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PRIMERO

DESKTOP STUDY REPORT

FIRST COBALT REFINERY REVIEW

16503-REP-GE-002

FIRST COBALT CORP

DATE	REVISION	STATUS	PREPARED	REVIEWED	APPROVED
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1 EXECUTIVE SUMMARY

First Cobalt Corp. (First Cobalt) commissioned Primero Group Ltd (Primero) to conduct a desktop level capital and operating cost estimate for the restart of the First Cobalt Refinery located in 600 km by road from Toronto, Ontario, Canada.

The study considered capital and operating costs associated with a restart of the refinery under the following throughput scenarios:

Option 1	:	12 tonnes per day (tpd) using one of the two existing autoclaves;
Option 2	:	24 tpd using both existing autoclaves; and
Option 3	:	45 tpd under an expansion scenario that would entail replacing the current autoclaves and other processing equipment.
Option 4	:	50 tpd under an expansion scenario that would entail replacing the current autoclaves and other processing equipment.
Option 5	:	400 tpd was estimated as the maximum volume of continuous autoclave that could be installed into the existing facility. Management advised that this size was not currently warranted, and no further investigation was undertaken.

First Cobalt Corp. is considering third party feed options to support a restart of the First Cobalt Refinery in Ontario, Canada.

The cost estimate for options 1 and 2 allows for reuse of the majority of the process plant equipment and infrastructure, with replacement for some unit operations that have been identified as bottlenecks. Options 3 and 4 make use of most of the existing site infrastructure (building, power, roads, tailing management facility, etc) but a capital cost estimate has been calculated for the replacement of the majority of the equipment in the existing refinery to accommodate a continuous 45 or 50 tpd feed rate. Existing buildings and services are retained under all four options.

This study has retained the original flowsheet producing cobalt carbonate, however cobalt sulphate could be produced in the refinery, with some additional capital requirements that have been estimated at a preliminary level in this study (see section 2.2.1).

The flowsheet that formed the basis of this review is shown in Figure 1-1:

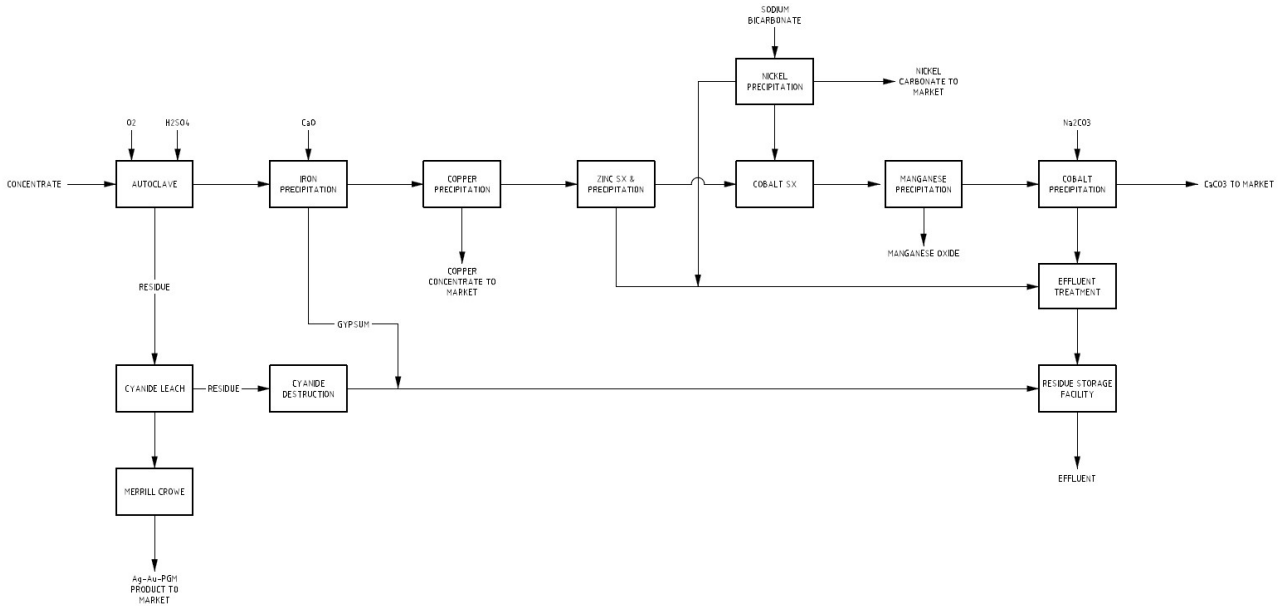

Figure 1-1- First Cobalt Refinery Flowsheet

Results of these cost estimates are summarised in Table 1-1 and Table 1-2.

Description	Cost (USD million)			
	Option 1 (12 tpd)	Option 2 (24 tpd)	Option 3 (45 tpd)	Option 4 (50 tpd)
Mechanical Cost	0.57	3.88	25.70	27.38
Discipline, Infrastructure, Buildings	4.94	11.33	29.81	31.76
Total Direct Cost	5.51	15.22	55.52	59.14
Indirect Cost	1.78	4.57	20.60	21.91
Total Direct and Indirect Cost	**7.28**	**19.78**	**76.11**	**81.05**
Contingency	2.19	5.94	22.83	24.31
Total Cost with Contingency	**9.47**	**25.72**	**98.95**	**105.36**

Table 1-1 - First Cobalt Refinery restart capital costs (3Q18, -30%/+50%)

	Total annual cost, USD			
	Option 1	Option 2	Option 3	Option 4
Sulphuric acid	63,072	126,144	236,520	262,800
Lime	165,564	331,128	620,865	689,850
Sodium Hydroxide	59,130	118,260	221,738	246,375
General Reagents/Consumables	194,423	462,758	1,148,643	1,316,730
SX reagents	156,202	262,636	448,895	493,243
Water and water treatment	51,328	61,183	78,429	82,536
Assay/Laboratory consumables	64,715	96,251	151,439	164,579
Grid power	405,270	740,151	1,400,452	1,573,310
Natural Gas	51,772	77,000	121,151	131,663
Labour	794,487	1,383,283	2,335,950	2,488,388
General expenses	952,705	1,685,052	2,862,304	3,133,732
Maintenance Materials	923,374	1,112,590	1,443,718	1,522,558
Contract Services	194,144	288,752	454,316	493,736

	Total annual cost, USD			
	Option 1	Option 2	Option 3	Option 4
Total	**4,076,185**	**6,745,188**	**11,524,419**	**12,599,499**

Table 1-2 - First Cobalt Refinery operating cost estimate

It is recommended that First Cobalt undertake either a Prefeasibility or Definitive Feasibility Study, dependent upon the level of certainty regarding the feedstock to the plant and the requirements of potential financing arrangements. At prefeasibility level and assuming that a throughput rate of 45 to 50 tonnes per day is selected, the study cost is estimated at between US$400,000 and US$600,000. Prefeasibility studies typically take between 4 and 6 months to complete. At a definitive feasibility study level and assuming a throughput rate of 45 to 50 tonnes per day, the study cost is estimated at between US$800,000 and US$1,200,000, Definitive feasibility studies typically take between 6 and 10 months to complete.

Typically for a brownfields study of this nature the total feasibility cost is approximately 3.7% of the total project cost (Mackenzie & Cusworth, 2007). For the 45 to 50 tpd option, this total cost would be US$3.9 M, and would include sampling, testwork, and owner's costs, including any permitting and environmental work that would be required for the project.

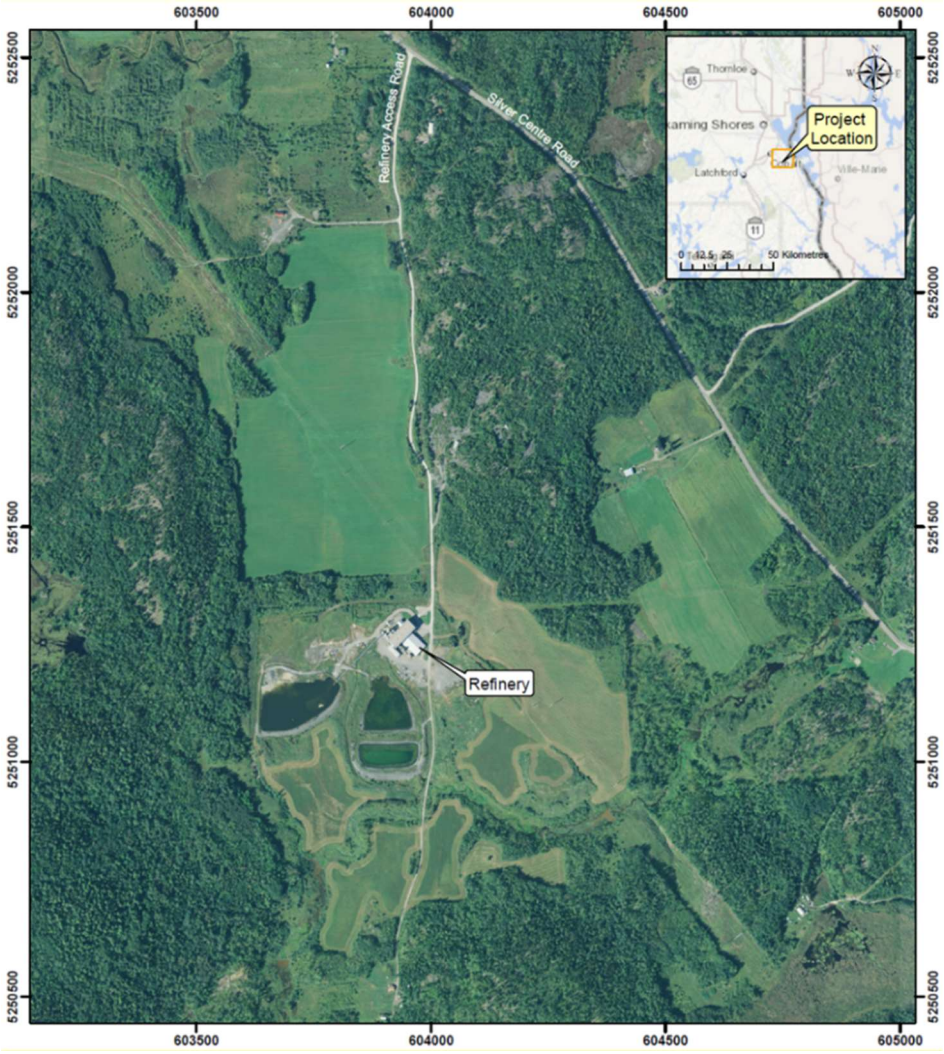

Figure 1-2 – First Cobalt Refinery Sire Plan

2 STUDY PARAMETERS

This document presents the findings of the desktop study of various restart and expansion scenarios for the First Cobalt Refinery undertaken by Primero Group (Primero) for First Cobalt Corp.

2.1 OBJECTIVES

The objectives of this study were to provide capital and operating costs for the restart of the First Cobalt Refinery at a suitable throughput rate.

The throughput rate was assessed on the following basis:

Option 1	:	12 tonnes per day (tpd) using one of the two existing batch autoclaves. This was the original design for the refinery and most of the available historical data relates to this throughput rate.
Option 2	:	24 tpd using both existing autoclaves. This represented the scenario entails using a second batch autoclave that was installed in 2012 but never fully commissioned.
Option 3	:	45 tpd under an expansion scenario that would entail replacing the current autoclaves and other processing equipment. This option makes use of the site buildings and infrastructure but represents a re-engineering of the existing facility to utilise a larger, continuous autoclave.
Option 4	:	50 tpd under an expansion scenario that would entail replacing the current autoclaves and other processing equipment. This option makes use of the site buildings and infrastructure but represents a re-engineering of the existing facility to utilise a larger, continuous autoclave.
Option 5	:	400 tpd was estimated as the maximum volume of continuous autoclave that could be installed into the existing facility. First Cobalt advised that their business plan did not currently warrant this size. While this throughput rate is believed to be feasible, no further investigation was undertaken.

2.2 ASSUMPTIONS

2.2.1 Cobalt sulphate unit process

This desktop study assumes that the refinery flowsheet would remain unchanged, and that the product would be cobalt carbonate. First Cobalt is also considering cobalt sulphate production. In order to produce a cobalt sulphate product, the flowsheet would be modified to include a cobalt crystallisation circuit at a preliminary cost estimate as shown in Table 2-1:

		Additional cost (US$)
Option 1	**:**	**1,700,000**
Option 2	**:**	**2,500,000**
Option 3	**:**	**3,500,000**
Option 4	**:**	**3,900,000**

Table 2-1 - Estimated capital cost for cobalt sulphate heptahydrate crystallisation

2.2.2 Currency

Unless otherwise stated, all dollar amounts are in US currency.

2.2.3 Feed grade and mass pull

Concentrate metal content fed into the First Cobalt Refinery will vary dependent upon feed source. A range of potential production rates for each option is provided in Table 2-2**.**

A mass pull to concentrate of 6% has been assumed.

			Option 1			Option 2			Option 3			Option 4		
ROM		**t/a**	65,700			131,400			246,375			273,750		
Feed Processed		**t/a**	3,942			7,884			14,783			16,425		
		tpd	12			24			45			50		
Head Grades	**Ni**	**%**	5.60	7.00	10.50	5.60	7.00	10.50	5.60	7.00	10.50	5.60	7.00	10.50
	Co	**%**	8.00	10.00	15.00	8.00	10.00	15.00	8.00	10.00	15.00	8.00	10.00	15.00
Availability		**%**	90								90			
		h/a	7,884			7,884			7,884			7,884		
Recoveries	**Co**	**%**	90			90			90			90		
	Ni	**%**	90			90			90			90		
Mass of metal recovered	**Ni**	**t/a**	199	248	373	397	497	745	745	931	1,397	828	1,035	1,552
	Co	**t/a**	284	355	532	568	710	1,064	1,064	1,330	1,996	1,183	1,478	2,217
	Co	**lb/a**	625,724	782,155	1,173,233	1,251,448	1,564,310	2,346,465	2,346,465	2,933,082	4,399,622	2,607,184	3,258,980	4,888,469

Table 2-2 - Design assumptions and metal production rates

2.3 ABBREVIATIONS

Ag	Silver
As	Arsenic
Au	Gold
AusIMM	Australian Institute of Mining and Metallurgy
CAPEX	Capital Cost Estimate
CIL	Carbon in Leach
Co	Cobalt
CPF	Cobalt Production Facility (Idaho Refinery)
Cu	Copper
CuS	Copper Sulphide
Cu_2S	Dicopper Sulphide
Fe	Iron
FEL	Front End Loader
mt	metric tonnes (2,200lbs)
Mg	Magnesium
MgO	Magnesium Oxide
$MgSO_4$	Magnesium Sulphate
Mn	Manganese
NaSH	Sodium Hydrosulphide
Ni	Nickel
NO_x	Nitrous Oxides
NSC	Nitrogen Species Catalysed
OPEX	Operational Cost Estimate
PLS	Pregnant Liquor Solution
POX	Pressure Oxidation
ROM	Run of Mine
st	short tons (2,000lb)
S	Sulphur
SX	Solvent Extraction
TSF	Tailings Storage Facility
Zn	Zinc

2.4 SCOPE OF REVIEW

The review has been completed at a desktop level, with assessment of existing reports and technical documentation as provided by First Cobalt. Data for the First Cobalt Refinery, upgrade studies and reports were provided by First Cobalt.

This review is based on treating a bulk cobalt-copper (Co-Cu) concentrate using the First Cobalt Refinery facility with no changes to the flowsheet.

