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WINCHELSEA MINING
BUILDING FUTURE GROOTE

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Winchelsea Mining Company Winchelsea Project

Process Plant Concept Study

9 June 2020

Revision Status

Revision	Date	Description	Author		Approver	
			Name	**Position Title**	**Name**	**Position Title**
A	26/05/2020	Internal review	T Donkin	Mechanical Engineer	S Brindley	Manager Studies
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1 Introduction

The Winchelsea Mining Company ('WMC') is a joint venture between the Anindilyakwa Advance Aboriginal Corporation ('AAAC' 60%) and Aust China Pty Ltd (40%) and are actively working towards the development of a proposed manganese mining project on Winchelsea Island located approximately 50 km off the eastern coast of Arnhem Land, Northern Territory and situated approximately 5 km north-east of Bartalumba on Groote Eylandt. Neighbouring Groote Eylandt is renowned for its large manganese mine operated by South 32, previously the Groote Eylandt Mining Company ('GEMCO').

Xenith Mining Consultants ('Xenith') is engaged by WMC to deliver a concept and a feasibility study, including an ongoing exploration program, Australasian Joint Ore Reserves Committee ('JORC') Report and mining approvals (both Northern Territory ('NT') and Federal Government environmental approvals) for the Winchelsea Manganese Project.

Xenith has engaged Ausenco to complete a conceptual design of an ore processing plant facility, inclusive of concept level capital and operating cost estimates. The processing plant is designed to treat 1.5 Mt/y of run-of-mine ('RoM') ore, producing 500 kt/y of product, comprising in nominally 390 kt/y of lump product (-75 +6 mm) and 110 kt/y of fine product (-6 +0.5 mm).

A conceptual layout has been developed to obtain an indication of the expected process plant footprint for integration into the overall project site layout.

2 Conclusions and Recommendations

2.1 Metallurgy, Processing and Plant & Infrastructure

The following conclusions have been drawn from the work completed:

- The process circuit design allows for manganese recovery in all size fractions, however further analysis is required to determine the economic benefit of crushing the coarse rejects (-75 +15 mm) as well as recovery of -1+0.5 mm product by means of Reflux Classifier.

- Due to the prescribed operating schedule, the plant utilisation is low and has an unfavourable effect on the process plant capacity and associated costs. The current proposed operating schedule has the following impacts:

    - Over capitalisation of process plant equipment to accommodate a higher design throughput.

    - Increased risk of production shortfalls and decreased economic return because of the dense medium separation ('DMS') medium (FeSi slurry) requiring to be in continual motion to prevent settling in vessels and pipe work. This results in lost production time to prepare the circuit for the weekly downtime, and unplanned outages resulting from a failure to restart if the FeSi settles and dries in the circuit.

- Metallurgical sighter testwork is required to determine the occurrence of Mn in the various size fractions. Results from the testwork will determine:

    - Viability of the particle sizes to be recovered, confirming if recrushing of coarse rejects and/or extend of ultrafine particle recovery

    - Separating density, to produce a product that meets the typical merchant grade

    - Product yield in different size fractions, which will subsequently confirm equipment sizing and baseline revenue forecasts

Ausenco recommends a review of the plant operating schedule, as potentially a capital cost saving in the order of $10M in direct cost (or $16M overall)can be achieved when the plant runtime is increased to 8,000 h/y from 4,940 h/y currently. The reduced plant capacity capital cost should be evaluated against operating costs, true modular scrubber and DSM circuit design and the benefits of continuous DMS operation.

- Ausenco recommends taking various trench samples to determine the particle size distribution. The variation in the "fines" (-1mm material) needs consideration to establish the plant design operating envelope.

- Although DMS technology is in concept very robust and does not require extensive automation, the success of a DMS circuit is driven by using proven knowhow, design details and experience of previous designs. For this reason, Ausenco recommends a technical and commercial evaluation of four or five established modular DSM technology suppliers prior or at the onset of to the Feasibility Study ('FS') stage. This allows prequalification and selection of a preferred supplier to engage with during the FS. As a result, the plant layout will be accurate at the completion of the FS.

- The proposed plant design incorporates co-disposal of tailings (filtered slimes and coarse material). The filtered slimes minimises the freshwater demand. Additional test work is required to confirm filtration rates and subsequent tailings filter capacity.

- Physical characteristics of the ore should be determined to confirm the crushing system selected will be able to perform to design capacity. Ausenco recommends some basic material testing is undertaken.

- Critical path activities for execution of the project include variability metallurgical testwork, feasibility study duration, long lead major equipment and transportation to site. Ausenco has developed a preliminary schedule for consideration.

2.2 Capital Cost Summary

A summary of the total project costs for the processing facility and associated infrastructure is provided in Table 1. Details are provided in Section 7.

Table 1: Capital Cost Summary

Area	Cost Estimate AUD million
Direct Costs	41.8
Indirect Costs	11.2
Continency @ 25% of Direct + Indirect costs	13.3
Total Beneficiation Plant Project Cost	**66.3**

2.3 Operating Cost Summary

Conceptual Operating costs are AUD 9.3 M/year or AUD 18.61/t product at 500kt/y. Details are provided in Section 8.

2.4 Diesel and Water demand

The beneficiation plant uses 17,900 MWh of electrical power per year which equates to approximately 4,850 m³ of diesel fuel per year when all power is generated by diesel driven power generator sets.

The yearly average fresh water demand to support the beneficiation plant is 44,335 m³ (or 9 m³/h). This probably an under estimation as the amount of dewatered tailings filter cake (-1 mm) is based on a single particle size distribution of the run-off mine product. The variation has not been assessed in this concept study.

Details are provided in Section 8.

3 Risks and Opportunities

In preparing this Conceptual Study, the following key risks have been identified:

- The effect of varying ore particle size distribution has not been considered in this study. The processing facilities were designed for a hard ore particle size distribution presented in the Hatch study report. Inherent to this type of ore body the feed material could vary from fine (lateritic) to coarse (mag-crete). This variation needs to be considered to ensure that the fines circuit (tailings) and reject crusher have sufficient capacity and not compromise the plant production rate. A plant bottleneck analysis needs to be conducted during the FS considering the mine production sequence.

- The ore grade and yield have significant impacts on the process design and project economics. Ausenco understands Xenith is progressing the JORC report and metallurgical variability testwork is required to confirm these factors.

- Due to the remote location of the project, delays in procurement and delivery of long lead equipment has the potential to impact the project schedule. In addition, if the anticipated construction period falls during the summer months, severe weather events are likely to cause delays and increase project costs.

The following key opportunities have been identified:

- Coarse rejects from the DMS circuit can be stockpiled in lieu of further crushing. This will result in decreased capital expenditure.

- The pricing basis for this concept study considers new equipment. There is potential to reduce the project implementation schedule by investigating second-hand equipment for common and non-major items, such as stackers, cyclones, tanks, pumps etc.

4 Process Design

4.1 Battery Limits

This concept study has used the following battery limits:

Input battery limits:

- RoM ore delivered into the Primary Crusher Surge Bin
- fresh water supplied to the clean water tank
- electrical power supplied to a switch room

Output battery limits:

- lump product onto a stockpile
- fines product onto a stockpile
- tailings, single stream consisting of DMS float fraction (-15+1 mm) combined with dewatered slimes filter cake (-1 mm) onto a stockpile
- overflow outlet of the site run-off pond to environment

4.2 Exclusions

The following exclusions apply to the concept study:

- power generation and reticulation to plant
- fresh water supply to the process plant
- tailings transfer from the plant to the mine areas
- product transfer from product stockpiles to shipping vessel load-out.

4.3 Metallurgical Testwork data

No metallurgical or testwork data was available for this concept study. The plant design is based on the criteria and parameters provided in Section 4.4.

4.4 Key Design Criteria

The beneficiation plant design is based on generic data and typical operating facilities for similar ore types. The process design is conceptual and metallurgical test work is required to support the circuit design, equipment sizing and production rate.

The key design criteria and their source are listed in Table 2.

Table 2: Key Design Criteria

Parameter	Unit	Value	Data source
Operating schedule		Monday – Friday 9 x 12 hr shifts per week	Project brief
Plant Runtime	hrs/y	4,940	Derived from operating schedule. Refer section **Error! Reference source not found.**
Plant feedrate	Mt/y	1.50	Project brief
Overall mass yield to product	%	33% (0.50 Mt/y)	Project brief
Mass yield in size fractions		Equal in each size fraction	Assumption
Lump product	mm	-75+6	Project brief
Fines product	mm	-6	Project brief
Ore SG	t/m^3	2.7	Assumption
Plant ROM feed particle size distribution		Same as used by Hatch in 2019	Assumption
Particle size reduction in scrubber		None	Assumption
Particle size range to DM Drum circuit	mm	-75+15	Conservative bottom cut-off size, typical for application
Particle size range to DM cyclone circuit	mm	-15+6	Bottom-cut-off size to suit lump requirement. Size range to suit DMS application
Particle size range to DM cyclone circuit	mm	-6+1	Top cut-off size to suit fines requirement. Size range to suit DMS application
Ultrafine recovery	mm	-1+0.5	Bottom size assumed
Slime tailings handling		Filtration and co-disposal with DMS reject material	Assumption
Reagent – FeSi	g/t of DM feed	500	Industry typical
Reagent – Floccuant	g/t thickener	20	Industry typical

Parameter	Unit	Value	Data source
Reagent – NaNO2	kg/t FeSi / shutdown	1	DMSPowder
Reagent - Lime	kg/t FeSi / shutdown	0.5	DMSPowder

4.5 Flowsheet Design

The objective of the selected flowsheet is to recover manganese in the full size range from 75 mm down to nominally 0.5 mm.

Recovery of manganese bearing minerals is maximised by re-crushing the coarse reject material (-75+15 mm) from the DMS circuit.

As a result of the tailings backfill project requirement, the slime tailings stream is dewatered and the dewatered product is combined with the coarse tailings generated by the DMS circuits. A positive outcome of this design is minimal water loss from the processing plant, resulting in a low freshwater demand. This subsequently reduces the seawater reverse osmosis plant size and associated energy requirement.

The flowsheet has not been optimised and no trade-offs have been undertaken (e.g. crushing of the coarse rejects and ultrafine particle recovery by means of a reflux classifier). Once testwork data is available, these trade-offs can be completed and optimisation undertaken to support the flowsheet selection.

The conceptual process block flow diagram from RoM ore to the product and tailings stream is shown in Figure 1.

