	2118.75	1	819.3	0	2316.82	1	730.5	0
Nb_ppm	20	9.68	0	0.67	0	2.84	0	7.36	0
Ni_ppm	75	86.13	0	8.93	0	18.76	0	24.64	0
Pb_ppm	12.5	10.31	0	6.78	0	5.95	0	40.26	1
Rb_ppm	90	17.81	0	1.39	0	6.53	0	32.73	0
Re_ppm	0.0005	0.0022	2	0.002	1	0.0035	2	0.002	1
Sc_ppm	16	20.31	0	1.22	0	1.22	0	6.48	0
Sn_ppm	2	0.86	0	0.22	0	0.42	0	1.16	0
Sr_ppm	375	70.7	0	17.99	0	5.1	0	21.13	0
Ta_ppm	2	0.55	0	0.07	0	0.19	0	0.63	0
Te_ppm	0.001	0.07	6	0.05	5	0.12	6	0.05	5
V_ppm	135	200.07	0	8.41	0	29.45	0	47.5	0
W_ppm	1.5	2.93	0	2.36	0	1.44	0	3.07	0
Y_ppm	30	13.89	0	4.12	0	3.53	0	11.59	0
Zn_ppm	70	89.29	0	25.43	0	28.64	0	75.5	0
Zr_ppm	165	69.43	0	6.34	0	18.35	0	110.75	0

Domain		HBF		ESZ		HEC		HEO	
SampleCount		40		23		3		2	
Element	Average Crustal Abundance (ppm)	Avg (ppm)	GAI	Avg (ppm)	GAI	Avg (ppm)	GAI	Avg (ppm)	GAI
As_ppm	1.8	2.63	0	4.82	1	3.13	0	4.75	1
Ba_ppm	425	10	0	17.83	0	10	0	65	0
Be_ppm	2.8	0.49	0	0.4	0	0.5	0	2.01	0
Bi_ppm	0.17	0.16	0	0.05	0	0.03	0	0.02	0
Cd_ppm	0.2	0.03	0	0.04	0	0.02	0	0.15	0
Co_ppm	25	5.63	0	4.28	0	2.9	0	10.2	0
Ce_ppm	60	3.12	0	4.32	0	14.29	0	63.86	0
Cr_ppm	100	21.25	0	16.43	0	43.33	0	23.5	0
Cs_ppm	3	0.07	0	0.32	0	0.05	0	2.94	0
Cu_ppm	55	30.44	0	15.97	0	27.07	0	20.4	0
Ga_ppm	15	2.28	0	0.91	0	2.21	0	2.52	0
Ge_ppm	1.5	0.16	0	0.08	0	0.23	0	0.48	0
In_ppm	0.1	0.01	0	0.01	0	0.02	0	0.01	0
La_ppm	30	1.99	0	2.52	0	9.3	0	7.25	0
Li_ppm	20	9.05	0	1.29	0	5.53	0	1.9	0
Tl_ppm	0.45	0.03	0	0.04	0	0.02	0	0.26	0
Mo_ppm	1.5	1.58	0	1.69	0	0.86	0	0.64	0
Se_ppm	0.05	1.08	4	1	4	1	4	1	4
Th_ppm	10	0.17	0	0.53	0	0.06	0	1.51	0
U_ppm	2.7	4.98	0	0.16	0	6.87	1	5.9	1
Sb_ppm	0.2	0.15	0	0.15	0	0.22	0	0.24	0
Mn_ppm	950	871.4	0	2109.26	1	770.67	0	1228	0
Nb_ppm	20	0.53	0	1.08	0	0.1	0	1.15	0
Ni_ppm	75	11.25	0	17.02	0	9.53	0	27.2	0
Pb_ppm	12.5	3.02	0	4.74	0	3.4	0	8.4	0
Rb_ppm	90	0.2	0	1.5	0	0.17	0	13.7	0
Re_ppm	0.0005	0.0028	2	0.002	1	0.002	1	0.002	1
Sc_ppm	16	1.02	0	0.91	0	0.27	0	2.45	0
Sn_ppm	2	0.23	0	0.22	0	0.2	0	0.25	0
Sr_ppm	375	2.5	0	5.32	0	4.43	0	5.2	0
Ta_ppm	2	0.07	0	0.09	0	0.05	0	0.12	0
Te_ppm	0.001	0.08	6	0.05	5	0.06	5	0.05	5
V_ppm	135	34.03	0	10.78	0	126.67	0	28.5	0
W_ppm	1.5	2.49	0	5.08	1	1.93	0	1.2	0
Y_ppm	30	2.65	0	2.28	0	4.3	0	5.6	0
Zn_ppm	70	44.83	0	16.57	0	13	0	125	0
Zr_ppm	165	6.35	0	7.02	0	1.57	0	15.4	0

Domain		MBF		MTC		MTS		SCH	
SampleCount		11		14		182		40	
Element	Average Crustal Abundance (ppm)	Avg (ppm)	GAI	Avg (ppm)	GAI	Avg (ppm)	GAI	Avg (ppm)	GAI
As_ppm	1.8	4.38	1	5.86	1	4.17	1	4.75	1
Ba_ppm	425	26.36	0	10	0	23.85	0	12	0
Be_ppm	2.8	0.5	0	0.34	0	0.47	0	0.54	0
Bi_ppm	0.17	0.05	0	0.04	0	0.07	0	0.04	0
Cd_ppm	0.2	0.03	0	0.1	0	0.03	0	0.04	0
Co_ppm	25	3.57	0	3.37	0	3.48	0	4.45	0
Ce_ppm	60	3.64	0	5.41	0	3.94	0	6.12	0
Cr_ppm	100	7.91	0	16.07	0	13.28	0	23.93	0
Cs_ppm	3	0.28	0	0.13	0	0.16	0	0.35	0
Cu_ppm	55	10.37	0	24.58	0	10.07	0	8	0
Ga_ppm	15	0.71	0	0.95	0	0.71	0	0.85	0
Ge_ppm	1.5	0.09	0	0.91	0	0.15	0	0.13	0
In_ppm	0.1	0.01	0	0.01	0	0.01	0	0.01	0
La_ppm	30	2.04	0	3.54	0	2.38	0	3.38	0
Li_ppm	20	2.25	0	1.59	0	1.7	0	1.38	0
Tl_ppm	0.45	0.04	0	0.02	0	0.05	0	0.05	0
Mo_ppm	1.5	1.43	0	0.95	0	1.56	0	1.94	0
Se_ppm	0.05	1	4	1	4	1	4	1.13	4
Th_ppm	10	0.32	0	0.23	0	0.21	0	0.32	0
U_ppm	2.7	0.22	0	0.22	0	0.64	0	0.14	0
Sb_ppm	0.2	0.14	0	0.1	0	0.14	0	0.17	0
Mn_ppm	950	1586.82	0	3329.07	1	1472.02	0	1721.98	0
Nb_ppm	20	0.35	0	0.77	0	0.74	0	1.57	0
Ni_ppm	75	9.14	0	15.46	0	9.03	0	11.85	0
Pb_ppm	12.5	1.55	0	2.79	0	2.13	0	2.44	0
Rb_ppm	90	2.69	0	0.46	0	0.99	0	1.5	0
Re_ppm	0.0005	0.002	2	0.003	2	0.002	2	0.002	2
Sc_ppm	16	0.56	0	0.76	0	0.51	0	1.1	0
Sn_ppm	2	0.22	0	0.22	0	0.21	0	0.21	0
Sr_ppm	375	15.19	0	15.27	0	5.36	0	3.18	0
Ta_ppm	2	0.05	0	0.07	0	0.07	0	0.12	0
Te_ppm	0.001	0.05	5	0.06	5	0.06	5	0.05	5
V_ppm	135	6.55	0	8.07	0	8.64	0	12.7	0
W_ppm	1.5	2.87	0	1.06	0	2.97	0	15.74	3
Y_ppm	30	2.73	0	3.81	0	2.1	0	2.59	0
Zn_ppm	70	9	0	19.57	0	12.34	0	14.3	0
Zr_ppm	165	3.96	0	6.21	0	4.94	0	7.9	0

Appendix D

Regression equations for NAPP predictions

Geozone	Code	Analytes	Regression Equation
10	AMP	12	-1053 + 14.035*Al2O3 + 3.258*CaO + 15.328*Fe + 102.378*K2O - 0.745*LoI + 11.907*MgO - 36.683*Mn - 17.98*Na2O - 448.413*P + 46.583*S + 10.514*SiO2 + 30.583*TiO2
20	BIF	12	-1282 + 14.434*Al2O3 - 5.041*CaO + 19.039*Fe + 16.811*K2O + 7.093*LoI + 11.042*MgO + 11.505*Mn + 28.035*Na2O + 57.625*P + 32.587*S + 12.799*SiO2
30	HEO	12	-8028 + 83.819*Al2O3 + 75.373*CaO + 115.054*Fe - 447.494*K2O + 113.637*LoI + 69.899*MgO - 983.683*Mn - 165.782*Na2O + 70.491*P - 22.251*S + 86.953*SiO2 + 529.324*TiO2
32	*HEC	-	-8028 + 83.819*Al2O3 + 75.373*CaO + 115.054*Fe - 447.494*K2O + 113.637*LoI + 69.899*MgO - 983.683*Mn - 165.782*Na2O + 70.491*P - 22.251*S + 86.953*SiO2 + 529.324*TiO2
37	HBF	12	340.852 - 3.474*Al2O3 - 29.125*CaO - 5.043*Fe - 148.455*K2O - 5.104*LoI - 3.255*MgO - 20.169*Mn - 29.786*Na2O + 38.979*P + 28.621*S - 3.413*SiO2 - 26.972*TiO2
40	MTS	12	-182.467 + 8.852*Al2O3 - 13.722*CaO + 2.181*Fe + 4.893*K2O - 4.122*LoI + 1.674*MgO - 3.165*Mn + 24.505*Na2O + 32.438*P + 35.003*S + 1.978*SiO2 - 29.751*TiO2
43	MTC#	-	-182.467 + 8.852*Al2O3 - 13.722*CaO + 2.181*Fe + 4.893*K2O - 4.122*LoI + 1.674*MgO - 3.165*Mn + 24.505*Na2O + 32.438*P + 35.003*S + 1.978*SiO2 - 29.751*TiO2
46	SCH	12	-543.256 + 9.669*Al2O3 - 10.118*CaO + 7.759*Fe + 2.347*K2O + 1.727*LoI + 5.813*MgO - 16.02*Mn + 11.911*Na2O + 22.086*P + 37.698*S + 5.326*SiO2 - 4.657*TiO2
47	MBF	12	1234 - 1.581*Al2O3 - 37.218*CaO - 17.796*Fe + 39.633*K2O - 16.28*LoI - 14.113*MgO - 23.246*Mn - 30.405*Na2O + 106.667*P + 44.003*S - 12.273*SiO2 - 10.977*TiO2
48	MSU	12	-1062 + 9.837*Al2O3 - 6.699*CaO + 16.777*Fe + 400.23*K2O + 9.577*LoI + 12.371*MgO + 40.072*Mn - 255.215*Na2O - 1659*P + 28.67*S + 10.577*SiO2 + 90.532*TiO2
70	BSQ	9	3796 - 68.473*Al2O3 - 18.373*CaO - 56.553*Fe - 41.353*LoI - 31.541*MgO - 136.852*Mn + 29.185*S - 39.046*SiO2 + 100.015*TiO2
71	DOM	12	8173 - 42.461*Al2O3 - 97.882*CaO - 112.51*Fe - 4120*K2O - 100.268*LoI - 87.043*MgO + 35.174*Mn - 251.19*Na2O - 1575*P + 174.829*S - 82.373*SiO2 - 191.95*TiO2
75	ESZ	12	-991.522 + 8.515*Al2O3 - 3.539*CaO + 14.194*Fe + 35.645*K2O + 6.042*LoI + 9.148*MgO - 9.248*Mn + 30.877*Na2O - 66.389*P + 31.735*S + 9.945*SiO2 + 34.105*TiO2
80	CGS	12	1931 - 20.826*Al2O3 - 38.566*CaO - 27.581*Fe - 16.169*K2O - 18.629*LoI - 20.211*MgO - 68.816*Mn - 11.383*Na2O - 129.965*P + 13.463*S - 19.355*SiO2 + 7.751*TiO2

* HEC 32 uses the HEO 30 regression equation

MTC 43 uses the MTS 40 regression equation

Appendix E Impact and Risk Register

E1 Impact Methodology

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Impact and Risk Methodology

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1 Impact and Risk Methodology

1.1 Proposed Development Area

The impact and risk assessment provides for the following Change in Operations (CiO) proposed at MPL 32:

- expansion of existing southern Waste Rock Dumps (WRD)
- a new topsoil stockpile
- realignment of the site access road from Lincoln Highway.

These structures are shown in Figure 1.

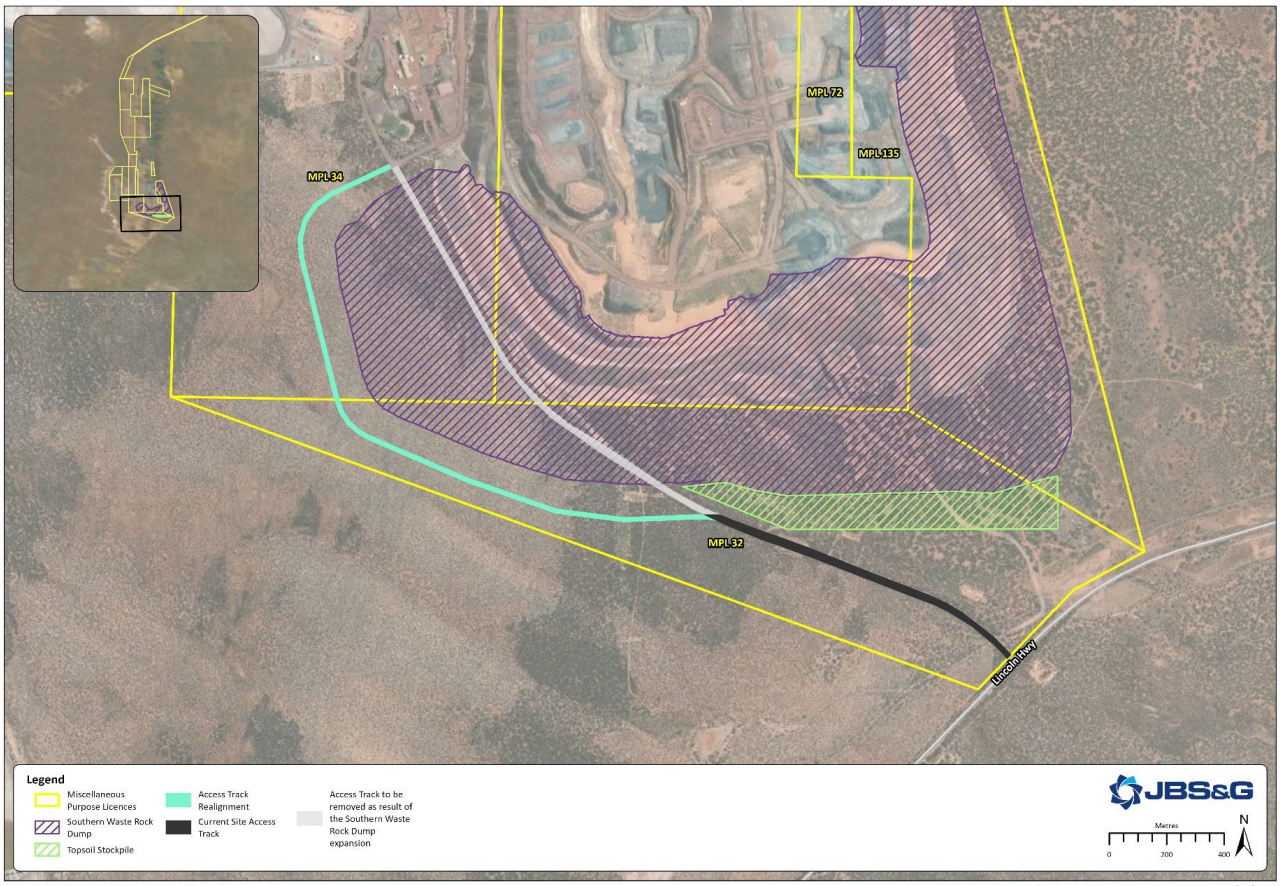


Figure 2-1: MEP1 features proposed within MPL32

Spatial Reference: GDA2020 MGA Zone 53; **Author:** rtandon; **Date:** 25/07/2024
Client: SIMEC; **Job Number:** 6622904

Figure 1: Proposed location of WRD, topsoil stockpile and access track

1.2 Assessment Method

The Mining Act and Mining Regulations set the minimum requirements and the assessment method via *"Terms of Reference for Metallic and Industrial Mineral Mine Applications 006*: (DEM 2021) (TOR006). TOR006 requires a mining proponent to assess the environmental impacts of a proposal and develop environmental outcomes and criteria for potential impact events.

This document describes the assessment methodology which has been applied to meet TOR006 requirements. This assessment methodology was undertaken for the Central Eyre Iron Project MLP (Iron Road 2015), which was approved in 2017.

The assessment methodology is also consistent with Minerals Regulatory Guideline MG2a *'Preparation of a mining application for metallic and industrial minerals'* (Guidelines), updated December 2020 (DEM 2020).

1.3 Determination of Potential Events

An Environmental Impacts and Risks Register (the Register) has been developed in accordance with the Guidelines to capture all credible environmental impacts, and associated risks, which relate to the CiO for MPL 32 as part of MEP1. The Register includes both environmental and social aspects, and impacts and risks associated with the proposed mining and processing operation, WRD and access road.

The assessment was undertaken in two stages:

- An impact assessment which considered the impacts expected to occur as part of the normal activities associated with the CiO at MPL 32.
- A risk assessment which considered the uncertainty in the impact assessment and the potential for adverse effects on the environment to be greater than predicted due to unplanned events, or if assumptions made in the impact assessment are incorrect.

1.3.1 Elements of the Environment associated with the proposed Change in Operations

Elements of the environment which may reasonably be expected to be impacted by the CiO were identified as part of the impact and risk assessment process. This included activities at all stages, including construction, operation and closure.

Environmental elements identified include:

- public safety
- traffic
- flora, fauna and native vegetation
- weeds, pests and plant pathogens
- groundwater
- surface water
- air quality
- noise and vibration
- soil and land quality
- visual amenity
- land use and tenure
- heritage (Aboriginal, Non-Aboriginal and geological)
- social.

1.3.2 Environmental Receptors

The environmental elements that could be impacted by the CiO were the subject of technical studies to describe the existing environment and the relevant environmental values. A receptor is an environmental value attributed to an environmental element and will have a degree of significance or value as determined by stakeholder engagement, science, cultural or philosophical views or recognised in legislative or other standards.

The views of affected stakeholders were also considered in identifying receptors through the community engagement strategy described in Section 3.4 of the CiO.

1.3.3 Potential Impact Events

Potential impact events are those that may be caused directly or indirectly by the CiO and may result in an impact to an environmental receptor. These events were identified:

- from technical studies which were completed for each relevant environmental element
- from consultation with landowners and community members, government personnel and stakeholders

- through review of other relevant mining projects.

Direct impacts are those that are caused directly by the CiO (e.g. clearing of vegetation). Indirect impacts are those where a secondary event occurs that is substantially caused by the CiO and which has an impact on the environment (e.g. dust deposition on agricultural land emanating from stockpiles within the CiO area which may result in reduced productivity).

Design or management controls that may be used to minimise or eliminate an impact were not considered during the identification of impact events.

1.3.4 Mine Life Phase

Impacts and risks are assessed based on their applicable mine life phase. This includes:

- construction
- operation
- closure.

Closure is the active closure phase (including rehabilitation) and also includes post closure impacts.

1.3.5 Source, Pathway, Receptor and Description of Uncertainty

TOR006 states that a potential impact event is the combination of a source, pathway and an environmental receptor.

- **Source** of the potential impact event means the source, or the origin of the impact, which alone or in combination has the potential to cause harm to an environmental receptor.
- **Pathway** describes the means or route by which an identified environmental receptor can be exposed to or may reasonably be expected to be impacted by an identified source.
- **Receptor** is an environmental value that may reasonably be expected to be adversely impacted by the source. A receptor must have a degree of significance (as determined by baseline studies, stakeholder consultation or recognised regulatory or other standards) to be considered further in the assessment.

An impact event can only occur if a source, pathway and receptor (SPR) are all present. Potential impact events were not considered further if the assessment demonstrated that an environmental receptor could not reasonably be expected to be adversely affected by the source. For example, where there has been no identified value or significance attributed to an environmental receptor, it can be assumed that there could be no potential impact on that receptor.

The assessment also considered any uncertainties regarding the evaluation of the SPR. Such uncertainties could derive from factors such as a lack of baseline information, limitations on modelling or other data deficiencies. The assumptions made in the assessment were subjected to a sensitivity analysis to determine the effect of any changes in assumptions and whether this changed the conclusion as to the presence of an SPR.

Potential impact events were not considered further in the impact assessment if the above analysis confirmed, with a high degree of confidence, that a SPR relationship was not present.

1.4 Impact Assessment

An environmental impact is any change, positive or negative, to environmental, social, cultural and economic values expected as part of the normal operation of the CiO. Unlike environmental risks, environmental impacts are expected to occur if the CiO proceeds.

Once potential impacts were identified, an assessment was undertaken of the adverse impact events, taking into account control measures used to reduce the magnitude of impacts.

1.4.1 Control Measures

Adverse environmental impacts can be minimised or avoided using control measures. Control measures should be proportionate to the consequence of the impact, achieve compliance with other applicable statutory requirements, and be technically and economically achievable.

Control measures used the 'hierarchy of controls' approach where they were applied in the following order:

- Elimination (prevention). Redesign to eliminate the impact, for example:
  - remove the hazard (source)

  - employ alternate processes that do not result in the impact
  - replace the material or process with a less hazardous one (substitution).
- Design/engineering (physical controls). For example:
  - location of plant and equipment
  - mining method
  - encapsulate or contain hazardous materials, pollutants and emissions
  - change height or location of major structures
  - install engineered barriers to control access by receptors
  - treat/destroy the pollutant/emission
  - control release to a level the environment can absorb.
- Management system (procedure) controls - i.e. manage the risk through procedures and the way the activity is conducted by personnel, for example:
  - trigger and response plan for managing dust emissions
  - clearance permit system for ensuring native vegetation clearance is in accordance with approved clearance
  - induction and training of new employees to ensure awareness of Aboriginal heritage and to avoid unauthorised disturbance.

1.4.2 Categorise Impact

The impact assessment considered each identified impact event and determined the expected consequence of each impact, taking into account any expected reduction in the magnitude of impacts as a result of the control measures. The consequence of each impact was categorised as set out in Table 1-1 considering the scale, intensity, duration and frequency of impacts and the sensitivity of the receptor.

Acceptability of Impact

The impact assessment was an iterative process as shown in Table 1-1. Impacts categorised as 'minimal' were considered to be acceptable. Impacts that were 'major' or 'catastrophic' were considered to be unacceptable and required redesign or additional control measures to reduce impacts to an acceptable level.

Impacts that were 'moderate' were reviewed to assess whether they were as low as reasonably practicable (ALARP). ALARP means that impacts are reduced to a level where the cost of further reducing impacts is not grossly disproportionate to the benefit obtained.