2.5 CLIENT SUPPLIED DOCUMENT

Primero has been supplied various internal and, in some cases, confidential documents associated with the refinery by First Cobalt. This includes:

- AGRA Simons Restart Study (18 April 2000)
- Hatch Order of Magnitude Replacement Cost Estimate (3 May 2012)
- BBA First Cobalt Refinery Reconnaissance Report (10 January 2017)
- Primero First Cobalt Refinery & Polymet Lab Desktop Review (2 February 2017)
- First Cobalt First Cobalt Refinery Presentation (27 October 2017)

3 OVERVIEW OF THE FIRST COBALT REFINERY

3.1 REFINERY OVERVIEW

The First Cobalt Refinery is a cobalt-silver-nickel refinery located approximately three kilometres southeast of North Cobalt in Lorrain Township, District of Temiskaming, Ontario, Canada. It is one of four cobalt capable refineries in Canada. The others belong to Sherritt International (Fort Saskatchewan, Alberta) and Vale (Long Harbour, Newfoundland and Port Colborne, Ontario). Permits at the First Cobalt Refinery allow arsenic treatment and storage without limitation.

The refinery uses a hydrometallurgical process and, as currently configured, it can produce CoCO3, NiCO3 and recover Au-Ag-PGE.

The facility was commissioned in 1996 with a nominal throughput of 12 tpd. A second autoclave was later purchased to add to the pressure oxidation circuit to double the throughput to 24 tpd, but never fully commissioned. The refinery is equipped and licensed to process ore containing arsenic (As). The facility has been on care and maintenance since 2015.

The refinery is located on a 40-acre property that can be expanded to 120 acres with two settling ponds and an autoclave pond. There is a variety of existing infrastructure and processing equipment remaining in place from the past upgrades. The current plant footprint includes an empty feed warehouse that once housed a mill.

Figure 3-1- Aerial view of the First Cobalt Refinery

In the 1980s, the location was the site of the Hellens-Eplett underground mine and featured a traditional silver and cobalt mill. The property and mill were purchased by Cobatec Ltd. in the 1990s and construction of the refinery commenced in 1994-95 for over $30 million to process ore from two nearby mines (AGRA report). The refinery was commissioned in 1996 and operated intermittently until 1999, when it was sold to

Canmine Resources. Canmine intended to modify and restart the refinery to treat residue and tailings material from Agnico Eagle Mines Limited's neighbouring properties to produce an intermediate product of Cobalt Carbonate ($CoCO_3$). This restart was commissioned by Canmine after it confirmed access to the available product from Agnico, resulting in CA$12M in improvements to the refinery.

Upon Canmine's bankruptcy, the ownership of the refinery devolved to bondholders represented by a Swiss financial group, which kept it on care and maintenance while trying to sell the business.

In 2012, United Commodity acquired the refinery and invested $20 million, which included upgrading the plant's Merrill-Crowe process, to produce nickel (Ni), cobalt (Co), silver (Ag) and gold (Au) from otherwise difficult to process concentrate. They also added a second batch autoclave, which was identified as the bottleneck to double throughput to 24 tpd.

Figure 3-2 – Batch autoclaves installed in First Cobalt Refinery

3.2 PROCESS OVERVIEW

The First Cobalt Refinery includes multi-step polymetallic extraction processes after repulping the bulk concentrate by means of a ball mill. The concentrate is subjected to autoclave pressure oxidation, with solution proceeding to copper removal via sulphide precipitation and the solids reporting to a precious metal recovery circuit. Cobalt is concentrated further with additional impurity rejection in a solvent extraction circuit. The concentrated liquor reports to manganese removal, followed by cobalt precipitation as a cobalt carbonate. Production of a cobalt sulphate product will entail replacement of the carbonate circuit with a sulphate crystallisation circuit.

The unwanted solids of the process are sent to an onsite process treatment and residue storage facility.

3.3 ENVIRONMENTAL AND PERMITTING CONSIDERATIONS

Figure 3-3 provides aerial imagery of the facility illustrating the existing footprints of the tailings ponds, as well as the outlines of the approved extents of each of the ponds. The tailings are stabilized through the autoclave prior to being sent to the autoclave pond and all water from the autoclave pond is sent back to the facility for reuse or treatment in the high-density sludge treatment system prior to discharge in accordance with the existing Industrial Sewage Works Environmental Compliance Approval.

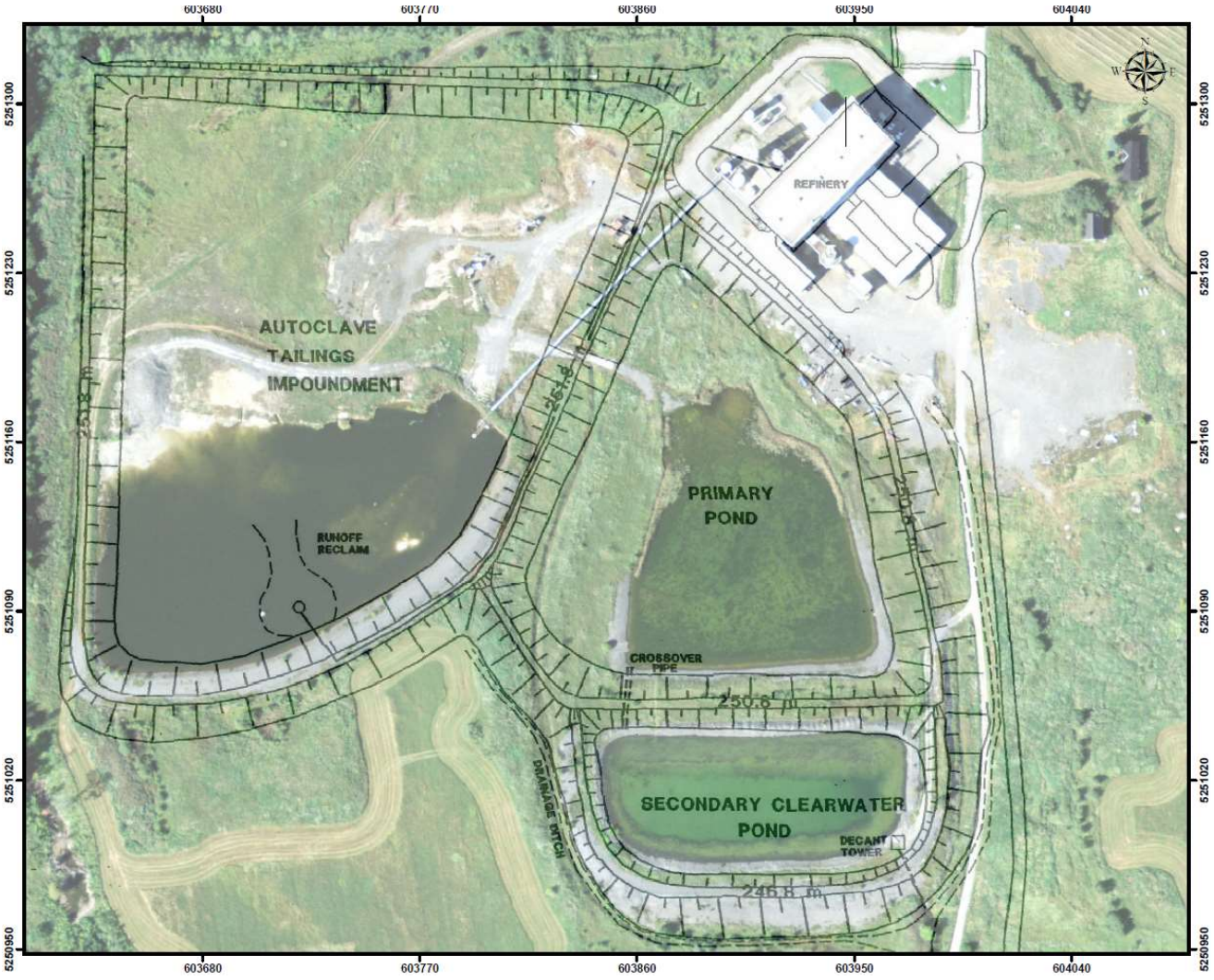

Figure 3-3 - Tailings Design

The autoclave pond has not been fully constructed and has an estimated 40,000 m3 (approximately 70,000 tonnes assuming a specific gravity of 1.74 tonnes per cubic metre) of remaining permitted capacity yet to be constructed. Operating at 24 tpd, the autoclave pond would reach capacity after 8 years of operation. The Primary Settling Pond is also not yet constructed to its full capacity.

The original Closure Plan for the First Cobalt Refinery was filed by the Ministry of Northern Development and Mines ("MNDM") in 1994. This Closure Plan was amended in 2013 to include the new Merrill Crowe processing building.

The site was permitted in 2001, including the following Environmental Compliance Approvals ("ECAs"): Air and Noise ECA (No. 5071-4XTKLB), Industrial Sewage Works ECA (No. 4-0036-85-979), and the Permit to take Water (No. 4752-6CRRK3).

Figure 3-4 illustrates two possible locations for future tailings on First Cobalt's property north of the refinery. These two areas represent approximately 16 hectares with an approximately 50m setback from the electricity power lines. The tailings management facility would extend over a 30-hectare area and be approximately 16m high. This illustration would require further investigation to confirm suitability. Another alternative is to relocate the power lines coming to the refinery which would increase overall capacity.

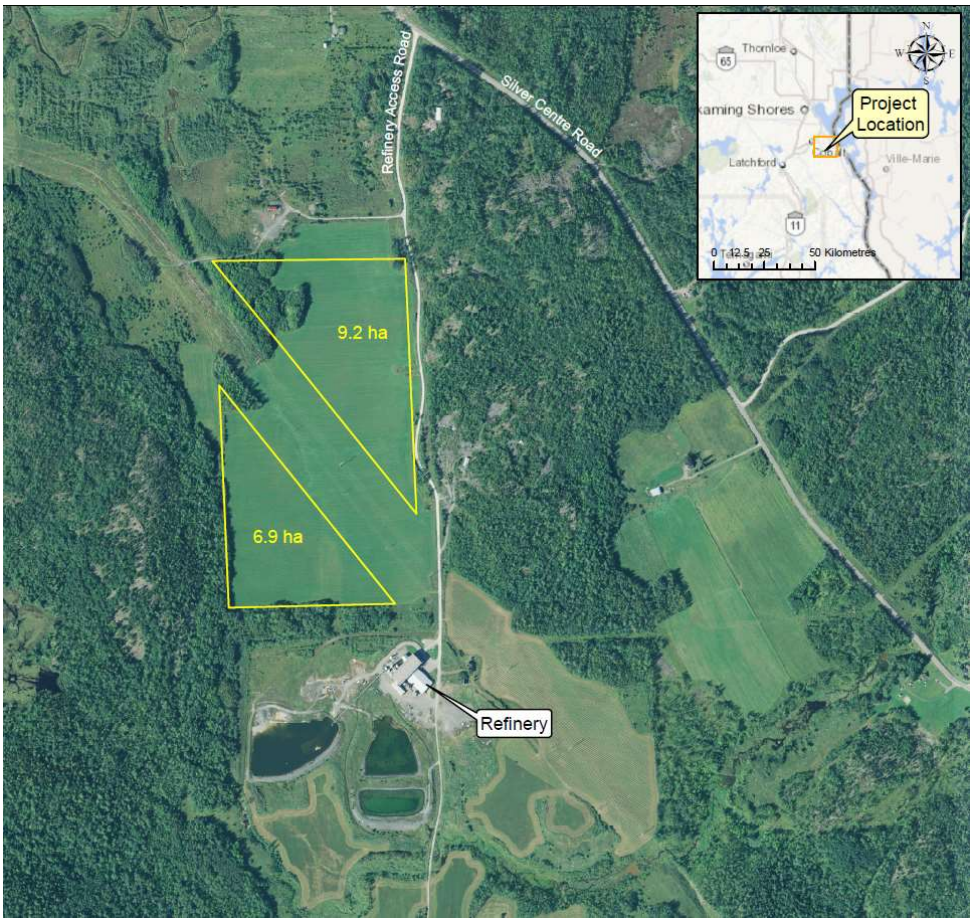

Figure 3-4 - Potential Tailings Expansion Area on First Cobalt Property

Figure 3-5 - Tailings Expansion Area – Partial View

This facility has an Industrial Sewage Works Environmental Compliance Approval which permits the treatment of tailings containing arsenic.

The refinery contains equipment, the autoclave, which allows the facility to treat their waste materials in such a way that the arsenic is less soluble and consequently will not adversely impact the environment. The autoclave renders the arsenic less soluble through oxidation to produce a crystalline form of arsenic called scorodite. It can therefore process materials which contain higher concentrations of arsenic than another facility which does not have this treatment stage.

3.4 BASIS OF DESIGN

The basis of design for all options included the following:

1. Utilise the existing equipment where practicable
2. Remain within the confines of the existing building, with some allowance to extend services outside of this footprint
3. Site visit reports indicate that the piping within the plant was drained on shut-down by drilling holes into it – a portion of the piping will therefore require replacement and repair
4. Due to the age of the plant it is unlikely that the existing electrical, instrumentation and control systems will meet code. Allowance has been made to replace all electrical, instrumentation and control within the plant, while retaining existing switch rooms, transformers and major distribution equipment
5. Replacement of the precious metals circuit was not considered in the study as the feed scenarios First Cobalt are considering do not require the circuit

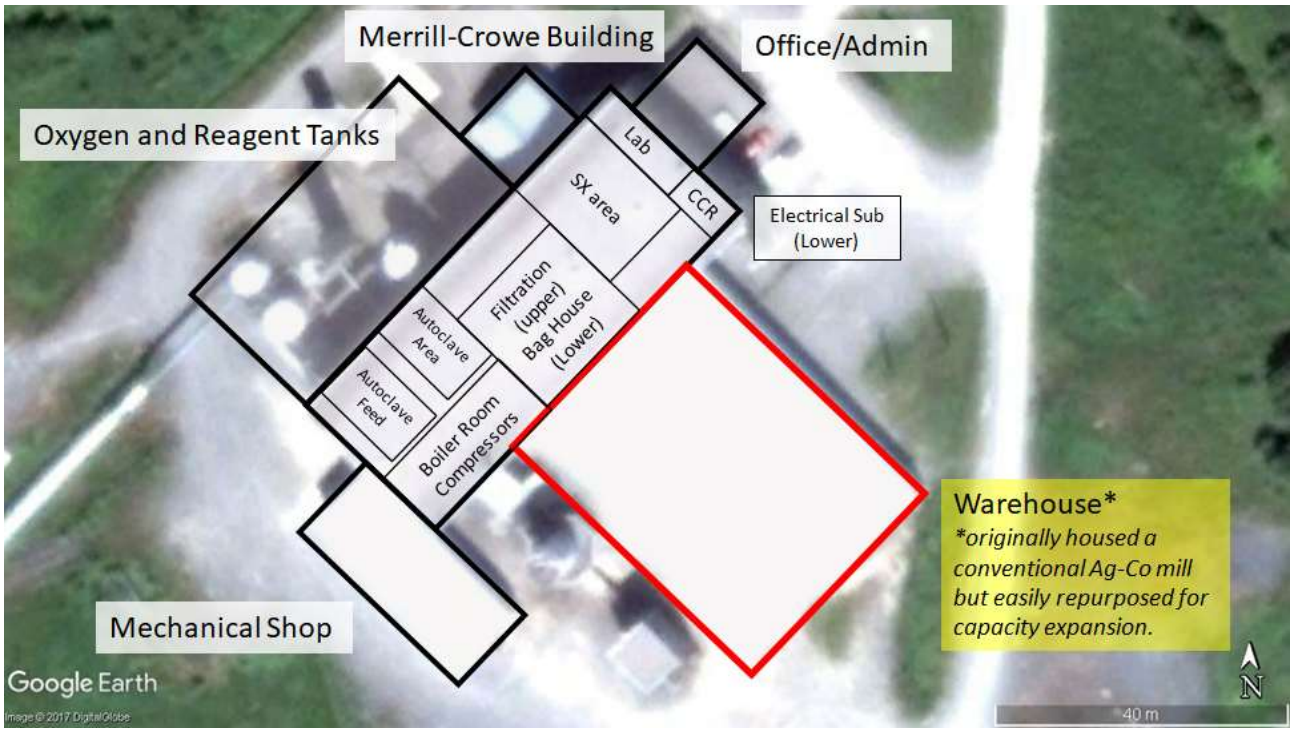

Figure 3-6 – Refinery layout

3.4.1 Option 1 – 12 tpd

Option 1 reuses the majority of the equipment currently installed in the process plant. The precious metals recovery circuit has not been included in the cost estimate, as per discussions with First Cobalt. An allowance has been made to recondition equipment, and to remove the piping and electrical equipment that requires replacement.