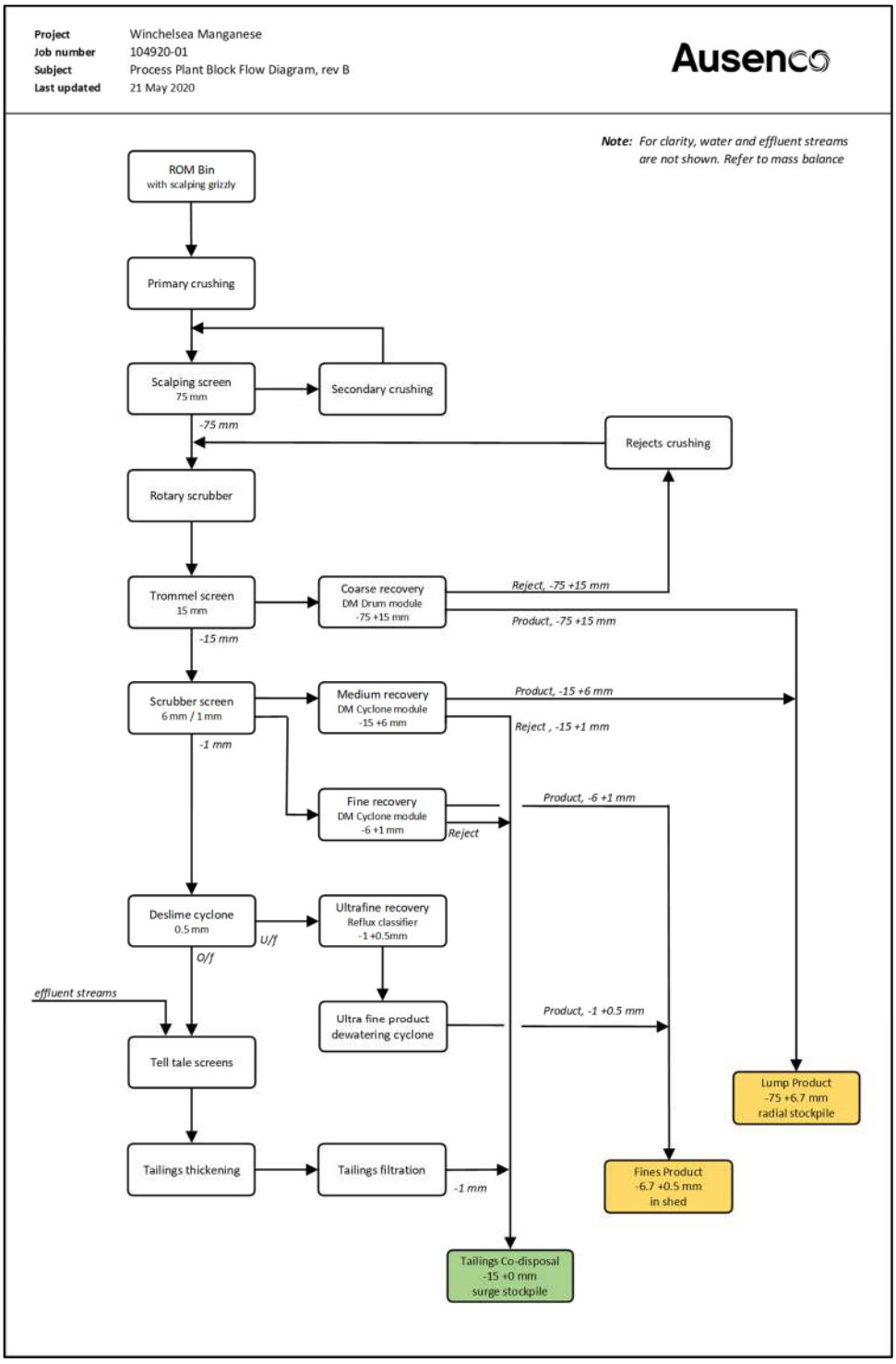


Figure 1: Process Block Flow Diagram

4.5.1 Mass balance

4.5.1.1 Operating Schedule

The mass balance is underpinned by the annual plant operating time. The current proposed Winchelsea operating schedule assumes shifts commencing Monday morning until Friday afternoon. This has a pronounced effect on the plant capacity. A production downtime allowance is included to allow the plant start and shut down at each week. In the case of a DMS plant start-up, it is likely that it will take more than 2 h to get the plant to operate at its name plate capacity. An allowance will also be required to clear the FeSi from the circuit prior to the shutdown. Figure 2 provides a summary of the throughput and operating schedule.

Plant Available hours				
Working roster				
Monday	d/s	12	hrs/y	624
	n/s	12	hrs/y	624
Tuesday	d/s	12	hrs/y	624
	n/s	12	hrs/y	624
Wednesday	d/s	12	hrs/y	624
	n/s	12	hrs/y	624
Thursday	d/s	12	hrs/y	624
	n/s	12	hrs/y	624
Friday	d/s	12	hrs/y	624
	n/s		hrs/y	0
Saturday	d/s		hrs/y	0
	n/s		hrs/y	0
Sunday	d/s		hrs/y	0
	n/s		hrs/y	0
Weekly Available hours	**hrs/w**	**108**	**hrs/y**	**5,616**
Plant Down time				
Plant start-up on Mondays	hrs/w	-2.0	hrs/y	-104
Plant rundown & clean-up on Fridays	hrs/w	-2.0	hrs/y	-104
Unplanned downtime, 0.5h/shift	hrs/w	-4.5	hrs/y	-234
Planned maintance, 36hr/8wk	hrs/w		hrs/y	-234
Plant Down time	**hrs/w**	**-8.5**	**hrs/y**	**-676**
Plant Run time	**hrs/w**	**99.5**	**hrs/y**	**4,940**
Plant Feed rate			dry t/y	1,500,000
			dry t/h	303.64

Figure 2: Operating Schedule and Throughput Rate

4.5.1.2 Particle Size Distribution

The beneficiation process design capacity is sensitive to particle size distribution, typical for plants of this nature. Coarse feed constraints the crushing circuits, with fine feed constraining the ultrafine and tailings filtration circuits.

For the Concept Study, these scenarios have not been explored, however the equipment in the tailings handling area has been selected with suitable design margins.

The RoM feed and primary crusher particle size distribution curves are provided in Figure 3. Proprietary Metso software (Bruno crusher simulation) was used to simulate the crushers, sizing screens and associated particle size distribution in each stream.

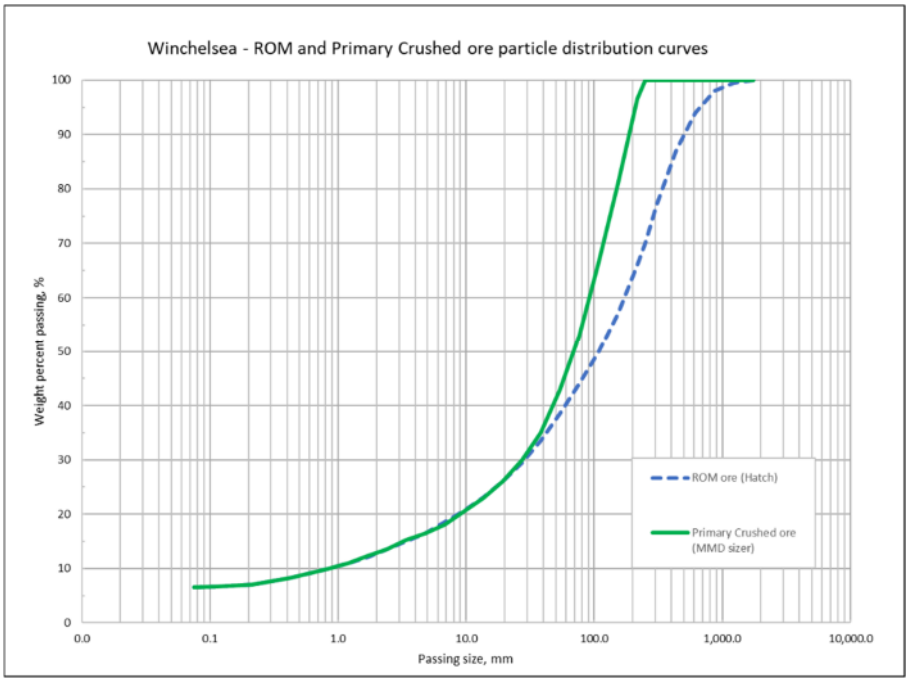


Figure 3: ROM Ore and Primary Crusher Product Particle Size Distribution

4.5.1.3 Mass Balance

Data from the Bruno model was used to develop a solid–liquid mass balance. The schematic flowsheet and stream data are included in Appendix 1.

This mass balance was used to size the various mechanical equipment items and derive the plant footprint.

4.6 Process Description

The following sections describe the main plant circuits and key design considerations.

4.6.1 Primary Crushing, Screening and Secondary Crushing

Ore is loaded directly into the dump hopper via articulated haul trucks (CAT 740 or similar) or front-end loader. The dump hopper is fitted with a static grizzly screen to prevent oversize rocks from entering the crusher and to avoid over capitalisation of the crusher size. An apron feeder feeds the Primary Crusher at a controlled rate. The primary crusher is a horizontal shaft (mineral sizer) type that minimises the generation of fines and handles wet lateritic materials well. Another feature of this type of crusher is that the overall height of the RoM bin is lower than if a jaw crusher is used.

The Primary Crusher discharges onto a transfer conveyor that feeds onto the Scalping Screen Feed Conveyor. The introduction of this transfer point is deliberate to allow the installation of a wood removal device (parallel bars) as it is expected that tree material could be present in the ore stream.

The Scalping Screen Feed conveyor feeds a vibrating double deck screen. The screen deck apertures are nominally 150 mm and 75 mm. The top deck is intended to minimise the impact of coarse material on the bottom deck and captures any tree material present. A wood removal static screen is installed in the +150 mm oversize chute to prevent the wood from entering the secondary crusher circuit. The +75 mm material is transferred by conveyor to the surge bin ahead of the Secondary Crusher. The Secondary Crusher operates in a closed circuit with the Scalping Screen.

4.6.2 Scrubbing and Reject Crushing

The Scalping Screen undersize material (-75 mm) discharges onto the Scrubber Feed Conveyor which feeds a horizontal rotary drum scrubber. A drum scrubber is used to mix water and ore to remove fine clays and sands of the manganese bearing rock. The slurry passes over a trommel screen after the scrubber. It is important that the scrubbing is effective as the fine particles have an unfavourable effect on the DSM separation efficiency.

The trommel screen is integral to the scrubber body and is fitted with 15 mm apertures. The screen oversize fraction feeds the Coarse DMS circuit (DMS 1) with undersize material advancing to the Scrubber Screen.

The Scrubber Screen is used to separate the -15+6 mm, -6+1 mm and -1 mm size fractions. The scrubber screen is a single deck screen but is fitted with two different deck apertures 1 mm and 6 mm respectively.

The -15+6 mm and -6+1 mm fractions discharge onto respective transport conveyors feeding surge bins. The -1 mm fraction is pumped to the ultrafine recovery circuit.

4.6.3 Coarse DMS Circuit – DMS 1

The -15+6 mm fraction is stored in a surge bin ahead of the Coarse DMS (DSM 1) circuit and allows for a steady and even feed rate into the DSM circuit.

The material passes over a feed preparation screen to wash the feed material. The feed preparation screen discharges into the Dense Medium Drum (DM Drum) and is mixed with FeSi slurry (medium). Particles with low SG (floats or rejects) separate from the high SG material. High SG material (sinks) contains the manganese product. The floats are transferred to the reject crusher. Sinks from the DMS 1 unit report to the Lump Product Conveyor and are stockpiled via a telescoping radial stacker.

The floats and sinks pass over a drain and rinse screen to recover valuable FeSi. A magnetic separator is also used to recover FeSi.

4.6.4 Medium and Fine DMS Circuit – DMS 2 and DSM 3

From the Scrubber Screen, the -15+6 mm and -6+1 mm material streams are transferred to the respective surge bins ahead of the Medium and Fine DMS circuits referred to as DMS 2 and DSM 3 respectively. The surge bins allow for steady and even feed rate into the DSM circuits.

The particle size ranges allow separation of floats and sinks by means of a DSM cyclone. The overflow stream contains floats/rejects and the underflow streams contains product.

Cyclone underflow (product) from the DMS 2 circuit is discharged to Lump Product Conveyor and rejects report to the Tailings Transfer Conveyor. Product from the DMS 3 circuit is discharged to the Fine Product Transfer Conveyor, where it is stockpiled in a covered building

via a telescoping radial stacker. Rejects from the DMS 3 circuit reports to the Tailings Transfer Conveyor.

Both the Medium and Fine DMS circuits comprise a similar FeSi screening and magnetic separation handling system to the Coarse DMS circuit.

4.6.5 Ultrafine Recovery

Minus 1 mm particles are recovered by a reflux classifier and is the equipment of choice to recover fine, high density particles like manganese.

Undersize, -1 mm, material from the Scrubber Screen is pumped to a Deslime Cyclone, with cyclone overflow (mainly water and -500 µm solids) reporting to the tailings circuit and the underflow (free of slimes) feeding the reflux classifier.