Table 1-1: Acceptability of Impact

Impact Category	Acceptability of Impact
Minimal	Impacts are considered to be ALARP and no further control measures are required.
Minor	Review to determine if impacts are ALARP and, if not, modify control measures or consider Development design changes to ensure impacts are ALARP.
Moderate	Review to determine if impacts are ALARP and, if not, modify control measures or consider Development design changes to ensure impacts are ALARP.
Major	Impacts are unacceptable without further controls identified. Review Development design and control measures to ensure impacts are no higher than 'moderate', unless the impact is identified as ALARP.
Catastrophic	Impacts are unacceptable without further controls identified. Review Development design and control measures to ensure impacts are no higher than 'moderate' unless the impact is identified as ALARP.

Table 1-2: Rating of Residual Impacts

Category	Level	Injury and/or fatality	Air Quality	Cultural	Social	Effect on Behavior of Listed Fauna	Effect on Viability of Listed Species	Effect on Behaviour of Fauna	Effect on Flora Community	Contamination	Recharge	Habitat	Ground and Surface Water	Landform
Minimal	1	No injuries.	Insignificant effect.	No impact to items of cultural significance.	No impact or minor social impacts on local population. Mostly reparable.	Insignificant effect.	Insignificant effect.	Local short term behavioural effect.	Local short-term decrease in abundance of some species without reduction in local community viability.	Insignificant effect.	Insignificant effect.	Insignificant effect.	Minimal change with no significant loss of quality.	Insignificant effect.
Minor	2	Moderate level of injuries requiring off-site (doctor) medical treatment.	Local short term and minor surpass of air quality standard.	Minor damage to items of cultural significance.	Ongoing social issues. Minor reparable /reversible damage to landowner property/ structures.	Local short term behavioural effect.	Local short-term decrease in abundance with no lasting effects on local population.	Local long term behavioural effect that does not unduly affect the ecology of the population.	Local long-term decrease in abundance of some species resulting in little or no change to community structure.	Local contamination that can be immediately remediated.	Local minor change in recharge patterns within sub-catchments.	Disturbance of well-represented landforms/ habitats.	Local minor short-term reduction or change in quality.	Minor change in geomorphology within localised portions of landform.
Moderate	3	Significant level of injuries requiring hospitalisation.	Local minor long term of air quality standard. Local major short term surpass of air quality standard.	Significant damage to items of cultural significance.	Ongoing serious social issues. Significant damage to local landowner property/ structures reparable/ reversible in the short term.	Local long term behavioural effect with no significant effects on the ecology of the species.	Local long-term decrease in abundance without reduction in local population viability.	Local long term behavioural impact that significantly affects the ecology of the population.	Regional long-term decrease in abundance of some species and/or local loss of some species diversity resulting in some change to the community structure.	Local contamination that can be remediated in long term.	Local major changes in recharge patterns within sub-catchments.	Local loss of well-represented landforms/ habitats.	Local minor long term or widespread short term, or local major short-term reduction or change in water quality.	Widespread minor changes in geomorphology
Major	4	Irreversible disability or impairment or serious injuries requiring long term hospitalisation. Single fatality	Widespread (regional) major short-term surpass of air quality standard. Regional long term surpass of air quality standard.	Irreparable damage to items of cultural significance.	Very serious wide spread social impacts. Significant damage to local landowner property/ structures reparable/ reversible in the long term.	Local long term behavioural effect that significantly effects the ecology of the species.	Regional long-term decrease in abundance and/or local loss resulting in reduction in regional viability.	Local long term behavioural impact that significantly affects the ecology of the species.	Regional long-term decrease in abundance of numerous species and/or some loss of species diversity resulting in significant changes to community structure.	Local contamination that cannot be remediated in long term.	Widespread major changes in recharge patterns within sub-catchments. Minor changes in regional recharge patterns.	Local loss of a unique or critical landform/ habitat.	Widespread (regional) major short-term reduction or change in quality.	Localised major changes in geomorphology.

Category	Level	Injury and/or fatality	Air Quality	Cultural	Social	Effect on Behavior of Listed Fauna	Effect on Viability of Listed Species	Effect on Behaviour of Fauna	Effect on Flora Community	Contamination	Recharge	Habitat	Ground and Surface Water	Landform
Catastrophic	5	Several fatalities.		Irreparable damage to highly valued items of great cultural significance.	Complete breakdown of social order.	Regional extinction of the species.	Regional extinction of the species.		Regional long-term loss of numerous species resulting in the dominance of only a few species.	Widespread contamination that can be remediated in long term.	Regional major changes in recharge patterns.	Regional loss of unique or critical landforms/ habitats.	Regional long-term reduction or change in water quality.	Major changes in geomorphology resulting in effects beyond footprint.

1.5 Risk Assessment

1.5.1 Description of Uncertainty

Regulation 46(7)(c) of the Mining Regulations requires the identification of matters for which there is a significant lack of relevant information or a significant degree of uncertainty. These matters could result in the actual CiO impacts being higher or lower than those predicted in the impact assessment. Uncertainties in the impact assessment can derive from:

- quality of site-specific data available
- the reliability of modelling undertaken and/or assumptions made as part of the impact assessment
- control measures not being as effective as expected.

The level of uncertainty in the impact assessment was assessed and a qualitative rating applied as shown in Table 1-3.

Table 1-3: Rating of Level of Certainty

Level of Uncertainty	Quality of Data	Extent to which Modelling has been Validated	Effectiveness of Design Measures	Effectiveness of Management Measures
Low	Comprehensive data. Further studies are unlikely to generate additional information that would change the conclusions reached in the impact assessment.	Excellent baseline data available. Model has been run and provides accurate predictions over different seasons. Model has been extensively used and is regarded by discipline experts as leading practice and/or the impact assessment does not rely to any significant extent on the use of a model.	Widely used and demonstrated to be effective at a range of mining sites including sites with similar topographical/climatic conditions. Requires minimal checking and failure risk has been shown to be low.	Management measures are considered routine and used effectively throughout industry. Reduction in the level of impact from an unmitigated level does not rely primarily on the management measures.
Medium	Some site-specific information available to provide ground-truthing of regional desktop information. Further studies could change some of the conclusions reached in the impact assessment.	Some baseline data available. Model shows a reasonable approximation of real conditions but relies on a number of assumptions and sufficient data not available to demonstrate the model accurately portrays seasonal conditions.	Has been used at sites with similar conditions but requires regular checking or maintenance to ensure performance. OR: Has only been used at limited sites. Effectiveness has not been established in the long term or at sites similar to the Development site.	Management measures have been effectively used at a limited number of sites and have not been demonstrated at similar sites or in the long term and/or reduction in the level of impact from an unmitigated level relies primarily on the management measures.
High	Minimal site-specific data available.	Minimal baseline data. Model is	Measures are novel and have not been	Management measures are novel

	Reliance on regional desktop studies that may not accurately reflect site conditions. Low level of confidence in the impact assessment.	unable to be validated with current data.	demonstrated in the field.	and/or heavily reliant on specialised technical expertise.

1.5.2 Sensitivity to Change in Assumptions

The risk assessment considers the sensitivity to any change in the assumptions used in the impact assessment and how this might affect the consequence for a receptor. The risk categorisation was calculated using the matrix in Table 1-4. The risk categorisation considered the:

- Credible worst-case consequence (as categorised in Table 1-2) that could occur if data is found to be not representative, modelling undertaken or assumptions made were found to be incorrect.
- Likelihood of such a consequence occurring, as shown in Table 1-5.

Table 1-4: Risk Rating Matrix

			Consequences				
			1	2	3	4	5
			Minimal	Minor	Moderate	Major	Catastrophic
Frequency	A	Almost Certain	Low	Medium	High	Extreme	Extreme
	B	Likely	Low	Medium	High	Extreme	Extreme
	C	Possible	Low	Low	Medium	High	Extreme
	D	Unlikely	Low	Low	Medium	High	High
	E	Rare	Low	Low	Low	Medium	High

Table 1-5: Description of Likelihood

Descriptor	Level	General Description	Change per year	Frequency
Almost Certain	A	This event is expected to occur in most circumstances. Expected to occur at least once each year.	>90%	1/year
Likely	B	This event may occur in some given circumstances. May occur during any given year.	20%	1/5 years
Possible	C	This event might occur at some time.	4%	1/12 years

Descriptor	Level	General Description	Change per year	Frequency
		Not likely to occur in any given year but is possible.		
Unlikely	D	This event could occur at some time. Very unlikely to occur in any given year.	0.5%	1/200 years
Rare	E	This event may only occur in very exceptional circumstances. Examples of this have occurred historically but are not anticipated.	<0.5%	<1/200 years

1.5.3 Acceptability of Risk

Similar to the impact assessment, the risk categorisation was reviewed to assess whether the risk was ALARP. 'Low' risks were considered to be ALARP. 'Medium' and 'High' risks were reviewed to determine if the identified risk was ALARP. Where necessary, changes were made to the Proposed Development design and control measures to ensure risks were ALARP.

'Extreme' risks were regarded as unacceptable; however, no such risks were identified.

1.6 Statement of Environmental Outcomes and Criteria

1.6.1 Statement of Proposed Environmental Outcomes

The impact and risk assessment provides the information needed to determine the environmental outcome that can be achieved for each impact event.

An outcome is a statement which reflects the acceptable impact on the environment (and may be no impact) resulting from the proposed CiO activities. The outcomes must be relevant to all stages of the operation (construction, operation and closure). These environmental impacts are those where a SPR relationship is present (before implementation of controls or management strategies).

Outcomes were reviewed for their applicability from the current approved PEPR and an assessment of whether they remain appropriate.

1.6.2 Draft Measurement and Leading Indicator Criteria

The intent of the measurement criteria is to demonstrate the achievement of an environmental outcome.

The intent of a leading indicator is to provide an early warning that a control measure may fail or is failing and therefore the environmental outcome is potentially at risk of not being achieved, giving time to respond appropriately.

Leading indicator criteria were reviewed from the current approved PEPR and included if applicable.

These will be finalised during development of the subsequent PEPR.

E2 Impact Tables

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1 Air Quality

Type:	Air Quality	Impact ID: AQ_01				
Planned Event	**Potential impact event**	Dust emissions (Total suspended particulates (TSP)) from Mining operations (Waste rock dump and topsoil stockpile related activities) impact land users / amenity.			**Stage**	Construction, Operation
	Source	Mining operations (Waste rock dump and topsoil stockpile related activities).			**Relevant technical Study**	Ramboll, 2024 – Appendix D2.
	Pathway	TSP / airborne emissions.				
	Receptor	• Native vegetation. • Neighbouring properties. • Road users.				
	Design Controls (Elimination, substitution, engineering)	Compliance to the Dust TARP, FDR Standard and associated activity EMP controls.				
	Is there a confirmed SPR?	Yes	**Sensitivity of change in assumptions**	Low sensitivity to change.	**Evidence for linkage / lack of linkage**	Air Quality Assessment (Ramboll, 2024) - Appendix D2. Results from the report modelling shows that TSP deposition results at all sensitive receptor locations are predicted to remain below the relevant guidelines from the undertaking of MEP1 activities.
	Is the SPR material?	Yes	**Legislative requirements / applicable standards**		*Legislation* • Environment Protection and Biodiversity Conservation Act 1999. • Environment Protection Act 1993. • Environment Protection (Air Quality) Policy 2016. • Native Vegetation Act 1991. • Mining Act 1971. • Landscape South Australia Act 2019. *Non-legislated Standards* • QP50.68 Mines FDR Standard. • QP50.84 Dust TARP. • QO50.85 Vegetation Dust Impact Assessment. • SIMEC Mining operational procedures and controls.	

Type:	Air Quality	Impact ID: AQ_01				
	Factors that limit / mitigate impact (control measures)	• Dust suppression on roads. • Staged removal of vegetation. • Implementation of speed limits on site. • Spray capping of dry dusty fines stockpiles during hot, dry and windy conditions. • Targeted dust control measures implemented ahead of days anticipated to generate extra dust. • Implementation of specific controls under the dust TARP (QP50.84) standard for dust-generating activities, such as postponement of operations when dust cannot be controlled and chemical suppression on these days. • Dust monitoring in impact areas. • Ceasing of operations when unacceptable limits are triggered in accordance with the QP50.84. • Environmental awareness training for staff and contractors, including training in the application of the dust TARP (QP50.84).	**Expected impact**	Minimal - Based on air quality modelling.	**Uncertainties and assumptions (regarding controls)**	Moderate level of certainty • Effectiveness of operational controls will occasionally fail particularly on very high wind days. • Dust control systems are known to be effective.
Unplanned event	**Risk event**	**Residual risk**				
	What is the consequence and likelihood that the impact is incorrect?	**Consequence**		**Likelihood**		**Risk**
		Minor		Low		Low
Statement of outcomes	**Proposed outcome (draft)**	No public health and/or public nuisance impacts from air emissions, dust or odour generated by mining operations.				
	Outcome Measurement Criteria (draft)	•Compliance with WI50_004 (Complaints Management Protocol) and WI50_008 (Stakeholder Engagement and Communications Management). •All equipment used, and analysis undertaken to measure dust deposition levels comply with the requirements of AS/NZS 3580 and AS 2724. •Regulatory compliance and EMS audits, as well as construction and operational process audits occurring through operations and closure, confirm no non-compliances against the Dust TARP (QP50.84) and Mines FDR Standard (QP50.68).				
	Leading Indicator criteria (draft)	•Internal trigger: Not proposed. Leading indicator criteria: Not proposed. •Internal trigger: Not proposed. Leading indicator criteria: Not proposed. •Internal Trigger: Incidents of operations continuing in SMR mining areas without the implementation of appropriate controls as per QP50.84 are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. Leading indicator criteria: Not proposed.				

<table>
<tr><th>Type:</th><th>Air Quality</th><th colspan="2">Impact ID: AQ_02</th><th colspan="2"></th><th colspan="2"></th></tr>
<tr><td rowspan="10">Planned Event</td><td>Potential impact event</td><td colspan="3">Particulate emissions from Mining operations (Waste rock dump and topsoil stockpile related activities) impacting surrounding land uses (neighbouring properties and road users).</td><td>Stage</td><td colspan="2">Construction, Operation, Closure</td></tr>
<tr><td>Source</td><td colspan="3">Mining operations (Waste rock dump and topsoil stockpile related activities).</td><td>Relevant Technical Study</td><td colspan="2">Ramboll, 2024 – Appendix D2.</td></tr>
<tr><td>Pathway</td><td colspan="6">Airborne particulate deposition.</td></tr>
<tr><td>Receptor</td><td colspan="6">Neighbouring properties, road users.</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="6">SIMEC Mining’s service providers are required to only use vehicles, machinery and equipment that comply with current fume emission control standards.</td></tr>
<tr><td>Is there a confirmed SPR?</td><td rowspan="2">No - receptor distance too far, and source not large enough to be of material impact against criteria.</td><td>Sensitivity of change in assumptions</td><td>Low sensitivity to change
Minor design changes may occur at the operation; however, these are unlikely to change the effectiveness of dust control measures.</td><td>Evidence for linkage / lack of linkage</td><td colspan="2">No.

In all construction and operating scenarios, the Proposed Development contributes less than 25% of the proposed criteria for PM10.
In all construction and operating scenarios, the Proposed Development contributes less than 1.5% of the proposed criteria for PM2.5.</td></tr>
<tr><td>Is the SPR material?</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="3">Legislation
• Environment Protection Act 1993.
• Environment Protection (Air Quality) Policy 2016.
• Mining Act 1971.
• Landscape South Australia Act 2019.

Non-legislated Standards
• QP50.68 Mines FDR Standard.
• QP50.84 Dust TARP.
• SIMEC Mining operational procedures and controls.</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>As per AQ_01.</td><td>Expected impact</td><td>Minimal - No impact expected based on air quality modelling.</td><td>Uncertainties and assumptions (regarding controls)</td><td colspan="2">Moderate level of certainty
• Modelling based on peak material movements and worst-case meteorological conditions.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="6">Residual risk</td></tr>
<tr><td rowspan="2">What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td colspan="2">Risk</td></tr>
<tr><td colspan="2">N/A</td><td colspan="2">N/A</td><td colspan="2">N/A</td></tr>
<tr><td rowspan="3">Statement of outcomes</td><td>Proposed outcome (draft)</td><td colspan="6">N/A</td></tr>
<tr><td>Outcome Measurement Criteria (draft)</td><td colspan="6">N/A</td></tr>
<tr><td>Leading Indicator criteria (draft)</td><td colspan="6">N/A</td></tr>
</table>

2 Visual

<table>
<tr><th>Type:</th><th>Visual</th><th colspan="2">Impact ID: V_01</th><th colspan="2"></th></tr>
<tr><td rowspan="9">Planned Event</td><td>Potential impact event</td><td colspan="2">Reduced visual amenity in project area associated with construction of final landform .</td><td>Stage</td><td>Construction, Operation, Closure</td></tr>
<tr><td>Source</td><td colspan="2">Landform, waste rock dump and topsoil stockpile.</td><td>Relevant Technical Study</td><td>Landform architects, 2024 – Appendix D3.</td></tr>
<tr><td>Pathway</td><td colspan="4">Line of sight.</td></tr>
<tr><td>Receptor</td><td colspan="4">Landowners, and members of the public road users.</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="4">• Design of final mine landform to maximise revegetation and enhance visual amenity.
• Minimise vegetation clearance.</td></tr>
<tr><td>Is there a confirmed SPR?</td><td>Yes</td><td>Sensitivity of change in assumptions</td><td>Moderate sensitivity to change Revegetation is moderately sensitive to change. Efforts to revegetate may vary depending on factors such as the climate.</td><td>Evidence for linkage / lack of linkage</td><td>Yes.

Landscape and Visual Impact Assessment (Landform Architects, 2024) - Appendix D3.</td></tr>
<tr><td>Is the SPR material?</td><td>No</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="2">Legislation
• Environment Protection Act 1993.
• Environment Protection (Noise) Policy 2007.
• Mining Act 1971.

Non-legislated Standards
• SIMEC Mining operational procedures and controls.
• SIMEC Mining Community Engagement Plan.</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>• Distance to receptors.
• Progress mine closure in accordance with the Mine Closure and Rehabilitation Plan.
• Stakeholder consultation on development of MEP1.</td><td>Expected impact</td><td>Minimal - No impact expected based on visual impact assessment.</td><td>Uncertainties and assumptions (regarding controls)</td><td>High level of certainty
• Early indicators from rehabilitation works on other Middleback Ranges mine sites suggests that rehabilitation will successfully result in stable and vegetated WRD slopes and all other operational areas.
• Final landforms are integrated with the surrounding landscape, and land function is returning to a level of sustainability that supports cover of native vegetation.
• Assume rehabilitation is undertaken progressively</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="4">Residual risk</td></tr>
<tr><td>What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td>Risk</td></tr>
<tr><td colspan="2">Moderate</td><td colspan="2">Low</td><td>Low</td></tr>
<tr><td rowspan="3">Statement of outcomes</td><td>Proposed outcome (draft)</td><td colspan="4">The contrasting and reflective aspects of WRDs and infrastructure are visually softened to blend in with the surrounding landscape .</td></tr>
<tr><td>Outcome Measurement Criteria (draft)</td><td colspan="4">Timing and rehabilitation outcomes are achieved in accordance with the Mine Plan closure and rehabilitation.</td></tr>
<tr><td>Leading Indicator criteria (draft)</td><td colspan="4">Internal Trigger: Audit findings show that rehabilitation outcomes and timings have not been achieved as per the mine closure plan.
Leading indicator criteria: Not proposed.</td></tr>
</table>

3 Noise

<table>
<tr><td>Type:</td><td>Noise</td><td colspan="2">Impact ID: N_01</td><td colspan="3"></td></tr>
<tr><td rowspan="9">Planned Event</td><td>Potential impact event</td><td colspan="3">Mining operations (Waste rock dump and topsoil stockpile related activities) noise impacting adjacent residents.</td><td>Stage</td><td>Construction, Operation, Closure</td></tr>
<tr><td>Source</td><td colspan="3">Mining equipment and plant.</td><td>Relevant Technical Study</td><td>Resonate, 2024 – Appendix D4.</td></tr>
<tr><td>Pathway</td><td colspan="5">Airborne noise.</td></tr>
<tr><td>Receptor</td><td colspan="5">Neighbouring properties .</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="5">• Original Equipment Manufacturers (OEM) design mining equipment to meet required industry standards to reduce or eliminate noise and vibration sources to protect the environment and operators as far as practicable. All equipment used on site will meet Australian mine industry standards.
• Selection and maintenance of vehicles and equipment will be compliant with current noise standards.
• Noise reduction devices such as mufflers will be fitted and will operate effectively and with white noise reversing alarm.
• Equipment will be serviced regularly and equipment in need of repair will not be used.</td></tr>
<tr><td>Is there a confirmed SPR?</td><td>Yes</td><td>Sensitivity of change in assumptions</td><td>Low sensitivity to change.</td><td>Evidence for linkage / lack of linkage</td><td>Yes.

Noise Assessment Report (Resonate, 2024) - Appendix D4.

Results from the report modelling shows that noise levels at all sensitive receptor locations are predicted to remain below the relevant guidelines from the undertaking of MEP1 activities.
Worst case noise levels of up to 39 dB(A) predicted at the nearest receiver.
Predicted noise levels are in the range of existing ambient noise levels at the nearest receiver locations, indicating that noise from the proposal may be audible. However, they are significantly below the Noise Policy criteria which are intended to prevent unreasonable adverse impacts on amenity and sleep.</td></tr>
<tr><td>Is the SPR material?</td><td>No - due to distance to receptors and modelling results.

Outcome and measurement criteria maintained for stakeholder considerations.</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="2">Legislation
•Environment Protection Act 1993 (SA);
•Environment Protection (Noise) Policy 2007 (SA) - superceded by Environment Protection (Commercial and Industrial Noise) Policy 2023</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>• Equipment will be shut off or throttled down whenever it is not in actual use.
• Horn use noise to be minimised.
• Distance to receptors.</td><td>Expected impact</td><td>Minimal - No impact expected based on noise modelling.</td><td>Uncertainties and assumptions (regarding controls)</td><td>Moderate level of certainty
• Modelling demonstrates noise is unlikely to exceed SA EPA policy at sensitive receivers.
• Noise may impact stock. Complaints of disruption of stock are possible for Project sites.
• Accuracy of noise source data.
• Modelling uncertainty.
• Assumptions in relation to noise source locations and operation.
• Conservative assumptions have been made which are expected to overpredict actual noise emissions for the majority of the time.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="5">Residual risk</td></tr>
<tr><td rowspan="2">What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td>Risk</td></tr>
<tr><td colspan="2">Low</td><td colspan="2">Low</td><td>Low</td></tr>
</table>

Type:	Noise	Impact ID: N_01	
Statement of outcomes	**Proposed outcome (draft)**	• No public nuisance impacts from noise emissions generated from mining operations. • Comply with Environment Protection (Noise) Policy 2007.	
	Outcome Measurement Criteria (draft)	Compliance with WI50_004 (Complaints Management Protocol) and WI50_008 (Stakeholder Engagement and Communications Management).	
	Leading Indicator criteria (draft)	Not proposed.	

4 Flora and Fauna

4.1 Native Vegetation

<table>
<tr><th>Type:</th><th>Native Vegetation</th><th colspan="2">Impact ID: NV_01</th><th colspan="2"></th></tr>
<tr><td rowspan="8">Planned Event</td><td>Potential impact event</td><td colspan="2">Clearing of native vegetation habitat hosting threatened flora.</td><td>Stage</td><td>Construction, Operation</td></tr>
<tr><td>Source</td><td colspan="2">Vegetation clearance.</td><td>Relevant Technical Study</td><td>N/A</td></tr>
<tr><td>Pathway</td><td colspan="4">Ground disturbing activities.</td></tr>
<tr><td>Receptor</td><td colspan="4">Threatened flora.</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="4">Design footprint altered to avoid listed species habitats
- SIMEC has selected disturbance areas which are within pre-existing mining tenements, and specifically avoids field survey verified Desert Greenhood (Pterostylis xerophila) habitat and known populations and avoids identified and field survey verified core habitat of both Sandhill Dunnart (Sminthopsis psammophila) and Malleefowl (Leipoa ocellata).</td></tr>
<tr><td>Is there a confirmed SPR?</td><td>No</td><td>Sensitivity of change in assumptions</td><td>Low sensitivity to change
Control strategies are well understood and are regularly implemented.</td><td>Evidence for linkage / lack of linkage</td><td>Yes - known from other sites.</td></tr>
<tr><td>Is the SPR material?</td><td>No</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="2">Legislation
• Environment Protection and Biodiversity Conservation Act 1999.
• Native Vegetation Act 1991.
• Environment Protection Act 1993.
• Mining Act 1971.
• Landscape South Australia Act 2019.