3.4.2 Option 2 – 24 tpd

Option 2 reuses a significant proportion of the existing facility. Review of the equipment capacities versus the increased flows, together with commentary from previous engineering reviews, has led to an estimate being made to replace some of the equipment, while retaining the majority. The basis for this allowance is as follows:

1. The refurbishment allowance made for Option 1 has been carried forward to this estimate
2. The batch autoclave linings will be replaced to allow for a reduced cycle time with respect to heating and cooling. Alternative strategies exist, however in each case a similar cost is likely with a less predictable outcome
3. It is assumed that the vent system for the new autoclave has already been installed, and that a common flash and conditioning system can be used – no allowance has been made for this item
4. Operating the batch autoclaves in an on/off configuration will allow better utilisation of the downstream capacity, and reduce inefficiencies associated with the batch operation method. This implies that most downstream operation should be able to deal with the increased throughput with relatively minimal replacement
5. Replacement of the filter presses. The presses are operating on fixed cycle times that are difficult to reduce. Additional filter presses operating in parallel will consume significant building volume in

addition to resulting in increased complexity in pumping and piping arrangements. It is most practical to utilise larger filter presses in the same general footprint as the existing filters

6. Replacement of slurry and solution heat exchangers. Heat exchangers are slurry volume dependant, and, as with the filters, will occupy significant building volume if installed in parallel, in addition to being inefficient in terms of pumps and piping
7. The current cobalt solvent extraction circuit is unlikely to be able to deal with the increased metal loadings. There may be efficiencies that can be realised in terms of extractant concentrations and reconfiguration of the circuit, however for the purposes of this estimate it has been assumed that a new solvent extraction circuit will be required and be located in the unused mill building
8. It has been assumed that the reagent systems will be sufficient, however allowance has been made to replace the sulphuric acid storage tank and dosing system

3.4.3 Option 3 – 45 tpd

Option 3 assumes that an entirely new, continuously operating 45 tpd autoclave will be installed in the plant. Review of the equipment and mass balances suggests that very little equipment will be reusable, extending through to the reagent's areas, where flowrates will exceed the pump capacities operating at 90% availability. An allowance has been made to recondition equipment, and to remove the piping and electrical equipment that requires replacement.

Some equipment may be reinstalled in alternative duties – at this level of study identification of these items is problematic, however the total direct cost of equipment has been discounted to allow for this;

The flowsheet will remain substantively as is, however as with Option 2, no allowance has been made for the precious metals' recovery circuit.

Allowance has been made to accommodate portions of the plant in another facility – the assumption is that the solvent extraction will be accommodated in the existing unused adjacent former mill building, and that the impurity removal areas will be accommodated in an adjacent facility.

3.4.4 Option 4 – 50 tpd

Option 3 assumes that an entirely new, continuously operating 50 tpd autoclave will be installed in the plant. Review of the equipment and mass balances suggests that very little equipment will be reusable, extending through to the reagent's areas, where flowrates will exceed the pump capacities operating at 90% availability. An allowance has been made to recondition equipment, and to remove the piping and electrical equipment that requires replacement.

Some equipment may be reinstalled in alternative duties – at this level of study identification of these items is problematic, however the total direct cost of equipment has been discounted to allow for this;

The flowsheet will remain substantively as is, however as with Option 2, no allowance has been made for the precious metal's recovery circuit.

Allowance has been made to accommodate portions of the plant in another facility – the assumption is that the solvent extraction will be accommodated in the existing unused adjacent former mill building, and that the impurity removal areas will be accommodated in an adjacent facility.

3.4.5 Option 5 – 400 tpd

Option 5 assumes that an entirely new, continuously operating 400 tpd autoclave will be installed in the plant. However, as First Cobalt has advised that this level of throughput is not currently being contemplated, no further investigation was undertaken.

4 PROCESS DESCRIPTION

A generic process flow description is provided in this section, with specific variations highlighted in Sections 4.1, 4.2 and 4.3

Feed material will be fed by FEL into an open circuit rubber lined ball mill, the solids will be mixed with process water and lime to form a slurry which will be stored in a concentrate storage tank.

From the concentrate storage tank, the slurry will be fed into the autoclave feed tank system. Steam and sulphuric acid will be added to the feed tank(s), which will discharge to the autoclave.

Steam and oxygen will be injected into the autoclave as required. The leaching process will dissolve the copper, cobalt, zinc, manganese and nickel into a pregnant leach solution.

The contents of the autoclave will be discharged through a flash let down system into a conditioning tank, before passing through a series of plate heat exchangers that will reduce the slurry temperature to 65°C before a filtration step. Filtration will include blowing and washing to recover the maximum possible amount of dissolved metal. The solids will be discharged to the cyanide circuit for silver recovery.

Figure 4-1- Filter presses, copper precipitation circuit and solvent extraction circuit

The PLS will then be treated with sodium hydrosulphide to precipitate copper from the PLS as a sulphide, followed by the addition of lime to precipitate iron and arsenic as a stable ferric arsenate. The resulting slurry will be filtered to remove the copper, iron and arsenic solids, which will proceed to disposal.

The purified PLS will be pumped into the solvent extraction feed tanks for pH adjustment and polish filtration ahead of the zinc and cobalt SX circuit. The cobalt SX will consist of three extract, two scrub and three strip stages. Crud treatment and a regeneration mixer settler will be allowed for to remove and treat crud and to treat a side stream of the organic phase. Raffinate will proceed to nickel recovery, while the rich strip solution, containing the cobalt, will proceed to manganese removal.

Manganese will be removed from the rich strip liquor by oxidisation in a series of reactors using oxygen sparge addition. The solids generated in the oxidation process will be filtered from the solution, which will then advance to the cobalt precipitation step.

Steam will be added to the purified rich strip solution to bring it to 60°C, and sodium carbonate will be added to precipitate the cobalt as a carbonate. The slurry from the cobalt precipitation circuit will be thickened, the thickener overflow will be sent to the high-density sludge reactor for treatment while the underflow will report to the $CoCO_3$ filter press. Filter cake will be bagged for sale as cobalt carbonate.

Figure 4-2 - Warehouse with cobalt carbonate bulk bags

If cobalt sulphate is included in the process then the cobalt carbonate precipitation circuit will be replaced with solution evaporation and crystallisation to produce $CoSO_4 \cdot 7H_2O$. A new circuit consisting of three glass lined reactors, centrifuges and ancillary equipment will be required to produce the cobalt sulphate heptahydrate product.

Raffinate from the cobalt SX circuit will report to the nickel precipitation circuit. Steam will be added to the raffinate to bring it to 60°C, and sodium carbonate will be added to precipitate the nickel as a carbonate. The slurry from the nickel precipitation circuit will be thickened, the thickener overflow will be sent to the high-density sludge reactor for treatment while the underflow will report to the $NiCO_3$ filter press. Filter cake will be bagged for sale as nickel carbonate.

Solids from the autoclave leach process will report the silver extraction circuit. Cyanide will be added to the repulped solids, and any precious metals contained within the solid residue from the autoclave will be leached. The slurry product will be filtered, and the filtrate will then be treated through a Merrill Crowe circuit to recover any precious metals via zinc cementation. Solids from this circuit will be processed through flotation cells with the addition of sodium metabisulphite and copper sulphate to remove any cyanide, prior to disposal in the autoclave catchment ponds.

Streams from the base metal recovery circuits that are not returned into the circuit will be treated in the high-density sludge circuit to remove any residual metals. Ferric sulphate and lime can be added to neutralise the material, with seed recycle to achieve high density slurries. Slurry from the high-density sludge circuit will be thickened, and the underflow will report to the autoclave catchment ponds. Overflow will either be utilised in the circuit or can be discarded.

4.1 OPTION 1 – 12 tpd

Option 1 is based on the existing 12 tonne/day facility, and all equipment is assumed to be existing.

From the concentrate storage tank, the slurry will be fed on a batch basis into the existing premix tank. Steam and sulphuric acid will be added to the premix tank, which will discharge to the existing batch autoclave.

The autoclave will be fed in 2 tonne batches with a total processing time of 4 hours, included the heating, processing and cooling down stages. Steam and oxygen will be injected to bring the contents to the required temperature to commence the oxidisation as an exothermic reaction.

4.2 OPTION 2 – 24 tpd

Option 2 is based on reuse of the majority of the existing 12 tonne/day facility, with an additional batch autoclave and replacement of equipment identified in Section 3.4.2.

From the concentrate storage tank, the slurry will be fed on a batch basis into the existing premix tank. Steam and sulphuric acid will be added to the premix tank, which will discharge to either the existing batch autoclave or to the new installed batch autoclave.

The contents of the autoclaves will be discharged alternately through an existing flash let down system into a conditioning tank, before passing through a series of new plate heat exchangers that will reduce the slurry temperature to 65°C before a filtration step consisting of new filter feed pumps and filtration equipment.

The PLS will then be treated with sodium hydrosulphide to precipitate copper from the PLS as a sulphide, followed by the addition of lime to precipitate iron and arsenic as a stable ferric arsenate. The resulting slurry will be filtered through a new filter to remove the copper, iron and arsenic solids, which will proceed to disposal.

The purified PLS will be pumped into the new solvent extraction feed tanks for pH adjustment and polish filtration ahead of the new zinc and cobalt SX circuit. The SX will consist of three extract, 2 scrub and three strip stages. The existing crud treatment and a regeneration mixer settler will be allowed for to remove and treat crud and to treat a side stream of the organic phase.

4.3 OPTIONS 3 AND 4 – 45 AND 50 tpd

The Option 3 and 4 flowsheet will be substantively the same as Option 1, with the primary difference being the use of a continuous autoclave rather than a batch unit. All equipment with the exception of the precious metal recovery circuit is assumed to be replaced or reutilised in alternative locations.

From the concentrate storage tank, the slurry will be fed on a continuous basis into an autoclave feed tank. Sulphuric acid will be added to the autoclave feed tank, and the slurry will be pumped into the new leach autoclave.

The autoclave will operate with a two-hour retention time, oxygen will be injected into the autoclave to maintain an oxidative environment. The leaching process will dissolve the copper, cobalt, zinc, manganese and nickel into a pregnant leach solution.

The contents of the autoclave will continuously discharge though a flash tank into a leach discharge tank, and through a series of new plate heat exchangers that will reduce the slurry temperature to 65°C before a filtration step

5 CAPITAL COST

5.1 TYPE OF ESTIMATE

This is a factored estimate, designated as an FEL 1 and AACE Class 5 (order of magnitude) estimate with and indicative accuracy range of -30%/+50%, and is based on previous historical data metrics from similar projects.

The cost estimate has been built up from the mechanical equipment list, with all equipment within the plant identified, and a direct capital cost of supply associated with each item. In the case of the First Cobalt Refinery, supply costs were obtained from the following sources:

1. Budget quotation – vendor budget quotation for the specified equipment
2. Database – costs from recent projects where quotations were obtained for equipment of the same or similar size
3. Factoring – where database costs are available for equipment of the same type, but of a different capacity. Factoring is typically based on the AUSIMM Estimating Guidelines, however in some instances the 6/10 rule has been utilised to obtain costs. It should be noted that the estimated cost for the cobalt sulphate crystallisation unit process has been drawn from publicly available information and factored using the 6/10 Rule, and the 45 tpd has been factored using the 50 tpd direct equipment supply cost

From the direct equipment supply cost, known factors drawn from literature, past projects and amended as required are applied to the direct costs to obtain installation and freight costs. The total direct costs of equipment is then used with similar factors to obtain items such as concrete, structural steel, piping, electrical, instrumentation and control and minor infrastructure costs for projects of a similar size. This provides a total direct cost of plant. The latter is then in turn used to calculate the indirect costs. Details are provided in Sections 5.3.1 and 5.3.2.

5.2 COST SUMMARY

Costs have been developed initially for the replacement (or new build) values of the facility at the various throughput rates. This exercise was carried out to allow the second, more relevant exercise, of calculating the restart capital costs, to be estimated. It also allowed a comparison between the base option cost and that estimated by Hatch in their 2012 estimate.

The replacement (or new build) value of the plant is summarised in Table 5-1. The estimated restart cost for the First Cobalt refinery is summarised in Table 5-2. In both options, site level costs such as the tailings management, power lines, and permitting have not been included. As the site is already developed for the intended use, costing of these elements was not regarded as pertinent.

Description	Cost (USD million)			
	12 tpd	24 tpd	45 tpd	50 tpd
Mechanical Cost	11.23	17.99	28.56	30.41
Discipline, Infrastructure, Buildings	18.76	30.04	47.97	50.79
Total Direct Cost	29.99	48.03	76.53	81.20
Indirect Cost	10.53	16.87	26.86	28.52

Description	Cost (USD million)			
	12 tpd	24 tpd	45 tpd	50 tpd
Total Direct and Indirect Cost	40.53	64.90	103.39	109.72
Contingency	12.16	19.47	31.02	32.92
Total Project Cost	52.69	84.37	134.41	142.64

Table 5-1 – Replacement (new build) value of First Cobalt Refinery

Description	COST (USD MILLION)			
	12 TPD	24 TPD	45 TPD	50 TPD
Mechanical Cost	0.57	3.88	25.70	27.38
Discipline, Infrastructure, Buildings	4.94	11.33	29.81	31.76
Total Direct Cost	5.51	15.22	55.52	59.14
Indirect Cost	1.78	4.57	20.60	21.91
Total Direct and Indirect Cost	7.28	19.78	76.11	81.05
Contingency	2.19	5.94	22.83	24.31
Total Project Cost	9.47	25.72	98.95	105.36

Table 5-2 – Restart cost for First Cobalt Refinery

Detailed cost estimates are provided in Appendix C.