Slurry containing particles with high SG (manganese rich) is pumped into a dewatering cyclone (whale or fish tail type) located above the Fine Product Transfer Conveyor.

4.6.6 Tailings Treatment

All effluent streams pass over “Tell Tale” sieve bend screens before entering the Tailings Thickener. The tell-tale screens are used to identify a damaged 1 mm screen panel in the upstream process and thus prevent the clarifier form blocking with coarse solids.

Underflow slurry from the Tailings Thickener is pumped to the Tailings Filter, which is a horizontal vacuum belt filter. The Tailings Filter discharges to the Tailings Product Transfer Conveyor, which feeds a stacking conveyor, creating a conical tailings stockpile.

The intent is for tailings (-15 mm) to progressively backfill the mined strips. Tailings will be free of hazardous reagents and materials and can be suitably comingled with mine strip material to create berms and backfill material for future reclamation. This includes creating pond structures for potential fish farming activities following mine closure.

4.6.7 Product Storage

The fine product will be stockpiled in an enclosed shed to provide protection from inclement weather. The lump/coarse product stockpile will not be covered and is located adjacent to the Fine Product Storage Shed.

4.6.8 Product Export

Product removal from the product stockpiles and loading onto a ship is outside the scope of this Concept Study.

In concept, the product will be reclaimed from each of the product stockpiles via front-end loader to feed via a hopper onto the export conveyors.

4.7 Reagents

The process plant uses the following reagents:

- Ferrosilicon powder – medium in DMS circuit
- Flocculant – setting aid to bind fine tailings particles

- Sodium nitrate – to passivate FeSi when DMS circuits are shut down for more than several hours. The quantities are low and are not further considered in the study
- Lime – used to maintain pH of FeSi when DMS circuits are shut down for more than several hours. The quantities are low and are not further considered in the study.

5 Equipment, Plant and Infrastructure

The major mechanical equipment items, selected for the process plant facility, are outlined in Table 3 below. The complete mechanical equipment list used to derive the capital cost estimate is provided in Appendix 2.

Table 3: Process Plant Major Equipment

Item	Qty	Type / Model / Description	Supplier used for costing
Primary crusher	1	Tooth roll crusher, 3 tooth, 8 rings, 500 mm shaft centre	MMD Australia
Secondary crusher	1	Cone crusher, GP 200S	Metso
Rejects crusher	1	Cone crusher, GP 330	Metso
Drum scrubber c/w trommel screen	1	Drum scrubber	McLanahan (Ausenco cost database)
Scalping screen	1	1.8 m W x 4.8 m L	Oreflow
Scrubber screen	1	2.4 m W x 4.8 m L	Oreflow
DMS 1 - Coarse DMS	1	250 t/h Drum module	Malvern (and Ausenco database)
DSM 2 - Medium DMS	1	125 t/h Cyclone module	Bond Equipment
DMs 3 - Fine DMS	1	125 t/h Cyclone module	Bond Equipment
Ultrafine particle recovery	1	RC1400 Reflux Classifier	FLSmidth
Tailings clarifier	1	30 m diameter	Outotec (Ausenco cost database)
Tailings filter	1	Horizontal vacuum belt filter	Tenova/Delkor (Ausenco cost database)
Conveyors	18	Various sizes (520 m total length)	Oreflow and Ausenco cost database
Radial stackers	3	35 m length, 120-degree slew	Ausenco cost database

5.1 Modular Design

Ausenco has based the design of the process plant on modular, skid mounted and/or vendor "plug-and-play" packages where possible. The benefits to this approach include:

- reduced construction time and onsite labour required, facilitated by easier installation
- reduced engineering design time, which has potential to be held up by a slow flow of information between multiple vendors and design check stage-gates
- upon completion of mining activities, the modular nature of the plant allows for expedited reclamation and salvage of major equipment.

Specific vendor packages where this approach has been targeted are detailed below:

1. **Primary Crushing –** MMD Australia are able to provide skid mounted mineral sizers, complete with dump hopper, feeders, discharge conveyors and ancillary equipment. These modules are sized based on throughput and are fabricated in Nerang, QLD. Ausenco is of the opinion the option provided for this concept study is fit for purpose and, although the lead time is long, provides the best opportunity to maintain the overall project schedule.

2. **Conveyors –** the current design comprises 15 fixed conveyors, three portable conveyors and three radial stackers. The fixed conveyors have been costed based on modular truss sections, with a single walkway. These sections are fitted with idler connections and are bolted on site before the belt is installed. The conveyors will include all instrumentation (pull chords, speed sensors etc.). Portable conveyors and radial stackers will be "off-the-shelf" standard selections.

3. **Dense Medium Circuits –** there are several vendors who specialise in dense medium circuits worldwide. These circuits are typically found in the coal industry, diamond, manganese, chromite and iron ore beneficiation, however crucial to manganese application is understanding the FeSi medium, which has a high SG of 3.1 and the medium to ore ratio. This needs to be carefully considered along with the anticipated tonnage throughput. In selecting equipment for costing in this study, Ausenco has selected Bond Equipment as the supplier. Bond Equipment is based in South Africa and Ausenco has used quotations from them in a recent coal application. It is noted, however, that the pricing of the Dense Medium Drum circuit appears low in comparison with the cyclone fed DMS modules. As such, pricing and selection of the Dense Media Drum circuit has used the price provided by Malvern. Based on recent project experience a cost allowance has been added to the DMS circuit to account for an anticipated cost to make upgrades to comply with Australian standards. It is recommended that vendor prequalification and equipment selection is assessed prior to or early in the FS stage to short list potential suppliers and de-risk the project schedule.

The Tailings Clarifier is intended to be a bolted tank design in order to limit the construction time and assist with transport of materials. A similar methodology will apply to the Process Water Tank and Fresh/Fire Water Tank, which are intended to be galvanised section tanks for ease of procurement and assembly.

5.2 Plant Layout

The plant layout has been developed at a conceptual level, with footprints and elevations for major equipment and process plant areas derived from vendor information and Ausenco experience. Conveyor lengths have been calculated within standard design incline and radius limits to determine the estimated conveyor lengths. Where possible, Ausenco has targeted a compact and efficient plant footprint, whilst still allowing for suitable access and maintenance space.

The proposed process plant layout and overall site layout is provided in Figure 4 and Figure 5 respectively on the pages below.