Non-legislated Standards
• QP50.65 (Vegetation Clearance) - Clearance protocols and approval system.</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>• Field surveys across multiple seasons undertaken (across 30 years).
• EPBC Act Self-Assessment utilising DCCEEW Significant Impact Guidelines undertaken and demonstrates no likely significant impact .
• All land clearance is subject to compliance assessment by the Environment Assurance Manager prior to approval by the Operations Manager in accordance with QP50.65 (Vegetation Clearance).
• Construction and operations management plans will be in place to ensure impact areas are surveyed and controlled within design.
• Unnecessary vegetation disturbance during exploration will be avoided with implementation of SIMEC Mining’s Exploration Guidelines QP51.01 and Exploration Regulatory Manual MM51.02 which incorporates DEMs guidelines and requirements of the Mining Act 1971, Native Vegetation Act.
• SMR NVMP updated and will be provided in PEPR.</td><td>Expected impact</td><td>Minimal</td><td>Uncertainties and assumptions (regarding controls)</td><td>High level of certainty
Area of clearance required is defined. Vegetation clearances are highly controlled and unlikely to result in clearance exceedance. There may be some minor changes to mine footprints during the project development stage, but these are unlikely to be material and affect the assessment provided herein.</td></tr>
<tr><td rowspan="2">Unplanned Event</td><td>Risk event</td><td colspan="4">Residual risk</td></tr>
<tr><td></td><td colspan="2">Consequence</td><td>Likelihood</td><td>Risk</td></tr>
</table>

	What is the consequence and likelihood that the impact is incorrect?	Minor	Possible	Low
Statement of outcomes	**Proposed outcome (draft)**	N/A		
	Outcome Measurement Criteria (draft)	N/A		
	Leading Indicator criteria (draft)	N/A		

<table>
<tr><th>Type:</th><th>Native Vegetation</th><th>Impact ID: NV_02</th><th colspan="3"></th></tr>
<tr><td rowspan="10">Planned Event</td><td>Potential impact event</td><td colspan="2">Unauthorised clearance of remaining native vegetation.</td><td>Stage</td><td>Construction, Operation</td></tr>
<tr><td>Source</td><td colspan="2">Vegetation clearance.</td><td>Relevant Technical Study</td><td>N/A – see CiO</td></tr>
<tr><td>Pathway</td><td colspan="5">Ground disturbing activities.</td></tr>
<tr><td>Receptor</td><td colspan="5">Native vegetation .</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="5">Design footprint altered to avoid listed species habitats
• SIMEC has selected disturbance areas which are within pre-existing mining tenements, and specifically avoids field survey verified Desert Greenhood (Pterostylis xerophila) habitat and known populations and avoids identified and field survey verified core habitat of both Sandhill Dunnart (Sminthopsis psammophila) and Malleefowl (Leipoa ocellata).</td></tr>
<tr><td>Is there a confirmed SPR?</td><td>Yes</td><td>Sensitivity of change in assumptions</td><td>Low sensitivity to change
Control strategies are well understood and are regularly implemented.</td><td>Evidence for linkage / lack of linkage</td><td>Yes known from other sites.</td></tr>
<tr><td>Is the SPR material?</td><td>Yes</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="2">Legislation
• Environment Protection and Biodiversity Conservation Act 1999.
• Native Vegetation Act 1991.
• Environment Protection Act 1993.
• Mining Act 1971.
• Landscape South Australia Act 2019.

Non-legislated Standards
• QP50.65 (Vegetation Clearance) - Clearance protocols and approval system.</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>• All land clearance is subject to compliance assessment by the Environment Assurance Manager prior to approval by the Operations Manager in accordance with QP50.65 (Vegetation Clearance) .
• Construction and operations management plans will be in place to ensure impact areas are surveyed and controlled within design.
• Unnecessary vegetation disturbance during exploration will be avoided with implementation of SIMEC Mining’s Ground Disturbance Permit Process QP50.65, DEM Guidelines and requirements of the Mining Act 1971, Native Vegetation Act 1991 and the Landscape South Australia Act 2019.
• Pre-clearance surveys in accordance with the EMP.
• Review existing survey data prior to endorsing QP50.65.</td><td>Expected impact</td><td>Minimal</td><td>Uncertainties and assumptions (regarding controls)</td><td>High level of certainty
Area of clearance required is defined. Vegetation clearances are highly controlled and unlikely to result in clearance exceedance. There may be some minor changes to mine footprints during the project development stage, but these are unlikely to be material and affect the assessment provided herein.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="5">Residual risk</td></tr>
<tr><td rowspan="2">What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td>Risk</td></tr>
<tr><td colspan="2">Minor</td><td colspan="2">Possible</td><td>Low</td></tr>
<tr><td>Statement of</td><td>Proposed outcome (draft)</td><td colspan="5">No loss of abundance and/or diversity of native vegetation on or off the Land through clearance unless a significant environmental benefit has been approved in accordance with the relevant legislation.</td></tr>
</table>

	Outcome Measurement Criteria (draft)	Annual aerial and/or ground surveys of operational areas demonstrates that the total area cleared does not exceed the approved clearance areas in the NVMP.
	Leading Indicator criteria (draft)	Internal Trigger: Unauthorised clearances in the SMR area (i.e., clearance of areas not included under Section 3.8) are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. Leading indicator criteria: Not proposed.

Type:	Native vegetation	Impact ID: NV_03				
Planned Event	**Potential impact event**	Loss of abundance or diversity of native vegetation on or off tenement due to dust impacts.			**Stage**	Construction, Operation, Closure
	Source	Mining operations (Waste rock dump and topsoil stockpile related activities).			**Relevant Technical Study**	Ramboll, 2024 – Appendix D2.
	Pathway	Airborne dust deposition.				
	Receptor	Native vegetation.				
	Design Controls (Elimination, substitution, engineering)	• FDR/Dust TARP/EMP controls. • Dust controls including postponing operations in accordance with the mines 'Fugitive Dust Ranking Procedure' and EMPs have been developed. • Dust suppression using water and/or agents will be used on haul roads and open areas. • Establish vegetation dust impact monitoring photo points/quadrats or transects in accordance with QP50.85.				
	Is there a confirmed SPR?	Yes	**Sensitivity of change in assumptions**	Moderate sensitivity to change Continuous improvement in dust control methods, application, technology and/or procedure could result in reduced extent and effect levels.	**Evidence for linkage / lack of linkage**	Yes - known from other sites.
	Is the SPR material?	Yes	**Legislative requirements / applicable standards**			*Legislation* • Environment Protection and Biodiversity Conservation Act 1999. • Native Vegetation Act 1991. • Environment Protection Act 1993. • Mining Act 1971. • Landscape South Australia Act 2019. • Environment Protection (Air Quality) Policy 2016. *Non-legislated Standards* • QP50.65 (Vegetation Clearance) -Clearance protocols and approval system. • QP50.68 Mines FDR Standard. • QP50.84 Dust TARP. • QP50.85 Vegetation Dust Impact Assessment. • SIMEC Mining operational procedures and controls.
	Factors that limit / mitigate impact (control measures)	Dust mitigation strategies including: • Dust suppression on roads. • Staged removal of vegetation. • Implementation of speed limits on site . • Spray capping of dry dusty fines stockpiles during hot, dry and windy conditions. • Targeted dust control measures implemented ahead of days anticipated to generate extra dust. • implementation of specific controls under the dust TARP (QP50.84) standard for dust-generating activities, such as postponement of operations when dust cannot be controlled and chemical suppression on these days • Dust monitoring in impact areas. • Ceasing of operations when unacceptable limits are triggered in accordance with the QP50.84. • Environmental awareness training for staff and contractors, including training in the application of the dust TARP (QP50.84). • Establish vegetation dust impact monitoring photo	**Expected impact**	Minimal	**Uncertainties and assumptions (regarding controls)**	High level of certainty due to five years of monitoring data and reporting through compliance reporting. Medium term and moderate extent reduced health of flora and reduced canopy cover to vegetation species susceptible to dust impact (e.g. *Maireana sedifolia*) and complaints of loss of or staining of vegetation. Some level of vegetation health impact or staining will occur despite controls. There is currently no evidence of extensive or long-term damage to vegetation from dust. It is assumed that impact is not long term or permanent, vegetation health will recover quickly once emissions cease.

Type:	Native vegetation	Impact ID: NV_03				
		points/quadrats or transects with co-located dust deposit gauges.				
Unplanned event	**Risk event**	**Residual risk**				
	What is the consequence and likelihood that the impact is incorrect?	**Consequence**		**Likelihood**		**Risk**
		Minor		Possible		Low
Statement of outcomes	**Proposed outcome (draft)**	No loss of abundance and/or diversity of native vegetation on or off the Land through clearance unless a significant environmental benefit has been approved in accordance with the relevant legislation.				
	Outcome Measurement Criteria (draft)	Assessments demonstrate that impact assessment scores at any of the three monitoring quadrats do not exceed a dust impact score of 2 from mine derived dust outside of approved clearance areas. Regulatory compliance and EMS audits, as well as construction and operational process audits occurring through operations and closure, confirm that SIMEC Mining dust management strategies are implemented as per the Dust TARP (QP50.84) and Mines FDR Standard (QP50.68).				
	Leading Indicator criteria (draft)	Internal Trigger: Dust impact scores of 2 from mine derived dust outside of approved clearance areas will require further investigation by the SIMEC Mining Environment Department Assurance to determine the likely contributing factors to the dust impact scores and review implementation of QP50.84. Internal Trigger: Incidents of operations continuing in SMR mining areas without the implementation of appropriate controls as per QP50.84 are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. Leading indicator criteria: Not proposed.				

4.2 Native Fauna

<table>
<tr><th>Type:</th><th>Native Fauna</th><th colspan="2">Impact ID: NF_01</th><th colspan="2"></th></tr>
<tr><td rowspan="9">Planned Event</td><td>Potential impact event</td><td colspan="2">Clearing of native vegetation resulting in impacts to habitat of threatened fauna</td><td>Stage</td><td>Construction, Operation</td></tr>
<tr><td>Source</td><td colspan="2">Vegetation clearance.</td><td>Relevant Technical Study</td><td>N/A</td></tr>
<tr><td>Pathway</td><td colspan="4">Ground disturbing activities.</td></tr>
<tr><td>Receptor</td><td colspan="4">Threatened fauna.</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="4">Design footprint altered to avoid listed species habitats
• SIMEC has selected disturbance areas which are within pre-existing mining tenements, and specifically avoids field survey verified Desert Greenhood (Pterostylis xerophila) habitat and known populations and avoids identified and field survey verified core habitat of both Sandhill Dunnart (Sminthopsis psammophila) and Malleefowl (Leipoa ocellata).</td></tr>
<tr><td>Is there a confirmed SPR?</td><td>Yes</td><td>Sensitivity of change in assumptions</td><td>Low sensitivity to change
Control strategies are well understood and are regularly implemented.</td><td>Evidence for linkage / lack of linkage</td><td>Yes - known from other sites.</td></tr>
<tr><td>Is the SPR material?</td><td>Yes</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="2">Legislation
• Environment Protection and Biodiversity Conservation Act 1999.
• Native Vegetation Act 1991.
• Environment Protection Act 1993.
• Mining Act 1971.
• Landscape South Australia Act 2019.

Non-legislated Standards
• Clearance protocols and approval system QP50.65 (Vegetation Clearance).</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>• Field surveys across multiple seasons undertaken (across 30 years).
• EPBC Act Self Assessment utilising DCCEEW Significant Impact Guidelines undertaken and demonstrates no likely significant impact .
• All land clearance is subject to compliance assessment by the Environment Assurance Manager prior to approval by the Operations Manager in accordance with QP50.65 (Vegetation Clearance).
• Construction and operations management plans will be in place to ensure impact areas are surveyed and controlled within design.
• Unnecessary vegetation disturbance during exploration will be avoided with implementation of SIMEC Mining’s Exploration Guidelines QP51.01 and Exploration Regulatory Manual MM51.02 which incorporates DEMs guidelines and requirements of the Mining Act 1971, Native Vegetation Act.
• SMR NVMP updated and will be provided in PEPR</td><td>Expected impact</td><td>Minimal</td><td>Uncertainties and assumptions (regarding controls)</td><td>High level of certainty
Area of clearance required is defined. Vegetation clearances are highly controlled and unlikely to result in clearance exceedance. There may be some minor changes to mine footprints during the project development stage, but these are unlikely to be material and affect the assessment provided herein.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="4">Residual risk</td></tr>
<tr><td rowspan="2">What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td>Risk</td></tr>
<tr><td colspan="2">Minor</td><td colspan="2">Possible</td><td>Low</td></tr>
</table>

Type:	Native Fauna	Impact ID: NF_01	
Statement of outcomes	**Proposed outcome (draft)**	No loss of abundance and/or diversity of native vegetation on or off the Land through clearance unless a significant environmental benefit has been approved in accordance with the relevant legislation.	
	Outcome Measurement Criteria (draft)	Annual aerial and/or ground surveys of operational areas demonstrates that the total area cleared does not exceed the approved clearance areas in the NVMP.	
	Leading Indicator criteria (draft)	Internal Trigger: Unauthorised clearances in the SMR area are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. Leading indicator criteria: Not proposed.	

4.3 Weeds and pests

<table>
<tr><th>Type:</th><th>Weeds and pests</th><th colspan="5">Impact ID: WP_01</th></tr>
<tr><td rowspan="9">Planned Event</td><td>Potential impact event</td><td colspan="3">Introduction or sustained increase of pests impacts on fauna.</td><td>Stage</td><td>Construction, Operation, Closure</td></tr>
<tr><td>Source</td><td colspan="3">Pests.</td><td>Relevant Technical study</td><td>N/A</td></tr>
<tr><td>Pathway</td><td colspan="6">Competition/predation.</td></tr>
<tr><td>Receptor</td><td colspan="6">Native fauna.</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="6">• Weed incursions are to be mapped using active searches and opportunistic sightings recorded by GPS location and controlled as per the Pest Plant and Animal Control Strategy QP50.62</td></tr>
<tr><td>Is there a confirmed SPR?</td><td>Yes</td><td>Sensitivity of change in assumptions</td><td>Low</td><td>Evidence for linkage / lack of linkage</td><td>Yes - known from other sites.</td></tr>
<tr><td>Is the SPR material?</td><td>Yes</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="2">Legislation
• Environment Protection and Biodiversity Conservation Act 1999.
• Native Vegetation Act 1991.
• Environment Protection Act 1993.
• Mining Act 1971.
• Landscape South Australia Act 2019.
• Environment Protection (Air Quality) Policy 2016.

Non-legislated Standards
• Exploration guideline QP51.01.
• Clearance protocols and approval system.
• QP50.65 (Vegetation Clearance).
• QP50.68 Mines FDR Standard.
• QO50.85 Vegetation Dust Impact Assessment.
• DSD Information Sheet M21 – Mineral exploration drill holes – General specification for construction and backfilling.</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>• Weed incursions are to be mapped using active searches and opportunistic sightings recorded by GPS location and controlled as per the Pest Plant and Animal Control Strategy QP50.62.
• Machinery brought into mining areas from areas of risk are to be certified, cleaned and inspected for soil and seeds.
• Induction program and ongoing training for mine employees to emphasise importance of prevention and control measures.</td><td>Expected impact</td><td>Minimal</td><td>Uncertainties and assumptions (regarding controls)</td><td>Moderate level of certainty
Low level effects to receptors of moderate adaptability and recovery potential sensitivity and high intrinsic worth. Controls are known to be effective as shown in SMR operations.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="5">Residual risk</td></tr>
<tr><td rowspan="2">What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td>Risk</td></tr>
<tr><td colspan="2">Minor</td><td colspan="2">Possible</td><td>Low</td></tr>
</table>

Type:	Weeds and pests	Impact ID: WP_01
Statement of outcomes	**Proposed outcome (draft)**	No introduction of new species of environmental weed, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species on the Land.
	Outcome Measurement Criteria (draft)	Annual survey of the tenement undertaken by an independent and suitably qualified person demonstrates: • no introduction of new species of weeds declared or listed under relevant legislation, plant pathogens or pests (including feral animals) as a result of mining-related activities when compared to previously recorded weed species and introduced fauna. • no increase in the abundance of existing weeds or pest species on the tenement compared to previous survey records as a result of mining-related activities. Continual pest animal observations and annual pest animal control reports demonstrate that feral animal abundance on the tenements is managed by control measures as per the Pest Plant and Animal Control Strategy QP50.62 on an ongoing basis such that pest animal abundance is low compared to the baseline fauna survey levels.
	Leading Indicator criteria (draft)	Internal trigger: A new pest animal species is reported or a notable increase in the abundance of existing pest or feral animal species are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. Leading indicator criteria: Not proposed.

<table>
<tr><td rowspan="9">Planned Event</td><td>Type:</td><td>Weeds and Pests</td><td>Impact ID: WP_02</td><td colspan="2"></td><td></td><td></td></tr>
<tr><td></td><td>Potential impact event</td><td colspan="3">Incursions of new declared weed species or increase in abundance or diversity of existing weed species</td><td>Stage</td><td>Construction, Operation, Closure</td></tr>
<tr><td></td><td>Source</td><td colspan="3">Unclean vehicles, incoming equipment/supplies to site.</td><td>Relevant Technical Study</td><td>N/A</td></tr>
<tr><td></td><td>Pathway</td><td colspan="6">Competition or predation.</td></tr>
<tr><td></td><td>Receptor</td><td colspan="6">Native flora</td></tr>
<tr><td></td><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="6">• Weed incursions are to be mapped using active searches and opportunistic sightings recorded by GPS location and controlled as per the Pest Plant and Animal Control Strategy QP50.62.</td></tr>
<tr><td></td><td>Is there a confirmed SPR?</td><td>Yes</td><td>Sensitivity of change in assumptions</td><td>Low sensitivity to change
Level may change if a currently unknown, but highly aggressive and difficult to control species invades the area.</td><td>Evidence for linkage / lack of linkage</td><td>Yes - known from other sites.</td></tr>
<tr><td></td><td>Is the SPR material?</td><td>Yes</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="2">*Legislation*
• Environment Protection and Biodiversity Conservation Act 1999.
• Native Vegetation Act 1991.
• Environment Protection Act 1993.
• Mining Act 1971.
• Landscape South Australia Act 2019.
• Environment Protection (Air Quality) Policy 2016.

Non-legislated Standards
• Exploration guideline QP51.01.
• Clearance protocols and approval system.
• QP50.65 (Vegetation Clearance).
• QP50.68 Mines FDR Standard.
• QO50.85 Vegetation Dust Impact Assessment.
• DSD Information Sheet M21 – Mineral exploration drill holes – General specification for construction and backfilling.</td></tr>
<tr><td></td><td>Factors that limit / mitigate impact (control measures)</td><td>• Weed incursions are to be mapped using active searches and opportunistic sightings recorded by GPS location and controlled as per the Pest Plant and Animal Control Strategy QP50.62.
• Machinery brought into mining areas from areas of risk are to be certified, cleaned and inspected for soil and seeds.
• Induction program and ongoing training for mine employees to emphasise importance of prevention and control measures.</td><td>Expected impact</td><td>Minimal - Introduced species such as goats already exist in the area, as do several weedy species.
Proposed measures are not expected to increase grazing pressure nor spread any invasive weeds. Weed management and vehicle hygiene practices will be implemented when working in the clearance area. The region is not considered a high-risk Phytophthora area.</td><td>Uncertainties and assumptions (regarding controls)</td><td>Moderate level of certainty
• Insignificant to low level effects to receptors of moderate adaptability and recovery potential.
• Current controls have been demonstrated to be effective at controlling declared weeds.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td></td><td>Risk event</td><td colspan="5">Residual risk</td></tr>
<tr><td></td><td>What is the consequence and likelihood that the</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td>Risk</td></tr>
<tr><td></td><td></td><td colspan="2">Minor</td><td colspan="2">Possible</td><td>Low</td></tr>
</table>

Type:	Weeds and Pests	Impact ID: WP_02			
	impact is incorrect?				
Statement of outcomes	**Proposed outcome (draft)**	No introduction of new species of environmental weed, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species on the Land.			
	Outcome Measurement Criteria (draft)	Annual survey of the tenement undertaken by an independent and suitably qualified person demonstrates: • no introduction of new species of weeds declared or listed under relevant legislation, plant pathogens or pests (including feral animals) as a result of mining-related activities when compared to previously recorded weed species and introduced fauna • no increase in the abundance of existing weeds or pest species on the tenement compared to previous survey records as a result of mining-related activities. Continual pest animal observations and annual pest animal control reports demonstrate that feral animal abundance on the tenements is managed by control measures as per the Pest Plant and Animal Control Strategy QP50.62 on an ongoing basis such that pest animal abundance is low compared to the baseline fauna survey levels.			
	Leading Indicator criteria (draft)	Internal Trigger: New weed species or a notable increase in the abundance of existing weed species are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department. Leading indicator criteria: Not proposed.			

5 Land and Soil

Type:	Land and Soil	Impact ID: LS_01				
Planned Event	**Potential impact event**	Loss and/or degradation of topsoil. Soil stripping and stockpiling resulting in degradation of soil quality and quantity.			**Stage**	Construction, Operation, Closure
	Source	Soil stockpiling.			**Relevant Technical Study**	N/A
	Pathway	removal and stockpiling of topsoil.				
	Receptor	Soil quality and quantity, rehabilitation results.				
	Design Controls (Elimination, substitution, engineering)	N/A				
	Is there a confirmed SPR?	Yes	**Sensitivity of change in assumptions**	Low sensitivity to change SIMEC has good control procedures that have resulted in effective storage of soils and successful rehabilitation results.	**Evidence for linkage / lack of linkage**	Yes - SPR exists.
	Is the SPR material?	Yes	**Legislative requirements / applicable standards**		*Legislation* • Environment Protection Act 1993. • Mining Act 1971. • Landscape South Australia Act 2019. • National Environment Protection (Assessment of Site Contamination) Measure 1999 (amended in 2013) (NEPM). *Non-legislated Standards* • Topsoil management procedures QP50.66. • Exploration guideline QP51.01 and Exploration. • Regulatory Manual MM51.02. • AS 1940 bunding guidelines. • ISO 14001 EMS.	
	Factors that limit / mitigate impact (control measures)	• Topsoil stockpiles to be placed in designated and mapped areas with signage to allow rapid crust development, to facilitate revegetation and to prevent the accidental removal, disturbance or degradation of the resource. • Stripping of topsoil to ensure maximum depth of topsoil obtained and that available seed reserves within topsoil is retained. • Grubbed material with 'A; horizon and 'B' horizon soils to be stripped and stockpiled separately where relevant. • Topsoil stockpiles to be maintained to prevent establishment of weeds. • 'A' horizon topsoil stockpiles to be restricted to 3 m uncompacted height to maintain soil and seed function • Reuse of topsoil stockpiles as soon as possible to ensure viability of seed stock is maintained.	**Expected impact**	Minor loss of soil micro-biomes and seed bank viability due to stockpiling no affecting ecosystem function.	**Uncertainties and assumptions (regarding controls)**	High level of certainty • Topsoils harvested and stockpiled appropriately will result in the maintenance of soil quantity and quality and effective rehabilitation. • If procedure is not followed, soil quality may be lost due to compaction or quantity lost through disturbance or erosion.