5.3 DEVELOPMENT OF COST ESTIMATE

The costs for the two options have been developed as summarised in Table 5-3 for the replacement value, and in Table 5-4 for the restart value. Details are provided in Sections 5.3.1 and 5.3.2

	All options
Direct Costs	
Total direct cost of equipment	Estimated replacement value, from database costing
Concrete	Factored based on installed equipment cost
Earthworks	Factored based on installed equipment cost
Structural steel	Factored based on installed equipment cost
Piping	Factored based on installed equipment cost
Electrical	Factored based on installed equipment cost
Instrumentation and Control	Factored based on installed equipment cost
Architecture and auxiliary buildings, minor infrastructure	Factored based on installed equipment cost
Indirect costs	
Construction Equipment	Factored based on installed direct cost of plant
Vendor representatives	Factored based on installed equipment cost
Commissioning and start-up	Factored based on installed equipment cost
Spares	Factored based on installed equipment cost
First fills	Factored based on installed direct cost of plant
Owner's costs	Factored based on installed direct cost of plant
EPCM	Factored based on installed direct cost of plant
Construction camp, temporary facilities etc	Factored based on installed direct cost of plant

Table 5-3 – Basis of capital estimate for replacement capital costs

	Option 1	Option 2	Option 3	Option 4
	12 tpd	24 tpd	45 tpd	50 tpd
Direct Costs				
Total direct cost of equipment	Percentage of estimated replacement value to account for refurbishment	Replacement value of items as nominated in Section 3.4.2 plus refurbishment cost from Option 1	Percentage of estimated replacement value to allow for reuse of equipment	Percentage of estimated replacement value to allow for reuse of equipment
Concrete	No allowance	No allowance	Factored based on installed equipment cost	Factored based on installed equipment cost
Earthworks	No allowance	No allowance	Factored based on installed equipment cost	Factored based on installed equipment cost
Structural steel	Percentage of estimated replacement value to account for refurbishment	Percentage of estimated replacement value to account for refurbishment	Factored based on installed equipment cost	Factored based on installed equipment cost
Piping	Estimated replacement value	Estimated replacement value	Factored based on installed equipment cost	Factored based on installed equipment cost
Electrical	Estimated replacement value	Estimated replacement value	Factored based on installed equipment cost	Factored based on installed equipment cost
Instrumentation and Control	Estimated replacement value	Estimated replacement value	Factored based on installed equipment cost	Factored based on installed equipment cost
Architecture and auxiliary buildings, minor infrastructure	Percentage of estimated replacement value to account for refurbishment	Percentage of estimated replacement value to account for refurbishment	Factored based on installed equipment cost	Factored based on installed equipment cost
Indirect costs				
Construction Equipment	Factored based on installed direct cost of plant		Factored based on installed direct cost of plant	
Demolition of existing facility	Factored based on installed direct cost of 12 tpd plant		Factored based on installed direct cost of 12 tpd plant	
Vendor representatives	Factored based on installed equipment cost		Factored based on installed equipment cost	
Commissioning and start-up	Factored based on installed equipment cost		Factored based on installed equipment cost	
Spares	Factored based on installed equipment cost		Factored based on installed equipment cost	
First fills	Factored based on installed direct cost of plant		Factored based on installed direct cost of plant	
Owner's costs	Factored based on installed direct cost of plant		Factored based on installed direct cost of plant	

	Option 1	Option 2	Option 3	Option 4
EPCM	Factored based on installed direct cost of plant		Factored based on installed direct cost of plant	
Construction camp, temporary facilities etc	Factored based on installed direct cost of plant		Factored based on installed direct cost of plant	

Table 5-4 – Basis of capital estimate for restart costs

5.3.1 Direct costs

5.3.1.1 Pricing equipment and materials

The available equipment lists have been combined to provide a list of the equipment required to replicate the current flowsheet.

Parametric models have been used to size equipment for the 24 and 50 tpd options. These included maintaining the same retention times at increased flowrates, or assuming that similar energy input would be required for increased mass flows.

The 45 tpd option has been factored from the 50 tpd model.

Costs for major unit operations (autoclave and solvent extraction circuits) were obtained for the 50 tpd options, these costs were factored appropriately.

Database costs have been utilised for the remainder of the equipment list and factored on capacity where applicable.

Minor equipment including platework was factored as a percentage of the mechanical supply cost.

5.3.1.2 Mechanical Installation Costs

Using historical data from similar projects, the installation labour hours were factored against the total major and minor mechanical equipment supply costs. The rate utilised is applicable to Ontario, and includes field labour, productivity factors, small tools and consumables, applicable premium time and contractor overhead and profit. The overall factor used is 20% of mechanical equipment supply cost.

5.3.1.3 Freight

Using historical data from similar projects located in Canada, the freight costs were factored against the total major and minor mechanical equipment supply costs.

5.3.1.4 Concrete

Concrete was calculated as a factor of the installed mechanical equipment cost.

In the case of the restart options, it is believed that no additional concrete works will be required for the 12 and 24 tpd options, as these will be located within the current plant layout. The 40 and 50 tpd plants will, however, require additional concrete for services such as oxygen, air and potentially for remediation within the existing mill building, and an allowance has been made in this instance.

5.3.1.5 Earthworks

Earthworks was calculated as a factor of the installed mechanical equipment cost.

In the case of the restart options, it is believed that no additional earthworks will be required for the 12 and 24 tpd options, as these will be located within the current plant layout and make use of the existing ponds.

The 40 and 50 tpd plants may, however, require earthworks to accommodate the additional services, and an allowance has been made in this instance.

5.3.1.6 Structural Steel

Structural steel was calculated as a factor of the installed mechanical equipment cost.

In the case of the restart options, an allowance has been made to remediate or replace structural steel. This allowance was based on the results of the report from BBA, whose visit indicated that pipework and electrical were in a poor condition and likely to require entire replacement – additional structural works will be required to accommodate this.

In the restart cases the replacement mechanical cost was used as the basis, to eliminate bias introduced by the lower refurbished equipment cost allowed for.

5.3.1.7 Other disciplines

Costs for other disciplines were estimated as a percentage of the installed mechanical equipment cost and based on historical data from similar, cold weather hydrometallurgical projects. Factors were also carefully checked against the factors recommended by the AUSIMM and compared to those used by Hatch in the original replacement cost study. These factors are provided in Table 5-5.

5.3.2 Indirect Costs

Indirects, as a whole, are 30% of the direct cost for the replacement cost estimates and between 20 and 25% for the restart costs, and have been developed as follows:

5.3.2.1 Construction Equipment

This cost was factored based on the direct cost and includes cranes and heavy mobile equipment required for construction.

5.3.2.2 Demolition costs

This cost was factored based on the installed equipment cost for the 12 tpd option and allows for the removal of a portion of the existing piping, electrical and instrumentation for Options 1 and 2 (at a factor of 3%), and for the full removal of all equipment in the case of Option 3 (at a factor of 5%).

5.3.2.3 Vendor Representative

This cost is estimated at 3 % of the total mechanical cost and covers the vendor commissioning team and all specialized labour and equipment required to make equipment operational.

5.3.2.4 Commissioning and Start-up

This cost is estimated at 5% of total mechanical cost.

5.3.2.5 Spares

This cost is estimated at 3% of total mechanical cost.

5.3.2.6 Initial Fills

This cost is estimated at 3% of the direct cost, and includes:

- grinding media
- reagents

- oil for all equipment
- other consumables

5.3.2.7 Owner Cost

This cost is estimated at 6% of the direct cost and covers:

- client project management costs
- corporate expenses
- commissioning

5.3.2.8 EPCM Services

Engineering, procurement and construction management was allocated based on total direct cost and also includes temporary facilities, utilities and expenses.

5.3.2.9 Construction camp and temporary facilities

Construction camp and catering cost has been omitted due to the proximity to local townships and facilities.

5.3.3 Project Contingency

Contingency is defined by the AACE as '*An amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, and/or effect is uncertain and that experience shows will likely result, in aggregate, in additional costs. Typically estimated using statistical analysis or judgment based on past asset or project experience. Contingency usually excludes;*

1. major scope changes such as changes in end product specification, capacities, building sizes, and location of the asset or project (see management reserve),
2. *extraordinary events such as major strikes and natural disasters,*
3. *management reserves, and*
4. *escalation and currency effects.*

Some of the items, conditions, or events for which the state, occurrence, and/or effect is uncertain include, but are not limited to, planning and estimating errors and omissions, minor price fluctuations (other than general escalation), design developments and changes within the scope, and variations in market and environmental conditions. Contingency is generally included in most estimates and is expected to be expended.'

For an estimate with this limited level of engineering development the recommended level of contingency is 30%.

The primary differences in cost estimates for the replacement and restart cases lie in the factors applied to the calculated equipment costs. These factors are detailed for all cases in Table 5-5. This table must be read in conjunction with Table 5-4, as the basis on which the factors are levied is differs between the replacement and restart cases.

	Option 1		Option		Option 3		Option 4	
	12 tpd		24 tpd		45 tpd		50 tpd	
	Replace	Restart	Replace	Restart	Replace	Restart	Replace	Restart
Direct Costs								
Total direct cost of equipment	100%	5%	100%	22%	100%	100%	100%	100%
Concrete	25%	0%	25%	0%	25%	10%	25%	10%
Earthworks	10%	0%	10%	0%	10%	3%	10%	3%
Structural steel	47%	5%	47%	10%	47%	25%	47%	25%
Piping	37%	15%	37%	25%	37%	37%	37%	37%
Electrical	19%	8%	19%	12%	19%	18%	19%	18%
Instrumentation and Control	14.0%	14%	14.0%	14%	14%	13%	14%	13%
Architecture and auxiliary buildings, minor infrastructure	15%	2%	15%	2%	15%	10%	15%	10%
Indirect costs								
Construction Equipment	4%	4%	4%	4%	4%	4%	4%	4%
Demolition of existing facility		3%		3%		5%		5%
Vendor representatives	3%	3%	3%	3%	3%	3%	3%	3%
Commissioning and start-up	5%	5%	5%	5%	5%	5%	5%	5%
Spares	3%	3%	3%	3%	3%	3%	3%	3%
First fills	3%	3%	3%	3%	3%	3%	3%	3%
Owner's costs	6%	6%	6%	6%	6%	6%	6%	6%
EPCM	18%	12%	18%	12%	18%	18%	18%	18%
Construction camp, temporary facilities etc	0%	0%	0%	0%	0%	0%	0%	0%

Table 5-5 – Factors used for capital cost estimates

5.4 BENCHMARK COMPARISON

The eCobalt Solution's refinery, which was estimated in 2017 as costing $129M, has an analogous flowsheet and location, albeit with a more complex copper recovery circuit. The cost estimate for the latter is comparatively similar to what has been estimated for the First Cobalt Refinery.

The capital costs calculated in this study are based on database and vendor budget costs, and on a derived mechanical equipment list. This supports the contingency utilised in this case.

An alternative estimating methodology that can be utilised in the early, order-of-magnitude (OOM) stages of a project or study, is the "economies of scale" method, discussed in Section 5.1. This has been utilised to benchmark the costs obtained from the current estimate to those publicly available for similar facilities. Economies of scale methods are sufficient for OOM comparisons, but care must be taken as the information made available publicly rarely provides full detail and cost breakdowns, and the categorisation of costs can be opaque, resulting in misleading comparison values.

As part of the desktop review, cost estimates derived from other studies were reviewed, and three of which are listed below.

5.4.1 Hatch Report

In May 2012 Hatch prepared a cost estimate for the replacement of the First Cobalt Refinery at 12 tpd throughput. The estimate at the time was US$77.7 M, with an estimated range of between US$54 and US$117M.

Description	Cost (US$M)
Mechanical	15.3
Discipline, Infrastructure and Buildings	25.3
Total Directs	*40.6*
Indirects	19.2
Total Direct and Indirect	*59.8*
Contingency	17.9
Total Project Cost	77.7

Table 5-6 - Hatch 2012 Replacement cost estimate

It should be noted that the replacement cost estimate by Hatch excluded costs associated with the tailings management facility, oxygen plant, Merrill-Crowe plant, land and property costs, permitting costs, power lines and mobile equipment.

In 2018 terms, the Hatch estimate escalated at 3% per annum would yield a replacement cost of US$93M.

To estimate the replacement cost of a 50 tpd refinery, the 6/10ths scale of economies rule was applied, resulting in a cost of approximately $219M.

5.4.2 BBA Report

In January 2017, BBA conducted a site visit to the First Cobalt Refinery and produced a report that included various comparisons for benchmarking the capital costs for a 50 tpd facility.

BBA estimated costs of between $60 and $90M for a 50 tpd facility. This is significantly lower than the escalated cost estimate derived by Hatch.

5.4.3 Comparative Facility

The nearest comparison in the market is the proposed refinery contained in a feasibility study prepared for eCobalt Solution's Idaho Cobalt Project (ICP) that was prepared by Micon, dated November 10, 2017.

The study is presented at a level of accuracy of +/-15% and the capital costs were reported as shown in Table 5-7.

Description	Cost (US$M)
Total Direct cost for Cobalt Processing Facility (CPF)	*93.9*
Indirects for CPF	20.5
Total Direct and Indirect	*114.4*
Contingency	14.6
Total CPF Project Cost	129

Table 5-7 - Hatch 2012 Replacement cost estimate

The eCobalt process is a fully continuous, modern design, with economies of scale that result in a lower capital cost when compared to the First Cobalt Refinery. The CPF design will treat 55.5 short tons of concentrate per day, or 50.3 metric tonnes per day. Several innovations adopted in the pressure leach circuit (discussed in Section 5.4.3.2) may reduce the cost of this area in comparison to the conventional flowsheet adopted for the First Cobalt Refinery.

The cost differential between the CPF and First Cobalt Refinery at the same tonnage is within the range of the estimate for the First Cobalt Refinery. It should be noted that items such as owner's costs are not explicitly stated in the capital estimate for the CPF and may be covered in cost descriptors not explicitly associated with the CPF.

The CPF flowsheet has been developed to cater specifically for the concentrate produced from the Ram deposit and to produce cobalt sulphate, copper sulphate and magnesium sulphate as final products. The production of magnesium sulphate is required due to the extensive use of magnesium oxide (MgO) for neutralisation. The CPF flowsheet has several significant differences to the more generic modified First Cobalt Refinery flowsheet.

In general, the CPF flowsheet is a more complex flowsheet developed specifically to treat the properties of the ICP concentrate, while the First Cobalt flowsheet is a more simplified generic flowsheet that has been developed and modified over time to process a variety of feed materials.

The key differences between the two refinery flowsheets are discussed in sections 5.4.3.1 to 5.4.3.9.

5.4.3.1 Concentrate Regrind and Pre-leach

The CPF flowsheet has a concentrate regrind circuit to produce an autoclave feed concentrate with P_{80} of 15µm prior to a one (1) hour pre-leach designed to dissolve acid consuming gangue and vent the associated volatile gases, such as carbon dioxide (CO_2), prior to the autoclave.

The First Cobalt Refinery has an open circuit ball mill for slurry repulping purposes.

5.4.3.2 Pressure Oxidation Leach

The CPF pressure leach section incorporates a continuous autoclave circuit operating at 155°C with a nominal retention time of 120 minutes. It has several specific design aspects which differentiate it from a more standard pressure oxidation leach circuit design, as discussed in this section.

Nitrogen Species Catalysed (NSC) Leach with Nitrate Recovery

The CPF circuit incorporates the addition of nitrate into the autoclave circuit (the NSC process) which catalyses the leach reaction by accelerating the oxygen transfer process. Nitrous oxides (NO_x) are scrubbed from the autoclave vent and returned as HNO_3. Its use can reduce the operating pressure and reduce the residence time required compared with standard pressure oxidation (POX) leaching, reducing capital cost.

Flash Thickener Recycle (FTR) Autoclave Circuit Design

The CPF design used a proprietary autoclave design called flash-thickener-recycle which manages the heat load and enables higher operating density and therefore a smaller autoclave.