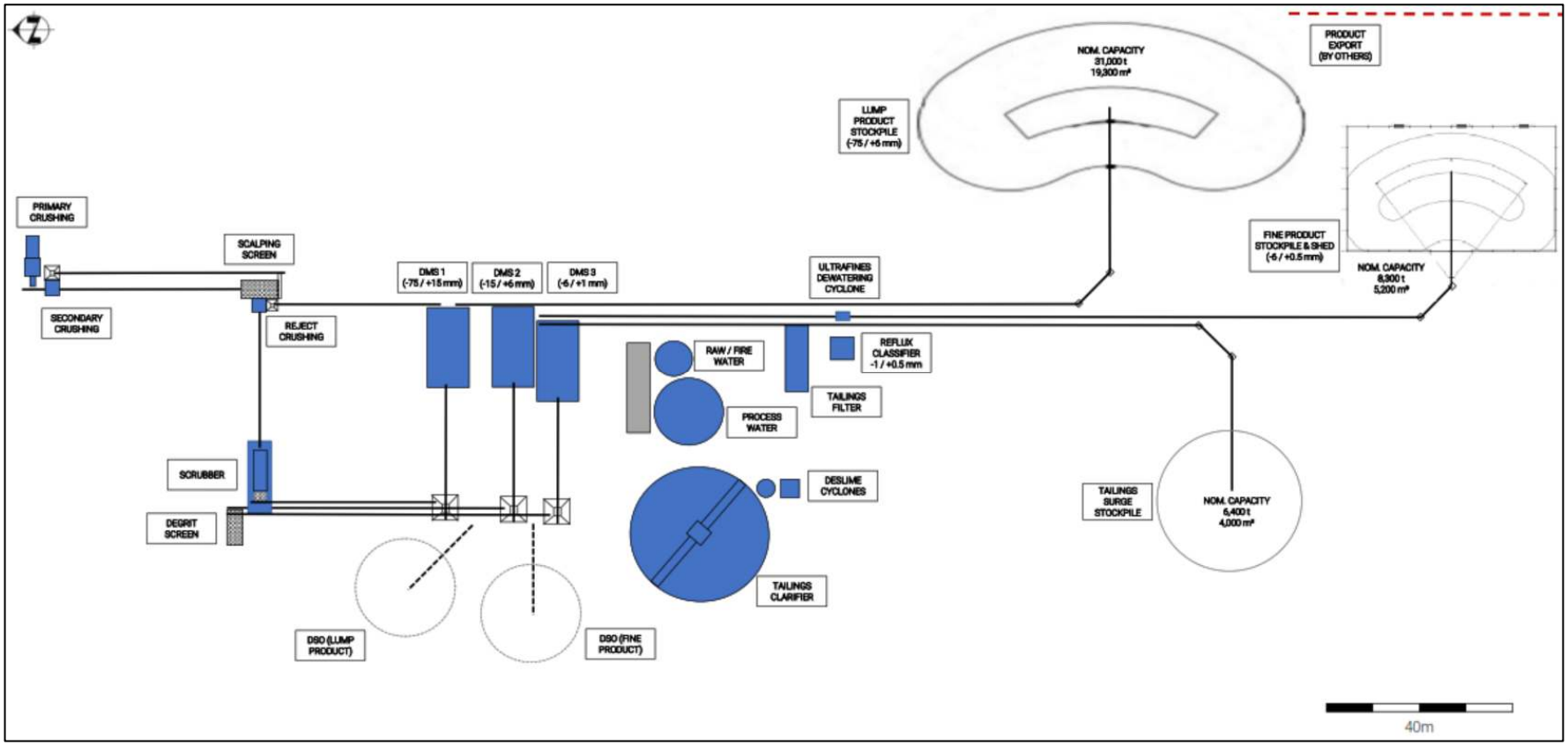


Figure 4: Process Plant Layout

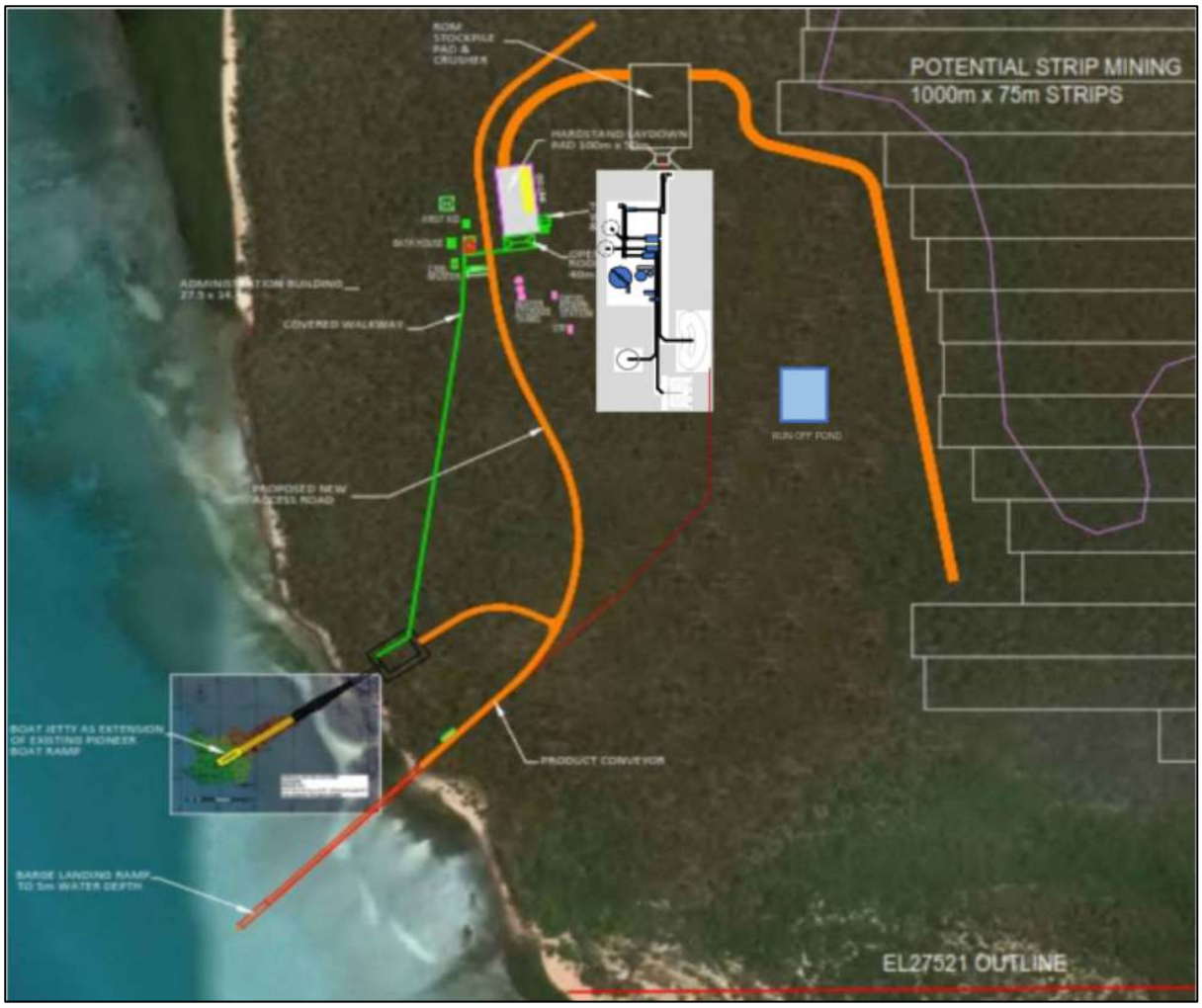


Figure 5: Overall Site Layout

5.3 Buildings

Costing for the proposed buildings to support the process facility is derived from similar, recent installations. Typically, containerised and modular/portal frame designs have been nominated to reduce cost. Fit out for these buildings has been excluded.

5.4 Ancillary Infrastructure

No provision has been made for mobile equipment or tyre/mobile equipment wash bays. It is assumed this will be captured in the mining contractor scope.

6 Project Implementation Schedule

A preliminary project implementation schedule has been developed incorporating the major activities from concept study phase through to first product shipment. The schedule is provided in Figure 6. The project implementation scheduled is based on the schedule provided by Xenith Mining Consultants in the Winchelsea Mining Project Overview presentation (March 2020). Ausenco has updated this schedule by providing additional detail pertaining to testwork, feasibility studies, detailed design, procurement and construction.

A somewhat ambitious timeline has been derived. The critical path activities that drive achievement of the proposed schedule are as follows:

1. **Metallurgical testwork –** includes collection of samples, transport to the lab, testwork and interpretation of results. It is anticipated the testwork program will take eight weeks, commencing in July 2020. The testwork is crucial to developing the process design criteria and equipment design at commencement of the Feasibility Study.

2. **Ausenco Feasibility Study (FS) –** the Ausenco FS will focus on the process plant and supporting infrastructure only and will take approximately five months. The outcome of the FS is to derive the final project capital and operating costs and facilitate purchase of long lead equipment items. The Ausenco FS will feed into the overall project feasibility study, which includes costs and designs for mining and port facilities.

3. **Procurement –** several items of major equipment will have extended lead time in the order of 26 – 34 weeks. This primarily comprises the primary crushing package, secondary and tertiary crushers, scrubber and DMS modules. Long lead equipment will need to be identified and appropriately selected/designed prior to and during the FS stage to achieve the earliest construction completion target.

4. **Detailed Design –** detailed design of the process plant is anticipated to take approximately six months, commencing in January 2021 (dependent on completion of the FS and Owner reviews). Ausenco will produce construction drawings, material take-offs and detailed lists to facilitate purchase of equipment packages and execution of contract packages, including civil, concrete, electrical and structural, mechanical and piping.

5. **Construction –** due to the remote location of the project site, a staged construction approach will be required. The intent will be to ensure key infrastructure (power, water etc.), camp accommodation and site preparation is completed well in advance of construction of the process plant. A detailed schedule will be developed during the FS stage, incorporating delivery of equipment, contractor availability and additional influencing factors (e.g. weather, labour force, work hours etc.)

Ausenco has not validated the proposed dates and timelines for activities outside the process plant scope of work.

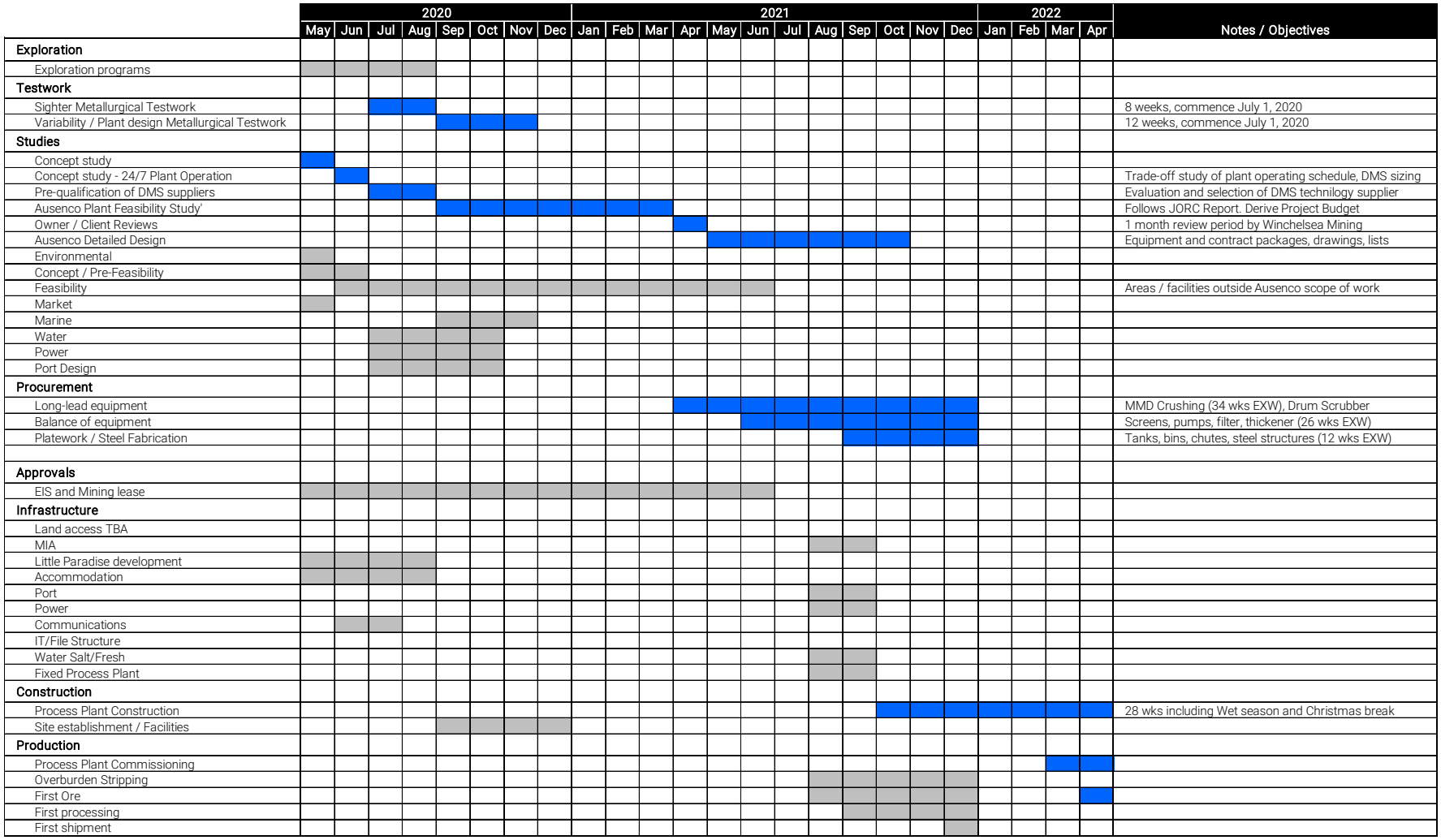


Figure 6: Project Implementation Schedule

7 Capital Cost Estimate

7.1 Base Case

For this Conceptual Study, a capital cost estimate was derived from the mechanical equipment list, with pricing obtained direct from vendor quotation and Ausenco's equipment cost database.

Installation hours and rates have been applied in accordance with Ausenco estimating standards, derived from an extensive database of similar installations. Factors have been applied against the mechanical equipment cost for bulk materials, such as earthworks, concrete, steel, platework, piping and electrical & instrumentation to arrive at a total direct cost for plant and infrastructure.

For the Conceptual Study, a provision has been made for temporary construction facilities, EPCM engineering costs and Owner's contingency. Other indirect costs have not been estimated at this stage.

The estimated direct capital cost uses cost of 2nd quarter 2020. The capital cost estimate is provided in Table 4.

Table 4: Capital Cost Estimate

Area	Cost Estimate AUD million
Direct Costs	
Primary Crushing	4.3
Secondary Crushing	4.0
Scrubbing	4.7
DMS 1 (-75 +15 mm)	4.0
DMS 2 (-15 +8 mm)	3.6
DMS 3 (-8 +1 mm)	3.3
FeSi	0.7
Ultrafine (-1 mm)	1.5
Tailings	6.4
Product Stacking	3.8
Reagents	0.2
Air and Water Services	2.2
Buildings & Infrastructure	3.1
Sub-total Direct Cost	**41.8**

Area	Cost Estimate AUD million
Indirect Costs	
Spares and First Fills	1.3
Temporary Facilities and Field Indirect cost	2.3
EPC Project costs / EPCM Services	7.7
Sub-total Indirect Cost	**11.2**
Continency and Escalation 25% of Direct + Indirect costs	13.3
Total Beneficiation Plant Project Cost	**66.3**

7.2 Capital Cost Estimate for Continuous Operation

It is worth noting that significant capital cost reductions can be achieved for a continuous operation scenario. This would require day shifts and night shifts to be implemented from Friday through Sunday (currently proposed as Monday through Friday). A continuous operating schedule would result in 8,000 hrs/year of operation as opposed to 4,940 hrs/year, resulting in the nominal throughput rate reducing by 35% to 188 t/h (currently 304 t/h).

The expected reduction in the direct capital cost for this scenario is approximately $10M equating to a reduction of the overall project cost of $15M. This indicative cost has been derived by applying the “6-tenth rule”. This is a commonly accepted method to scale process plant facility costs at a different plant throughput rate. The 6-tenth rule has been applied to the mechanical equipment cost component, with subsequent installation and bulk quantities factors reduced (with the exception of earthworks, which has been retained).

It is recommended that further analysis of the operating schedule is undertaken in conjunction with the associated increase in labour costs, as well as operating cost changes resulting from changes in power use, maintenance, reagents and consumables.

8 Operating Cost Estimate

8.1 Operating Cost Summary

The operating cost estimate is derived from the design criteria, conceptual mass balance and input data provided by Xenith.

The operating cost estimate covers the following cost centres:

- Labour
- Electrical power
- Reagents
- Maintenance
- Maintenance consumables
- General and Administration

The operating cost estimate of each cost centre was developed from several sources and is described in Table 5.