Type:	Land and Soil	Impact ID: LS_01		
Unplanned event	**Risk event**	**Residual risk**		
	What is the consequence and likelihood that the impact is incorrect?	**Consequence**	**Likelihood**	**Risk**
		Minor	Possible	Low
Statement of outcomes	**Proposed outcome (draft)**	Ensure that the existing (pre-mining) soil quality and quantity is maintained.		
	Outcome Measurement Criteria (draft)	Topsoil is stripped, stockpiled and maintained in accordance with QP50.66, with stockpiles showing no evidence of disturbance, compaction, erosion or weed infestations and maximum stockpile heights adhered to. Zero outstanding action items after 60 days from audits.		
	Leading Indicator criteria (draft)	Internal Trigger: Evidence of disturbance or compaction, sheet or gully erosion, weed infestations or exceedance of maximum stockpile heights are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department.		

<table>
<tr><td>Type:</td><td>Land and Soil</td><td colspan="5">Impact ID: LS_02</td></tr>
<tr><td rowspan="9">Planned Event</td><td>Potential impact event</td><td colspan="3">Soil contamination onsite.</td><td>Stage</td><td>Construction, Operation</td></tr>
<tr><td>Source</td><td colspan="3">Hydrocarbons and chemicals stored/used on.</td><td>Relevant Technical Study</td><td>N/A</td></tr>
<tr><td>Pathway</td><td colspan="5">Uncontrolled releases (spills, leaks etc.).</td></tr>
<tr><td>Receptor</td><td colspan="5">Soil quality.</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="5">• Bunding around any hazardous materials to prevent spillage to soils.</td></tr>
<tr><td>Is there a confirmed SPR?</td><td>Yes</td><td>Sensitivity of change in assumptions</td><td>Low sensitivity to change
SIMEC has control procedures that have resulted in effective management and control of potential soil contamination.</td><td>Evidence for linkage / lack of linkage</td><td>Yes - SPR exists.</td></tr>
<tr><td>Is the SPR material?</td><td>Yes</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="2">Legislation
• Environment Protection Act 1993.
• Mining Act 1971.
• Landscape South Australia Act 2019.
• National Environment Protection (Assessment of Site Contamination) Measure 1999 (amended in 2013) (NEPM).

Non-legislated Standards
• Topsoil management procedures QP50.66.
• Exploration guideline QP51.01 and Exploration.
• Regulatory Manual MM51.02.
• AS 1940 bunding guidelines.
• ISO 14001 EMS.</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>• Utilise Quality Procedures to ensure that potential contaminants are stored and handled in accordance with EPA guidelines and Australian Standards (QP 29.22; Chemical Management Manual), that incidents of spillages are reported (QP 75.WHS.INV.001 Incident Investigation and Reporting) and that spillages are confined and that contaminated soil is removed and treated (QP50.67; Spills Response).
• All oils and chemicals are stored in compliance to EPA Bunding guideline and AS 1940 as standard practice. No underground pipelines or storage facilities will be installed.</td><td>Expected impact</td><td>Contamination of soil from small volume spillages of limited lateral and vertical extent with the site resulting in insignificant harm.</td><td>Uncertainties and assumptions (regarding controls)</td><td>High level of certainty
Quality procedures used to store, handle and manage spills follow EPA guidelines and Australian Standards. High degree of certainty of effectiveness of the control measures.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="5">Residual risk</td></tr>
<tr><td rowspan="2">What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td>Risk</td></tr>
<tr><td colspan="2">Moderate</td><td colspan="2">Rare</td><td>Low</td></tr>
<tr><td>Statement</td><td>Proposed outcome (draft)</td><td colspan="5">No contamination of Land and soils either on or off the land as a result of mining operations.</td></tr>
</table>

Type:	Land and Soil	Impact ID: LS_02	
	Outcome Measurement Criteria (draft)	All contaminated material was disposed of off-site in accordance with the requirements of QP60.57 Spills Response. Inspection records demonstrate that all storage of potential contaminants are stored in accordance with EPA Guidelines and Australian Standards.	
	Leading Indicator criteria (draft)	Internal trigger: Not proposed. Leading indicator criteria: Not proposed.	

6 Surface Water

Type:	Surface Water	Impact ID: SW_01				
Planned Event	**Potential impact event**	Stormwater leaving the site creates an impact to sensitive receptors due to high suspended solids (siltation) or other contaminants.			**Stage**	Construction, Operation, Closure
	Source	Mine site.			**Relevant Technical Study**	HydroBalance, 2024 – Appendix D1. CDM Smith, 2024 – Appendix D5.
	Pathway	Storm water movement.				
	Receptor	Surrounding sensitive receptors (including Native vegetation, soil quality and quantity, surface water bodies, rehabilitation outcomes).				
	Design Controls (Elimination, substitution, engineering)	N/A				
	Is there a confirmed SPR?	Yes	**Sensitivity of change in assumptions**	Low sensitivity to change.	**Evidence for linkage / lack of linkage**	Yes - Known from other sites. See HydroBalance (2024) - Appendix D1.
	Is the SPR material?	Yes	**Legislative requirements / applicable standards**			*Legislation* • Environment Protection and Biodiversity Conservation Act 1999. • Native Vegetation Act 1991. • Environment Protection Act 1993. • Mining Act 1971. • Landscape South Australia Act 2019. *Non-legislated Standards* • SIMEC Mining procedures for hazardous materials storage, use and spill response. •AS 1940 bunding guidelines.

<table>
<tr><td>Type:</td><td>Surface Water</td><td colspan="5">Impact ID: SW_01</td></tr>
<tr><td rowspan="3"></td><td>Factors that limit / mitigate impact (control measures)</td><td>• Operational infrastructure designs divert stormwater around contaminant sources.
• Flood mitigation structures, retention dams, silt traps, culverts and installed drainage channels are in place and maintained.
• All fuels, oils and other chemicals to be stored in accordance with AS 1940 and EPA bunding guidelines
• All spills to be cleaned up as soon as practicable and contaminated material to be moved to the bioremediation pad.
• Spills greater than 20 litres reported on the environment incident reporting system and corrective actions tracked.
• Drainage from WRDs, roads and mine operation hardstand areas will be diverted to siltation traps to avoid soil erosion or sedimentation of channels and retained on site.
• Preservation of natural drainage systems through gully head and down culvert gully armouring.
• Flood mitigation structures, retention dams, silt traps, culverts and installed drainage channels are in place and maintained.
• Preservation of natural drainage systems through gully head and down culvert gully armouring.
• HydroBalance (2024) - The disturbed areas (WRD extension and stockpile) will be managed to mitigate any potential impacts on regional water quality and environmental values through the preparation of a Surface Water Management Plan (SWMP). The SWMP will comprise a practical guide manage risks to soil and water associated with specific management measures for all discrete disturbance areas.
• Any potential impacts on downstream water quality due to the disturbed areas will be mitigated through best-practice runoff management methods.</td><td>Expected impact</td><td>Minimal.

HydroBalance (2024) - No impacts to the downstream environment were identified as part of this assessment.</td><td>Uncertainties and assumptions (regarding controls)</td><td>High level of certainty
• The described control measures have been, and continue to be, implemented in the wider SMR region and are noted to be effective.
• Low level staining effect within drainage channels restricted to the extent of the site is expected.
• Most likely that silt traps will contain sediment and this will ensure there is no visual impact offsite.
• Quality procedures used to store, handle and manage spills follow EPA guidelines and Australian Standards. High degree of certainty of effectiveness of the control measures.
• HydroBalance (2024) - Modelling shows that, even with conservatively high-yielding parameters, floodwaters would not interact with the Project. Hence, the outcomes of this assessment are not expected to be sensitive to potential uncertainties.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="4">Residual risk</td></tr>
<tr><td>What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td>Likelihood</td><td>Risk</td></tr>
<tr><td colspan="2">Minor</td><td>Possible</td><td>Low</td></tr>
<tr><td rowspan="3">Statement of outcomes</td><td>Proposed outcome (draft)</td><td colspan="5">No surface water contaminated as a result of mining operations leaves the land.</td></tr>
<tr><td>Outcome Measurement Criteria (draft)</td><td colspan="5">All drainage channels and silt traps are installed as proposed and reactive maintenance and corrective actions closed out within 30 days of assignment to demonstrate that adequate head remains in the silt traps to retain surface water (contaminated by mining operations) on the Land.
A review of all spill incident records demonstrates that all spills were cleaned up prior to reaching the tenement boundary.</td></tr>
<tr><td>Leading Indicator criteria (draft)</td><td colspan="5">Internal Trigger: Damaged or inadequately maintained stormwater infrastructure (including blocked culverts, insufficient remaining freeboard in silt traps, eroded or damaged spillways) are observed during regular site inspections conducted by Environment Assurance personnel or are otherwise reported to the SIMEC Mining Environment Department.

Leading indicator criteria: Not proposed.</td></tr>
</table>

7 Groundwater

Type:	Groundwater	Impact ID: GW_04				
Planned Event	**Potential impact event**	Contamination of groundwater from AMD seepage from southern WRD.			**Stage**	Construction, Operation, Closure
	Source	PAF in southern WRD.			**Relevant Technical Study**	HydroBalance, 2024 – Appendix D1. CDM Smith, 2024 – Appendix D5. Mine Earth, 2024 – Appendix D6.
	Pathway	AMD seepage.				
	Receptor	Groundwater.				
	Design Controls (Elimination, substitution, engineering)	N/A				
	Is there a confirmed SPR?	Yes	**Sensitivity of change in assumptions**	Low sensitivity to change Verification of PAF/NAF classification through analysis of rock types from Iron Duchess is unlikely to change assumptions.	**Evidence for linkage / lack of linkage**	Yes - known from other sites. The WRD will include PAF material however it will be isolated by appropriately designed and constructed containment.
	Is the SPR material?	Yes	**Legislative requirements / applicable standards**		*Legislation* • Environment Protection (Water Quality Policy) 2015. • Landscape South Australia Act 2019. *Non-legislated Standards* • Australian and New Zealand Guidelines for Fresh and Marine Water Quality.	
	Factors that limit / mitigate impact (control measures)	• Seepage assessment indicates limited seepage expected from WRD (CDM Smith, 2024). • Geochemical assessment of all waste material undertaken with significant database and drilling samples (SIMEC and Mine Earth, 2024). • PAF storage cells designed with sufficient capacity (see s 2.2.4.1 of CiO). • Sufficient NAF to cover PAF storage cells as outlined in s 2.2.4.1 of CiO. • Waste rock dumps will be rehabilitated to minimise erosion and sedimentation of any surface water runoff (Hydrobalance, 2024).	**Expected impact**	Minimal - The WRD will include PAF material however it will be isolated by appropriately designed and constructed containment. CDM (2024) - • It is considered highly unlikely that the WRD seepage will cause groundwater to daylight at surface. • Seepage from WRDs is predicted to cause a localised increase in groundwater heads beneath the WRDs, varying between 12m (48m bgl) and 18m (40m bgl) beneath the Southern WRD. • The extent of the groundwater mounding is predicted to be up to 5km (worst-case scenario) surrounding the Southern WRD. • Groundwater flow is not predicted to interact with	**Uncertainties and assumptions (regarding controls)**	High level of certainty SIMEC mining have a solid understanding of geochemical characteristics of waste rock and groundwater seepage. See Appendix D5 and D6.

Type:	Groundwater	Impact ID: GW_04				
				regional aquifers outside the mining areas, with groundwater flow beneath the WRDs predicted to report to Iron Magnet pit either entirely, or partially (via a groundwater sink feature directly adjacent to the Northern WRD). • The threat imposed by seepage induced mounding from the MEP1 WRDs is considered low.		
Unplanned event	**Risk event**	**Residual risk**				
	What is the consequence and likelihood that the impact is incorrect?	**Consequence**		**Likelihood**		**Risk**
		Moderate		Unlikely		Medium
Statement of outcomes	**Proposed outcome (draft)**	No adverse impact to the environmental value of groundwater or groundwater dependent ecosystems as a result of AMD (from Iron Duchess WRDs or Magnetite TSF buttress). *Note, Geochemistry of TSF buttress material indicates AMD seepage from buttress is of negligible risk, however an outcome was proposed due to stakeholder (DEM) interest.				
	Outcome Measurement Criteria (draft)	Groundwater criteria do not elevate beyond the following investigation trigger levels: a change in pH by more than 2 pH units. ***Updated monitoring bore locations to be provided in PEPR.***				
	Leading Indicator criteria (draft)	Internal Trigger: Any elevation of indicator values greater than the natural range of variability plus 2 standard deviations. Leading indicator criteria: Not proposed.				

8 Heritage

Type:	Heritage	Impact ID: H01				
Planned Event	**Potential impact event**	Disturbance to (unforeseen) Aboriginal and non-Aboriginal heritage during construction and operation of southern WRD.			**Stage**	Construction, Operation
	Source	Land clearance mining and excavation.			**Relevant Technical Study**	N/A
	Pathway	Disturbance to ground surface and sub-surface.				
	Receptor	Heritage objects and places (Recorded and unrecorded sites, artefacts and remains).				
	Design Controls (Elimination, substitution, engineering)	• Design footprint avoids identified heritage areas as identified by Traditional Owners.				
	Is there a confirmed SPR?	Yes	**Sensitivity of change in assumptions**	Moderate level of sensitivity to change low potential to disturb unknown artefacts or remains. Ground disturbance activities provide additional assessment to surface assessments undertaken as part of heritage clearances, and to existing databases. Unforeseen heritage items may not be discovered or noticed and be destroyed unintentionally.	**Evidence for linkage / lack of linkage**	Yes - SPR exists.
	Is the SPR material?	Yes	**Legislative requirements / applicable standards**		Legislation • Environment Protection Act 1993. • Heritage Places Act 1993. • Mining Act 1971. • Native Title (South Australia) Act 1994. *Non-legislated Standards* • Barngarla – OneSteel ILUA.	
	Factors that limit / mitigate impact (control measures)	Management Strategies: • Site developments and activities will be conducted in accordance with the ILUA protocols, which includes a heritage clearance protocol. • All personnel to be provided with training prior to attending work on site with known cultural heritage Compliance with regulatory requirements in the event of a discovery. • In the event of discovery of a potential Aboriginal or non-Aboriginal heritage artefact all works will stop in the immediate vicinity, the area clearly marked and isolated from other work and relevant authorities will be notified (in accordance with regulatory requirements). Work will recommence only after authorisation has been received.	**Expected impact**	An impact is not likely to occur to known sites. Discovery of unknown artefacts or remains is unlikely.	**Uncertainties and assumptions (regarding controls)**	High level of certainty Heritage Clearances, government database register searches are based on historical and recent assessments and local knowledge. Operational procedures, ILUA requirements, or other agreements, satisfactorily manage events of unexpected discovery.

Type:	Heritage	Impact ID: H01		
Unplanned event	Risk event	Residual risk		
	What is the consequence and likelihood that the impact is incorrect?	Consequence	Likelihood	Risk
		Moderate	Unlikely	Medium
Statement of outcomes	Proposed outcome (draft)	No damage, disturbance or interference to Aboriginal and non-Aboriginal heritage sites, objects or remains as a result of mining operations unless authorised under the relevant legislation.		
	Outcome Measurement Criteria (draft)	All suspected discoveries of Aboriginal or non-Aboriginal sites, objects or remains are left without further disturbance, reported to the authorities and investigated with work recommenced only after authorisation from the appropriate authority.		
	Leading Indicator criteria (draft)	Internal trigger: Not proposed. Leading indicator criteria: Not proposed.		

9 Public Safety

<table>
<tr><th>Type:</th><th>Public Safety</th><th colspan="5">Impact ID: PS01</th></tr>
<tr><td rowspan="9">Planned Event</td><td>Potential impact event</td><td colspan="3">Injury or death to members of the public as a result of mining activities.</td><td>Stage</td><td>Construction, Operation</td></tr>
<tr><td>Source</td><td colspan="3">Unauthorised site access – mining, operations and WRD areas.</td><td>Relevant Technical Study</td><td>N/A</td></tr>
<tr><td>Pathway</td><td colspan="5">Site security failures.</td></tr>
<tr><td>Receptor</td><td colspan="5">Members of the public (including neighbouring properties and road users).</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="5">Design measures:
• Existing site security and gates.
• Maintain site fencing and signage (existing mining areas). Erect site fencing and signage (new mining areas).</td></tr>
<tr><td>Is there a confirmed SPR?</td><td>Yes</td><td>Sensitivity of change in assumptions</td><td>Moderate sensitivity to change
Deliberate breaches of site security and safety controls and procedures could lead to injury or fatality to a member of the public .</td><td>Evidence for linkage / lack of linkage</td><td>Yes.
SPR Exists - It is unlikely that the public will gain access to the site, however it remains a possibility.</td></tr>
<tr><td>Is the SPR material?</td><td>Yes</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="2">Legislation
• Mining Act 1971.
• Work Health and Safety Act 2012.

Non-legislated Standards
• SMR Blast Management Protocols.</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>Management Measures:
• Traffic Management.
• Adopt practices to protect personnel, land users and the public from dangers to health and safety arising from mining activities.
• Maintain the implementation of site induction, visitor sign in and site access protocols. Control entry and exit points.
• Adopt practices to protect personnel, land users and the public from dangers to health and safety arising from mining activities.
• Comply with all relevant fire restrictions and safeguards in the conduct of mining activities.</td><td>Expected impact</td><td>Moderate
Significant level of injuries requiring hospitalisation.</td><td>Uncertainties and assumptions (regarding controls)</td><td>High level of certainty.
No injury or fatality to members of the public has occurred in the past, as a result of exploration activities.
Control measures are considered effective as no injuries or fatalities to members of the general public have been recorded in the past.
Assumes that controls, such erected signage and fencing of operational mine areas (including during exploration and closure), will deter unauthorised access.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="5">Residual risk</td></tr>
<tr><td rowspan="2">What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td>Risk</td></tr>
<tr><td colspan="2">Major</td><td colspan="2">Rare</td><td>Medium</td></tr>
<tr><td>Statement</td><td>Proposed outcome (draft)</td><td colspan="5">Ensure that unauthorised entry to the land does not result in public injuries and or deaths that could have been reasonably prevented.</td></tr>
</table>

Type:	Public Safety	Impact ID: PS01
	Outcome Measurement Criteria (draft)	No public injuries or deaths as a result of unauthorised entry to the site that could have reasonable been prevented by SIMEC Mining.
	Leading Indicator criteria (draft)	Internal Trigger: Any incident of unauthorised access by a member of the public. Leading indicator criteria: Not proposed.

10 Adjacent land use and third-party property

<table>
<tr><th>Type:</th><th>Adjacent land use and third-party property</th><th colspan="5">Impact ID: TPP01</th></tr>
<tr><td rowspan="9">Planned Event</td><td>Potential impact event</td><td colspan="3">Claims of damage to third party property natural resources, livelihood, enjoyment or infrastructure by mining operations including by dust, over clearance, stormwater, blasting, inundation and fire.</td><td>Stage</td><td>Construction, Operation</td></tr>
<tr><td>Source</td><td colspan="3">Dust emissions, earth mover equipment, fire ignition sources.</td><td>Relevant Technical Study</td><td>Ramboll, 2024 – Appendix D2.</td></tr>
<tr><td>Pathway</td><td colspan="5">Atmosphere, procedure breach, vegetation.</td></tr>
<tr><td>Receptor</td><td colspan="5">Adjacent land and third-party property .</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="5">• Site operations are contained within the fenced boundary.
• Design measures which take into account dust management, visual impact, surface water run off.</td></tr>
<tr><td>Is there a confirmed SPR?</td><td>Yes</td><td>Sensitivity of change in assumptions</td><td>Low sensitivity to change.</td><td>Evidence for linkage / lack of linkage</td><td>Yes - SPR exists.</td></tr>
<tr><td>Is the SPR material?</td><td>Yes</td><td colspan="3">Legislative requirements / applicable standards</td><td>Legislation
• Mining Act 1971 Native Vegetation Act 1991.
• Landscape South Australia Act 2019 Work Health and Safety Act 2012.
• Work Health and Safety Regulations 2012.

Non-legislated Standards
• SIMEC Mining procedures and controls.
• Community and Stakeholder Engagement Plan .</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>• SIMEC Mining procedures are in place to minimise the impact on adjacent land (dust and clearance)
• Any complaints received will be investigated and actions put in place to achieve an agreed (by SIMEC Mining and complainant) resolution within one month of the complaint. Details will be communicated to DEM.
• Ignition of fires is completely banned.
• Extensive zero fuel zones (breaks) exist between potential ignition sources and vegetated areas.
• Surface mobile equipment (SME) maintenance and Original Equipment Manufacturers (OEM) design mining equipment to meet required industry standards to reduce or eliminate fire ignition sources.</td><td>Expected impact</td><td>Claims of damage to third party property natural resources, livelihood, enjoyment or infrastructure by mining operations including by dust, over clearance, stormwater, blasting, inundation and fire.</td><td>Uncertainties and assumptions (regarding controls)</td><td>High level of certainty
Based on similar sites, staining of vegetation with no permanent health impact within approximately 1 km of the source is possible. Vegetation clearance is highly controlled and unlikely to result in clearance exceedance Bush fires ignited by mining operations are not expected to occur.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="4">Residual risk</td></tr>
<tr><td rowspan="2">What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td>Risk</td></tr>
<tr><td colspan="2">Minor</td><td colspan="2">Possible</td><td>Low</td></tr>
<tr><td>Statement</td><td>Proposed outcome (draft)</td><td colspan="5">No unauthorised damage (including that caused by fire) to adjacent public or private property and infrastructure.</td></tr>
</table>

Type:	Adjacent land use and third-party property	Impact ID: TPP01	
	Outcome Measurement Criteria (draft)	No confirmed damage to adjacent property or infrastructure.	
	Leading Indicator criteria (draft)	Internal Trigger: Not proposed. Leading indicator criteria: Not proposed.	

11 Mine Closure and Completion

Type:	Mine Completion and Closure	Impact ID: MCC_01			
Planned Event	**Potential impact event**	Rehabilitation of WRDs, haul roads and mine services areas resulting in increased sediment land in surface water.		**Stage**	Closure
	Source	WRD		**Relevant Technical Study**	N/A
	Pathway	Air/water movement of dust/sediment.			
	Receptor	Surface water.			
	Design Controls (Elimination, substitution, engineering)	• Reduce the area of exposed soil that could be eroded by stormwater by maintaining vegetative cover for as long as possible. • Surface water drainage control measures such as berm (contour banking), toe drains and sediment ponds.			
	Is there a confirmed SPR?	Yes	**Sensitivity of change in assumptions**	Moderate sensitivity to change Revegetation is moderately sensitive to change. Efforts to revegetate may vary depending on factors such as the climate.	**Evidence for linkage / lack of linkage**	Yes - SPR exists.
	Is the SPR material?	Yes	**Legislative requirements / applicable standards**		*Legislation* • Environment Protection Act 1993. • Environment Protection (Noise) Policy 2007. • Mining Act 1971. *Non-legislated Standards* • SIMEC Mining operational procedures and controls. • SIMEC Mining Community Engagement Plan.
	Factors that limit / mitigate impact (control measures)	• Rehabilitation plans include industry standards of landform, vegetation cover and controls that will reduce erosion and sedimentation risks. • Gather baseline surface water quality data and monitor surface water quality throughout closure and post-closure monitoring. • Continuous use of dust suppression throughout demolition and closure period, and to accommodate for increased material movement and vehicle movements • Updated SWMP based on conceptual SW assessment in CiO.	**Expected impact**	Minor	**Uncertainties and assumptions (regarding controls)**	High level of certainty • Control and management strategies rely on vegetative cover to reduce erosion and sedimentation risks. • Early indicators from rehabilitation works on other Middleback Ranges mine sites suggests that rehabilitation will successfully result in stable and vegetated WRD slopes and all other operational areas. • Final landforms are integrated with the surrounding landscape, and land function is returning to a level of sustainability that supports cover of native vegetation.
Unplanned event	**Risk event**	**Residual risk**			
	What is the consequence and likelihood that the impact is incorrect?	**Consequence**		**Likelihood**	**Risk**
		Minor		Possible	Low
State ment	**Proposed outcome (draft)**	Integrate and harmonise final landforms and vegetation with surrounding landscape.			