The First Cobalt Refinery has a batch operated autoclave circuit utilising conventional pressure oxidation technology with a nominal cycle time of four hours (allowing for 6 batch cycles per day). This provides for a nominal autoclave retention time of two hours at elevated temperature (> 135°C).

It should be noted that batch operation of pressure autoclaves is not ideal, with the following operating issues historically identified:

- heat generation and temperature control variations
- variable acid production
- high and variable arsenic levels in the leachate
- poorly crystalline leach residues resulting in low filtration rates

5.4.3.3 Impurity Removal

The CPF circuit diverges further from the basic First Cobalt flowsheet in that impurity removal is necessarily completed in two stages, one before and one after the copper solvent extraction (Cu SX) circuit. The first stage impurity removal prepares the solution for feed to the Cu SX circuit and is essentially for acid neutralisation and takes place on the autoclave discharge slurry using MgO to pH 3. The neutralised slurry is fed to a thickener to recover the solution for feed to Cu SX and the residue for feed to the gold recovery circuit. The second stage of impurity removal precipitates iron and remnant copper from the Cu SX discharge solution by addition of MgO and fresh concentrate at pH 4.5. The neutralised slurry is fed to a thickener to recover the solution for feed to Co SX and the thickened solids are returned to the autoclave feed circuit. The thickener overflow solution is filtered and proceeds to cobalt solvent extraction (Co SX).

The First Cobalt Refinery flowsheet has two sequential stages of impurity removal applied to the leach residue filtrate. The first stage neutralises acid and oxidises and precipitates iron (and arsenic) from solution. The second stage then removes low levels of copper from the first stage discharge slurry using NaHS prior to advancing the slurry to a filter to recover filtered solution for feed to the Co SX circuit and an iron/copper/gypsum cake for disposal.

5.4.3.4 Copper Recovery

The CPF circuit has a purpose designed copper recovery circuit to produce a copper sulphate product and to cater for the very high copper concentrations expected in the leach solution. The circuit comprises three (3) stages of extraction and two (2) stages of stripping, with the raffinate being recycled to a preliminary leach circuit for the incoming concentrate prior to it being advanced to the autoclave for final leaching. This configuration is required to address the very high copper concentrations in the SX feed solution and the subsequent high acid concentrations in the Cu SX raffinate. The loaded strip solution from the SX circuit is fed to a crystalliser to produce copper sulphate.

5.4.3.5 Zinc Removal

The CPF circuit identifies a Ni / Zn precipitation circuit after the Co SX circuit and does not have a zinc removal SX circuit ahead of Co SX. This is inconsistent with existing commercial flowsheets for Zn/Co/Ni refineries and suggests a low concentration of Zn may be present. Commentary in the MICON 43-101 document regarding future processing testwork identifies that for the Co SX circuit "*The cobalt and zinc stripping conditions also need to be confirmed*." This indicates that low levels of zinc are present and may be addressed in the Co SX stripping circuit, rather than requiring a separate Zn SX circuit.

The First Cobalt Refinery flowsheet has a "conventional" base metal recovery circuit configuration, with Zn SX preceding the Co SX circuit.

5.4.3.6 Cobalt Recovery

The proposed cobalt recovery circuit for the CPF precipitates around 90% of the cobalt as cobalt hydroxide from the filtered Copper / Iron removal circuit solution (after Cu SX) using MgO at pH ~8.5. The hydroxide precipitate is filtered, with the cobalt hydroxide filter cake being advanced to the Co SX circuit and the filtrate

being advanced to the Trace Metals (Co/Ni/Zn/Cu) removal circuit. In the Trace Metals removal circuit, the residual cobalt, along with Ni, Zn and Cu are precipitated with MgO at a (relatively high) pH = 9, and the precipitate is recycled back to the autoclave feed circuit. The filtrate is advanced to the Mg Crystallisation circuit for recovery of magnesium sulphate.

The cobalt hydroxide filter cake is re-leached with Co SX raffinate and other recycled process solutions in preparation as a high tenor feed to the Co SX circuit. Co SX circuit is designed for high purity product, comprising a single extraction stage, four scrub stages and a single strip stage. The strip solution from the Co SX circuit is advanced to the cobalt sulphate crystallisation circuit for production of a (low impurity) cobalt sulphate product.

The two-stage cobalt recovery circuit has been proposed to produce low impurity cobalt sulphate as a high value product.

The existing First Cobalt Refinery flowsheet has a two-stage cobalt recovery circuit comprising direct Co SX on the leach PLS (after copper recovery and single-stage impurity removal), with subsequent cobalt carbonate precipitation from the Co SX strip liquor. This circuit is expected to produce a cobalt carbonate product of reasonably low impurity level.

5.4.3.7 Precious metals recovery

The CPF flowsheet features sulphur flotation and pre-aeration prior to cyanidation in a carbon in leach (CIL) circuit. Lime is used to raise the cyanidation slurry pH to 10. The loaded carbon is transported off site for precious metals recovery. CIL tailings slurry is filtered to produce a dry solid tailing for disposal, while the filtrate is recycled with a bleed being sent to cyanide destruction and discharge.

The First Cobalt refinery flowsheet does not have sulphur flotation or pre-oxidation stages and has a Merrill-Crowe recovery circuit which can be used in place of CIL.

5.4.3.8 Other metals recovery

The CPF flowsheet removes residual trace amounts of cobalt, nickel and zinc from the circuit by precipitation at pH =9.

The filtrate from the cobalt hydroxide filter is advanced to the Trace Metals Precipitation circuit for precipitation as a mixed Co / Ni / Zn carbonate product, potentially for sale.

The First Cobalt refinery flowsheet processes the Co SX raffinate through a Nickel Carbonate Precipitation Circuit. Residual cobalt from the Co SX raffinate, along with trace levels of nickel and zinc are expected to be recovered in this circuit. Although the precipitate in the First Cobalt Refinery flowsheet is identified as "$NiCO_3$ Product", it would likely be a mixed metal (predominantly Co, Ni, Zn) precipitate of relatively low mass.

The First Cobalt refinery flowsheet has a manganese removal circuit between the Co SX circuit and the cobalt carbonate precipitation circuit. The CPF makes no mention of the specific removal of manganese from the process streams, however it is noted as present in the feed concentrate in ppm levels.

5.4.3.9 Magnesium sulphate recovery

For the CPF, magnesium oxide (MgO) is the predominant neutralising agent used throughout the various unit process operations, with sodium and calcium based reagents (hydroxide and/or carbonate) absent from the flowsheet. The basis for the exclusive use of MgO in the refinery is the inherent solubility of magnesium throughout the refinery circuit and the subsequent ability to recover (and potentially sell) a low value $MgSO_4$ by-product.

Filtrate from the Impurity Removal circuits is advanced to the Magnesium Sulphate Crystalliser to remove the significant quantities of magnesium from the PLS that build up due to the use of MgO for the acid neutralisation requirements throughout the refinery circuit. The magnesium sulphate is recovered as a low value $MgSO_4$ crystal by-product. The Magnesium Sulphate Crystalliser essentially closes the elemental and water balance of the refinery and presents an essentially zero environmental emission refinery. The only environmental discharge from the CPF is the filtered tailings solids from the gold recovery circuit.

In the First Cobalt Refinery, a combination of sodium and calcium based reagents (hydroxide and/or carbonate) are used throughout the circuit for neutralisation and pH control requirements. Calcium addition manifests as gypsum ($CaSO_4.2H_2O$) and reports to intermediate filter cake streams and/or the solids residue tailings stream. Sodium addition manifests as soluble sodium sulphate and is not currently removed from the refinery circuit.

6 OPERATING COST

Summaries of the operating costs are provided in Table 6 1 and Table 6 2.

Cost Item	Total annual cost, US$			
	Option 1	Option 2	Option 3	Option 4
	12 tpd	24 tpd	45 tpd	50 tpd
Sulphuric acid	63,072	126,144	236,520	262,800
Lime	165,564	331,128	620,865	689,850
Sodium Hydroxide	59,130	118,260	221,738	246,375
General Reagents/Consumables	194,423	462,758	1,148,643	1,316,730
SX reagents	156,202	262,636	448,895	493,243
Water and water treatment	51,328	61,183	78,429	82,536
Assay/Laboratory consumables	64,715	96,251	151,439	164,579
Grid power	405,270	740,151	1,400,452	1,573,310
Natural Gas	51,772	77,000	121,151	131,663
Labour	794,487	1,383,283	2,335,950	2,488,388
General expenses	952,705	1,685,052	2,862,304	3,133,732
Maintenance Materials	923,374	1,112,590	1,443,718	1,522,558
Contract Services	194,144	288,752	454,316	493,736
Total	**4,076,185**	**6,745,188**	**11,524,419**	**12,599,499**

Table 6-1 – Operating cost estimates

Cost Item	$/t concentrate				$/lb Co				$/t mill feed			
	Option 1	Option 2	Option 3	Option 4	Option 1	Option 2	Option 3	Option 4	Option 1	Option 2	Option 3	Option 4
	12 tpd	24 tpd	45 tpd	50 tpd	782,155 lb/a	1,564,310 lb/a	2,933,082 lb/a	3,258,980 lb/a	200 tpd	400 tpd	750 tpd	833 tpd
Sulphuric acid	16.00	16.00	16.00	16.00	0.08	0.08	0.08	0.08	0.96	0.96	0.96	0.96
Lime	42.00	42.00	42.00	42.00	0.21	0.21	0.21	0.21	2.52	2.52	2.52	2.52
Sodium Hydroxide	15.00	15.00	15.00	15.00	0.08	0.08	0.08	0.08	0.90	0.90	0.90	0.90
General Reagents/Consumables	49.32	58.70	77.70	80.17	0.25	0.30	0.39	0.40	2.96	3.52	4.66	4.81
SX reagents	39.63	33.31	30.37	30.03	0.20	0.17	0.15	0.15	2.38	2.00	1.82	1.80
Water and water treatment	13.02	7.76	5.31	5.03	0.07	0.04	0.03	0.03	0.78	0.47	0.32	0.30
Assay/Laboratory consumables	16.42	12.21	10.24	10.02	0.08	0.06	0.05	0.05	0.99	0.73	0.61	0.60
Grid power	102.81	93.88	94.74	95.79	0.52	0.47	0.48	0.48	6.17	5.63	5.68	5.75
Natural Gas	13.13	9.77	8.20	8.02	0.07	0.05	0.04	0.04	0.79	0.59	0.49	0.48
Labour	201.54	175.45	158.02	151.50	1.02	0.88	0.80	0.76	12.09	10.53	9.48	9.09
General expenses	241.68	213.73	193.63	190.79	1.22	1.08	0.98	0.96	14.50	12.82	11.62	11.45
Maintenance Materials	234.24	141.12	97.66	92.70	1.18	0.71	0.49	0.47	14.05	8.47	5.86	5.56
Contract Services	49.25	36.63	30.73	30.06	0.25	0.18	0.15	0.15	2.96	2.20	1.84	1.80
Infrastructure												
Total	**1,034**	**856**	**780**	**767**	**5.21**	**4.31**	**3.93**	**3.87**	**62.04**	**51.33**	**46.78**	**46.03**

Table 6-2 –First Cobalt Refinery operating costs for benchmark comparison

6.1 TYPE OF ESTIMATE

This is a factored estimate, designated as an FEL 1 and AACE Class 5 (order of magnitude) estimate with an indicative accuracy range of -30%/+50%, and is based on previous historical data metrics from similar projects.

Costs have been developed based on similar projects, with amendments to match the First Cobalt Refinery flowsheet. Operating costs are typically based on first principles; however, feed characteristics are not available at this time for the First Cobalt Refinery, and the operating costs provided in Table 6-1 are indicative only.

6.2 BENCHMARK COMPARISION

In order to compare the derived costings with other similar operations, the assumptions listed in Section 2.2 were used to derive ROM tonnages and masses of cobalt produced. These were then compared to similar costs obtained for the eCobalt Idaho Project (MICON International Limited, 2017) and the Saskatchewan Metals Processing Plant for Fortune Minerals (MICON International Limited, 2014).

	CPF (US$)	SMPP (US$)	First Cobalt (US$)
Per tonne of concentrate	925.1	434	767 – 1,034
Per tonne of ore	40.72	18.11	46.03 – 62.04
Per lb Co	4.69	NA	3.87 – 5.21

Table 6-3 – Benchmark operating costs

The CPF report provides costs for the hydrometallurgical facility in the range of US$925.1/tonne of concentrate, US$40.72/tonne of ore milled, and US$ 4.69/lb of cobalt produced. The values per tonne of concentrate and cobalt are within the range of accuracy for the desktop study, and it is possible that the project mass pull is sufficiently different to explain the difference in terms of $/tonne ROM.

The SMPP costs are lower per tonne of concentrate, at C$564/t concentrate, or approximately US$434/t concentrate and C$18.11 per tonne of ROM or US$12.68/t.

7 RECOMMENDATIONS AND CONCLUSIONS

- The First Cobalt Refinery can be upgraded to accommodate unit processes that would support a throughput of up to 50 tonnes per day
- An increase in throughput capacity from 12 to 24 tonnes per day can be achieved with comparatively little capital expenditure, assuming that the feed and processing characteristics remain unchanged
- An increase in throughput capacity from 12 to either 45 or 50 tonnes per day will require extensive replacement of the processing plant unit operations, and expansion beyond the current layout of the processing plant. Sufficient room is available in the unused milling building to allow expansion while remaining within existing building areas.
- The Study has been conducted at a very high level, and the costs will require further refinement prior to a final investment decision. The brownfields nature of the project requires a more in depth assessment than a desktop study can realistically provide, due to the multiple factors at play that contribute to the capital and operating costs.
- Initial operating cost estimates are in-line with two comparable projects, and where variations occur they are generally in areas that are underpinned by assumptions with regard to feedstock.

- First Cobalt should undertake either a Prefeasibility or Definitive Feasibility Study, dependent upon the level of certainty regarding the feedstock to the plant and the requirements of potential financing arrangements.
- At prefeasibility level and assuming that a throughput rate of 50 tonnes per day is selected, the study cost is estimated at between US$400,000 and US$600,000. Prefeasibility studies typically take between 4 and 6 months to complete.
- At a definitive feasibility study level and assuming a throughput rate of 50 tonnes per day, the study cost is estimated at between US$800,000 and US$1,200,000, Definitive feasibility studies typically take between 6 and 10 months to complete.
- Typically for a brownfields study of this nature the total feasibility cost is approximately 3.7% of the total project cost (Mackenzie & Cusworth, 2007). For the 50 tpd option, this total cost would be US$3.9 M, and would include sampling, testwork, and owner's costs, including any permitting and environmental work that would be required for the project.

8 REFERENCES

Mackenzie, W., & Cusworth, N. (2007). The Use and Abuse of Feasibility Studies. *Project Evaluation Conference*, (pp. 1 - 12).

MICON International Limited. (2014). *Techncial Report on the Feasibility Study for the Nico Gold-Cobalt-Bismuth-Copper Porject Northwest Territories, Canada.* SEDAR.