Table 5: Operating Cost Estimate

Cost Centre	Items	AUD / year	AUD/t plant feed	AUD/t product
Labour	Plant operating labour, 3.5 FTE per shift Plant maintenance labour, 4 FTE on day shift Crew leader, 1 FTE on day shift Cost of employment $100, 110, 120 /h/ea G&A personnel excluded	1,341,600	0.89	2.68
General Maintenance	8% of equipment supply cost	1,531,900	1.02	3.06
General & Admin	Allowance for laboratory cost (plant and exploration samples), $100 k/y Allowance for consultants, $40k /y, 4 consultants Allowance for site vehicles, $150 /d/ea, 1x ute, 1x bobcat	369,500	0.25	0.74
Electrical Power	Drive size, 80% loading, 4,940 hrs /y, $0.20/kWh	3,577,167	2.38	7.15

Cost Centre	Items	AUD / year	AUD/t plant feed	AUD/t product
Reagents	FeSi, 0.5kg / t DMS feed, $1,815 /t delivered Flocculant, 20 g/t solids in thickener feed, $4,840 /t delivered Excludes NaNO3 and Lime due to small yearly quantities	1,845,976	1.23	3.69
Maintenance Consumables	Allowance for primary crusher wear parts, $40k, x 6 times per year Allowance for cone crusher wear parts, $25 k, x 6 times per year each Allowance for 30% of the screen deck replacement, 58m2, $110/sq ft panel Allowance for three vacuum filter cloth replacements, $10k /ea	638,820	0.43	1.28
Fresh water	44,000 m³/y, free of charge to beneficiation plant	excluded	excluded	excluded
TOTAL		**9,304,963**	**6.20**	**18.61**

8.2 Diesel and Water demand

The running load of the beneficiation plant is 3.9 MW which results in 17,900 MWh of electrical power per year. On the basis that all electrical power is generated by diesel driven generator sets approximately 4,850 m³ of diesel fuel is required. The diesel demand is derived from a typical diesel consumption rate of 0.27 L/kW.

The yearly average fresh water demand to support the beneficiation plant is 44,335 m³ (or 9 m³/h). This probably an under estimation as the amount of dewatered tailings filter cake (-1 mm) is based on a single particle size distribution of the run-off mine product. The variation has not been assessed in this concept study.

It has been assumed that the fresh water is free of charge to the beneficiation plant.

9 Metallurgical Testwork Program

9.1 Introduction

Ausenco proposes a sighter test program is completed to progress the Winchelsea project evaluation further, by developing a more accurate plant design and associated costing.

The initial program is based on:

1. Examine the material that will be fed to the plant first and represents the material that is used to pay the plant off
2. Variability samples, in order to gain an understanding of how the feed stock varies in terms of particle size and grade
3. Test amenability to dense medium separation and expected recovery to product
4. Investigate the suitability of sizer technology

Ultimately, the more variability samples that are tested, the better the data set.

Ausenco recommends the services of the Nagrom laboratory are used to carry out the gravity separation testwork. Nagrom is highly specialist in this work and commodity.

As an initial testwork program, the below program (divided into two parts) is proposed. A quotation is included in Appendix 3.

1. Metallurgical characterisation to support
    a. product yield in each size range
    b. understand the loss to tailings
2. Ore characterisation to support crusher type selection

9.2 Sighter Tests Program

9.2.1 Sighter Tests Metallurgical Test Sequence

- Particle size distribution of extracted sample – this provides an indication of the particle size distribution and variance
- Crush to -75 mm, being the maximum particle size to be recovered
- Produce fractions -75 +10 mm, -8 +10 mm and -1 +0.25 mm, to determine the dense medium separation performance
- Dense medium separation tests in each size fraction, to determine the density cut point and product recovery
- Assay by size of the -1 mm fraction, to determine the presence of manganese. This will set the bottom cut-off size
- XRD on head sample, to provide head grade of major element

- XRD on product and reject samples, to provide product and reject grades

9.2.2 Ore crushing characteristics

Ore crushing parameters are required to determine the suitability of a mineral sizer or jaw crusher. The following data is required:

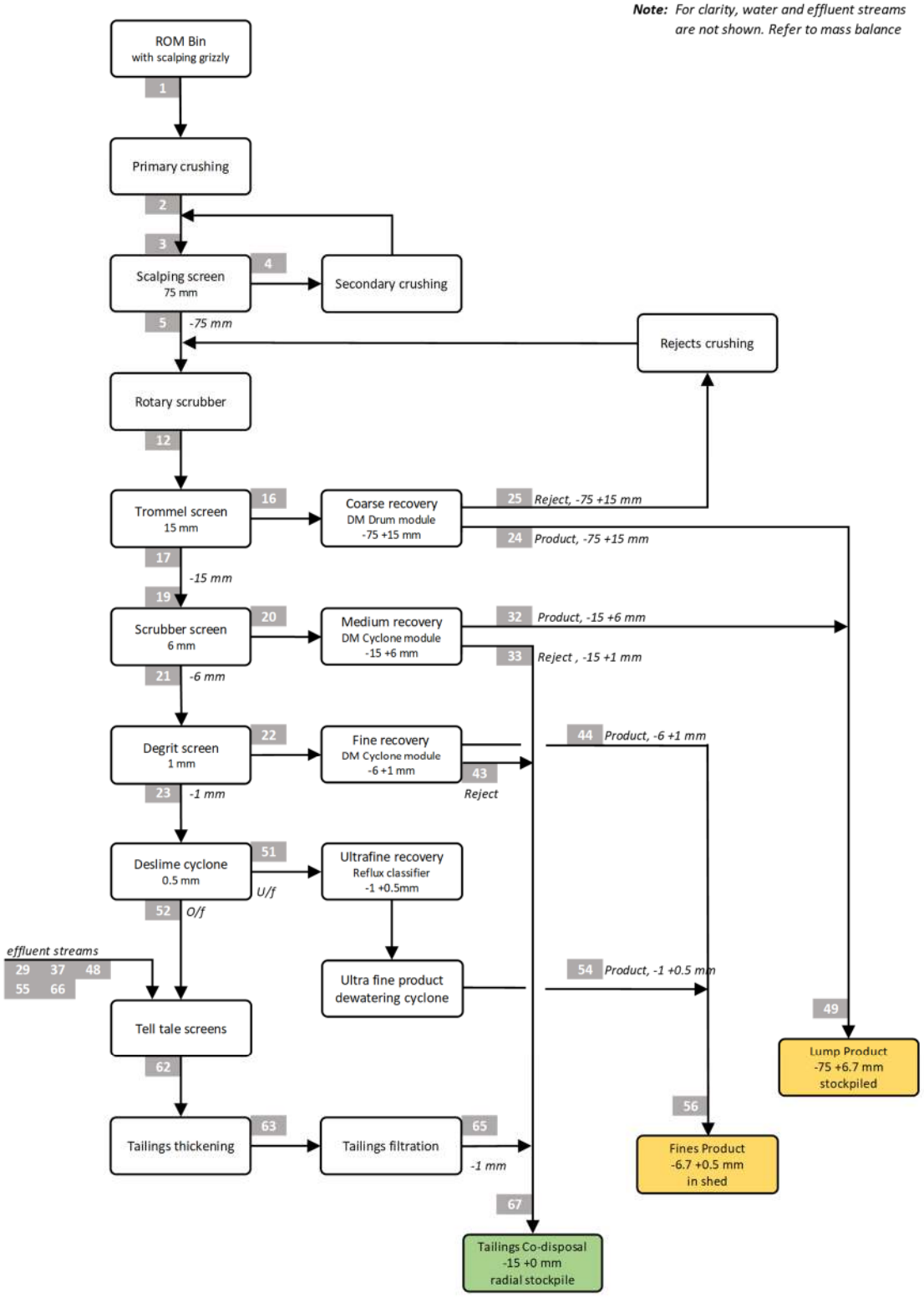
- Unconfined stress (UCS)
- Bond Abrasion index (Ai)
- Crusher work index (CWi)

Appendix 1 – Flowsheet and Stream Data

Project	Winchelsea Manganese
Job number	104920-01
Subject	Process Plant Block Flow Diagram, rev B
Last updated	15 May 2020

Ausenco

Note: *For clarity, water and effluent streams are not shown. Refer to mass balance*



Project	Winchelsea Manganese
Job no.	104920-01
Subject	Process Plant Mass balance
Last updated	19 May 2020

Ausenco

Stream no.	Stream name	design t/h solids	solids t/h	water t/h	stream t/h	stream m3/h	stream % w/w solids	solids dist'n
1	ROM feed (-600mm)		304	9	313		97	100
2	Primary crushed product		304	9	313		97	100
3	Scalping screen combined feed							
4	Scalping screen o/s		186	6	192		97	61
5	Scalping screen u/s		304	9	313		97	100
7	Reject crusher product		155	5	160		97	51
11	PW - Scrubber water addition		-	444	444	444	-	-
12	Scubber discharge		458	458	917	602	50	151
15	PW - Trommel screen sprays		-	45	45	45	-	-
16	Trommel screen o/s (+15 mm)		204	6	210		97	67
17	Trommel screen u/s (-15 mm)		254	497	751	577	34	84
23	DMS 1 feed (-75 +15 mm)		204	6	210		97	67
24	DMS 1 product / Lump sub-total		49	2	51		97	16
25	DMS 1 reject		155	5	160		97	51
26	PW - DMS 1 feed prep pulping		-	77	77	77	-	
27	PW - DMS 1 product screen sprays		-	30	30	30	-	
28	PW - DMS 1 reject screen sprays		-	30	30	30	-	-
29	DMS 1 effluent		-	137	137	137	-	
18	PW - Degrit screen sprays		-	45	45	45	-	-
19	Scrubber screen feed		254	497	751	577	34	84
dummy	Screen feed o/s 15+1 mm		202					
20	Scrubber screen top deck o/s +6 mm		125	5	130		96	41
21	Scrubber screen feed		129	537	666	577	19	43
22	Degrit screen bottom deck o/s +1 mm		77	4	81		95	25
23	Degrit screen u/s -1mm		52	533	585	549	9	17
31	DMS 2 feed (-15 +6 mm)		125	5	130		96	41
32	DMS 2 product / Lump sub-total		30	2	32		95	10
33	DMS 2 reject, sub-total		95	5	100		95	31
34	PW - DMS 2 feed prep pulping		-	175	175	175	-	-
35	PW - DMS 2 product screen sprays		-	30	30	30	-	
36	PW - DMS 2 reject screen sprays		-	30	30	30	-	-
37	DMS 2 effluent		-	233	233	233	-	-
38	**Lump Product - Total**		80	3.1	83		96.2	26
21	DMS 3 feed (-6 +1 mm)		77	4	81		95	25
44	DMS 3 product / Fines sub-total		19	1	20		95	6
43	DMS 3 reject, sub-total		59	3	62		95	19
45	PW - DMS 3 feed prep pulping		-	108	108	108	-	
46	PW - DMS 3 product screen sprays		-	30	30	30	-	
47	PW - DMS 3 reject screen sprays		-	30	30	30	-	-
48	DMS 3 effluent		-	168	168	168	-	
51	Deslime cyclone u/f		12	37	49	40	25	4
52	Deslime cyclone o/f		40	496	536	509	7	13
53	PW - Reflux Classifier circuit		-	20	20	20	-	-
54	Ultra fines product, sub-total		3	1	3.7	1.7	80	1
55	RC effluent		9	56	65	59	14	3
56	**Fines Product - Total**		22	1.7	23		93	7
						-		
61	Tell tale screen feed		49	1,166	1,215	1,181	4	16
62	Tailings thickener feed		49	1,166	1,215	1,181	4	16
63	Tailings filter feed		49	60	109	75	45	16
64	PW - Tails filter water demand		-	20	20	20	-	-
65	Tailings filter cake		49	5	55		90	
66	Tailings filter filtrate		-	75	75	75	-	
67	**Plant tailings**		202	14	216	77	94	67
71	Thickener o/f (PW internal recycle)		-	1,106	1,106	1,106	-	
72	PW plant demand		-	1,115	1,115	1,115	-	-
73	TSF decant water return		-	-	-	-		
74	PW make-up		-	9	9	9	-	