Type:	Mine Completion and Closure	**Impact ID: MCC_01**	
	Outcome Measurement Criteria (draft)	Design, closure and rehabilitation strategy as described in Section 3.10 of the PEPR (once updated to account for southern WRD).	
	Leading Indicator criteria (draft)	Internal trigger: Not proposed. Leading indicator criteria: Not proposed.	

<table>
<tr><td>Type:</td><td>Mine Completion and Closure</td><td colspan="5">Impact ID: MCC_02</td></tr>
<tr><td rowspan="10">Planned Event</td><td>Potential impact event</td><td colspan="3">Reduced visual amenity in project area (local and regional) associated with final southern WRD landform and infrastructure areas.</td><td>Stage</td><td>Closure</td></tr>
<tr><td>Source</td><td colspan="3">Rehabilitation landforms.</td><td>Relevant Technical Study</td><td>Landform Architects, 2024 – Appendix D3.</td></tr>
<tr><td>Pathway</td><td colspan="5">Earthworks (new landforms)</td></tr>
<tr><td>Receptor</td><td colspan="5">Neighbouring landholders Highway users and other transient receptors</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="5">N/A</td></tr>
<tr><td>Is there a confirmed SPR?</td><td>Yes</td><td>Sensitivity of change in assumptions</td><td>Moderate sensitivity to change Revegetation is moderately sensitive to change. Efforts to revegetate may vary depending on factors such as the climate.</td><td>Evidence for linkage / lack of linkage</td><td>Yes - SPR exists.</td></tr>
<tr><td>Is the SPR material?</td><td>Yes</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="2">Legislation
• Environment Protection Act 1993.
• Environment Protection (Noise) Policy 2007.
• Mining Act 1971.

Non-legislated Standards
• SIMEC Mining operational procedures and controls.
• SIMEC Mining Community Engagement Plan.</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>• Remediate and revegetate mined out areas and waste rock dumps as soon as possible after they become inactive
• Minimise vegetation clearance.
• Design of final mine landform to maximise revegetation and enhance visual amenity.
• Progressive rehabilitation undertaken in accordance with staged design and rehabilitation plans.
• Stakeholder consultation on development of final landform designs.</td><td>Expected impact</td><td>Minor</td><td>Uncertainties and assumptions (regarding controls)</td><td>High level of certainty
• Early indicators from rehabilitation works on other Middleback Ranges mine sites suggests that rehabilitation will successfully result in stable and vegetated WRD slopes and all other operational areas.
• Final landforms are integrated with the surrounding landscape, and land function is returning to a level of sustainability that supports cover of native vegetation.
• Assume rehabilitation is undertaken progressively.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="5">Residual risk</td></tr>
<tr><td rowspan="2">What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td>Risk</td></tr>
<tr><td colspan="2">Minor</td><td colspan="2">Possible</td><td>Low</td></tr>
<tr><td rowspan="3">Statement of outcomes</td><td>Proposed outcome (draft)</td><td colspan="5">Integrate and harmonise final landforms and vegetation with surrounding landscape.</td></tr>
<tr><td>Outcome Measurement Criteria (draft)</td><td colspan="5">Design, closure and rehabilitation strategy as described in Section 3.10 of the PEPR (once updated to account for southern WRD).</td></tr>
<tr><td>Leading Indicator criteria (draft)</td><td colspan="5">Internal trigger: Not proposed.
Leading indicator criteria: Not proposed.</td></tr>
</table>

<table>
<tr><th>Type:</th><td>Mine Completion and Closure</td><th colspan="5">Impact ID: MCC_03</th></tr>
<tr><td rowspan="10">Planned Event</td><td>Potential impact event</td><td colspan="3">Mine site ecosystem and landscape function not re-established.</td><td>Stage</td><td>Closure</td></tr>
<tr><td>Source</td><td colspan="3">Rehabilitation.</td><td>Relevant Technical Study</td><td>N/A</td></tr>
<tr><td>Pathway</td><td colspan="6">Rehabilitation works.</td></tr>
<tr><td>Receptor</td><td colspan="6">Ecosystem and landscape function.</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="6">N/A</td></tr>
<tr><td>Is there a confirmed SPR?</td><td>Yes</td><td>Sensitivity of change in assumptions</td><td colspan="2">Moderate sensitivity to change Rehabilitation and final landform design is moderately sensitive to change. Despite rehabilitation conforming to detailed designs, unprecedented weather events may vary success of landform slope stability.</td><td>Evidence for linkage / lack of linkage</td><td>Yes - SPR exists.</td></tr>
<tr><td>Is the SPR material?</td><td>Yes</td><td colspan="3">Legislative requirements / applicable standards</td><td colspan="2">Legislation
• Environment Protection Act 1993.
• Environment Protection (Noise) Policy 2007.
• Mining Act 1971.

Non-legislated Standards
• SIMEC Mining operational procedures and controls.
• SIMEC Mining Community Engagement Plan.</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>• Rehabilitation plans include industry standards of landform, vegetation cover and controls that will reduce erosion and sedimentation risks.
• Current WRD rehabilitation demonstrates this can be achieved.
• Continuous use of dust suppression throughout demolition and closure period, and to accommodate for increased material movement and vehicle movements.</td><td>Expected impact</td><td colspan="2">Minor</td><td>Uncertainties and assumptions (regarding controls)</td><td>High level of certainty
• Control and management strategies rely on vegetative cover to reduce erosion and sedimentation risks.
• Early indicators from rehabilitation works on other Middleback Ranges mine sites suggests that rehabilitation will successfully result in stable and vegetated WRD slopes and all other operational areas.
• Final landforms are integrated with the surrounding landscape, and land function is returning to a level of sustainability that supports cover of native vegetation.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="6">Residual risk</td></tr>
<tr><td rowspan="2">What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td colspan="2">Risk</td></tr>
<tr><td colspan="2">Minor</td><td colspan="2">Possible</td><td colspan="2">Low</td></tr>
<tr><td rowspan="2">Statement of outcomes</td><td>Proposed outcome (draft)</td><td colspan="6">Re-establishment of mine site ecosystem and landscape function.</td></tr>
<tr><td>Outcome Measurement Criteria (draft)</td><td colspan="6">LFA curve has moved above, or is likely to move above, the critical threshold of sustainability as determined by qualified external consultant.</td></tr>
</table>

Type:	Mine Completion and Closure	Impact ID: MCC_03	
	Leading Indicator criteria (draft)	Internal trigger: Not proposed. Leading indicator criteria: Not proposed.	

<table>
<tr><th>Type:</th><td>Mine Completion and Closure</td><th colspan="5">Impact ID: MCC_07</th></tr>
<tr><td rowspan="11">Planned Event</td><td>Potential impact event</td><td colspan="3">Unacceptable final land use.</td><td>Stage</td><td>Closure</td></tr>
<tr><td>Source</td><td colspan="3">Landform.</td><td>Relevant Technical Study</td><td>Landform Architects, 2024 – Appendix D3.</td></tr>
<tr><td>Pathway</td><td colspan="6">Stability.</td></tr>
<tr><td>Receptor</td><td colspan="6">Members of the public, road users, land users, native flora and fauna.</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="6">• Designed as outlined in PEPR section 3.10 (once updated with southern WRD detail from this CiO).</td></tr>
<tr><td>Is there a confirmed SPR?</td><td colspan="2">Yes</td><td>Sensitivity of change in assumptions</td><td>Moderate sensitivity to change. Stakeholder acceptance of final land use may vary.</td><td>Evidence for linkage / lack of linkage</td><td>Yes - SPR exists.</td></tr>
<tr><td>Is the SPR material?</td><td colspan="2">Yes</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="2">Legislation
• Mining Act 1971.
• Native Vegetation Act 1991.
• Landscape South Australia Act 2019.
• Work Health and Safety Act 2012.
• Work Health and Safety Regulations 2012.

Non-legislated Standards
• SIMEC Mining procedures and controls.
• Community and Stakeholder Engagement Plan.</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td colspan="2">• Rehabilitation to be undertaken in alignment with the Mine Plan.
• Final land use considers community engagement outcomes.
• Design of final mine landform to maximise revegetation and enhance visual amenity.</td><td>Expected impact</td><td>Minor</td><td>Uncertainties and assumptions (regarding controls)</td><td>High level of certainty
• Stakeholder consultation and early closure planning are considered reasonable controls.
• Assume rehabilitation is undertaken progressively, which will provide early indications of community perceptions of rehabilitation.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="6">Residual risk</td></tr>
<tr><td rowspan="2">What is the consequence and likelihood that the impact is incorrect?</td><td colspan="2">Consequence</td><td colspan="2">Likelihood</td><td colspan="2">Risk</td></tr>
<tr><td colspan="2">Moderate</td><td colspan="2">Unlikely</td><td colspan="2">Medium</td></tr>
<tr><td rowspan="3">Statement of outcomes</td><td>Proposed outcome (draft)</td><td colspan="6">The site will be rehabilitated to a stable condition that supports a resilient, self-sustaining natural ecosystem suitable for the post-mining land use that will be determined in consultation with relevant stakeholders.</td></tr>
<tr><td>Outcome Measurement Criteria (draft)</td><td colspan="6">Design, closure and rehabilitation strategy as described in Section 3.10 (once updated to account for southern WRD).

Relevant stakeholders accept final land use.</td></tr>
<tr><td>Leading Indicator criteria (draft)</td><td colspan="6">Internal trigger: Not proposed.
Leading indicator criteria: Not proposed.</td></tr>
</table>

<table>
<tr><td>Type:</td><td>Mine Completion and Closure</td><td colspan="5">Impact ID: MCC_09</td></tr>
<tr><td rowspan="9">Planned Event</td><td>Potential impact event</td><td colspan="3">Mine waste materials are not correctly stored/disposed of (identified PAF).</td><td>Stage</td><td>Closure</td></tr>
<tr><td>Source</td><td colspan="3">Waste rock material</td><td>Relevant Technical Study</td><td>HydroBalance, 2024 – Appendix D1.
CDM Smith, 2024 – Appendix D5.
Mine Earth, 2024 – Appendix D6.</td></tr>
<tr><td>Pathway</td><td colspan="5">Contamination</td></tr>
<tr><td>Receptor</td><td colspan="5">Soil quality and water resources (ground and surface water).</td></tr>
<tr><td>Design Controls (Elimination, substitution, engineering)</td><td colspan="5">• Designed with PAF storage cells as outlined in PEPR section 3.10 (once updated with southern WRD detail from this CiO).</td></tr>
<tr><td>Is there a confirmed SPR?</td><td>Yes</td><td>Sensitivity of change in assumptions</td><td>Medium</td><td>Evidence for linkage / lack of linkage</td><td>Yes - SPR exists.</td></tr>
<tr><td>Is the SPR material?</td><td>Yes</td><td colspan="2">Legislative requirements / applicable standards</td><td colspan="2">Legislation
• Environment Protection (Water Quality Policy) 2015.
• Landscape South Australia Act 2019.

Non-legislated Standards
• Australian and New Zealand Guidelines for Fresh and Marine Water Quality.</td></tr>
<tr><td>Factors that limit / mitigate impact (control measures)</td><td>• Seepage assessment indicates limited seepage expected from WRD (CDM Smith, 2024).
• Geochemical assessment of all waste material undertaken with significant database and drilling samples (SIMEC and Mine Earth, 2024).
• PAF storage cells designed with sufficient capacity (see s 2.2.4.1 of CiO).
• Sufficient NAF to cover PAF storage cells as outlined in s 2.2.4.1 of CiO.
• Waste rock dumps will be rehabilitated to minimise erosion and sedimentation of any surface water runoff (Hydrobalance, 2024).</td><td>Expected impact</td><td>Minor</td><td>Uncertainties and assumptions (regarding controls)</td><td>High level of certainty
SIMEC mining have a solid understanding of geochemical characteristics of waste rock. See Appendix D6.</td></tr>
<tr><td rowspan="3">Unplanned event</td><td>Risk event</td><td colspan="5">Residual risk</td></tr>
<tr><td rowspan="2">What is the consequence and likelihood that the impact is incorrect?</td><td>Consequence</td><td colspan="2">Likelihood</td><td colspan="2">Risk</td></tr>
<tr><td>Moderate</td><td colspan="2">Unlikely</td><td colspan="2">Medium</td></tr>
<tr><td rowspan="3">Statement of outcomes</td><td>Proposed outcome (draft)</td><td colspan="5">All mine waste materials left on site are chemically and physically stable.</td></tr>
<tr><td>Outcome Measurement Criteria (draft)</td><td colspan="5">Local groundwater levels remain within long term (or otherwise agreed) safe and acceptable ranges and do not have an unacceptable impact on the health of the vegetation adjacent to the TSF, or adverse effects on Salt Creek.</td></tr>
<tr><td>Leading Indicator criteria (draft)</td><td colspan="5">Triggers and Indicators are being developed in consultation with DEM and will be incorporated into future PEPR reviews.

Internal trigger: Not proposed.
Leading indicator criteria: Not proposed.</td></tr>
</table>

Appendix F Environmental Outcome Assessment

Table 0-2: Assessment against SMR Outcomes (as per WPC-234 Rev 4)

Environmental Outcome	Outcome achievability
No loss of abundance and/or diversity of native vegetation on or off the land through clearance unless a significant environmental benefit has been approved in accordance with the relevant legislation.	Outcome remains appropriate and achievable.
No vegetation health impacts to neighbouring pastoral properties from dust generated by mining activities	Outcome remains appropriate and achievable.
No native fauna injuries or deaths due to mining operations that could have reasonably been prevented.	Outcome remains appropriate and achievable.
No introduction of new species of environmental weed, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species on the Land.	Outcome remains appropriate and achievable.
Ensure that the existing (pre-mining) soil quality and quantity is maintained.	Outcome remains appropriate and achievable.
No contamination of Land and soils either on or off the Land as a result of mining operations	Outcome remains appropriate and achievable.
No surface water contaminated as a result of mining operations leaves the Land.	Outcome remains appropriate and achievable.
No adverse impact to the quantity of groundwater available to existing users and groundwater dependent ecosystems due to Magnetite TSF operations.	Outcome remains appropriate and achievable.
No adverse impact to the environmental value of groundwater or groundwater dependent ecosystems as a result of leached elements from a TSF or the movement of the solid contents of a TSF beyond the boundaries of the TSFs	Outcome remains appropriate and achievable.
No changes to groundwater levels that adversely impact vegetation due to Iron Duchess water storage operations	Outcome remains appropriate and achievable.
No adverse impact to the environmental value of groundwater or groundwater dependent ecosystems as a result of AMD from Iron Duchess WRDs or Magnetite TSF buttress) *Note, Geochemistry of TSF buttress material indicates AMD seepage from buttress is of negligible risk, however an outcome was proposed due to stakeholder (DEM) interest	Outcome remains appropriate and achievable.
No public health and/or public nuisance impacts from air emissions, dust or odour generated by mining operations.	Outcome remains appropriate and achievable.

Environmental Outcome	Outcome achievability
The contrasting and reflective aspects of WRDs and infrastructure are visually softened to blend in with the surrounding landscape	Outcome remains appropriate and achievable.
No public nuisance impacts from noise emissions generated from mining operations.	Outcome remains appropriate and achievable.
No adverse impacts from airblast, flyrock, vibration, fumes, or dust caused by blasting to: -Public safety, human comfort, third party property (including stock), adjacent land use, adjacent infrastructure and operations, adjacent public roads, aircraft, other receptors.	Outcome not applicable to proposed activity.
No adverse impact to the surrounding environment due to the TSF	Outcome not applicable to proposed activity.
No adverse impact to the surrounding environment due the Tailings Storage Facilities	Outcome not applicable to proposed activity.
Ensure that unauthorised entry to the Land does not result in public injuries and or deaths that could have been reasonably prevented.	Outcome remains appropriate and achievable.
No unauthorised damage (including that caused by fire) to adjacent public or private property and infrastructure.	Outcome remains appropriate and achievable.
No damage, disturbance or interference to Aboriginal and non-Aboriginal heritage sites, objects or remains as a result of mining operations unless it is authorised under the relevant legislation.	Outcome remains appropriate and achievable.
No incidents or accidents resulting from road accidents associated with the SMR operational or access traffic that could have been reasonably prevented	Outcome remains appropriate and achievable.

Appendix G PMST Search

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 30-Nov-2023

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	15
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	4
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	5
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species			[Resource Information]
Status of Conservation Dependent and Extinct are not MNES under the EPBC Act. Number is the current name ID.			
Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Amytornis textilis myall			
Western Grasswren (Gawler Ranges) [64454]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Aphelocephala leucopsis			
Southern Whiteface [529]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Falco hypoleucos			
Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Grantiella picta			
Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area	In feature area
Leipoa ocellata			
Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area	In feature area
Neophema chrysostoma			
Blue-winged Parrot [726]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Numenius madagascariensis			
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat may occur within area	In feature area
MAMMAL			
Sminthopsis psammophila Sandhill Dunnart [291]	Endangered	Species or species habitat known to occur within area	In feature area
PLANT			
Limosella granitica Granite Mudwort [6704]	Vulnerable	Species or species habitat may occur within area	In feature area
Pterostylis xerophila Desert Greenhood [7997]	Vulnerable	Species or species habitat may occur within area	In feature area
Swainsona pyrophila Yellow Swainson-pea [56344]	Vulnerable	Species or species habitat known to occur within area	In feature area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
[Bubulcus ibis as Ardea ibis](#) Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
[Chalcites osculans as Chrysococcyx osculans](#) Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
[Charadrius veredus](#) Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area overfly marine area	In feature area
[Haliaeetus leucogaster](#) White-bellied Sea-Eagle [943]		Species or species habitat may occur within area	In feature area
[Merops ornatus](#) Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
[Neophema chrysostoma](#) Blue-winged Parrot [726]	Vulnerable	Species or species habitat likely to occur within area overfly marine area	In feature area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Rostratula australis as Rostratula benghalensis (sensu lato)](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
[Sterna striata](#) White-fronted Tern [799]		Migration route may occur within area	In feature area
[Tringa nebularia](#) Common Greenshank, Greenshank [832]		Species or species habitat may occur within area overfly marine area	In buffer area only

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Ironstone Hill	Conservation Park	SA	In feature area
Unnamed (No.HA589)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA977)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA991)	Heritage Agreement	SA	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Project Magnet	2004/1724	Not Controlled Action	Completed	In feature area
Project Magnet Phase 2	2009/4971	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Appendix H NatureMaps BDBSA Super table search

NSXCODE	CLASS NAME	SPECIES	COMMON NAME	NATIVE	NATIONAL RATING	STATE RATING	NUMBER OF RECORDS	DATE OF LAST RECORD
S03085	AMPHIBIA	Neobatrachus pictus	Burrowing Frog	Y			2	09-Nov-2015
M10194	AMPHIBIA	Neobatrachus sp.		Y			4	19-Apr-2012
S04117	AVES	Acanthagenys rufogularis	Spiny-cheeked Honeyeater	Y			4	25-Nov-2022
A00476	AVES	Acanthiza apicalis	Inland Thornbill	Y			4	03-Mar-2022
E00486	AVES	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Y			2	14-Oct-2016
S00481	AVES	Acanthiza uropygialis	Chestnut-rumped Thornbill	Y			2	03-Mar-2022
W04127	AVES	Anthochaera carunculata	Red Wattlebird	Y			4	25-Nov-2022
Z21071	AVES	Anthochaera carunculata woodwardi	Red Wattlebird (MLR, AP, YP, EP, far west, Yellabinna)	Y			3	16-May-2008
G00647	AVES	Anthus australis	Australian Pipit	Y			2	06-Jul-2019
U00466	AVES	Aphelocephala leucopsis leucopsis	Southern Whiteface	Y	sp		3	16-May-2023
G04139	AVES	Aquila audax audax	Wedge-tailed Eagle	Y			1	14-May-2008
W00547	AVES	Artamus cyanopterus	Dusky Woodswallow	Y			4	14-May-2008
M00294	AVES	Barnardius zonarius	Australian Ringneck	Y			5	14-May-2008
S00341	AVES	Chalcites osculans	Black-eared Cuckoo	Y			3	03-Mar-2022
Y00508	AVES	Cincloramphus cruralis	Brown Songlark	Y			1	14-May-2008
A05676	AVES	Cinclosoma castanotum	Chestnut Quailthrush (Chestnut-backed Quailthrush)	Y		R	1	17-May-2023
G21175	AVES	Cinclosoma cinnamomeum cinnamomeum	Cinnamon Quailthrush (central and eastern SA)	Y			1	03-Mar-2022
C05677	AVES	Cinclosoma clarum	Copperback Quailthrush	Y			2	01-Oct-2021
A00556	AVES	Climacteris rufus	Rufous Treecreeper	Y			6	14-Oct-2016
A00408	AVES	Colluricincla harmonica	Grey Shrikethrush	Y			8	25-Nov-2022
S00693	AVES	Corcorax melanorhamphos	White-winged Chough	Y		R	1	15-May-2008
A04144	AVES	Corvus coronoides	Australian Raven	Y			1	14-May-2008
W04151	AVES	Cracticus torquatus leucopterus	Grey Butcherbird	Y			4	04-Mar-2022
C00549	AVES	Daphoenositta chrysoptera pileata	Black-capped Sittella	Y			1	14-May-2008
C00001	AVES	Dromaius novaehollandiae	Emu	Y	ssp	ssp	7	16-May-2023
C00441	AVES	Drymodes brunneopygia	Southern Scrub Robin	Y			4	03-Mar-2022
C00273	AVES	Eolophus roseicapilla	Galah	Y			2	16-May-2023
U00394	AVES	Eopsaltria griseogularis rosinae	Western Yellow Robin	Y			5	24-Nov-2022
Z04131	AVES	Epthianura albifrons	White-fronted Chat	Y			1	06-Jul-2019
A10368	AVES	Epthianura sp.		Y			1	13-May-2008
W00239	AVES	Falco berigora berigora	Brown Falcon	Y			5	27-May-2018
C04129	AVES	Falco cenchroides cenchroides	Nankeen Kestrel	Y			15	17-May-2023
Q00608	AVES	Gavicalis virescens	Singing Honeyeater	Y			11	25-Nov-2022
S00705	AVES	Gymnorhina tibicen	Australian Magpie	Y			3	06-Jul-2019
K00357	AVES	Hirundo neoxena neoxena	Welcome Swallow	Y			2	01-Oct-2021
K21061	AVES	Hylacola cauta cauta	Shy Heathwren (EP, YP, FR, MM, upper SE)	Y		R	4	25-Nov-2022
Z00007	AVES	Leipoa ocellata	Malleefowl	Y	VU	V	1	11-Dec-2018
Y00620	AVES	Lichenostomus cratitius	Purple-gaped Honeyeater	Y		ssp	1	01-Oct-2021
Z21179	AVES	Malurus assimilis assimilis	Purple-backed Fairywren	Y			7	25-Nov-2022
S06009	AVES	Malurus lamberti	Variegated Fairywren	Y			1	02-Oct-2021
Q00536	AVES	Malurus lamberti (NC)	Variegated Fairywren	Y			1	06-Jul-2019
Z00535	AVES	Malurus leucopterus leuconotus	White-winged Fairywren	Y			1	13-May-2008
Y00540	AVES	Malurus pulcherrimus	Blue-breasted Fairywren	Y			2	03-Mar-2022
W10359	AVES	Malurus sp.	fairywrens	Y			2	03-Mar-2022
Y00532	AVES	Malurus splendens	Splendid Fairywren	Y			2	03-Mar-2022
G00583	AVES	Melithreptus brevirostris	Brown-headed Honeyeater	Y	ssp		1	14-Oct-2016
C00329	AVES	Merops ornatus	Rainbow Bee-eater	Y			3	24-Nov-2022
S00377	AVES	Microeca fascinans	Jacky Winter	Y		ssp	8	03-Mar-2022