MICON International Limited. (2017). *NI 43-101 F1 TECHNICAL REPORT FEASIBILITY STUDY FOR THE IDAHO COBALT PROJECT IDAHO, U.S.A.*

APPENDIX A BLOCK FLOW DIAGRAM

APPENDIX B MECHANICAL EQUIPMENT LIST

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
ORE RECEIPT												
Ore Feeder No. 1	FE-001	1	new						$29,029.61	$29,029.61	$29,029.61	
Ore Feeder No. 2	FE-002	1	new		1.0	0.7			$29,029.61	$29,029.61	$29,029.61	2 t/hr VFD conveyor
Overhead Crane	CK-001	1	existing					$2,000.00	$3,404.87	$3,404.87	$3,404.87	10 tonne
Ore Loading Bin c/w Grizzly Grate	B1-001	1	new					$4,000.00	$6,809.73	$10,321.62	$16,032.58	
Feed Conveyor 1	CV-001	1	new	400mm W x 14m L	5.0	3.7		$11,750.00	$20,003.59	$30,319.77	$47,095.69	
Feed Conveyor 2	CV-002	1	new	400 mm W x 25m L	10.0	7.5		$20,600.00	$35,070.12	$53,156.36	$82,567.76	
Open Circuit Mill	MM-001	1	new	1000x1800	200.0	149.2		$37,500.00	$63,841.24	$96,765.22	$150,305.39	
Ball Mill Feed Hopper	BI-002	1	new	10 ton					$15,000.00	$15,000.00	$15,000.00	
ball mill feed chute	av 0102	1	new						$7,500.00	$7,500.00	$7,500.00	carbon steel
Concentrate Transfer Pump	PU-001	1	new	50 mm	7.5	5.6		$1,500.00	$2,553.65	$3,870.61	$5,866.75	Sala vert +box
Concentrate Storage Tank Agitator	AG-040	1	existing		7.5	5.6	39.34	-	$29,842.70	$44,746.69	$44,746.69	no shaft
Concentrate Storage Tank	TK-048	1	existing	3.3m x 4.6m			39.34	-	$7,136.72	$10,817.25	$27,878.88	carbon steel
Premix Reactor Feed Pump	PU-039	1	refurbished	50 mm x 50mm	7.5	5.6		$1,500.00	$15,000.00	$11,875.57	$18,000.00	SRL
Autoclave Pond Reclaim Pump	PU-038	1	new	50mm	3.0	2.2		$2,910.00	$3,191.92	$4,360.33	$5,531.16	submersible
Autoclave Pond Reclaim Barge		1	existing					$35,000.00				Based on Ravensthorpe costs
PRESSURE LEACH												
Premix Reactor Agitator	AG-001	1	existing		1.5	1.1	12.05	-	$23,243.49	$35,230.54	$50,431.48	Inconel 625
Premix Reactor	RE-001	1	existing	2.3m x 3m			12.05	-	$25,875.25	$32,823.22	$48,991.08	carbon steel brick lined
Autoclave Feed Pump	PU-002	1	refurbished	40mm x 75mm	7.5	5.6		$1,500.00	$10,000.00	$12,045.34	$18,000.00	stainless steel
Autoclave Agitator	AG-002	1	existing		25.0	18.7		-	*Included in Autoclave Pricing			titanium
Batch Autoclave	VE-001	1	existing	2.1m x3.3m			12.05	-	$3,197,260.97	$6,394,521.94	$12,545,850.00	carbon steel brick lined
Vent System for Autoclave - condenser	VE-002	1	new						$78,965.07	$119,688.66	$181,414.09	From database for Jord
Vent System for Autoclave - scrubber	VE-003	1	existing	1219mm od x 3200mm					$75,000.00	$75,000.00	$75,000.00	316ss cone bottom chill vessel
Flash Tank	TK-001	1	new					$117,000.00	$126,873.74	$192,304.63	$291,479.31	Estimated from database
Conditioning Tank Agitator	AG-003	1	existing		5.0	3.7	50.30	-	$25,875.25	$32,823.22	$48,991.08	Inconel 625
Conditioning Tank	TK-002	1	new	4m x 4m			50.30	$125,000.00	$8,270.64	$20,799.85	$32,308.40	carbon steel brick lined
Filter Press Feed Tank Agitator	AG-004	1	existing		5.0	3.7	50.30	-	$25,875.25	$32,823.22	$48,991.08	Inconel 625
Filter Press Feed Tank	TK-003	1	existing	4m x 4m			50.30	-	$8,270.64	$20,799.85	$32,308.40	carbon steel brick lined
Filter Press Feed Pump	PU-003	1	new	80mm				$6,000.00	$13,000.00	$13,000.00	$13,000.00	AOD pump
Spiral Heat Exchanger	HX-001	1	new					$6,000.00	$314,971.82	$477,408.00	$723,615.21	HPA database
Heat Exchanger No. 2	HX-002	1	new						$13,953.80	$21,150.00	$32,057.41	Plate 316ss
heat exchanger pump	PU-032	1	new	65mm x 65mm	3.0	2.2			$12,082.07	$18,313.00	$27,757.32	srl horiz vert. mech seal
Leach Residue Filter Press	FL-001	1	new	1200mm x 50 plates	1.0	0.7		$94,250.00	$160,454.32	$243,203.26	$377,767.56	poly plates

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Screw Conveyor	CV-003	1	new		2.0			$2,000.00	$3,404.87	$5,160.81	$8,016.29	
COPPER & IRON REMOVAL												
Copper Removal Tank Agitator	AG-005	1	existing		5.0	3.7	7.67	-	$16,903.29	$17,712.75	$21,442.12	carbon steel rubber lined
Copper Removal Tank	TK-004	1	existing				7.67	-	$28,694.75	$43,493.11	$67,557.84	FRP
Iron Removal Tank 1 Agitator	AG-006	1	existing		5.0	3.7	7.67	-	$16,903.29	$17,712.75	$21,442.12	carbon steel rubber lined
Iron Removal Tank 1	TK-005	1	existing	2.0m x 2.44m			7.67	-	$28,694.75	$43,493.11	$67,557.84	FRP
Iron Removal Tank 2 Agitator	AG-007	1	existing		5.0	3.7	7.67	-	$16,903.29	$17,712.75	$21,442.12	carbon steel rubber lined
Iron Removal Tank 2	TK-006	1	existing	2.0m x 2.44m			7.67	-	$28,694.75	$43,493.11	$67,557.84	FRP
Iron Removal Tank 3 Agitator	AG-008	1	existing		5.0	3.7	7.67	-	$16,903.29	$17,712.75	$21,442.12	316ss,
Iron Removal Tank 3	TK-007	1	existing	2.0m x 2.44m			7.67	-	$28,694.75	$43,493.11	$67,557.84	FRP
Fe / Cu / Gypsum Filter Press Feed Tank Agitator	AG-009	1	existing				7.85	-	$16,903.29	$17,712.75	$21,442.12	
Fe / Cu / Gypsum Filter Press Feed Tank	TK-008	1	existing	2.0m x 2.5m			7.85	-	$103,660.69	$157,120.23	$244,054.81	FRP
Fe / Cu / Gypsum Filter Press Feed Pump	PU-004	1	new	80mm				$6,000.00	$13,000.00	$13,000.00	$13,000.00	AOD
Fe / Cu / Gypsum Filter Press	FL-002	1	new	1200mm x 50 plates	1.0	0.7		$94,250.00	$160,454.32	$243,203.26	$377,767.56	poly plates
Fe Filter Press	FL-004	1	existing	1200mm x 50 plates	1.0	0.7		$14,300.00	$24,344.79	$36,899.81	$57,316.46	poly plates
Iron press feed pump	PU-053	1	existing	50mm	7.5	5.6		$1,500.00	$2,553.65	$3,870.61	$5,866.75	Sala vert+box
SX Feed Tank 1	TK-009	1	existing	3.66m x 4.1m			43.14	-	$103,660.69	$157,120.23	$244,054.81	FRP
SX Feed Tank 2	TK-010	1	existing	3.66m x 4.1m			43.14	-	$103,660.69	$157,120.23	$244,054.81	FRP
SX Feed Pump 1	PU-005	1	refurbished	25mm x 40mm	3.0	2.2		$1,500.00	$8,945.56	$12,220.10	$15,000.00	316ss, mechseal VFD
SX Feed Pump 2	PU-006	1	refurbished	25mm x 40mm	3.0	2.2		$1,500.00	$8,945.56	$12,220.10	$15,000.00	316ss, mechseal VFD
SX Feed Filter Package 1	FL-003/004	1	new	600mmx2				$14,300.00	$24,344.79	$36,899.81	$57,316.46	FRP
Copper Removal Tank No. 1 Agitator	AG-048	1	existing		5.0	3.7			$16,903.29	$17,712.75	$21,442.12	carbon steel rubber lined
Copper Removal Tank No. 1	TK-054	1	existing	2.0m x2.5m			7.85		$29,029.17	$44,000.00	$66,691.53	carbon steel rubber lined
Copper Removal Tank No. 2 Agitator	AG-049	1	existing		5.0	3.7			$16,903.29	$17,712.75	$21,442.12	carbon steel rubber lined
Copper Removal Tank No. 2	TK-055	1	existing	2.0m x 2.5m			7.85		$29,029.17	$44,000.00	$66,691.53	carbon steel rubber lined
Copper Removal Tank No. 3 Agitator	AG-050	1	existing		5.0	3.7			$16,903.29	$17,712.75	$21,442.12	carbon steel rubber lined
Copper Removal Tank No. 3	TK-056	1	existing	2.0m x 2.5m			7.85		$29,029.17	$44,000.00	$66,691.53	carbon steel rubber lined
Copper Precipitation Discharge Pump	PU-054	1	existing	50mm	7.5	5.6		$1,500.00	$2,553.65	$3,870.61	$5,866.75	Sala vert+box
COBALT SX CIRCUIT												
Cobalt Extraction Mixer - Settler No. 1 Agitator	AG-043	1	existing		3.0	2.2			$27,114.37	$27,114.37	$27,114.37	316ss
Cobalt Extraction Mixer - Settler No. 1	EX-004	1	existing	3.25mL x 1.0mW x 1.2mH					$19,658.00	$29,797.00	$46,283.00	FRP
Cobalt Extraction Mixer - Settler No.2 Agitator	AG-044	1	existing		3.0	2.2			$27,114.37	$27,114.37	$27,114.37	316ss

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Cobalt Extraction Mixer - Settler No.2	EX-005	1	existing	3.25mL x 1.0mW x 1.2mH					$19,658.00	$29,797.00	$46,283.00	FRP
Cobalt Extraction Mixer - Settler No. 3 Agitator	AG-045	1	existing		3.0	2.2			$27,114.37	$27,114.37	$27,114.37	316ss
Cobalt Extraction Mixer - Settler No. 3	EX-006	1	existing	3.25mL x 1.0mW x 1.2mH					$19,658.00	$29,797.00	$46,283.00	FRP
Extraction Mixer - Settler 3 Agitator	AG-012	1	existing		3.0	2.2	3.90	-	$27,114.37	$27,114.37	$27,114.37	316ss
Extraction Mixer - Settler 3	EX-003	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	-	$19,658.00	$29,797.00	$46,283.00	FRP
Extraction Mixer - Settler 2 Agitator	AG-011	1	existing		3.0	2.2	3.90	-	$27,114.37	$27,114.37	$27,114.37	316ss
Extraction Mixer - Settler 2	EX-002	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	-	$19,658.00	$29,797.00	$46,283.00	FRP
Extraction Mixer - Settler 1 Agitator	AG-010	1	existing		3.0	2.2	3.90	-	$27,114.37	$27,114.37	$27,114.37	316ss
Extraction Mixer - Settler 1	EX-001	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	-	$19,658.00	$29,797.00	$46,283.00	FRP
Raffinate Tank	TK-011	1	existing	3.66m x 5.5m			58.00	-	$123,806.32	$187,655.29	$291,484.91	FRP
Raffinate Transfer Pump	PU-007	1	refurbished	40mm x 75mm	3.0	2.2		$1,500.00	$8,945.56	$12,220.10	$15,000.00	316ss, horiz. centr., mechanical seal
Raffinate Filter Package 2	FL-005/006	1	new	800 mm dia.				$14,300.00	$24,344.79	$36,899.81	$57,316.46	SS or FRP
Scrub Mixer - Settler 1 Agitator	AG-013	1	existing		3.0	2.2	3.90	-	$27,114.37	$27,114.37	$27,114.37	316ss
Scrub Mixer - Settler 1	SC-001	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	$1,000.00	$19,658.00	$29,797.00	$46,283.00	FRP
Scrub Mixer - Settler 2 Agitator	AG-014	1	existing		3.0	2.2	3.90	-	$27,114.37	$27,114.37	$27,114.37	316ss
Scrub Mixer - Settler 2	SC-002	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	$1,000.00	$19,658.00	$29,797.00	$46,283.00	FRP
Stripping Mixer - Settler 1 Agitator	AG-015	1	existing		3.0	2.2	3.90	-	$27,114.37	$27,114.37	$27,114.37	316ss
Stripping Mixer - Settler 1	ST-001	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	$1,000.00	$19,658.00	$29,797.00	$46,283.00	FRP
Stripping Mixer - Settler 2 Agitator	AG-016	1	existing		3.0	2.2	3.90	-	$27,114.37	$27,114.37	$27,114.37	316ss
Stripping Mixer - Settler 2	ST-002	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	$1,000.00	$19,658.00	$29,797.00	$46,283.00	FRP
Stripping Mixer - Settler 3 Agitator	AG-017	1	existing		3.0	2.2	3.90	-	$27,114.37	$27,114.37	$27,114.37	316ss
Stripping Mixer - Settler 3	ST-003	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	$1,000.00	$19,658.00	$29,797.00	$46,283.00	FRP
Regeneration Mixer - Settler Agitator	AG-018	1	existing		3.0	2.2	3.90	-	$27,114.37	$27,114.37	$27,114.37	316ss
Regeneration Mixer - Settler	RG-001	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	$1,000.00	$19,658.00	$29,797.00	$46,283.00	FRP
Regenerated Organic Holding Tank	TK-012	1	existing	1.4m x 2m			3.08	-	$2,415.61	$3,661.39	$5,549.62	
Regenerated Organic Feed Pump	PU-008	1	refurbished	25mm x 40mm	1.0			$1,500.00	$4,500.00	$5,901.87	$9,000.00	
Crud Treatment Package	PK-001	1	new					$15,000.00	$25,536.50	$38,706.09	$60,122.16	Possibly includes all items within "CRUD TREATMENT"
Crud Tank Agitator	AG-055	1	new		1.5	1.1			$4,773.60	$4,773.60	$4,773.60	316ss