Yearly stream data:	Solids M t/y	Water M t/y	Stream M t/y	Stream M m3/y	Stream % solids	Solids dist'n %
Plant feed	1.500	0.046	1.546	-	97	100
Lump Product -75+6.7mm	0.393	0.015	0.408	-	96	26
Fines Product -6.7+0.5mm	0.107	0.009	0.115	-	93	7
Combined tailings	1.000	0.057	1.057	0.379	94	67

Water demand, average	44,335	m3/y
Flocculant usage	4.9	t/y
FeSi usage	1,004	t/y

Appendix 2 – Mechanical Equipment List

MECHANICAL EQUIPMENT LIST

Ausenco

Doc. No.: 104920-LST-MX-001

Project: Wichelsea Project

Client: Xenith Consulting

Rev: A

Date: 28/05/2020

Equip Tag	Area	Equip.	No.	Equipment Title	Equipment Package	Vendor Name	Specifications	Duty / Standby	Starter Type	Total Installed (kW)
10-BN-001	10	BN	001	ROM Bin	001	MMD	Vendor package: To suit CAT-740 (22m3) 40 m3 live c/w 600 mm parallel grizzly bars. Includes all platework.	D	n/a	n/a
10-CR-001	10	CR	001	Primary Crusher	001	MMD	Vendor package: 500 Series 3 Tooth 8 Ring Sizer c/w single R200 GB and 132kw WEG Motor	D	VSD	132
10-CV-001	10	CV	001	CNV - Primary Crusher Discharge	001	MMD	Vendor package: design 380 t/h, Particle top size 180 mm	D	DOL	11
10-CV-002	10	CV	002	CNV - Scalping Screen Feed	012	database	Design 600 t/h, Belt speed 1.9 m/s, Particle top size 180 mm, horizontal length 50 m, lift 10 m, B.W. 650 mm	D	Soft	30
10-DC-001	10	DC	001	Dust Collector	017	database	Dust extraction system c/w bag house, extraction fan, discharge onto belt	D	DOL	7.5
10-FD-001	10	FD	001	Primary Crusher Feeder	001	MMD	Vendor package: 10m Apron Feeder, design 350 t/h	D	VSD	18.5
10-PP-001	10	PP	001	Floor Pump - Primary Crusher	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
10-WT-001	10	WT	001	Belt Scale - Scalping Screen Feed	022	database	Type : dual idler set, 1% accuracy	D	n/a	n/a
15-CR-002	15	CR	002	Secondary Crusher	002	Metso	Cone crusher, 220 t/h, ccs 50 mm, c/w oil lube system	D	Soft	160
15-CR-003	15	CR	003	Rejects Crusher	002	Metso	Cone crusher, 220 t/h, ccs 13mm, c/s oil lube system	D	Soft	315
15-CV-003	15	CV	003	CNV - Secondary Crusher Feed	012	database	Design 250 t/h, Belt speed 1.5 m/s, Particle size 180 +75 mm, horizontal length 50 m, lift 11 m, B.W. 500 mm	D	DOL	15
15-CV-004	15	CV	004	CNV - DMS 1 Rejects Transfer	012	database	Design 200 t/h, Belt speed 1.5 m/s, Particle size -75 +15 mm, horizontal length 40 m, lift 9 m, B.W. 500 mm	D	DOL	11
15-FD-002	15	FD	002	Secondary Crusher Feeder	014	database	Vibrating pan feeder, 150-220 t/h	D	VSD	7.5
15-FD-	15	FD	003	Reject Crusher Feeder	014	database	Vibrating pan feeder, 150-220 t/h	D	VSD	7.5
15-SC-001	15	SC	001	Scalping Screen	004	Oreflow	Vibrating, double deck. Screen size, 1.8 m x 4.8 m Top deck = 150 mm, Bottom deck = 75 mm aperture.	D	DOL	18
15-WT-002	15	WT	002	Belt Scale - Secondary Crushing Feed	022	database	Type: dual idler set, 1% accuracy	D	n/a	n/a
20-CV-005	20	CV	005	CNV - Scrubber Feed	012	database	Design 600 t/h, Belt speed 2.1 m/s, Particle size -75 mm, horizontal length 40 m, lift 10 m, B.W. 650 mm	D	Soft	30

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Equip Tag	Area	Equip.	No.	Equipment Title	Equipment Package	Vendor Name	Specifications	Duty / Standby	Starter Type	Total Installed (kW)
20-PP-002	20	PP	002	Floor Pump - Scrubber Screen	011	database	Vertical spindle pump, 50 m3/h, 20 m	D	DOL	11
20-PP-003	20	PP	003	Floor Pump - Scrubber Discharge End	011	database	Vertical spindle pump, 50 m3/h, 20 m	D	DOL	11
20-PP-004	20	PP	004	Pump - Degrit screen effluent 1	011	database	Centrigual, head 20 m, flowrate 549 m3/h	D	VSD	55
20-PP-005	20	PP	005	Pump - Degrit screen effluent 2 s/b	011	database	Centrigual, head 20 m, flowrate 549 m3/h	S	VSD	55
20-PP-006	20	PP	006	Pump - Degrit screen feed 1	011	database	Centrigual, head 10 m, flowrate 577 m3/h	D	VSD	75
20-PP-007	20	PP	007	Pump - Degrit screen feed 2 s/b	011	database	Centrigual, head 10 m, flowrate 577 m3/h	S	VSD	75
20-SB-001	20	SB	001	Drum Scrubber	003	McLanahan	Rotary drum scrubber tyre mounted. Drum 3 m dia x 9.1 m, 500 t/h solids. Trommel screen 15 mm aperture, length 2.1m	D	VSD	250
20-SC-002	20	SC	002	Scrubber Screen	004	Oreflow	Vibrating, dual deck. Screen size, 1.8 m x 4.8 m First deck = 1 mm, Second deck = 6.8 mm aperture.	D	DOL	18
20-WT-003	20	WT	003	Belt Scale - Scrubber Feed	022	database	Type : dual idler set, 1% accuracy	D	n/a	n/a
31-AG-001	31	AG	001	Agitator - DMS 1 FeSi storage tank	015	database	to store the FeSi inventory, assume 15 m3 tank, full bottom suspension	D	DOL	7.5
31-CV-006	31	CV	006	CNV - DMS 1 Bin Feed	012	database	Design 300 t/h, Belt speed 2.1 m/s, Particle size -75 +15 mm, horizontal length 42 m, lift 10 m, B.W. 500 mm	D	DOL	15
31-CV-007	31	CV	007	CNV - DMS 1 Feed	012	database	Design 300 t/h, Belt speed 2.1 m/s, Particle size -75 +15 mm, horizontal length 30 m, lift 6 m, B.W. 500 mm	D	DOL	11
31-CY-001	31	CY	001	CY - DMS 1 densifier cyclone	005A	Bond	Vendor package	D	n/a	n/a
31-MS-001	31	MS	001	MS - DMS 1 magnetic separator	005A	Bond	Vendor package: Permanent drum magent, counter current, double drum	D	DOL	3
31-PP-008	31	PP	008	Floor pump - DMS 1 feed side	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
31-PP-009	31	PP	009	Floor pump - DMS 1 product end	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
31-PP-010	31	PP	010	PP - Pump - DMS 1 correct medium	005A	Bond	Vendor package	D	DOL	185

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Equip Tag	Area	Equip.	No.	Equipment Title	Equipment Package	Vendor Name	Specifications	Duty / Standby	Starter Type	Total Installed (kW)
31-PP-011	31	PP	011	PP - Pump - DMS 1 dilute medium	005A	Bond	Vendor package	D	DOL	75
31-PP-012	31	PP	012	PP - Pump - DMS 1 densifier feed	005A	Bond	Vendor package	D	DOL	75
31-PP-013	31	PP	013	PP - Pump - DMS 1 effluent	005A	Bond	Vendor package	D	DOL	90
31-SB-002	31	SB	002	SB - DM Drum DMS 1	005A	Bond	Malvern : Drum 4.2 m dia x 5.4 m. Max througput 275 t/h	D	Soft	22
31-SC-003	31	SC	003	SC - DMS 1 feed prep screen	005A	Bond	Vendor package	D	DOL	18.5
31-SC-004	31	SC	004	SC - DMS 1 product screen drain panel	005A	Bond	Vendor package	D	n/a	n/a
31-SC-005	31	SC	005	SC - DMS 1 product drain/rinse screen	005A	Bond	Vendor package	D	DOL	45
31-SC-006	31	SC	006	SC - DMS 1 reject screen drain panel	005A	Bond	Vendor package	D	n/a	n/a
31-SC-007	31	SC	007	SC - DMS 1 reject drain/rinse screen	005A	Bond	Vendor package	D	DOL	55
31-WT-004	31	WT	004	Belt Scale - DMS 1 Feed	022	database	Type : dual idler set, 1% accuracy	D	n/a	n/a
31-WT-005	31	WT	005	Belt scale - DMS 1 Rejects	022	database	Type : dual idler set, 1% accuracy	D	n/a	n/a
31-XE-001	31	XE	001	XE - DMS 1 demagnetising coil	005A	Bond	Vendor package	D	DOL	7.5
32-AG-002	32	AG	002	Agitator - DMS 2 FeSi storage tank	015	database	to store the FeSi inventory, assume 25 m3 tank, full bottom suspension	D	DOL	11
32-CV-008	32	CV	008	CNV - DMS 2 Bin Feed	012	database	Design 200 t/h, Belt speed 1 m/s, Particle size -15 +6 mm, horizontal length 60 m, lift 10 m, B.W. 500 mm	D	DOL	11
32-CV-009	32	CV	009	CNV - DMS 2 Feed	012	database	Design 200 t/h, Belt speed 1.5 m/s, Particle size -15 +6 mm, horizontal length 30 m, lift 6 m, B.W. 500 mm	D	DOL	11
32-CY-002	32	CY	002	CY - DMS 2 cyclone	005B	Bond	Vendor package	D	n/a	n/a
32-CY-003	32	CY	003	CY - DMS 2 densifier cyclone	005B	Bond	Vendor package	D	n/a	n/a

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Equip Tag	Area	Equip.	No.	Equipment Title	Equipment Package	Vendor Name	Specifications	Duty / Standby	Starter Type	Total Installed (kW)
32-MS-002	32	MS	002	MS - DMS 2 magnetic separator	005B	Bond	Vendor package: Permanent drum magent, counter current, double drum	D	DOL	3
32-PP-014	32	PP	014	Floor pump - DMS 2 feed side	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
32-PP-015	32	PP	015	Floor pump - DMS 2 product end	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
32-PP-016	32	PP	016	PP - Pump - DMS 2 cyclone feed	005B	Bond	Vendor package	D	VSD	185
32-PP-017	32	PP	017	PP - Pump - DMS 2 correct medium	005B	Bond	Vendor package	D	Soft	160
32-PP-018	32	PP	018	PP - Pump - DMS 2 dilute medium	005B	Bond	Vendor package	D	DOL	75
32-PP-019	32	PP	019	PP - Pump - DMS 2 densifier feed	005B	Bond	Vendor package	D	DOL	75
32-PP-020	32	PP	020	PP - Pump - DMS 2 effluent	005B	Bond	Vendor package	D	DOL	55
32-SC-008	32	SC	008	SC - DMS 2 feed prep screen	005B	Bond	Vendor package	D	DOL	18.5
32-SC-009	32	SC	009	SC - DMS 2 product screen drain panel	005B	Bond	Vendor package	D	n/a	n/a
32-SC-010	32	SC	010	SC - DMS 2 product drain/rinse screen	005B	Bond	Vendor package	D	DOL	37
32-SC-011	32	SC	011	SC - DMS 2 reject screen drain panel	005B	Bond	Vendor package	D	n/a	n/a
32-SC-012	32	SC	012	SC - DMS 2 reject drain/rinse screen	005B	Bond	Vendor package	D	DOL	45
32-WT-006	32	WT	006	Belt scale - DMS 2 feed	022	database	Type : dual idler set, 1% accuracy	D	n/a	n/a
32-XE-002	32	XE	002	XE - DMS 2 demagnetising coil	005B	Bond	Vendor package	D	DOL	7.5
33-AG-003	33	AG	003	Agitator - DMS 3 FeSi storage tank	015	database	to store the FeSi inventory, assume 25 m3 tank, full bottom suspension	D	DOL	11
33-CV-010	33	CV	010	CNV - DMS 3 Bin Feed	012	database	Design 150 t/h, Belt speed 1.5 m/s, Particle size -15 +6 mm, horizontal length 75 m, lift 12 m, B.W. 500 mm	D	DOL	11