A21068	AVES	Microeca fascinans assimilis	Jacky Winter (NW, EP, FR, LNE, MM)	Y			4	24-Nov-2022
K04173	AVES	Myiagra inquieta	Restless Flycatcher	Y		R	1	13-May-2008
E04218	AVES	Nesoptilotis leucotis	White-eared Honeyeater	Y	ssp		2	03-Mar-2022
C21113	AVES	Nesoptilotis leucotis novaenorciae	White-eared Honeyeater (far south-west of NW)	Y			2	25-Nov-2022
W21155	AVES	Nesoptilotis leucotis schoddei	White-eared Honeyeater (Yellabinna, Gawler Ranges, EP)	Y			10	01-Oct-2021
E00274	AVES	Nymphicus hollandicus	Cockatiel	Y			2	25-Nov-2022
W00043	AVES	Ocyphaps lophotes lophotes	Crested Pigeon	Y			3	25-Nov-2022
G00419	AVES	Oreoica gutturalis	Crested Bellbird	Y			12	25-Nov-2022
E09418	AVES	Pachycephala fuliginosa fuliginosa	Western Whistler	Y			1	14-May-2008
G04227	AVES	Pardalotus punctatus	Spotted Pardalote	Y			3	03-Mar-2022
Y21116	AVES	Pardalotus punctatus xanthopyge	Yellow-rumped Pardalote	Y			2	14-May-2008
C10393	AVES	Pardalotus sp.	pardalotus	Y			1	01-Oct-2021
G21167	AVES	Pardalotus striatus	Striated Pardalote	Y			7	25-Nov-2022
Q00976	AVES	Pardalotus striatus substriatus	Striated Pardalote	Y			15	06-Jul-2019
G00259	AVES	Parvipsitta porphyrocephala	Purple-crowned Lorikeet	Y			1	15-May-2008
A04128	AVES	Petrochelidon nigricans	Tree Martin	Y			3	14-Oct-2016
K00381	AVES	Petroica goodenovii	Red-capped Robin	Y			5	06-Jul-2019
Q00384	AVES	Petroica rosea	Rose Robin	Y			2	03-Jun-1981
U00034	AVES	Phaps chalcoptera	Common Bronzewing	Y			3	16-May-2023
G10299	AVES	Phaps sp.	bronzewings	Y			1	15-May-2008
K00445	AVES	Pomatostomus superciliosus	White-browed Babbler	Y			5	03-Mar-2022
Q00296	AVES	Psephotellus varius	Mulga Parrot	Y			11	06-Jul-2019
M00622	AVES	Ptilotula ornata	Yellow-plumed Honeyeater	Y			4	04-Mar-2022
S00625	AVES	Ptilotula penicillata	White-plumed Honeyeater	Y			2	24-Nov-2022
M00594	AVES	Purnella albifrons	White-fronted Honeyeater	Y			7	25-Nov-2022
C00361	AVES	Rhipidura albiscapa	Grey Fantail	Y			1	14-May-2008
M04114	AVES	Rhipidura leucophrys leucophrys	Willie Wagtail	Y			6	04-Mar-2022
S00465	AVES	Smicrornis brevirostris	Weebill	Y			20	25-Nov-2022
C00697	AVES	Strepera versicolor	Grey Currawong	Y		ssp	2	03-Mar-2022
E09426	AVES	Strepera versicolor intermedia	Brown Currawong (Yellabinna, GR, EP, YP)	Y			5	25-Nov-2022
U00326	AVES	Todiramphus sanctus sanctus	Sacred Kingfisher	Y			2	24-Nov-2022
E00574	AVES	Zosterops lateralis	Silvereye	Y			1	06-Jul-2019
A21076	AVES	Zosterops lateralis pinarochrous	Silvereye (EP, YP, FR, MLR, MM, SE)	Y			1	03-Mar-2022
S01521	MAMMALIA	Capra hircus	Goat (Feral Goat)	N			6	02-Dec-2023
W01151	MAMMALIA	Cercartetus concinnus	Western Pygmy-possum	Y			22	11-Jan-2023
C01349	MAMMALIA	Chalinolobus gouldii	Gould's Wattled Bat	Y			4	16-May-2008
Z01263	MAMMALIA	Macropus fuliginosus	Western Grey Kangaroo	Y			4	16-May-2008
E10490	MAMMALIA	Macropus sp.		Y			3	16-May-2008
Y01412	MAMMALIA	Mus musculus	House Mouse	N			49	11-Jan-2023
U01054	MAMMALIA	Ningaui ridei	Wongai ningaui	Y			9	14-Jan-2022
W01055	MAMMALIA	Ningaui yvonneae	Southern Ningaui	Y			92	18-Nov-2012
Y01480	MAMMALIA	Notomys mitchellii	Mitchell's Hopping-mouse	Y			258	13-Jan-2023
Z01335	MAMMALIA	Nyctophilus geoffroyi	Lesser Long-eared Bat	Y			1	16-May-2008
M01510	MAMMALIA	Oryctolagus cuniculus	Rabbit (European Rabbit)	N			4	22-Nov-2022
M01474	MAMMALIA	Pseudomys bolami	Bolam's Mouse	Y			1	11-Jan-2023
A01072	MAMMALIA	Sminthopsis crassicaudata	Fat-tailed Dunnart	Y			1	15-May-2008
U01062	MAMMALIA	Sminthopsis dolichura	Little Long-tailed Dunnart	Y			15	16-Nov-2012
W01071	MAMMALIA	Sminthopsis psammophila	Sandhill Dunnart	Y	EN	V	35	26-Mar-2012
A01532	MAMMALIA	Vulpes vulpes	Fox (Red Fox)	N			2	16-May-2008
A02640	REPTILIA	Acanthophis antarcticus	Common Death Adder	Y			2	01-Jan-2011

G02715	REPTILIA	Brachyurophis semifasciatus	Half-girdled Snake	Y			4	12-Jan-2023
M02126	REPTILIA	Christinus marmoratus	Marbled Gecko	Y			1	30-Jan-1977
G04323	REPTILIA	Cryptoblepharus australis	Desert Wall Skink	Y			3	15-May-2008
W04275	REPTILIA	Cryptoblepharus cf plagiocephalus (NC)	Desert Wall skink	Y			2	07-Jun-1987
A02180	REPTILIA	Ctenophorus cristatus	Crested Dragon	Y			10	02-Dec-2023
Y02184	REPTILIA	Ctenophorus fionni	Eyre Peninsula Dragon	Y			2	07-Jun-1987
Q06772	REPTILIA	Ctenophorus ibiri	Eyre Peninsula Mallee Dragon	Y			8	11-Jan-2023
A02340	REPTILIA	Ctenotus atlas	Southern Spinifex Ctenotus	Y			21	12-Jan-2023
W02375	REPTILIA	Ctenotus robustus	Eastern Striped Skink	Y			1	07-Jun-1987
G06795	REPTILIA	Ctenotus schomburgkii (revised)	Common Sandplain Ctenotus	Y			2	14-May-2008
Q10584	REPTILIA	Ctenotus sp.		Y			1	30-Jan-1977
K02573	REPTILIA	Cyclodomorphus melanops	Spinifex Slender Bluetongue	Y			1	07-Jun-1987
U02154	REPTILIA	Delma australis	Marble-faced Delma	Y			2	04-Oct-1997
W04259	REPTILIA	Delma butleri	Unbanded Delma	Y			1	14-Jan-2022
S04345	REPTILIA	Delma petersoni	Painted Delma	Y			1	07-Jun-1987
W10579	REPTILIA	Delma sp.		Y			1	07-Jun-1987
C04049	REPTILIA	Demansia cyanochasma	Desert Whipsnake	Y			1	07-Jun-1987
M04490	REPTILIA	Diplodactylus calcicolus	South Coast Stone Gecko	Y			1	11-Jan-2022
A04444	REPTILIA	Diplodactylus vittatus complex (NC)	Stone Geckos	Y			1	07-Jun-1987
W02667	REPTILIA	Echiopsis curta	Bardick	Y		R	1	12-Jan-2022
Z02427	REPTILIA	Egernia stokesii	Gidgee Skink	Y			1	30-Jan-1977
S02429	REPTILIA	Egernia striolata	Eastern Tree Skink	Y			2	07-Jun-1987
S04193	REPTILIA	Gehyra lazelli	Southern Rock Dtella	Y			2	15-May-2008
G10571	REPTILIA	Gehyra sp.		Y			1	11-Jan-2022
A02092	REPTILIA	Gehyra variegata (NC)	Tree Dtella	Y			2	07-Jun-1987
S02445	REPTILIA	Hemiergis millewae	Rusty Earless Skink	Y			4	04-Oct-1997
C02105	REPTILIA	Heteronotia binoei	Bynoe's Gecko	Y			5	15-May-2008
E02482	REPTILIA	Lerista dorsalis	Southern Four-toed Slider	Y			1	14-Jan-2022
G04023	REPTILIA	Lerista edwardsae	Myall Slider	Y			3	13-Jan-2022
Z10591	REPTILIA	Lerista sp.		Y			1	07-Jun-1987
A02332	REPTILIA	Lerista taeniata	Ribbon Slider	Y			1	13-Jan-2022
U02170	REPTILIA	Lialis burtonis	Burton's Snake-lizard	Y			4	10-Jan-2023
C02413	REPTILIA	Liopholis inornata	Desert Skink	Y			28	12-Jan-2023
K02109	REPTILIA	Lucasium damaeum	Beaded Gecko	Y			8	12-Jan-2023
W02519	REPTILIA	Menetia greyii	Dwarf Skink	Y			5	13-Jan-2023
U02526	REPTILIA	Morethia boulengeri	Common Snake-eye	Y			2	15-May-2008
C02529	REPTILIA	Morethia obscura	Mallee Snake-eye	Y			2	12-Jan-2023
S10593	REPTILIA	Morethia sp.		Y			1	30-Jan-1977
E02678	REPTILIA	Neelaps bimaculatus	Western Black-naped Snake	Y		R	1	08-Nov-2015
C02113	REPTILIA	Nephrurus stellatus	Starred Knob-tailed Gecko	Y			16	13-Jan-2023
Z10567	REPTILIA	Pogona sp.		Y			1	11-Oct-2012
Y02204	REPTILIA	Pogona vitticeps	Central Bearded Dragon	Y			1	07-Jun-1987
U02690	REPTILIA	Pseudechis australis	Mulga Snake	Y			2	15-May-2008
S02137	REPTILIA	Rhynchoedura ornata (NC)	Beaked Gecko	Y			1	30-Jan-1977
W02059	REPTILIA	Strophurus intermedius	Southern Spiny-tailed Gecko	Y			2	07-Jun-1987
Y02724	REPTILIA	Suta nigriceps	Mitchell's Short-tailed Snake	Y			1	07-Jun-1987
W02579	REPTILIA	Tiliqua occipitalis	Western Bluetongue	Y			1	12-May-2008
Z02583	REPTILIA	Tiliqua rugosa	Sleepy Lizard	Y			7	14-Jan-2022
Y02580	REPTILIA	Tiliqua scincoides	Eastern Bluetongue	Y			1	30-Jan-1977
U02138	REPTILIA	Underwoodisaurus milii	Common Barking Gecko	Y			2	07-Jun-1987
G02271	REPTILIA	Varanus gouldii	Sand Goanna	Y			1	11-Jan-2022
W02287	REPTILIA	Varanus rosenbergi	Heath Goanna	Y		V	1	27-Dec-2015

NSXCODE	FAMILY NAME	SPECIES	COMMON NAME	NATIVE	NATIONAL RATING	STATE RATING	NUMBER OF RECORDS	DATE OF LAST RECORD
Q15184	AIZOACEAE	Carpobrotus modestus/rossii	Native Pigface	Y			1	25-Aug-1993
Q06164	AIZOACEAE	Carpobrotus rossii	Native Pigface	Y			4	23-Nov-2022
E04886	AIZOACEAE	Disphyma crassifolium ssp. clavellatum	Round-leaf Pigface	Y			8	25-Nov-2022
E01022	AIZOACEAE	Mesembryanthemum aitonis	Angled Iceplant	N			1	22-Sep-1981
G01023	AIZOACEAE	Mesembryanthemum crystallinum	Common Iceplant	N			4	15-Apr-2021
Y01024	AIZOACEAE	Mesembryanthemum nodiflorum	Slender Iceplant	N			2	15-Apr-2021
G01031	AIZOACEAE	Sarcozona praecox	Sarcozona	Y			2	14-May-2008
U01038	AIZOACEAE	Tetragonia eremaea	Desert Spinach	Y			4	22-Nov-2022
G06311	AIZOACEAE	Tetragonia tetragonoides	New Zealand Spinach	Y			2	13-Apr-2021
Z04035	AMARANTHACEAE	Atriplex acutibractea ssp. karoniensis	Pointed Saltbush	Y			1	13-Jun-1975
E01154	AMARANTHACEAE	Atriplex stipitata (NC)	Bitter Saltbush	Y			8	15-Apr-2021
U32322	AMARANTHACEAE	Atriplex vesicaria	Bladder Saltbush	Y			23	23-Nov-2023
Z20027	AMARANTHACEAE	Atriplex vesicaria ssp. (NC)	Bladder Saltbush	Y			5	25-Nov-2002
S03925	AMARANTHACEAE	Chenopodium curvispicatum	Cottony Goosefoot	Y			5	14-May-2008
M20042	AMARANTHACEAE	Chenopodium desertorum ssp.	Desert Goosefoot	Y			4	25-Nov-2022
Q03984	AMARANTHACEAE	Chenopodium desertorum ssp. anidiophyllum	Mallee Goosefoot	Y			6	15-Apr-2021
K01165	AMARANTHACEAE	Chenopodium desertorum ssp. desertorum	Frosted Goosefoot	Y			4	18-Sep-2003
S03985	AMARANTHACEAE	Chenopodium desertorum ssp. rectum	Erect Goosefoot	Y			2	11-Oct-1991
K04561	AMARANTHACEAE	Dissocarpus paradoxus	Ball Bindyi	Y			1	24-Nov-2022
W01179	AMARANTHACEAE	Einadia nutans ssp. nutans	Climbing Saltbush	Y			1	21-Sep-1981
U20070	AMARANTHACEAE	Enchylaena tomentosa var.	Ruby Saltbush	Y			15	25-Nov-2022
Q01504	AMARANTHACEAE	Enchylaena tomentosa var. tomentosa	Ruby Saltbush	Y			20	15-May-2008
K04009	AMARANTHACEAE	Eriochiton sclerolaenoides	Woolly-fruit Bluebush	Y			1	21-Sep-1981
K01181	AMARANTHACEAE	Maireana aphylla	Cotton-bush	Y			2	25-Nov-2002
Q01184	AMARANTHACEAE	Maireana brevifolia	Short-leaf Bluebush	Y			12	15-Apr-2021
W01187	AMARANTHACEAE	Maireana ciliata	Hairy Fissure-plant	Y			1	19-Sep-2003
Z01191	AMARANTHACEAE	Maireana erioclada	Rosy Bluebush	Y			18	22-Nov-2022
S01193	AMARANTHACEAE	Maireana georgei	Satiny Bluebush	Y			1	22-Nov-2022
M01202	AMARANTHACEAE	Maireana pentatropis	Erect Mallee Bluebush	Y			7	25-Nov-2022
Q01204	AMARANTHACEAE	Maireana pyramidata	Black Bluebush	Y			5	22-Nov-2022
S01205	AMARANTHACEAE	Maireana radiata	Radiate Bluebush	Y			7	23-Nov-2023
A03996	AMARANTHACEAE	Maireana schistocarpa	Split-fruit Bluebush	Y			1	17-Sep-2003
C01209	AMARANTHACEAE	Maireana sedifolia	Bluebush	Y			13	24-Nov-2022
M01210	AMARANTHACEAE	Maireana suaedifolia	Lax Bluebush	Y		R	15	15-Apr-2021
Q01212	AMARANTHACEAE	Maireana trichoptera	Hairy-fruit Bluebush	Y			6	22-Nov-2022
C10721	AMARANTHACEAE	Osteocarpum sp.	Bonefruit	Y			1	25-Nov-2022
E32730	AMARANTHACEAE	Ptilotus nobilis	Yellow-tails	Y			1	23-Nov-2023
S32241	AMARANTHACEAE	Ptilotus nobilis ssp. nobilis (NC)	Yellow-tails	Y			2	09-Nov-1998
K32257	AMARANTHACEAE	Ptilotus obovatus	Silver Mulla Mulla	Y			12	23-Nov-2023
Y01308	AMARANTHACEAE	Ptilotus obovatus (NC)	Silver Mulla Mulla	Y			4	15-May-2008
C01313	AMARANTHACEAE	Ptilotus seminudus	Rabbit-tails	Y			3	23-Nov-2023
U32242	AMARANTHACEAE	Ptilotus spathulatus	Pussy-tails	Y			1	16-Oct-1998
E20162	AMARANTHACEAE	Rhagodia candolleana ssp.	Sea-berry Saltbush	Y			1	22-Nov-2022
C03477	AMARANTHACEAE	Rhagodia candolleana ssp. candolleana	Sea-berry Saltbush	Y			1	22-Nov-2022
S01221	AMARANTHACEAE	Rhagodia crassifolia	Fleshy Saltbush	Y			8	14-Apr-2021
S01505	AMARANTHACEAE	Rhagodia parabolica	Mealy Saltbush	Y			17	25-Nov-2022
U01506	AMARANTHACEAE	Rhagodia preissii ssp. preissii	Mallee Saltbush	Y			2	25-Aug-1993
U10850	AMARANTHACEAE	Rhagodia sp.	Saltbush	Y			1	22-Nov-2022
W01507	AMARANTHACEAE	Rhagodia spinescens	Spiny Saltbush	Y			7	22-Nov-2022
Q03500	AMARANTHACEAE	Rhagodia ulicina	Intricate Saltbush	Y			12	25-Nov-2022
S04565	AMARANTHACEAE	Salsola australis	Buckbush	Y			2	15-May-2008
U01230	AMARANTHACEAE	Sclerolaena bicornis var. bicornis	Goat-head Bindyi	Y			1	25-Nov-2022
W01231	AMARANTHACEAE	Sclerolaena bicuspis	Two-spine Bindyi	Y			1	25-Nov-2022
C01233	AMARANTHACEAE	Sclerolaena brevifolia	Small-leaf Bindyi	Y			5	15-May-2008
C01241	AMARANTHACEAE	Sclerolaena diacantha	Grey Bindyi	Y			13	22-Nov-2022
M01246	AMARANTHACEAE	Sclerolaena holtiana	Holt's Bindyi	Y			1	15-May-2008
Q01256	AMARANTHACEAE	Sclerolaena obliquicuspis	Oblique-spined Bindyi	Y			5	16-Oct-1998
W01259	AMARANTHACEAE	Sclerolaena parviflora	Small-flower Bindyi	Y			4	30-Jan-2015
Y01260	AMARANTHACEAE	Sclerolaena patenticuspis	Spear-fruit Bindyi	Y			3	15-May-2008
Q01264	AMARANTHACEAE	Sclerolaena uniflora	Small-spine Bindyi	Y			7	23-Nov-2023
S01117	AMARANTHACEAE	Tecticornia arbuscula	Shrubby Samphire	Y			1	29-Mar-2008
Q03120	AMARANTHACEAE	Tecticornia disarticulata		Y			4	25-Nov-2022
U01118	AMARANTHACEAE	Tecticornia halocnemoides ssp. halocnemoides	Grey Samphire	Y			2	29-Mar-2008
S03481	AMARANTHACEAE	Tecticornia indica ssp. leiostachya	Brown-head Samphire	Y			2	29-Mar-2008
K02441	AMARANTHACEAE	Tecticornia lylei	Wiry Samphire	Y			4	29-Mar-2008
Y03488	AMARANTHACEAE	Tecticornia pergranulata ssp. pergranulata	Black-seed Samphire	Y			4	29-Mar-2008
E01218	AMARANTHACEAE	Tecticornia tenuis	Slender Samphire	Y			2	15-Apr-2021
M01270	AMARANTHACEAE	Threlkeldia diffusa	Coast Bonefruit	Y			2	14-May-2008
S10981	AMARANTHACEAE	Threlkeldia sp.	Bonefruit	Y			2	15-Apr-2021
W02359	APIACEAE	Daucus glochidiatus	Native Carrot	Y			3	09-Nov-1998
C02481	APOCYNACEAE	Alyxia buxifolia	Sea Box	Y			14	23-Nov-2022
W02375	ARALIACEAE	Hydrocotyle laxiflora	Stinking Pennywort	Y			1	21-Sep-1981
U02382	ARALIACEAE	Hydrocotyle trachycarpa	Wild Parsley	Y			1	02-Oct-1958
G02395	ARALIACEAE	Trachymene cyanopetala	Purple Trachymene	Y			2	18-Sep-2003
A06424	ARALIACEAE	Trachymene ornata	Cotton-ball Trachymene	Y			1	21-Sep-1981
M00682	ASPARAGACEAE	Lomandra effusa	Scented Mat-rush	Y			21	25-Nov-2022
U00686	ASPARAGACEAE	Lomandra leucocephala ssp. robusta	Woolly Mat-rush	Y			11	23-Nov-2023
M00702	ASPARAGACEAE	Thysanotus baueri	Mallee Fringe-lily	Y			2	21-Oct-1981
M00666	ASPHODELACEAE	Asphodelus fistulosus	Onion Weed	N			15	23-Nov-2022
S00669	ASPHODELACEAE	Bulbine semibarbata	Small Leek-lily	Y			6	16-Oct-1998
G04827	ASPHODELACEAE	Dianella brevicaulis	Short-stem Flax-lily	Y			6	23-Nov-2023
Y20288	ASPHODELACEAE	Dianella revoluta var.		Y			5	15-Apr-2021