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
TK-031 Agitator	AG-035	1	new		3.0			$4,150.00	$7,065.10	$10,708.68	$16,633.80	Not sure if TK-031 exists?
Crud Tank	TK-031	1	new	1500mm x 1500mm			2.65		$2,415.61	$3,661.39	$5,549.62	polyethylene
Crud Holding Tank		1	new						$2,415.61	$3,661.39	$5,549.62	
Crud Pump	PU-066	1	new						$6,000.00	$6,000.00	$6,000.00	AOD
Crud Treatment Filter Press	FL-015	1	existing	800mm x 800 x 25mm				$14,300.00	$24,344.79	$36,899.81	$57,316.46	40 plates
MANGANESE REMOVAL												
Mn Removal Tank 1 Agitator	AG-019	1	existing		3.0	2.2	3.81	-	$27,114.37	$27,114.37	$27,114.37	carbon steel rubber lined
Mn Removal Tank 1	TK-013	1	existing	1.52m x 2.1m			3.81	-	$8,780.02	$28,582.37	$44,396.99	FRP
Mn Removal Tank 2 Agitator	AG-020	1	existing		3.0	2.2	3.81	-	$27,114.37	$27,114.37	$27,114.37	carbon steel rubber lined
Mn Removal Tank 2	TK-014	1	existing	1.52m x 2.1m			3.81	-	$8,780.02	$28,582.37	$44,396.99	FRP
Mn Removal Tank 3 Agitator	AG-021	1	existing		3.0	2.2	3.81	-	$27,114.37	$27,114.37	$27,114.37	carbon steel rubber lined
Mn Removal Tank 3	TK-015	1	existing	1.52m x 2.1m			3.81	-	$8,780.02	$28,582.37	$44,396.99	FRP
MnO2 Filter Feed Pump	PU-009	1	new	25mm x 40mm	2.0	1.5		$1,500.00	$8,945.56	$12,220.10	$15,000.00	316ss, horiz. centr., mechanical seal
MnO2 Filter Package 3	FL-007/008	1	new	250mm dia x 2				$14,300.00	$24,344.79	$36,899.81	$57,316.46	CS Epoxy Painted
COBALT PRECIPITATION												
CoCO3 Precipitation Tank 1 Agitator	AG-022	1	new		3.0	2.2	7.85	$4,300.00	$27,114.37	$27,114.37	$32,823.22	316ss
CoCO3 Precipitation Tank 1	TK-016	1	new	2.0mm x 2.5mm			7.85	$2,500.00	$29,096.92	$44,102.69	$87,797.28	FRP
CoCO3 Precipitation Tank 2 Agitator	AG-023	1	new		3.0	2.2	7.85	$4,300.00	$27,114.37	$27,114.37	$32,823.22	316ss
CoCO3 Precipitation Tank 2	TK-017	1	new	2.0mm x 2.5mm			7.85	$2,500.00	$29,096.92	$44,102.69	$87,797.28	FRP
CoCO3 Precipitation Tank 3 Agitator	AG-024	1	new		3.0	2.2	7.85	$4,300.00	$27,114.37	$27,114.37	$32,823.22	316ss
CoCO3 Precipitation Tank 3	TK-018	1	new	2.0mm x 2.5mm			7.85	$2,500.00	$29,096.92	$44,102.69	$87,797.28	FRP
CoCO3 Thickener Tank/Mechanism	TH-001	1	new	3.6m x 3m	0.5	0.4	31.56	$60,000.00	$102,145.98	$154,824.36	$240,488.63	FRP
CoCO3 Sand Filter Feed Pump	PU-010	1	refurbished	40mm	5.0	3.7		$1,500.00	$2,553.65	$2,553.65	$2,553.65	Sala vert+box
CoCO3 Thickener O'flow Filter Package 4	FL-009A/B	1	new	1100mm dia x 2	0.5			$12,910.00	$21,978.41	$33,313.04	$51,745.14	CS Epoxy Painted
CoCO3 Filter Press Feed Pump	PU-011	1	new	25mm				$4,000.00	$1,800.00	$1,800.00	$5,500.00	AOD, Fluoro polymer dai.
CoCO3 Filter Press	FL-010	1	existing	800mm x 50 plates	1.0	0.7		$1,000.00	$1,702.43	$2,580.41	$4,008.14	poly plates
CoCO3 Bin	BI-003	1	new	750kg				$4,500.00	$7,660.95	$11,611.83	$18,036.65	
CoCO3 Seed Recycle Pump	PU-047	1	new	25mm	1.5	1.1			$20,000.00	$20,000.00	$20,000.00	Peristaltic
NICKEL REMOVAL												
NiCO3 Precipitation Tank 1 Agitator	AG-025	1	existing		5.0	3.7	15.43	-	$25,875.25	$32,823.22	$40,672.22	carbon steel rubber lined
NiCO3 Precipitation Tank 1	TK-019	1	existing	2440mm x 3300mm			15.43	-	$43,646.04	$66,155.03	$131,697.90	FRP
NiCO3 Precipitation Tank 2 Agitator	AG-026	1	existing		5.0	3.7	15.43	-	$25,875.25	$32,823.22	$40,672.22	carbon steel rubber lined

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
NiCO3 Precipitation Tank 2	TK-020	1	existing	2440mm x 3300mm			15.43	-	$43,646.04	$66,155.03	$131,697.90	FRP
NiCO3 Precipitation Tank 3 Agitator	AG-027	1	existing		5.0	3.7	15.43	-	$25,875.25	$32,823.22	$40,672.22	carbon steel rubber lined
NiCO3 Precipitation Tank 3	TK-021	1	existing	2440mm x 3300mm			15.43	-	$43,646.04	$66,155.03	$131,697.90	FRP
NiCO3 Thickener Tank/Mechanism	TH-002	1	new	3.6m x 3m			12.05	$60,000.00	$102,145.98	$154,824.36	$240,488.63	FRP
NiCO3 Sand Filter Feed Pump	PU-012	1	new	40mm	3.0	2.2		$1,500.00	$2,553.65	$2,553.65	$2,553.65	Sala vert + box APV 180-1.5"
NiCO3 Thickener O'Flow Filter Package 5	FL-011A/B	1	new	1200 dia x 2				$21,010.00	$35,768.12	$54,214.33	$84,211.10	CS Epoxy Painted
NiCO3 Filter Press Feed Pump	PU-013	1	new	25mm				$4,000.00	$1,800.00	$1,800.00	$5,500.00	AOD
NiCO3 Filter Press	FL-012	1	existing	1200mm x 46 plates	1.0	0.7		$1,000.00	$1,702.43	$2,580.41	$4,008.14	poly plates
NiCO3 Bin	BI-004	1	new	200kg				$1,100.00	$1,872.68	$2,838.45	$4,408.96	
NiCO3 Seed Recycle Pump	PU-048	1	new	25mm		1.5	1.10		$20,000.00	$20,000.00	$20,000.00	peristaltic
NiCO3 Transfer Pump	PU-055	1	existing	50mm	7.5	5.6		$1,500.00	$2,553.65	$3,870.61	$5,866.75	Sala vert + box
HDS CIRCUIT												
HDS Reactor Tank 1 Agitator	AG-028	1	new		5.0	3.7	17.18	$6,000.00	$13,779.77	$18,647.07	$28,263.67	
HDS Reactor Tank 1	TK-022	1	new	2700mm x 3000mm			17.18	$9,000.00	$15,321.90	$23,223.65	$35,200.48	polyethylene
HDS Reactor Tank 2 Agitator	AG-029	1	new		5.0	3.7	17.18	$6,000.00	$13,779.77	$18,647.07	$28,263.67	
HDS Reactor Tank 2	TK-023	1	new	2700mm x 3000mm			17.18	$9,000.00	$46,552.09	$90,431.12	$140,466.63	polyethylene
HDS Clarifier Tank c/w Mechanism	TH-003	1	existing	5200mm diameter	0.5	0.4		$2,000.00	$3,404.87	$5,160.81	$8,016.29	carbon steel
HDS Clarifier Underflow Pump	PU-040	1	new	32mm	2.0	1.5		$1,500.00	$9,000.00	$12,294.47	$9,859.06	peristaltic
HDS Clarifier Underflow Disposal Pump	PU-057	1	new	32mm	2.0	1.5			$35,000.00	$35,000.00	$35,000.00	peristaltic
Treated Effluent Overflow Tank	TK-049	1						-	$6,265.95	$9,497.41	$24,477.30	
Treated Effluent Transfer Pump	PU-018	1	refurbished	50mm	1.0	0.7		$1,500.00	$2,553.65	$2,553.65	$2,553.65	Sala vert + box
CYANIDE LEACH CIRCUIT												
Cyanide Leach Tank 1 Agitator	AG-030	1	new		5.0	3.7	22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 1	TK-024	1	new	2.7m x 3.9m			22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 2 Agitator	AG-031	1	new		5.0	3.7	22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 2	TK-025	1	new	2.7m x 3.9m			22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 3 Agitator	AG-032	1	new		5.0	3.7	22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 3	TK-026	1	new	2.7m x 3.9m			22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 4 Agitator	AG-033	1	new		5.0	3.7	22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 4	TK-027	1	new	2.7m x 3.9m			22.33		Not included	Not included	Not included	carbon steel
Cyanide Residue Filter Press Feed Tank Agitator	AG-034	1	new		2.0		5.34		Not included	Not included	Not included	

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Cyanide Residue Filter Press Feed Tank	TK-028	1	new	1.8m x 2.1m			5.34		Not included	Not included	Not included	
Cyanide Residue Filter Press Feed Pump	PU-014	1	new						Not included	Not included	Not included	AOD
Cyanide Residue Filter Press	FL-013	1	new	1200mm x 50 plates	1.0				Not included	Not included	Not included	
Cyanide Residue Repulper	PP-001	1	existing	2m3/hour	5.0	3.7			Not included	Not included	Not included	
Residue Repulper #2	PP-002	1	existing	2m3/hour	5.0	3.7			Not included	Not included	Not included	
Residue Transfer Pump	PU-015	1	new		5.0				Not included	Not included	Not included	
MERRILL-CROWE & CN DETOX												
Cyanide Destruction Cells	FC-001/A/B/C	1	existing		22.0	16.4			Not included	Not included	Not included	Wouldn't really do this though
Cyanide Destruction Feed Tank Agitator	AG-056	1	existing		5.0	3.7			Not included	Not included	Not included	carbon steel rubber lined
Cyanide Destruction Feed Tank	TK-046	1	existing	2.45m x 3m			14.14		Not included	Not included	Not included	HDPE
Cyanide Destruction Feed Pump	PU-071	1	new	50mm x 50mm	2.0	1.5			Not included	Not included	Not included	SRL
Ag Barren Transfer Pump	PU-017	1	refurbished		1.0				Not included	Not included	Not included	
Ag Barren Storage Tank	TK-030	1	existing	1.8m x 2.4m			6.11		Not included	Not included	Not included	
Merrill-Crowe Package Plant	PK-002	1	new	1.5m3/hour	25.0	18.7			Not included	Not included	Not included	
Sand Filter	FL-014/015	1	new						Not included	Not included	Not included	
Sand Filter Feed Pump	PU-016	1	refurbished	25mm x 40mm	1.0	0.7			Not included	Not included	Not included	316ss, horiz. centr., mechanical seal
Cyanide PLS Storage Tank	TK-029	1	existing	1.8m x 2.4m			6.11		Not included	Not included	Not included	carbon steel
REAGENTS - H2SO4 STORAGE												
Sulphuric Acid Storage Tank	TK-032	1	new	3500mm x 4200mm			40.41	$15,000.00	$7,252.56	$10,992.83	$28,331.40	carbon steel
Sulphuric Acid Transfer Pump	PU-019	1	refurbished	25mm	1.0	0.7		$1,500.00	$4,500.00	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
Dilute Acid Mixing Tank	TK-033	1	existing	1.52m x 2.5m			4.54	-	$9,753.80	$31,752.42	$49,321.02	FRP
Dilute Acid Transfer Pump	PU-020	1	refurbished	25mm x 40mm	1.0	0.7		$1,500.00	$4,500.00	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
Strip Acid Day Tank	TK-034	1	existing	1500mm x 2500mm			4.42	-	$9,598.29	$31,246.16	$48,534.65	FRP
Strip Acid Feed Pump	PU-021	1	refurbished	25mm x 40mm	1.0	0.7		$1,500.00	$4,500.00	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
Regeneration Solution Tank	TK-035	1	existing	1500mm x 2500mm			4.42	-	$9,598.29	$31,246.16	$48,534.65	FRP
Regeneration Solution Feed Pump	PU-022	1	refurbished	25mm x 40mm	1.0	0.7		$1,500.00	$4,500.00	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
REAGENTS - ORGANIC & NA2CO3												
Organic Drum Pump	PU-024	1	existing					$1,450.00	$2,468.53	$3,741.59	$5,811.81	
Organic Mix Tank Agitator	AG-036	1	new		0.3	0.2	1.58	$1,650.00	$2,306.63	$11,701.26	$11,701.26	316ss
Organic Mix Tank	TK-036	1	existing	1.2m x 1.4m			1.58	-	$5,177.67	$7,847.89	$26,181.40	FRP
Organic Transfer Pump	PU-023	1	refurbished		3.0			$1,500.00	$8,945.56	$12,220.10	$15,000.00	
Soda Ash Solution Mix Tank Agitator	AG-037	1	new		2.0	1.5	7.27	$4,000.00	$7,727.07	$11,701.26	$17,632.32	carbon steel rubber lined

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Soda Ash Solution Mix Tank	TK-037	1	new	2.1m x 2.1m			7.27	$6,100.00	$4,044.06	$3,927.69	$6,100.87	carbon steel
Soda Ash Solution Transfer Pump	PU-025	1	new	25mm x 40mm	1.0	0.7		$4,060.00	$4,500.00	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
Soda Ash Solution Sand Filters	FL-016/017	1	new					$9,460.00	$16,105.02	$24,410.64	$37,917.04	
Soda Ash Solution Day Tank	TK-038	1	new	2.4m x 3.8m			17.19	$6,100.00	$46,568.35	$90,462.70	$140,515.69	polyethylene
Soda Ash Solution Dist. Pump	PU-026	1	refurbished	25mm	1.0	0.7		$1,500.00	$4,500.00	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
Barren Organic Holding Tank	TK-012A	1	existing	1.4m x 2m			3.08		$7,728.07	$7,728.07	$7,728.07	FRP
Barren Organic Holding Tank	TK-012B	1	new	1.6m x 2.5m			5.03		$7,728.07	$7,728.07	$7,728.07	FRP
Barren Organic Feed Pump #1	PU-008A	1	existing	25mm x 40mm	1.0	0.7			$4,500.00	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
Barren Organic Feed Pump #2	PU-008B	1	existing	25mm x 40mm	1.0	0.7			$4,500.00	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
REAGENTS - NaSH												
NaSH Mix Tank Agitator	AG-038	1	new		5.0	3.7	9.76	$4,150.00	$16,826.53	$26,495.95	$26,495.95	carbon steel rubber lined
NaSH Mix Tank	TK-039	1	existing	2.13m x 2.74m			9.76	-	$4,825.77	$4,686.90	$7,280.17	carbon steel
NaSH Transfer Pump	PU-027	1	refurbished	25mm x 40mm	1.0	0.7		$1,500.00	$4,500.00	$5,901.87	$9,000.00	
NaSH Day Tank	TK-040	1	new	2.4m x 2.4m			10.86	$5,000.00	$35,352.75	$53,584.75	$106,673.66	FRP
NaSH Distribution Pump	PU-028	1	refurbished		3.0			$1,500.00	$8,945.56	$12,220.10	$15,000.00	
Ferric Sulphate Storage Tank, Stainless Steel	TK-041	1	existing	4.6m x 7.0m			116.33	-	$22,694.28	$34,398.10	$49,859.49	stainless steel
Ferric Sulphate Dist. Pump	PU-029	1	refurbished	25mm x 40mm	3.0	3.2		$1,500.00	$12,220.10	$12,452.95	$15,000.00	316ss, horiz. centr., mechanical seal
REAGENTS - NaOH												
Caustic Storage Tank	TK-042	1	existing	3.5m x 4.2m			40.41	-	$7,252.56	$10,992.83	$28,331.40	carbon steel
Caustic Transfer Pump	PU-030	1	refurbished	25mm x 40mm	5.0	3.7		$1,500.00	$12,220.10	$12,452.95	$15,000.00	316ss, horiz. centr., mechanical seal
Diluted Caustic Storage Tank	TK-043	1	existing	2.5m x 2.69m			13.20	-	$3,706.32	$5,617.73	$8,726.01	carbon steel
Diluted Caustic Feed Pump	PU-031	1	refurbished	25mm x 40mm	3.0	2.2		$1,500.00	$8,945.56	$12,220.10	$15,000.00	SRL, horiz. centr., mechanical seal
Caustic Heater	HE-001	1	existing						$3,525.00	$3,525.00	$3,525.00	elements - fused 30A
PROCESS WATER												
Lake Water Pump 1	PU-040	1	existing		125.0			-	$21,828.00	$24,141.25	$33,304.00	Horizontal
Lake Water Pump 2	PU-041	1	existing		125.0			-	$21,828.00	$24,141.25	$33,304.00	Horizontal
Process Water Tank	TK-044	1	existing	5m x 7m			137.44	-	$25,082.41	$38,017.83	$55,106.23	carbon steel
Process Water Distribution Pump 1	PU-32	1	refurbished					$1,500.00	$10,616.00	$11,881.28	$14,372.00	
Process Water Distribution Pump 2	PU-33	1	refurbished					$1,500.00	$10,616.00	$11,881.28	$14,372.00	
Process Water Filter Package 8	FL-018/019	1	new	2m dia				$115,000.00	$115,000.00	$115,000.00	$270,751.64	CS Epoxy Painted
Filtered Water Tank	TK-045	1	existing	1.6m x 3.75			15.16	-	$4,027.33	$6,104.30	$9,481.80	carbon steel
Filtered Water Distribution Pump 1	PU-034	1	refurbished		30.0			$1,500.00	$10,616.00	$7,817.80	$14,372.00	Horizontal
Filtered Water Distribution Pump 2	PU-035	1	refurbished		30.0			$1,500.00	$10,616.00	$7,817.80	$14,372.00	Horizontal