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Equip Tag	Area	Equip.	No.	Equipment Title	Equipment Package	Vendor Name	Specifications	Duty / Standby	Starter Type	Total Installed (kW)
33-CV-011	33	CV	011	CNV - DMS 3 Feed	012	database	Design 150 t/h, Belt speed 1.5 m/s, Particle size -15 +6 mm, horizontal length 30 m, lift 6 m, B.W. 500 mm	D	DOL	5.5
33-CY-004	33	CY	004	CY - DMS 3 cyclone	005C	Bond	Vendor package	D	n/a	n/a
33-CY-005	33	CY	005	CY - DMS 3 densifier cyclone	005C	Bond	Vendor package	D	n/a	n/a
33-MS-003	33	MS	003	MS - DMS 3 magnetic separator	005C	Bond	Vendor package: Permanent drum magent, counter current, double drum	D	DOL	3
33-PP-021	33	PP	021	Floor pump - DMS 3 feed side	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
33-PP-022	33	PP	022	Floor pump - DMS 3 product end	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
33-PP-023	33	PP	023	PP - Pump - DMS 3 cyclone feed	005C	Bond	Vendor package	D	VSD	185
33-PP-024	33	PP	024	PP - Pump - DMS 3 correct medium	005C	Bond	Vendor package	D	DOL	160
32-PP-025	32	PP	025	PP - Pump - DMS 3 densifier feed	005C	Bond	Vendor package	D	DOL	75
33-PP-026	33	PP	026	PP - Pump - DMS 3 dilute medium	005C	Bond	Vendor package	D	DOL	75
33-PP-027	33	PP	027	PP - Pump - DMS 3 effluent	005C	Bond	Vendor package	D	DOL	55
33-SC-013	33	SC	013	SC - DMS 3 feed prep screen	005C	Bond	Vendor package	D	DOL	18.5
33-SC-014	33	SC	014	SC - DMS 3 product screen drain panel	005C	Bond	Vendor package	D	n/a	n/a
33-SC-015	33	SC	015	SC - DMS 3 product drain/rinse screen	005C	Bond	Vendor package	D	DOL	37
33-SC-016	33	SC	016	SC - DMS 3 reject screen drain panel	005C	Bond	Vendor package	D	n/a	n/a
33-SC-017	33	SC	017	SC - DMS 3 reject drain/rinse screen	005C	Bond	Vendor package	D	DOL	45
33-WT-007	33	WT	007	Belt Scale - DMS 3 Feed	022	database	Type : dual idler set, 1% accuracy	D	n/a	n/a

MECHANICAL EQUIPMENT LIST

Ausenco

Doc. No.: 104920-LST-MX-001

Project: Wichelsea Project

Client: Xenith Consulting

Rev: A

Date: 28/05/2020

Equip Tag	Area	Equip.	No.	Equipment Title	Equipment Package	Vendor Name	Specifications	Duty / Standby	Starter Type	Total Installed (kW)
33-XE-003	33	XE	003	XE - DMS 3 demagnetising coil	005C	Bond	Vendor package	D	DOL	7.5
34-AG-004	34	AG	004	FeSi make-up tank agitator	015	database	Agitator, full suspension	D	DOL	5.5
34-FD-004	34	FD	004	FeSi feeder	023	database	Screw feeder	D	DOL	2.2
34-HT-001	34	HT	001	FeSi hoist	023	database	Monorail beam with hoist, 1T bulk bags	D	feeder	5.5
34-PP-028	34	PP	028	Pump - FeSi transfer	023	database	Centrifugal, 25 m3/h, 15 m	D	DOL	15
34-PP-029	34	PP	029	Floor pump - FeSi makeup	011	database	Vertical spindle pump, 25 m3/h, 15 m	D	DOL	7.5
40-CY-006	40	CY	006	Deslime cyclone cluster	010	database	Cyclone cluster 2 duty cylones, 1 spare, 500 mm (20") diameter	D	n/a	n/a
40-CY-007	40	CY	007	Ultrafine product dewatering cyclone	010	database	Fishtail, 100 mm (4") diameter	D	n/a	n/a
40-PP-030	40	PP	030	Floor pump - Ultra fines	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
40-PP-031	40	PP	031	Floor pump - dewatering cyclone water return	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
40-PP-032	40	PP	032	Pump - Classifier feed 1	011	database	Centrigual, head 15 m, flowrate 40 m3/h	D	VSD	5.5
40-PP-033	40	PP	033	Pump - Classifier feed 2 s/b	011	database	Centrigual, head 15 m, flowrate 40 m3/h	S	VSD	5.5
40-PP-034	40	PP	034	Pump - Classifier overflow 1	011	database	Centrigual, head 15 m, flowrate 60 m3/h	D	DOL	7.5
40-PP-035	40	PP	035	Pump - Classifier overflow 2 s/b	011	database	Centrigual, head 15 m, flowrate 60 m3/h	S	DOL	7.5
40-PP-036	40	PP	036	Pump - Ultra fines product 1	011	database	Centrigual, head 20 m, flowrate 4 m3/h	D	VSD	1.5
40-PP-037	40	PP	037	Pump - Ultra fines product 2 s/b	011	database	Centrigual, head 20 m, flowrate 4 m3/h	S	VSD	1.5
40-CL-001	40	CL	001	Reflux Classifier	007	FLS	Reflux classifier	D	n/a	n/a

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50-CV-012	50	CV	012	CNV - Tailings Transfer	012	database	Design 300 t/h, Belt speed 2.1 m/s, Particle size -15 +6 mm, horizontal length 145m, lift 2m, B.W. 500 mm	D	DOL	11
50-CV-013	50	CV	013	CNV - Tailings Mobile Conveyor	013	database	Mobile/Grasshopper conveyor. Design 250 t/h.	D	DOL	30
50-SA-001	50	SA	001	Sampler - Coarse talings	021	database	Cross trajectory cutter c/w collection hopper and discharge feeder	D	Feeder	5.5
50-FL-001	50	FL	001	Tailings filter	009	database	Horizontal vacuum belt filter. Design 100 t/h solids	D	VSD	20.5
50-PP-038	50	PP	038	Floor pump - FIter discharge end	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
50-PP-039	50	PP	039	Floor pump - Tailings thickener	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
50-PP-040	50	PP	040	Pump - Filter feed 1	011	database	Centrifugal, 75 m3/h, 10 m	D	VSD	7.5
50-PP-041	50	PP	041	Pump - Filter feed 2 s/b	011	database	Centrifugal, 75 m3/h, 10 m	S	VSD	7.5
50-PP-042	50	PP	042	Pump - Tailings filter filtrate	011	database	Vertical spindle pump, 75 m3/h, 15 m	D	VSD	11
50-VP-001	50	VP	001	Tailings filter vacuum pump	009	database	Liquid ring, Nash or equivalent	D	VSD	130
50-RS-001	50	RS	001	Tailings Stacker	013	database	Radial stacker 120 deg, desing 250 t/h	D	VSD	18.5
50-SC-018	50	SC	018	Tell Tale screen 1 - DMS 1 effluent	006	Minco	Sieve bend c/w diffuser box, 3 mm aperture, 45 deg, L =1.6 m, R = 2.036 m, W > 0.6 m, bottom mounted, design 165 m3/h	D	n/a	n/a
50-SC-019	50	SC	019	Tell Tale screen 2 - DMS 2 effluent	006	Minco	Sieve bend c/w diffuser box, 3 mm aperture, 45 deg, L =1.6 m, R = 2.036 m, W > 1.1 m, bottom mounted, design 280 m3/h	D	n/a	n/a
50-SC-020	50	SC	020	Tell Tale screen 3 - DMS 3 effluent	006	Minco	Sieve bend c/w diffuser box, 3 mm aperture, 45 deg, L =1.6 m, R = 2.036 m, W > 0.8 m, bottom mounted, design 200 m3/h	D	n/a	n/a
50-SC-021	50	SC	021	Tell Tale screen 4 - Deslime o/f	006	Minco	Sieve bend c/w diffuser box, 3 mm aperture, 45 deg, L =1.6 m, R = 2.036 m, W > 2.3 m, bottom mounted, design 612 m3/h	D	n/a	n/a
50-TH-001	50	TH	001	Tailings thickener	008	database	Clarifying thickener, diameter 30 m, flowrate 1200 m3/h, design 100 t/h solids, 30 micron recovery	D	DOL	11
50-WT-008	50	WT	008	Belt scale - Tailings Transfer	022	database	Type : dual idler set, 1% accuracy	D	n/a	n/a

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60-CV-014	60	CV	014	CNV - Lump Product Transfer	012	database	Design 150 t/h, Belt speed 1.1 m/s, Particle size -75 +15 mm, horizontal length 135m, lift 2 m, B.W. 500 mm	D	DOL	5.5
60-CV-015	60	CV	015	CNV - Lump Product Mobile Conveyor	013	database	Mobile/Grasshopper conveyor. Design 150 t/h	D	DOL	18.5
60-CV-016	60	CV	016	CNV - Fines Product Transfer	012	database	Design 100 t/h, Belt speed 1 m/s, Particle size -15 +6 mm, horizontal length 190 m, lift 2 m, B.W. 500 mm	D	DOL	5.5
60-CV-017	60	CV	017	CNV - Fines Product Mobile Conveyor	013	database	Mobile/Grasshopper conveyor. Design 100 t/h	D	DOL	11
60-PP-043	60	PP	043	Floor pump - Product shed 1	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
60-PP-044	60	PP	044	Floor pump - Product shed 1	011	database	Vertical spindle pump, 35 m3/h, 15 m	D	DOL	7.5
60-RS-002	60	RS	002	Lump Product Radial Stacker	013	database	Radial stacker, 120 degrees. Design 150 t/h	D	VSD	18.5
60-RS-003	60	RS	003	Fines Product Radial Stacker	013	database	Radial stacker, 90 degrees. Design 100 t/h	D	VSD	11
60-SA-002	60	SA	002	Sampler - Lump	021	database	Cross trajectory cutter c/w collection hopper and discharge feeder	D	Feeder	5.5
60-SA-003	60	SA	003	Sampler - Fines	021	database	Cross trajectory cutter c/w collection hopper and discharge feeder	D	Feeder	5.5
60-WT-009	60	WT	009	Belt Scale - Lump Product Transfer	022	database	Type : dual idler set, 1% accuracy	D	n/a	n/a
60-WT-010	60	WT	010	Belt Scale - Fines Product Transfer	022	database	Type : dual idler set, 1% accuracy	D	n/a	n/a
70-PK-001	70	PK	001	Flocc mixing package	018	database	Design 2 kg/h (50 kg/d) , 25 kg bags	D	Feeder	5.5
70-PP-045	70	PP	045	Floor pump - Flocculant	011	database	Vertical spindle pump, 25 m3/h, 15m	D	DOL	5.5
70-PP-046	70	PP	046	Pump - flocc dosing 1	011	database	Positive displacement, 40 - 80 L/h	D	VSD	0.11
70-PP-047	70	PP	047	Pump - flocc dosing 2 s/b	011	database	Positive displacement, 40 - 80 L/h	S	VSD	0.11
80-FL-002	80	FL	002	GSW filter		database	Dual filter cartidges, 50 micron c/w differential pressure switch	D	n/a	n/a