C04893	ASPHODELACEAE	Dianella revoluta var. revoluta	Black-anther Flax-lily	Y			8	16-May-2008
U10314	ASPHODELACEAE	Dianella sp.	Flax-lily	Y			2	25-Nov-2022
A11000	ASPHODELACEAE	Tricoryne sp.	Yellow Rush-lily	Y			1	25-Nov-2022
Z02939	ASTERACEAE	Actinobole uliginosum	Flannel Cudweed	Y			1	20-Sep-1981
E02950	ASTERACEAE	Angianthus tomentosus	Hairy Angianthus	Y			1	14-Jul-1993
U02966	ASTERACEAE	Brachyscome ciliaris var. ciliaris	Variable Daisy	Y			2	17-Sep-2003
M03518	ASTERACEAE	Brachyscome ciliaris var. lanuginosa	Woolly Variable Daisy	Y			1	07-Aug-1992
E02978	ASTERACEAE	Brachyscome lineariloba	Hard-head Daisy	Y			3	09-Nov-1998
E02986	ASTERACEAE	Brachyscome trachycarpa	Smooth Daisy	Y			1	20-Sep-1981
C03001	ASTERACEAE	Calotis erinacea	Tangled Burr-daisy	Y			1	11-Oct-1991
E03002	ASTERACEAE	Calotis hispidula	Hairy Burr-daisy	Y			1	09-Nov-1998
Y03012	ASTERACEAE	Carthamus lanatus	Saffron Thistle	N			16	25-Nov-2002
Q32680	ASTERACEAE	Cassinia arcuata	Drooping Cassinia	Y			1	08-Aug-1992
Z03015	ASTERACEAE	Cassinia laevis ssp. laevis	Curry Bush	Y			2	23-Nov-2022
K03021	ASTERACEAE	Centaurea melitensis	Malta Thistle	N			2	16-Oct-1998
Q05892	ASTERACEAE	Centipeda crateriformis ssp. crateriformis	Common Sneezeweed	Y			1	14-Jul-1993
S32217	ASTERACEAE	Chrysocephalum apiculatum	Common Everlasting	Y			1	14-Jul-1993
K03101	ASTERACEAE	Chrysocephalum apiculatum (NC)	Common Everlasting	Y			1	25-Aug-1993
S03165	ASTERACEAE	Chrysocephalum semipapposum	Clustered Everlasting	Y			2	25-Aug-1993
E03054	ASTERACEAE	Cratystylis conocephala	Bluebush Daisy	Y			8	22-Nov-2022
M03198	ASTERACEAE	Dittrichia graveolens	Stinkweed	N			8	25-Nov-2002
W32023	ASTERACEAE	Eriochlamys behrii	Woolly Mantle	Y			3	15-May-2008
Z03091	ASTERACEAE	Euchiton sphaericus	Annual Cudweed	Y			1	07-Oct-1990
Y04200	ASTERACEAE	Gnephosis drummondii	Slender Golden-tip	Y			2	09-Nov-1998
S03157	ASTERACEAE	Helichrysum leucopsideum	Satin Everlasting	Y			1	25-Aug-1993
A03176	ASTERACEAE	Hyalosperma glutinosum ssp. glutinosum	Golden Sunray	Y			2	06-Oct-1990
Y03196	ASTERACEAE	Hypochaeris glabra	Smooth Cat's Ear	N			2	09-Nov-1998
Z03199	ASTERACEAE	Isoetopsis graminifolia	Grass Cushion	Y			1	02-Oct-1958
K04977	ASTERACEAE	Leiocarpa semicalva ssp. semicalva	Scented Button-bush	Y			3	07-Oct-1990
Z03059	ASTERACEAE	Lemooria burkittii	Wires-and-wool	Y			1	23-Nov-2022
W03343	ASTERACEAE	Millotia muelleri	Common Bow-flower	Y			1	20-Sep-1981
E03222	ASTERACEAE	Millotia myosotidifolia	Broad-leaf Millotia	Y			2	21-Sep-1981
Q03228	ASTERACEAE	Minuria leptophylla	Minnie Daisy	Y			1	21-Sep-1981
Q05216	ASTERACEAE	Olearia brachyphylla	Short-leaf Daisy-bush	Y			1	23-Nov-2023
Z03235	ASTERACEAE	Olearia calcarea	Crinkle-leaf Daisy-bush	Y			6	19-Sep-2003
S03237	ASTERACEAE	Olearia ciliata var. ciliata	Fringed Daisy-bush	Y			1	25-Aug-1993
U03238	ASTERACEAE	Olearia decurrens	Winged Daisy-bush	Y			10	24-Nov-2022
Y03240	ASTERACEAE	Olearia exiguifolia	Lobed-leaf Daisy-bush	Y			2	13-Apr-2021
M03242	ASTERACEAE	Olearia floribunda	Heath Daisy-bush	Y			3	13-Apr-2021
W03247	ASTERACEAE	Olearia lepidophylla	Clubmoss Daisy-bush	Y			12	25-Nov-2022
M03250	ASTERACEAE	Olearia muelleri	Mueller's Daisy-bush	Y			17	24-Nov-2022
Z04951	ASTERACEAE	Olearia pimeleoides	Pimelea Daisy-bush	Y			21	23-Nov-2023
A03256	ASTERACEAE	Olearia ramulosa	Twiggy Daisy-bush	Y			1	25-Nov-2022
C03109	ASTERACEAE	Ozothamnus decurrens	Ridged Bush-everlasting	Y			1	25-Aug-1993
S03105	ASTERACEAE	Ozothamnus retusus	Notched Bush-everlasting	Y			4	25-Nov-2022
Z03279	ASTERACEAE	Podolepis capillaris	Wiry Podolepis	Y			8	23-Nov-2023
U04450	ASTERACEAE	Podolepis tepperi	Delicate Copper-wire Daisy	Y			2	10-Nov-1998
K03285	ASTERACEAE	Podotheca angustifolia	Sticky Long-heads	Y			3	25-Nov-2022
U01346	ASTERACEAE	Pogonolepis muelleriana	Stiff Cup-flower	Y			1	07-Oct-1990
Y03292	ASTERACEAE	Reichardia tingitana	False Sowthistle	N			2	23-Nov-2022
W03183	ASTERACEAE	Rhodanthe polygalifolia	Milkwort Everlasting	Y			2	21-Sep-1981
C03185	ASTERACEAE	Rhodanthe pygmaea	Pigmy Daisy	Y			2	16-Oct-1998
S06297	ASTERACEAE	Senecio glossanthus	Annual Groundsel	Y			3	21-Sep-1981
Y03304	ASTERACEAE	Senecio glossanthus (NC)	Annual Groundsel	Y			4	10-Nov-1998
M04790	ASTERACEAE	Senecio pinnatifolius (NC)	Variable Groundsel	Y			1	25-Aug-1993
K03321	ASTERACEAE	Senecio quadridentatus	Cotton Groundsel	Y			2	20-Sep-1981
Q03332	ASTERACEAE	Sonchus asper	Rough Sow-thistle	N			1	21-Sep-1981
K30081	ASTERACEAE	Sonchus oleraceus	Common Sow-thistle	N			1	16-Oct-1998
C10925	ASTERACEAE	Sonchus sp.	Sow-thistle	Y			1	23-Nov-2022
G03339	ASTERACEAE	Stuartina muelleri	Spoon Cudweed	Y			2	16-Oct-1998
Q04424	ASTERACEAE	Triptilodiscus pygmaeus	Small Yellow-heads	Y			1	14-Jul-1993
G03347	ASTERACEAE	Vittadinia cervicularis var. cervicularis	Waisted New Holland Daisy	Y			4	16-Oct-1998
K03497	ASTERACEAE	Vittadinia dissecta var. hirta	Dissected New Holland Daisy	Y			11	23-Nov-2023
Y03284	ASTERACEAE	Vittadinia eremaea	Desert New Holland Daisy	Y			1	15-Apr-2021
E03494	ASTERACEAE	Vittadinia gracilis	Woolly New Holland Daisy	Y			5	20-Sep-2003
K03349	ASTERACEAE	Vittadinia megacephala	Giant New Holland Daisy	Y			1	29-Aug-1995
Q11040	ASTERACEAE	Vittadinia sp.	New Holland Daisy	Y			1	25-Aug-1993
E02546	BORAGINACEAE	Echium plantagineum	Salvation Jane	N			2	25-Nov-2002
G02547	BORAGINACEAE	Embadium johnstonii	Johnston's Slipper-plant	Y		R	1	02-Oct-1958
A03192	BORAGINACEAE	Halgania andromedifolia	Scented Blue-flower	Y			8	25-Nov-2022
Q02568	BORAGINACEAE	Halgania cyanea	Rough Blue-flower	Y			11	23-Nov-2023
W02551	BORAGINACEAE	Heliotropium asperrimum	Rough Heliotrope	Y			1	
G02563	BORAGINACEAE	Omphalolappula concava	Burr Stickseed	Y			1	20-Sep-1981
Y01392	BRASSICACEAE	Arabidella filifolia	Thread-leaf Cress	Y			1	20-Sep-1981
W10147	BRASSICACEAE	Brassica sp.		N			1	22-Nov-2022
Y01412	BRASSICACEAE	Carrichtera annua	Ward's Weed	N			13	22-Nov-2022
A01436	BRASSICACEAE	Lepidium leptopetalum	Shrubby Peppercress	Y			2	08-Aug-1992
Q01440	BRASSICACEAE	Lepidium papillosum	Warty Peppercress	Y			1	02-Oct-1958
G01471	BRASSICACEAE	Sisymbrium erysimoides	Smooth Mustard	N			1	16-Oct-1998
Y01472	BRASSICACEAE	Sisymbrium irio	London Mustard	N			1	21-Sep-1981
Z32047	BRASSICACEAE	Stenopetalum lineare	Narrow Thread-petal	Y			3	19-Sep-2003
W01479	BRASSICACEAE	Stenopetalum sphaerocarpum	Round-fruit Thread-petal	Y			1	09-Nov-1998

S03861	CACTACEAE	Opuntia tomentosa	Velvet Pear	N			1	Declared Landscape Act - Not For Sale
W02835	CAMPANULACEAE	Isotoma petraea	Rock Isotome	Y			3	23-Nov-2022
W01071	CARYOPHYLLACEAE	Herniaria cinerea	Rupturewort	N			2	16-Oct-1998
G01083	CARYOPHYLLACEAE	Sagina apetala	Annual Pearlwort	N			1	20-Sep-1981
Q01088	CARYOPHYLLACEAE	Scleranthus minusculus	Cushion Knawel	Y			1	07-Oct-1990
C06273	CARYOPHYLLACEAE	Spergularia diandroides	Lesser Sand-spurrey	Y			1	14-Jul-1993
A03636	CASUARINACEAE	Allocasuarina verticillata	Drooping Sheoak	Y			3	21-Sep-1981
C10473	CHENOPODIACEAE > AMARANTHACEAE (100.297)	Halosarcia sp. (NC)	Samphire	Y			4	25-Nov-2002
A05976	COLCHICACEAE	Wurmbea dioica ssp. brevifolia	Early Nancy	Y			1	07-Aug-1992
S05957	CONVOLVULACEAE	Convolvulus crispifolius	Silver Bindweed	Y			2	11-Oct-1991
Z04731	CONVOLVULACEAE	Convolvulus eyreanus (NC)	Silver Bindweed	Y			1	25-Aug-1993
K01385	CONVOLVULACEAE	Convolvulus remotus	Grassy Bindweed	Y			1	20-Sep-1981
Y05820	CRASSULACEAE	Crassula colligata ssp. lamprosperma		Y			2	16-Oct-1998
K00877	CRASSULACEAE	Crassula colorata var. acuminata	Dense Crassula	Y			4	10-Nov-1998
S01485	CRASSULACEAE	Crassula colorata var. colorata	Dense Crassula	Y			2	09-Nov-1998
A00880	CRASSULACEAE	Crassula sieberiana ssp. tetramera (NC)	Australian Stonecrop	Y			3	10-Nov-1998
W05819	CRASSULACEAE	Crassula tetramera	Australian Stonecrop	Y			2	21-Sep-1981
M03382	CUPRESSACEAE	Callitris gracilis	Southern Cypress Pine	Y			6	22-Nov-2022
Q03384	CUPRESSACEAE	Callitris verrucosa	Scrub Cypress Pine	Y			10	14-Apr-2021
A00564	CYPERACEAE	Isolepis australiensis	Southern Club-rush	Y			1	14-Jul-1993
Q00536	CYPERACEAE	Lepidosperma viscidum	Sticky Sword-sedge	Y			5	09-Nov-1998
Q10892	CYPERACEAE	Schoenus sp.	Bog-rush	Y			1	14-Apr-2021
S00561	CYPERACEAE	Schoenus subaphyllus	Desert Bog-rush	Y			2	05-Sep-2018
K15173	DILLENIACEAE	Hibbertia devitata	Smooth Guinea-flower	Y			1	25-Aug-1993
A01080	DILLENIACEAE	Hibbertia riparia (NC)	Guinea-flower	Y			1	01-Jan-1981
Z01351	DILLENIACEAE	Hibbertia virgata	Twiggy Guinea-flower	Y			2	16-May-2008
G02183	ELATINACEAE	Bergia trimera	Three-part Water-fire	Y			1	14-Jul-1993
W10579	ERICACEAE	Leucopogon sp.	Beard-heath	Y			1	25-Nov-2022
M02426	ERICACEAE	Styphelia cordifolia	Heart-leaf Beard-heath	Y			3	16-May-2008
E01914	EUPHORBIACEAE	Bertya tasmanica ssp. vestita	Mitchell's Bertya	Y			2	16-May-2008
Y01916	EUPHORBIACEAE	Beyeria lechenaultii	Pale Turpentine Bush	Y			13	23-Nov-2022
K01917	EUPHORBIACEAE	Beyeria opaca	Dark Turpentine Bush	Y			2	25-Nov-2022
E04762	EUPHORBIACEAE	Euphorbia tannensis ssp. eremophila	Desert Spurge	Y			1	06-Oct-1990
Z03763	FABACEAE	Acacia ancistrophylla var. lissophylla	Hook-leaf Wattle	Y			7	16-May-2008
A05984	FABACEAE	Acacia calamifolia	Wallowa	Y			7	25-Nov-2022
Q01548	FABACEAE	Acacia calamifolia (NC)	Wallowa	Y			6	25-Nov-2002
M01554	FABACEAE	Acacia continua	Thorn Wattle	Y			4	23-Nov-2022
C05985	FABACEAE	Acacia euthycarpa	Wallowa	Y			4	16-May-2008
S01565	FABACEAE	Acacia farinosa	Mealy Wattle	Y			1	01-Jan-1981
U05438	FABACEAE	Acacia halliana	Hall's Wattle	Y			1	15-May-2008
W01575	FABACEAE	Acacia iteaphylla	Flinders Ranges Wattle	Y		R	1	21-Sep-1981
E05238	FABACEAE	Acacia ligulata	Umbrella Bush	Y			9	23-Nov-2023
G01587	FABACEAE	Acacia microcarpa	Manna Wattle	Y			2	15-Apr-2021
K01589	FABACEAE	Acacia montana	Mallee Wattle	Y		R	8	25-Nov-2010
C01593	FABACEAE	Acacia notabilis	Notable Wattle	Y			7	23-Nov-2022
E01594	FABACEAE	Acacia nyssophylla	Spine Bush	Y			6	25-Nov-2022
G01595	FABACEAE	Acacia oswaldii	Umbrella Wattle	Y			3	20-Sep-2003
U01610	FABACEAE	Acacia rhigiophylla	Dagger-leaf Wattle	Y		R	1	16-Aug-1980
W01611	FABACEAE	Acacia rigens	Nealie	Y			9	18-May-2007
K01617	FABACEAE	Acacia sclerophylla var. sclerophylla	Hard-leaf Wattle	Y			10	25-Nov-2022
M01618	FABACEAE	Acacia spinescens	Spiny Wattle	Y			3	23-Nov-2023
G01631	FABACEAE	Acacia wilhelmiana	Dwarf Nealie	Y			11	25-Nov-2002
Z04167	FABACEAE	Aotus subspinescens	Mallee Aotus	Y			1	25-Aug-1993
A05528	FABACEAE	Cullen discolor	Prostrate Scurf-pea	Y			1	11-Oct-1991
S01661	FABACEAE	Daviesia aphylla	Dryland Bitter-pea	Y			2	16-May-2008
G03655	FABACEAE	Daviesia benthamii ssp. humilis (NC)	Mallee Bitter-pea	Y		R	1	25-Aug-1993
W01663	FABACEAE	Daviesia genistifolia	Broom Bitter-pea	Y			3	23-Nov-2023
A05624	FABACEAE	Daviesia ulicifolia ssp.	Gorse Bitter-pea	Y			4	25-Nov-2002
A01672	FABACEAE	Dillwynia sparsifolia	Sparse-leaf Parrot-pea	Y			2	16-May-2008
E01674	FABACEAE	Eutaxia microphylla	Common Eutaxia	Y			9	23-Nov-2023
Z01679	FABACEAE	Glycine rubiginosa	Twining Glycine	Y			4	18-Sep-2003
Q01708	FABACEAE	Lotus cruentus	Red-flower Lotus	Y			2	21-Sep-1981
K01721	FABACEAE	Medicago minima	Little Medic	N			3	15-May-2008
C10625	FABACEAE	Medicago sp.	Medic	N			1	25-Nov-2002
A15348	FABACEAE	Senna artemisioides ssp. alicia x ssp. coriacea	Desert Senna	Y			1	22-Nov-2022
W15283	FABACEAE	Senna artemisioides ssp. artemisioides x ssp. coriacea	Desert Senna	Y			3	23-Nov-2023
C05025	FABACEAE	Senna artemisioides ssp. filifolia	Fine-leaf Desert Senna	Y			1	14-Apr-2021
E05598	FABACEAE	Senna artemisioides ssp. petiolaris		Y			11	22-Nov-2022
Q01036	FABACEAE	Senna artemisioides ssp. petiolaris (NC)	Flat-stalk Senna	Y			1	09-Nov-1998
M01642	FABACEAE	Senna artemisioides ssp. X artemisioides	Silver Senna	Y			1	15-May-2008
Z03287	FABACEAE	Senna artemisioides ssp. X coriacea	Broad-leaf Desert Senna	Y			2	10-Nov-1998
M05118	FABACEAE	Senna cardiosperma ssp. gawlerensis	Gawler Ranges Senna	Y			3	14-May-2008
A05552	FABACEAE	Swainsona microphylla	Small-leaf Swainson-pea	Y			1	25-Aug-1993
Q32292	FABACEAE	Templetonia egena	Broombush Templetonia	Y			3	15-Apr-2021
U01814	FABACEAE	Templetonia egena (NC)	Broombush Templetonia	Y			1	14-May-2008
Q20088	FRANKENIACEAE	Frankenia pauciflora var.	Southern Sea-heath	Y			1	25-Nov-2022
C10413	FRANKENIACEAE	Frankenia sp.	Sea-heath	Y			1	15-Apr-2021
W01867	GERANIACEAE	Erodium cicutarium	Cut-leaf Heron's-bill	N			1	01-Oct-1958
G32707	GERANIACEAE	Pelargonium australe	Austral Stork's-bill	Y			1	03-Nov-1992
S01881	GERANIACEAE	Pelargonium littorale	Native Pelargonium	Y			1	11-Oct-1991

M10750	GERANIACEAE	Pelargonium sp.	Storks-bill	Y			1	25-Aug-1993
M04758	GOODENIACEAE	Dampiera lanceolata var. lanceolata	Grooved Dampiera	Y			2	25-Aug-1993
M02866	GOODENIACEAE	Dampiera rosmarinifolia	Rosemary Dampiera	Y			3	09-Nov-1998
U02922	GOODENIACEAE	Goodenia connata	Cup Velleia	Y			1	25-Aug-1993
K02881	GOODENIACEAE	Goodenia havilandii	Hill Goodenia	Y			1	07-Oct-1990
M02890	GOODENIACEAE	Goodenia ovata	Hop Goodenia	Y			5	23-Nov-2023
Z02891	GOODENIACEAE	Goodenia pinnatifida	Cut-leaf Goodenia	Y			1	06-Oct-1990
U04346	GOODENIACEAE	Goodenia quasilibera		Y			2	09-Nov-1998
W02895	GOODENIACEAE	Goodenia robusta	Woolly Goodenia	Y			2	25-Aug-1993
G02899	GOODENIACEAE	Goodenia varia	Sticky Goodenia	Y			6	14-Apr-2021
Q04352	GOODENIACEAE	Goodenia willisiana	Silver Goodenia	Y			6	23-Nov-2023
W04495	GOODENIACEAE	Scaevola humilis	Inland Fanflower	Y			2	25-Nov-1970
U02914	GOODENIACEAE	Scaevola linearis ssp. linearis	Rough Fanflower	Y			2	25-Aug-1993
G02919	GOODENIACEAE	Scaevola spinescens	Spiny Fanflower	Y			14	23-Nov-2022
W01003	GYROSTEMONACEAE	Codonocarpus cotinifolius	Desert Poplar	Y			2	07-Aug-1992
E01006	GYROSTEMONACEAE	Gyrostemon australasicus	Buckbush Wheel-fruit	Y			2	25-Aug-1993
G01007	GYROSTEMONACEAE	Gyrostemon ramulosus	Bushy Wheel-fruit	Y			1	25-Aug-1993
C02325	HALORAGACEAE	Glischrocaryon behrii	Golden Pennants	Y			2	25-Nov-2022
E02326	HALORAGACEAE	Glischrocaryon flavescens	Yellow Pennants	Y			3	25-Aug-1993
G02327	HALORAGACEAE	Gonocarpus elatus	Hill Raspwort	Y			5	23-Nov-2022
M03606	HALORAGACEAE	Haloragis acutangula f. subacutangula	Smooth Raspwort	Y			1	12-Sep-1993
S02349	HALORAGACEAE	Myriophyllum verrucosum	Red Milfoil	Y			1	14-Jul-1993
K02581	LAMIACEAE	Dicrastylis verticillata	Whorled Sand-sage	Y			9	25-Nov-2022
Y02600	LAMIACEAE	Marrubium vulgare	Horehound	N			5	25-Nov-2002
G04251	LAMIACEAE	Prostanthera ammophila	Sand Mintbush	Y			2	08-Aug-1992
S02613	LAMIACEAE	Prostanthera aspalathoides	Scarlet Mintbush	Y			9	23-Nov-2023
C02625	LAMIACEAE	Prostanthera striatiflora	Striated Mintbush	Y			1	21-Sep-1981
M20166	LAMIACEAE	Salvia verbenaca var.	Wild Sage	N			8	15-May-2008
Y04756	LAMIACEAE	Salvia verbenaca var. verbenaca	Wild Sage	N			1	15-May-2008
K02645	LAMIACEAE	Westringia rigida	Stiff Westringia	Y			17	25-Nov-2022
Z01319	LAURACEAE	Cassytha melantha	Coarse Dodder-laurel	Y			4	23-Nov-2022
C02457	LOGANIACEAE	Orianthera nuda	Leafless Logania	Y			3	25-Nov-2022
A00960	LORANTHACEAE	Amyema miquelii	Box Mistletoe	Y			1	21-Mar-2004
M10054	LORANTHACEAE	Amyema sp.	Mistletoe	Y			1	23-Nov-2022
M00966	LORANTHACEAE	Lysiana exocarpi ssp. exocarpi	Harlequin Mistletoe	Y			3	21-Sep-1981
K15085	Major Group only - Lichens	Lichen sp.		Y			4	10-Nov-1998
M15166	Major Group only - Mosses	Moss sp.		Y			3	10-Nov-1998
S02073	MALVACEAE	Alyogyne hakeifolia	Hakea-leaf Hibiscus	Y			1	25-Aug-1993
Q32540	MALVACEAE	Alyogyne sp. Hutt River (B.J.Lepschi & T.R.Lally 2310)	Native Hibiscus	Y			1	25-Nov-2022
G02115	MALVACEAE	Lasiopetalum baueri	Slender Velvet-bush	Y			2	23-Nov-2023
Y02116	MALVACEAE	Lasiopetalum behrii	Pink Velvet-bush	Y			5	23-Nov-2022
G02087	MALVACEAE	Lawrencia glomerata	Clustered Lawrencia	Y			2	25-Aug-1993
W04971	MALVACEAE	Lawrencia squamata	Thorny Lawrencia	Y			3	15-Apr-2021
G02095	MALVACEAE	Radyera farragei	Desert Rose Mallow	Y			1	21-Sep-1981
W05279	MALVACEAE	Sida ammophila	Sand Sida	Y			1	15-Apr-2021
E04666	MALVACEAE	Sida petrophila	Rock Sida	Y			12	23-Nov-2023
A03872	MALVACEAE	Sida phaeotricha	Hill Sida	Y			1	22-Sep-1981
Q10912	MALVACEAE	Sida sp.	Sida	Y			1	15-May-2008
K01025	MOLLUGINACEAE	Glinus lotoides	Hairy Carpet-weed	Y			1	14-Jul-1993
Q01044	MONTIACEAE	Calandrinia corrigioloides	Strap Purslane	Y			1	08-Aug-1992
W01047	MONTIACEAE	Calandrinia eremaea	Dryland Purslane	Y			5	09-Nov-1998
C01049	MONTIACEAE	Calandrinia granulifera	Pigmy Purslane	Y			1	09-Nov-1998
U10162	MONTIACEAE	Calandrinia sp.	Purslane/Parakeelya	Y			2	23-Nov-2022
K02205	MYRTACEAE	Calytrix involucrata	Cup Fringe-myrtle	Y			6	25-Nov-2022
Z02207	MYRTACEAE	Calytrix tetragona	Common Fringe-myrtle	Y			1	
M05338	MYRTACEAE	Darwinia salina	Salt Darwinia	Y			1	29-Mar-2008
Q02216	MYRTACEAE	Eucalyptus brachycalyx	Gilja	Y			25	23-Nov-2023
A32404	MYRTACEAE	Eucalyptus cajuputea	Green Mallee	Y			6	12-Dec-1996
C03417	MYRTACEAE	Eucalyptus calcareana	Nundroo Mallee	Y			5	24-Oct-1977
W02227	MYRTACEAE	Eucalyptus dumosa	White Mallee	Y			7	24-Nov-2022
E02238	MYRTACEAE	Eucalyptus gracilis	Yorrell	Y			36	23-Nov-2023
Q02240	MYRTACEAE	Eucalyptus incrassata	Ridge-fruited Mallee	Y			12	23-Nov-2023
G32395	MYRTACEAE	Eucalyptus leptophylla	Narrow-leaf Red Mallee	Y			8	25-Nov-2022
S05101	MYRTACEAE	Eucalyptus leptophylla (NC)	Narrow-leaf Red Mallee	Y			18	30-Mar-2008
G02255	MYRTACEAE	Eucalyptus oleosa (NC)	Red Mallee	Y			6	25-Nov-2002
M05882	MYRTACEAE	Eucalyptus oleosa ssp.		Y			7	23-Nov-2023
K05881	MYRTACEAE	Eucalyptus oleosa ssp. ampliata	Red Mallee	Y			14	14-May-2008
Y05880	MYRTACEAE	Eucalyptus oleosa ssp. oleosa	Red Mallee	Y			2	29-Mar-2008
Z15203	MYRTACEAE	Eucalyptus oleosa X Eucalyptus socialis ssp.	Red Mallee	Y			8	15-Apr-2021
E05686	MYRTACEAE	Eucalyptus phenax ssp. phenax	White Mallee	Y			7	15-Apr-2021
C02261	MYRTACEAE	Eucalyptus porosa	Mallee Box	Y			11	30-Mar-2008
K05661	MYRTACEAE	Eucalyptus socialis (NC)	Beaked Red Mallee	Y			1	25-Nov-2002
M02266	MYRTACEAE	Eucalyptus socialis (NC)	Beaked Red Mallee	Y			1	09-Nov-1998
K05661	MYRTACEAE	Eucalyptus socialis (NC)	Beaked Red Mallee	Y			11	25-Nov-2002
M02266	MYRTACEAE	Eucalyptus socialis (NC)	Beaked Red Mallee	Y			1	25-Aug-1993
K05661	MYRTACEAE	Eucalyptus socialis (NC)	Beaked Red Mallee	Y			6	25-Nov-2002
M02266	MYRTACEAE	Eucalyptus socialis (NC)	Beaked Red Mallee	Y			1	01-Jan-1981
K05661	MYRTACEAE	Eucalyptus socialis (NC)	Beaked Red Mallee	Y			1	25-Nov-2002
E05978	MYRTACEAE	Eucalyptus socialis ssp.	Beaked Red Mallee	Y			6	25-Nov-2022
E05950	MYRTACEAE	Eucalyptus socialis ssp. socialis	Beaked Red Mallee	Y			2	18-Sep-2003
G05951	MYRTACEAE	Eucalyptus socialis ssp. viridans	Beaked Red Mallee	Y			3	11-Aug-1998
C10393	MYRTACEAE	Eucalyptus sp.		Y			1	25-Aug-1993
S02197	MYRTACEAE	Hysterobaeckea behrii	Silver Broombush	Y			1	25-Aug-1993
Q02276	MYRTACEAE	Leptospermum coriaceum	Dune Tea-tree	Y			9	25-Nov-2022