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80-PK-002	80	PK	002	Fire suppression pump skid	019	database	Fire water pump skid, duty pump, diesel drive pump and jockey pump c/w control panel	D	feeder	n/a
80-PK-003	80	PK	003	Air compressor package	020	database	Small : Air compressor c/w air dryer, pre/post filters, air reciever	D	DOL	45
80-PP-048	80	PP	048	Floor pump - Services	011	database	Vertical spindle pump, 25 m3/h, 15m	D	DOL	5.5
80-PP-049	80	PP	049	Floor pump - Water storage area	011	database	Vertical spindle pump, 25 m3/h, 15m	D	DOL	5.5
80-PP-050	80	PP	050	Pump - Clean water 1	011	database	for floc mixing and vacuum seal, 10m3/h, 15 m	D	DOL	1.1
80-PP-051	80	PP	051	Pump - Clean water 2 s/b	011	database	for floc mixing and vacuum seal, 10m3/h, 15 m	S	DOL	1.1
80-PP-052	80	PP	052	Pump - gland water 1	011	database	Centrifugal, 22 m3/h, 30 m	d	DOL	4
80-PP-053	80	PP	053	Pump - gland water 2 s/b	011	database	Centrifugal, 22 m3/h, 30 m	S	DOL	4
80-PP-054	80	PP	054	Pump - process water 1	011	database	Centrifugal, 400 m3/h, 35 m	D	VSD	75
80-PP-055	80	PP	055	Pump - process water 2	011	database	Centrifugal, 400 m3/h, 35 m	D	VSD	75
80-PP-056	80	PP	056	Pump - process water 3	011	database	Centrifugal, 400 m3/h, 35 m	D	VSD	75
80-PP-057	80	PP	057	Pump - process water 4 s/b	011	database	Centrifugal, 400 m3/h, 35 m	S	VSD	75
90-BD-001	90	BD	001	Fines storage shed	016	database	Portal frame, 30m long x 45m wide cyclone proof (incl. roof and cladding)	-	n/a	n/a
90-BD-002	90	BD	002	Workshop	016	database	2 x 40ft sea containers with domed roof	-	n/a	n/a
90-BD-003	90	BD	003	Warehouse - general	016	database	Portal frame, 20m long x 20m wide cyclone proof (incl. roof and cladding)	-	n/a	n/a
90-BD-004	90	BD	004	Warehouse - reagents	016	database	Sea containers with domed roof, FeSi and floccuant storage	-	n/a	n/a
90-BD-005	90	BD	005	Site Offices & ablutions	016	database	x4 transportables, 12 x 3m each, cyclone proof	-	n/a	n/a

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90-BD-006	90	BD	006	Sample prep laboratory	016	database	x2 transportables, 12 x 3m each, cyclone proof, basic fit out	-	n/a	n/a
90-PP-058	90	PP	058	Floor pump - Vehicle wash bay	011	database	Vertical spindle pump, 25 m3/h, 15m	D	DOL	5.5
90-PP-059	90	PP	059	Site run-off pump	011	database	Float mounted submersible pump 200 m3/h, 30 m	D	DOL	30
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Appendix 3 – Quotation for Sighter Testwork (Nagrom)

NAGROM
the mineral processors

A.C.N. 008 868 335
A.B.N. 55 008 868 335

T: 08 9399 3934
F: 08 9497 1415

PO Box 66
Kelmscott WA 6991

49 Owen Road,
Kelmscott WA 6111

Nagrom Test Work Quotation Q06769

Prepared for: Aernout Boere
Ausenco
44 St Georges Terrace
Perth, WA 6112
Australia

Quotation Date: 20/5/2020
Valid Until: 19/6/2020

Aernout Boere of Ausenco has requested a quotation for Metallurgical Characterisation Testwork on three (3) Manganese samples.

The testwork is outlined as follows:

Sample Preparation and Comminution Testwork (3 Sample Allowance)

- Sample Receipt and Log:
  - ~200kg Winchelsea Manganese sample
- Sample Selection for Comminution Testing:
  - 3x ~200-300mm Segments for Uniaxial Compressive Strength (UCS)
  - 20x -76+51mm Segments for Bond Crusher Work Index (CWi)
  - 1x 5kg -19+12.5mm Segments for Bond Abrasion Index (Ai)
- Dry Particle Size Distribution in entirety at 150, 100, 75, 50 and 6.3mm:
  - Screen sizes to be confirmed with Aernout Boere of Ausenco
  - Five (5) screen size allowance
  - Recombine all PSD fractions in entirety to reproduce one (1) sample
- Stage Crush to P_{100} 75mm
- RSD Blend and Split:
  - 1x Xkg Analysis/Moisture Determination
  - Remainder to Sighter Testwork

Sighter Testwork (3 Sample Allowance)

- Wet Screen Sighter Testwork charge at 6.3 and 1mm
- Dry, RSD Blend and Split the +6.3mm fraction:
  - 1x Xkg Analysis/Semi-Quantitative XRD
  - Remainder into 4x equal Ericsson Cone charges
- Dry, RSD Blend and Split the -6.3+1mm fraction:
  - 1x Xkg Analysis/Semi-Quantitative XRD
  - Remainder into 4x equal DMS100 charges
- Filter Press and Cone and Quarter the -1mm fraction:
  - 1x Xkg Analysis/Moisture Determination/Semi-Quantitative XRD
  - 1x 1kg Size by Assay
  - 1x 10kg Wet Screen
  - Reserve Remainder
- Size by Assay (1kg) at 1, 0.5, 0.25, 0.106, 0.053 and 0.038mm
- Ericsson Cone Testwork on -75+6.3mm fraction to produce one (1) Underflow and one (1) Overflow fraction, per test:
  - Four (4) test allowance
  - SG's to be confirmed with Aernout Boere of Ausenco
- Dry and RSD Split each fraction:

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    - 1x Xkg Analysis/Microscopy/SG Determination via Gas Pycnometry/Semi-Quantitative XRD:
        - 1x Product and 1x Reject sample to be selected in discussion with Aernout Boere of Ausenco for Semi-Quantitative XRD
    - Reserve Remainder
- Dense Media Separation (DMS100) on -6.3+1mm fraction to produce one (1) Underflow and one (1) Overflow fraction, per test:
    - Four (4) test allowance
    - SG's to be confirmed with Aernout Boere of Ausenco
- Dry and RSD Split each fraction:
    - 1x Xkg Analysis/Microscopy/SG Determination via Gas Pycnometry/Semi-Quantitative XRD:
        - 1x Product and 1x Reject sample to be selected in discussion with Aernout Boere of Ausenco for Semi-Quantitative XRD
    - Reserve Remainder
- Wet Screen -1mm (~10kg) fraction at Xmm
    - Screen Size to be confirmed with Aernout Boere of Ausenco based on Size by Analysis results
- Filter Press and Cone and Quarter -Xmm fraction:
    - 1x Xkg Assay/Moisture Determination
    - Reserve Remainder
- Dry, RSD Blend and Split -1+Xmm fraction:
    - 1x Xkg Analysis
    - 1x 5kg Batch RC
    - Reserve Remainder
- Batch Reflux Classification (Batch RC) to produce eight (8) Overflow and one (1) Underflow fraction:
    - Parameters to be confirmed with Aernout Boere of Ausenco
- Dry and RSD Split each fraction:
    - 1x Xkg Analysis/Microscopy/Semi-Quantitative XRD:
        - 1x Product and 1x Reject sample to be selected in discussion with Aernout Boere of Ausenco for Semi-Quantitative XRD
    - Reserve Remainder

All samples will be analysed via XRF and ICP for MnO, Al_2O_3, As_2O_3, BaO, CaO, CoO, Cr_2O_3, CuO, Fe_2O_3, K_2O, MgO, Na_2O, NiO, P_2O_5, PbO, Sb_2O_3, SiO_2, SO_3, SrO, TiO_2, V_2O_5, ZnO, ZrO_2 and LOI_{1000}.

A data report summarising the testwork will be provided. The total cost of the testwork program is AUD$ 66,916.00 (Excluding GST).

Description	Qty	Unit Price	Ext. Price
Sample Preparation and Comminution Testwork			
• Sample Receipt and Log (~200kg)	3	$ 50.00	$ 150.00
• Comminution Sample Selection	3	$ 250.00	$ 750.00
• Uniaxial Compressive Strength	9	$ 185.00	$ 1,665.00
• Crusher Work Index	3	$ 700.00	$ 2,100.00
• Bond Abrasion Index	3	$ 550.00	$ 1,650.00
• Particle Size Distribution	3	$ 680.00	$ 2,040.00
• Stage Crush to P100 75mm	3	$ 450.00	$ 1,350.00
• RSD Blend and Split	3	$ 150.00	$ 450.00
• Moisture Determination	3	$ 25.00	$ 75.00

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Sighter Testwork					
• Wet Screening at 6.3 and 1mm	3	$	850.00	$	2,550.00
• Dry and RSD Blend and Split	6	$	150.00	$	900.00
• Filter Press and Cone and Quarter	3	$	250.00	$	750.00
• Moisture Determination	3	$	25.00	$	75.00
• Semi-Quantitative XRD	9	$	280.00	$	2,520.00
• Size by Assay (1kg)	3	$	380.00	$	1,140.00
• Ericsson Cone Setup	1	$	1,200.00	$	1,200.00
• Ericsson Cone Run	12	$	650.00	$	7,800.00
• Dry and RSD Blend and Split	24	$	80.00	$	1,920.00
• Microscopy	24	$	20.00	$	480.00
• SG Determination via Gas Pycnometer	24	$	36.00	$	864.00
• Semi-Quantitative XRD	6	$	280.00	$	1,680.00
• DMS100 Setup	1	$	1,200.00	$	1,200.00
• DMS100 Run	12	$	680.00	$	8,160.00
• RSD Blend and Split	24	$	50.00	$	1,200.00
• Microscopy	24	$	20.00	$	480.00
• SG Determination via Gas Pycnometer	24	$	36.00	$	864.00
• Semi-Quantitative XRD	6	$	280.00	$	1,680.00
• Wet Screening at Xmm (10kg)	3	$	350.00	$	1,050.00
• Filter Press and Cone and Quarter	3	$	80.00	$	240.00
• Moisture Determination	3	$	25.00	$	75.00
• RSD Blend and Split	3	$	50.00	$	150.00
• Batch Reflux Classifier Run	3	$	1,680.00	$	5,040.00
• Dry and RSD Blend and Split	27	$	50.00	$	1,350.00
• Microscopy	27	$	20.00	$	540.00
• Semi-Quantitative XRD	6	$	280.00	$	1,680.00
Sundries					
• Reporting and Supervision	1	$	13,950.00	$	13,950.00
• Analysis (XRF)	114	$	32.00	$	3,648.00
• Consumables Allowance	1	$	2,000.00	$	2,000.00
• Courier Allowance	1	$	500.00	$	500.00
• Discount	1	$	-9,000.00	$	-9,000.00
			Subtotal	$	66,916.00
			GST	$	6,691.60
			Total	$	73,607.60

Rain Lewis
Metallurgical Supervisor

Maxwell Lees
Metallurgist – Process Engineer