S02285	MYRTACEAE	Melaleuca acuminata ssp. acuminata	Mallee Honey-myrtle	Y			4	23-Nov-2023
E04234	MYRTACEAE	Melaleuca eleuterostachya	Hummock Honey-myrtle	Y			12	14-Apr-2021
M05830	MYRTACEAE	Melaleuca lanceolata	Dryland Tea-tree	Y			22	25-Nov-2022
U02294	MYRTACEAE	Melaleuca lanceolata ssp. lanceolata (NC)	Dryland Tea-tree	Y			11	25-Nov-2002
C05589	MYRTACEAE	Melaleuca pauperiflora ssp. mutica	Boree	Y			4	14-May-2008
E05986	MYRTACEAE	Melaleuca uncinata	Broombush	Y			13	23-Nov-2023
U02198	MYRTACEAE	Rinzia orientalis	Desert Heath-myrtle	Y			2	16-May-2008
W02307	MYRTACEAE	Thryptomene elliottii		Y			3	14-Apr-2021
K03885	MYRTACEAE	Thryptomene micrantha	Ribbed Thryptomene	Y			11	23-Nov-2022
A01884	NITRARIACEAE	Nitraria billardierei	Nitre-bush	Y			2	14-May-2008
Q10160	ORCHIDACEAE	Caladenia sp.	Spider-orchid	Y			15	18-Oct-2021
G05159	ORCHIDACEAE	Caladenia toxochila	Bow-lip Spider-orchid	Y			1	27-Sep-2022
U06174	ORCHIDACEAE	Pterostylis excelsa	Dryland Greenhood	Y			24	18-Oct-2022
K05193	ORCHIDACEAE	Pterostylis excelsa (NC)	Dryland Greenhood	Y			2	10-Nov-1998
M00842	ORCHIDACEAE	Pterostylis mutica	Midget Greenhood	Y			47	18-Oct-2022
Z00843	ORCHIDACEAE	Pterostylis nana	Dwarf Greenhood	Y			15	29-Sep-2022
G04411	ORCHIDACEAE	Pterostylis ovata	Gawler Ranges Greenhood	Y			1	01-Oct-1992
U10834	ORCHIDACEAE	Pterostylis sp.	Greenhood	Y			90	18-Oct-2022
K04413	ORCHIDACEAE	Pterostylis xerophila	Desert Greenhood	Y	VU	V	6	28-Sep-2022
W32383	ORCHIDACEAE	Thelymitra alcockiae	Scented Sun-orchid	Y			18	11-Oct-2021
E10978	ORCHIDACEAE	Thelymitra sp.	Sun-orchid	Y			27	28-Sep-2022
Y32820	OXALIDACEAE	Oxalis perennans	Native Sorrel	Y			1	21-Sep-1981
M32822	OXALIDACEAE	Oxalis perennans/exilis	Native Oxalis	Y			2	10-Nov-1998
W30087	PHYLLANTHACEAE	Poranthera leiosperma	Small Poranthera	Y			1	03-Nov-1992
U30086	PHYLLANTHACEAE	Poranthera microphylla	Small Poranthera	Y			2	25-Nov-2022
W06415	PITTOSPORACEAE	Billardiera cymosa ssp.	Sweet Apple-berry	Y			2	14-Apr-2021
C06361	PITTOSPORACEAE	Billardiera cymosa ssp. pseudocymosa	Sweet Apple-berry	Y			1	28-Oct-1988
A01496	PITTOSPORACEAE	Billardiera sericophora	Silky Apple-berry	Y			2	21-Sep-1981
A04208	PITTOSPORACEAE	Bursaria spinosa ssp. spinosa	Sweet Bursaria	Y			1	25-Aug-1993
A01508	PITTOSPORACEAE	Pittosporum angustifolium	Native Apricot	Y			6	22-Nov-2022
Z02815	PLANTAGINACEAE	Plantago drummondii	Dark Plantain	Y			2	09-Nov-1998
S02817	PLANTAGINACEAE	Plantago hispida	Hairy Plantain	Y			1	14-Jul-1993
G02803	PLANTAGINACEAE	Plantago turrifera	Crowned Plantain	Y			2	14-Jul-1993
E10026	POACEAE	Aira sp.	Hair-grass	N			1	23-Nov-2022
C00301	POACEAE	Amphipogon caricinus var. caricinus	Long Grey-beard Grass	Y			4	09-Nov-1998
Q00200	POACEAE	Aristida contorta	Curly Wire-grass	Y			3	09-Nov-1998
A00124	POACEAE	Austrostipa acrociliata	Graceful Spear-grass	Y			3	10-Nov-1998
Y00136	POACEAE	Austrostipa elegantissima	Feather Spear-grass	Y			10	14-May-2008
K00137	POACEAE	Austrostipa eremophila	Rusty Spear-grass	Y			4	10-Nov-1998
M00138	POACEAE	Austrostipa hemipogon	Half-beard Spear-grass	Y			5	09-Nov-1998
K15341	POACEAE	Austrostipa hemipogon/mollis		Y			1	23-Nov-2023
U00130	POACEAE	Austrostipa mollis	Soft Spear-grass	Y			2	11-Oct-1991
W15179	POACEAE	Austrostipa mollis group	Soft Spear-grass	Y			1	23-Nov-2022
K00145	POACEAE	Austrostipa nitida	Balcarra Spear-grass	Y			7	17-Sep-2003
M00146	POACEAE	Austrostipa nodosa	Tall Spear-grass	Y			1	20-Sep-1981
Q00148	POACEAE	Austrostipa platychaeta	Flat-awn Spear-grass	Y			2	18-Sep-2003
W20187	POACEAE	Austrostipa scabra ssp.	Rough Spear-grass	Y			1	23-Nov-2023
S04769	POACEAE	Austrostipa scabra ssp. falcata	Slender Spear-grass	Y			3	08-Aug-1992
G03911	POACEAE	Austrostipa scabra ssp. scabra	Rough Spear-grass	Y			1	21-Sep-1981
E10950	POACEAE	Austrostipa sp.	Spear-grass	Y			18	23-Nov-2023
K03913	POACEAE	Avena barbata	Bearded Oat	N			27	25-Nov-2002
W00211	POACEAE	Bromus arenarius	Sand Brome	Y			2	20-Sep-2003
G00207	POACEAE	Bromus diandrus (NC)	Great Brome	N			6	25-Nov-2002
K00209	POACEAE	Bromus rubens	Red Brome	N			4	19-Sep-2003
C05369	POACEAE	Cenchrus ciliaris	Buffel Grass	N			1	07-Jul-2001
Q00392	POACEAE	Digitaria brownii	Cotton Panic-grass	Y			1	15-May-2008
M00218	POACEAE	Hordeum glaucum	Blue Barley-grass	N			1	16-Oct-1998
C00185	POACEAE	Pentameris airoides ssp. airoides	False Hair-grass	N			3	10-Nov-1998
W00123	POACEAE	Piptatherum miliaceum	Rice Millet	N			2	01-Jan-2010
Y00284	POACEAE	Rostraria pumila	Tiny Bristle-grass	N			2	19-Sep-2003
Z32779	POACEAE	Rytidosperma caespitosum	Common Wallaby-grass	Y			1	17-Sep-2003
S00165	POACEAE	Rytidosperma caespitosum (NC)	Common Wallaby-grass	Y			3	10-Nov-1998
U32410	POACEAE	Rytidosperma sp.	Wallaby-grass	Y			5	15-Apr-2021
K00189	POACEAE	Schismus barbatus	Arabian Grass	N			4	15-May-2008
W00191	POACEAE	Triodia compacta	Spinifex	Y			1	21-Sep-1981
C03717	POACEAE	Triodia irritans	Spinifex	Y			13	24-Nov-2022
K32549	POACEAE	Triodia scariosa	Spinifex	Y			10	23-Nov-2023
G20279	POACEAE	Triodia scariosa ssp. (NC)	Spinifex	Y			16	25-Nov-2002
G05927	POACEAE	Triodia sp.	Spinifex	Y			5	30-Mar-2008
G00011	POACEAE	Vulpia muralis	Wall Fescue	N			1	16-Oct-1998
Y00268	POACEAE	Vulpia myuros f. myuros	Rat's-tail Fescue	N			2	22-Sep-1981
U01998	POLYGALACEAE	Comesperma scoparium	Broom Milkwort	Y			2	07-Aug-1992
W01999	POLYGALACEAE	Comesperma volubile	Love Creeper	Y			3	19-Sep-2003
Q00976	POLYGONACEAE	Duma florulenta	Lignum	Y			1	25-Nov-2002
C00989	POLYGONACEAE	Polygonum plebeium	Small Knotweed	Y			1	14-Jul-1993
A00996	POLYGONACEAE	Rumex crystallinus	Glistening Dock	Y			1	14-Jul-1993
K00905	PROTEACEAE	Grevillea huegelii	Comb Grevillea	Y			14	23-Nov-2023
M20094	PROTEACEAE	Grevillea ilicifolia complex	Holly-leaf Grevillea	Y			1	01-Jan-1981
K00913	PROTEACEAE	Grevillea pterosperma	Dune Grevillea	Y			5	25-Nov-2022
S00925	PROTEACEAE	Hakea francisiana	Bottlebrush Hakea	Y			11	23-Nov-2023
A00928	PROTEACEAE	Hakea leucoptera ssp. leucoptera	Silver Needlewood	Y			5	22-Nov-2022
K04033	PTERIDACEAE	Cheilanthes austrotenuifolia	Annual Rock-fern	Y			3	21-Sep-1981
Q00040	PTERIDACEAE	Cheilanthes lasiophylla	Woolly Cloak-fern	Y			5	23-Nov-2022
M32150	RANUNCULACEAE	Clematis microphylla	Old Man's Beard	Y			2	14-Apr-2021
M01326	RANUNCULACEAE	Clematis microphylla var. microphylla (NC)	Old Man's Beard	Y			1	25-Aug-1993

W01339	RANUNCULACEAE	Ranunculus sessiliflorus var. sessiliflorus	Annual Buttercup	Y			1	20-Sep-1981
C02033	RHAMNACEAE	Cryptandra propinqua	Silky Cryptandra	Y			1	25-Aug-1993
Y32792	RHAMNACEAE	Cryptandra sabulicola	Sand Cryptandra	Y			1	14-Apr-2021
W10279	RHAMNACEAE	Cryptandra sp.	Cryptandra	Y			1	23-Nov-2022
G32791	RHAMNACEAE	Cryptandra sp. Floriferous (W.R.Barker 4131)	Pretty Cryptandra	Y			3	24-Nov-2022
Y20180	RHAMNACEAE	Spyridium bifidum var.		Y			1	01-Jan-1981
E05490	RHAMNACEAE	Spyridium bifidum var. bifidum (NC)	Forked Spyridium	Y			1	25-Aug-1993
A32368	RHAMNACEAE	Spyridium stenophyllum ssp. renovatum	Forked Spyridium	Y			3	25-Nov-2022
C32369	RHAMNACEAE	Spyridium stenophyllum ssp. stenophyllum	Forked Spyridium	Y			1	18-Sep-2003
A02032	RHAMNACEAE	Stenanthemum leucophractum	White Cryptandra	Y			4	25-Aug-1993
G02491	RUBIACEAE	Asperula conferta	Common Woodruff	Y			1	
Z32099	RUBIACEAE	Galium leptogonium	Reflexed Bedstraw	Y			1	01-Sep-1886
C32105	RUBIACEAE	Galium microlobum	Rough Bedstraw	Y			1	06-Oct-1992
Y02504	RUBIACEAE	Galium murale	Small Bedstraw	N			1	20-Sep-1981
K02513	RUBIACEAE	Opercularia turpis	Twiggy Stinkweed	Y			1	07-Aug-1992
Z02515	RUBIACEAE	Pomax umbellata	Pomax	Y			1	21-Sep-1981
A04920	RUTACEAE	Boronia coerulescens ssp. coerulescens	Blue Boronia	Y			8	23-Nov-2023
K01977	RUTACEAE	Geijera linearifolia	Sheep Bush	Y			26	25-Nov-2022
M01978	RUTACEAE	Geijera parviflora	Wilga	Y		R	2	24-Nov-2022
Y20120	RUTACEAE	Microcybe multiflora ssp.	Small-leaf Microcybe	Y			2	14-Apr-2021
Z04995	RUTACEAE	Microcybe multiflora ssp. baccharoides	Scale-leaf Microcybe	Y			1	29-Aug-1995
E04622	RUTACEAE	Microcybe multiflora ssp. multiflora	Small-leaf Microcybe	Y			5	23-Nov-2023
A01980	RUTACEAE	Microcybe pauciflora ssp. pauciflora	Yellow Microcybe	Y			2	25-Nov-2022
E01982	RUTACEAE	Phebalium bullatum	Silvery Phebalium	Y			9	15-Apr-2021
W00943	SANTALACEAE	Exocarpos aphyllus	Leafless Cherry	Y			10	24-Nov-2022
C00945	SANTALACEAE	Exocarpos sparteus	Slender Cherry	Y			11	23-Nov-2023
Y00948	SANTALACEAE	Leptomeria aphylla	Leafless Currant-bush	Y			1	01-Jan-1981
U00950	SANTALACEAE	Santalum acuminatum	Quandong	Y			7	23-Nov-2022
C00953	SANTALACEAE	Santalum spicatum	Sandalwood	Y		V	7	22-Nov-2022
Q04652	SAPINDACEAE	Alectryon oleifolius ssp. canescens	Bullock Bush	Y			9	23-Nov-2022
A02008	SAPINDACEAE	Dodonaea bursariifolia	Small Hop-bush	Y			5	18-Sep-2003
Q02012	SAPINDACEAE	Dodonaea lobulata	Lobed-leaf Hop-bush	Y			7	23-Nov-2022
A02016	SAPINDACEAE	Dodonaea stenozyga	Desert Hop-bush	Y			8	23-Nov-2022
G20067	SAPINDACEAE	Dodonaea viscosa ssp.	Sticky Hop-bush	Y			3	29-Mar-2008
C04921	SAPINDACEAE	Dodonaea viscosa ssp. angustissima	Narrow-leaf Hop-bush	Y			37	25-Nov-2022
E04930	SCROPHULARIACEAE	Eremophila alternifolia	Narrow-leaf Emubush	Y			7	24-Nov-2022
K02769	SCROPHULARIACEAE	Eremophila crassifolia	Thick-leaf Emubush	Y			14	23-Nov-2023
Q04572	SCROPHULARIACEAE	Eremophila deserti	Turkey-bush	Y			6	15-May-2008
S11077	SCROPHULARIACEAE	Eremophila glabra ssp.	Tar Bush	Y			11	15-Apr-2021
Z05427	SCROPHULARIACEAE	Eremophila glabra ssp. glabra	Tar Bush	Y			22	23-Nov-2023
C04905	SCROPHULARIACEAE	Eremophila oppositifolia ssp. oppositifolia	Opposite-leaved Emubush	Y			10	22-Nov-2022
Q02796	SCROPHULARIACEAE	Eremophila scoparia	Broom Emubush	Y			30	25-Nov-2022
S02797	SCROPHULARIACEAE	Eremophila serrulata	Green Emubush	Y			1	31-Aug-1965
U05138	SCROPHULARIACEAE	Eremophila subfloccosa ssp. lanata	Woolly Emubush	Y			3	05-Sep-2018
Q03836	SCROPHULARIACEAE	Myoporum brevipes	Warty Boobialla	Y			1	13-Apr-1984
S20257	SCROPHULARIACEAE	Myoporum platycarpum ssp.	False Sandalwood	Y			13	22-Nov-2022
U05358	SCROPHULARIACEAE	Myoporum platycarpum ssp. perbellum	Mallee Sandalwood	Y			1	15-May-2008
S05357	SCROPHULARIACEAE	Myoporum platycarpum ssp. platycarpum	False Sandalwood	Y			4	23-Nov-2022
E02650	SOLANACEAE	Cyphanthera myosotidea	Small-leaf Ray-flower	Y			3	25-Aug-1993
A03360	SOLANACEAE	Grammosolen dixonii		Y			15	05-Sep-2018
C03361	SOLANACEAE	Grammosolen truncatus	Shrubby Ray-flower	Y			3	23-Nov-2023
Y02660	SOLANACEAE	Lycium australe	Australian Boxthorn	Y			3	24-Nov-2022
M02662	SOLANACEAE	Lycium ferocissimum	African Boxthorn	N			2	25-Nov-2002
S02665	SOLANACEAE	Nicotiana goodspeedii	Small-flower Tobacco	Y			1	07-Aug-1992
Y10696	SOLANACEAE	Nicotiana sp.	Tobacco	Y			1	15-May-2008
Z02671	SOLANACEAE	Nicotiana velutina	Velvet Tobacco	Y			1	18-Sep-2003
W02675	SOLANACEAE	Solanum capsiciforme	Capsicum Kangaroo-apple	Y			1	25-Aug-1993
E02678	SOLANACEAE	Solanum coactiliferum	Tomato-bush	Y			8	15-May-2008
G32627	SOLANACEAE	Solanum petrophilum	Rock Nightshade	Y			2	16-Oct-1998
G02695	SOLANACEAE	Solanum petrophilum (NC)	Rock Nightshade	Y			2	16-Oct-1998
M02134	THYMELAEACEAE	Pimelea microcephala ssp. microcephala	Shrubby Riceflower	Y			5	16-Sep-2003
C03777	THYMELAEACEAE	Pimelea simplex ssp. continua	Desert Riceflower	Y			1	07-Aug-1992
G04551	URTICACEAE	Parietaria cardiostegia	Mallee Smooth-nettle	Y			1	21-Sep-1981
S05761	URTICACEAE	Parietaria debilis	Smooth-nettle	Y			1	17-Sep-2003
A02148	VIOLACEAE	Pigea floribunda	Shrub Spade Flower	Y			1	25-Aug-1993
A01892	ZYGOPHYLLACEAE	Roepera apiculata	Pointed Twinleaf	Y			8	25-Nov-2022
M06322	ZYGOPHYLLACEAE	Roepera aurantiaca ssp. aurantiaca	Shrubby Twinleaf	Y			10	24-Nov-2022
A15188	ZYGOPHYLLACEAE	Roepera aurantiacum/eremaeum	Shrubby Twinleaf	Y			2	24-Nov-2022
W05287	ZYGOPHYLLACEAE	Roepera confluens	Forked Twinleaf	Y			3	10-Nov-1998
Q06324	ZYGOPHYLLACEAE	Roepera eremaea		Y			2	25-Nov-2022
Z01899	ZYGOPHYLLACEAE	Roepera glauca	Pale Twinleaf	Y			3	15-Apr-2021
Z11067	ZYGOPHYLLACEAE	Roepera sp.	Twinleaf	Y			1	29-Mar-2008
K05521	ZYGOPHYLLACEAE	Zygophyllum aurantiacum ssp. aurantiacum (NC)	Shrubby Twinleaf	Y			1	25-Aug-1993
M01898	ZYGOPHYLLACEAE	Zygophyllum eremaeum (NC)	Pale-flower Twinleaf	Y			1	10-Nov-1998