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Potable Water Pump No. 1	PU-069	1	existing		7.5	5.6			$2,553.65	$3,870.61	$5,866.75	Horizontal
Potable Water Pump No. 2	PU-070	1	existing		7.5	5.6			$2,553.65	$3,870.61	$5,866.75	Horizontal
Cooling Water Tank	TK-061	1	new	2.4m x 3.8m			17.19		$15,321.90	$23,223.65	$35,200.48	polyethylene
Vent Cooling Water Feed Pump	PU-074	1	new		25.0	18.5						Horizontal
FLOCCULANT												
Flocculant Venturi Mixer	MX-001	1	new					$200.00	$340.49	$516.08	$801.63	
Flocculant Mix Tank Agitator	AG-039	1	new		0.25		3.53	$1,650.00	$11,701.26	$11,701.26	$17,632.32	
Flocculant Mix Tank	TK-046	1	existing	1.5m x 2m			3.53	-	$8,386.97	$27,302.86	$42,409.52	polyethylene
Flocculant Transfer Pump	PU-036	1	new					$4,190.00	$6,745.26	$8,094.31	$8,094.31	
Flocculant Solution Day Tank	TK-047	1	existing	1.5m x 2m			3.53	-	$2,621.57	$3,973.56	$3,954.91	
Flocculant Solution Distribution Pump	PU-037	1	new					$4,190.00	$6,745.26	$8,094.31	$8,094.31	
Flocculant Pump No. 1	PU-059	1	new						$6,210.00	$6,210.00	$6,210.00	metering pump
Flocculant Pump No. 2	PU-060	1	new						$6,210.00	$6,210.00	$6,210.00	metering pump
Flocculant Pump No. 3	PU-061	1	new						$6,210.00	$6,210.00	$6,210.00	metering pump
Flocculant Pump No. 4	PU-067	0										
Flocculant Pump No. 5	PU-072	0										
LIME STORAGE & SLURRY												
Limestone Slurry Preparation & Distribution Package	PK-004	1	existing		20.0	14.9		$10,000.00	$17,024.33	$25,804.06	$40,081.44	
Lime Silo	BI-003	1	existing									
Lime Transfer Screw Conveyor	CV-003	1	existing									
Lime Slurry Storage Tank Agitator	AG-052	1	existing		5.0	3.7		$4,150.00	$16,826.53	$26,495.95	$26,495.95	carbon steel rubber lined
Lime Slurry Storage Tank	TK-057	1	existing	3.6m x 2.5m			25.45					carbon steel
Lime Slurry Mix Tank Agitator	AG-051	1	new		2.0	1.5						carbon steel rubber lined
Lime Slurry Mix Tank	TK-049	1	existing	1.32m x 1.4m			1.92		$2,415.61	$3,661.39	$5,549.62	polyethylene
Lime Slurry Distribution Pump	PU-062	1	existing	50mm	5.0	3.7		$0.00	Not included	Not included	Not included	
PLANT AIR SYSTEM												
Plant Air Compressor 1	CO-001	1	existing	265 cfm	75.0	56		-	$51,000.00	$51,000.00	$51,000.00	From database
Plant Air Compressor 2	CO-003	1	existing	265 cfm	75.0	56			$51,000.00	$51,000.00	$51,000.00	From database
Plant Air Receiver	CO-002	1	existing					-	$11,280.00	$11,280.00	$11,280.00	200 psi @ 450F
Low Pressure Blower	BL-001	1	new	1000cfm	50.0	37.3		$30,000.00	$51,072.99	$77,412.18	$120,244.32	
Instrument Air Dryer	DR-001	1	existing		1.0	0.7		-	$10,575.00	$10,575.00	$10,575.00	
STEAM, OXYGEN & OZONE SYSTEM												
Boiler Package	PK-006	1	existing		15.0	11.2		-	$208,503.15	$208,503.15	$208,503.15	
Oxygen Plant	PK-003	1	existing		40.0	29.8		-	$150,000.00	$150,000.00	$150,000.00	
Ozone Generator	PK-005	1	new					$88,200.00	$150,154.60	$227,591.81	$353,518.29	
EXHAUST FANS AND HEATERS (GAS)												
Gas Fired Unit Heater	UH-1	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-10	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Gas Fired Unit Heater	UH-11	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-12	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-13	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-14	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-15	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-16	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-2	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-3	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-4	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-5	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-6	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-7	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-8	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Gas Fired Unit Heater	UH-9	1	existing	60 - 250 MBH					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Makeup Air Unit	MAU-1	1	existing	200MBH heating					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Four Way Propeller Fan	EF-3	1	existing	11768 cfm	3.0	2.2			Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Inline Fan	EF-10	1	existing	5000 cfm	1.5	1.1			Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Makeup Air Unit	MAU-2	1	existing	9000 - 12000 cfm					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Roof Exhauster	EF-1	1	existing	14000 cfm	3.0	2.2			Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Roof Exhauster	EF-2	1	existing	14000 cfm	3.0	2.2			Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Roof Exhauster	EF-4	1	existing	14000 cfm					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Roof Exhauster	EF-5	1	existing	14000 cfm					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Rooftop Unit, Gas/Electric	AC-1	1	existing	12.5-ton cooling					Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Side Wall Exhauster	EF-8	1	existing	1000 cfm	0.1	0.1			Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Side Wall Exhauster	EF-9	1	existing	1000 cfm	0.1	0.1			Included in refurbish allowance	Included in refurbish allowance	Included in refurbish allowance	
Exhaust Fan		1	new					$2,000.00	$3,404.87	$5,160.81	$8,016.29	
Gas Scrubber	VE-004 (SB-001)	1	new		5.0			$10,000.00	$17,024.33	$25,804.06	$40,081.44	carbon steel - caustic bath
Gas Scrubber	VE-005	1	new		5.0			$10,000.00	$17,024.33	$25,804.06	$40,081.44	
MOBILE EQUIPMENT												

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Front End Loader (John Deere # 544B)	N/A	1	Sold						Not included	Not included	Not included	
Forklift (Clark)		1		3500 lbs					Not included	Not included	Not included	
1998 Chevrolet 4X4		1							Not included	Not included	Not included	white
1995 Chevrolet Van (8 passenger) GONE		1	Sold						Not included	Not included	Not included	white
Meyer Snow Plow for 4x4 with Hydraulic lift		1		Model E-47					Not included	Not included	Not included	
Set of forks for loader		1	Sold						Not included	Not included	Not included	
Grieve dryer		1							Not included	Not included	Not included	
Self-dumping bins		2							Not included	Not included	Not included	
Trash pumps		9							Not included	Not included	Not included	
Flygt pumps		3							Not included	Not included	Not included	
RETREATMENT												
retreatment tank agitator	AG-042	1	existing		10.0	7.5			$17,034.00	$25,818.72	$39,133.86	
retreatment tank	TK-050	1	existing	4.5m x 6.4m			101.79		$25,082.41	$38,017.83	$55,106.23	carbon steel
retreatment tank pump	PU-043	1	new		7.5	5.6			$2,553.65	$3,870.61	$5,866.75	SRL
LEACH SLURRY												
leach slurry o/f tank agitator	AG-054	1	existing		5.0	3.7			$25,875.25	$32,823.22	$40,672.22	carbon steel rubber lined
leach slurry o/f tank	TK-059	1	existing	2.4m x 3.66m			16.56		$25,875.25	$32,823.22	$40,672.22	carbon steel rubber lined
leach slurry o/f pump	PU-037	1	existing	50mm x 50mm	5.0	3.7			Not included	Not included	Not included	SRL
METABISULPHITE												
Metabisulphite Mix Tank Agitator	AG-046	1	new		0.8	0.6			Not included	Not included	Not included	316ss
Metabisulphite Mix Tank	TK-051	1	existing	1.22m x 2.14m			2.50		Not included	Not included	Not included	polyethylene
Metabisulphite Distribution Pump	PU-044	1	existing	25mm x 40mm	1.0	0.7			Not included	Not included	Not included	316ss, horiz. centr., mechanical seal
PRECOAT												
Pre-Coat Tank Agitator	AG-053	1	existing		0.3	0.2			$6,496.08	$6,496.08	$6,496.08	carbon steel
Pre-Coat Tank	TK-058	1	existing	1220mm x 2135mm			2.50		$2,415.61	$3,661.39	$5,549.62	polyethylene
SPENT REGENERANT												
Spent Regenerant Tank	TK-060	1	new	1.07m x 0.9m			0.81		$2,415.61	$3,661.39	$5,549.62	PE - square
Spent Regenerant Pump	PU-073	1	existing		1.0	0.7			$4,500.00	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
COPPER SULPHATE												
Copper Sulphate Mix Tank Agitator	AG-047	1	new		0.3	0.2			$6,496.08	$6,496.08	$6,496.08	316ss
Copper Sulphate Mix Tank	TK-052	1	new	1.0m x 1.0m			0.79		$2,415.61	$3,661.39	$5,549.62	polyethylene
Copper Sulphate Pump	PU-045	1	new	25mm	1.5	1.1			$4,500.00	$5,901.87	$9,000.00	peristaltic
COOLANT												
Spent Coolant Tank	TK-053	1	existing	1.5m x 2.0m			3.53		$27,114.37	$27,114.37	$27,114.37	carbon steel
Spent Coolant Pump	PU-049	1	new	50mm x 75mm	3.0	2.2			Not included	Not included	Not included	Cast Iron, horiz. Centr., packed gland
SUMPS												
General Floor Sump No. 1	PU-063	1	existing		5.0	3.7			$15,032.40	$15,032.40	$15,032.40	
General Floor Sump No.2	PU-064	1	existing		5.0	3.7			$15,032.40	$15,032.40	$15,032.40	
HOOTENANNY?												
Hootenanny	XX-001	1	new						Not included	Not included	Not included	suction device
Total equipment supply									$8,639,898.01	$13,834,771.03	$23,393,081.16	

Table 8-1 - Mechanical Equipment list with replacement capital cost values

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
ORE RECEIPT												
Ore Feeder No. 1	FE-001	1	new						Existing - refurbish			
Ore Feeder No. 2	FE-002	1	new		1.0	0.7			Existing - refurbish			2 t/hr VFD conveyor
Overhead Crane	CK-001	1	existing					$2,000.00	Existing - refurbish			10 tonne
Ore Loading Bin c/w Grizzly Grate	B1-001	1	new					$4,000.00	Existing - refurbish			
Feed Conveyor 1	CV-001	1	new	400mm W x 14m L	5.0	3.7		$11,750.00	Existing - refurbish			
Feed Conveyor 2	CV-002	1	new	400 mm W x 25m L	10.0	7.5		$20,600.00	Existing - refurbish			
Open Circuit Mill	MM-001	1	new	srro 1000x1800	200.0	149.2		$37,500.00	Existing - refurbish			
Ball Mill Feed Hopper	BI-002	1	new	10 ton					Existing - refurbish		$15,000.00	
ball mill feed chute	av 0102	1	new						Existing - refurbish		$7,500.00	carbon steel
Concentrate Transfer Pump	PU-001	1	new	50 mm	7.5	5.6		$1,500.00	Existing - refurbish		$5,866.75	Sala vert +box
Concentrate Storage Tank Agitator	AG-040	1	existing		7.5	5.6	39.34	-	Existing - refurbish		$44,746.69	no shaft
Concentrate Storage Tank	TK-048	1	existing	3.3m x 4.6m			39.34	-	Existing - refurbish		$27,878.88	carbon steel
Premix Reactor Feed Pump	PU-039	1	refurbished	50 mm x 50mm	7.5	5.6		$1,500.00	Existing - refurbish		$18,000.00	SRL
Autoclave Pond Reclaim Pump	PU-038	1	new	50mm	3.0	2.2		$2,910.00	Existing - refurbish		$5,531.16	submersible
Autoclave Pond Reclaim Barge		1	existing					$35,000.00	Existing - refurbish		$0.00	Based on Ravensthorpe costs
PRESSURE LEACH											$0.00	
Premix Reactor Agitator	AG-001	1	existing		1.5	1.1	12.05	-	Existing - refurbish		$50,431.48	Inconel 625
Premix Reactor	RE-001	1	existing	2.3m x 3m			12.05	-	Existing - refurbish		$48,991.08	carbon steel brick lined
Autoclave Feed Pump	PU-002	1	refurbished	40mm x 75mm	7.5	5.6		$1,500.00	Existing - refurbish		$18,000.00	stainless steel
Autoclave Agitator	AG-002	1	existing		25.0	18.7		-	Existing - refurbish		$0.00	titanium
Batch Autoclave	VE-001	1	existing	2.1m x3.3m			12.05	-	Existing - refurbish		$12,545,850.00	carbon steel brick lined
Vent System for Autoclave - condenser	VE-002	1	new						Existing - refurbish		$181,414.09	From database for Jord
Vent System for Autoclave - scrubber	VE-003	1	existing	1219mm od x 3200mm					Existing - refurbish		$75,000.00	316ss cone bottom chill vessel
Flash Tank	TK-001	1	new					$117,000.00	Existing - refurbish		$291,479.31	Estimated from database

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Conditioning Tank Agitator	AG-003	1	existing		5.0	3.7	50.30	-	Existing - refurbish		$48,991.08	Inconel 625
Conditioning Tank	TK-002	1	new	4m x 4m			50.30	$125,000.00	Existing - refurbish		$32,308.40	carbon steel brick lined
Filter Press Feed Tank Agitator	AG-004	1	existing		5.0	3.7	50.30	-	Existing - refurbish	$32,823.22	$48,991.08	Inconel 625
Filter Press Feed Tank	TK-003	1	existing	4m x 4m			50.30	-	Existing - refurbish	$20,799.85	$32,308.40	carbon steel brick lined
Filter Press Feed Pump	PU-003	1	new	80mm				$6,000.00	Existing - refurbish	$13,000.00	$13,000.00	AOD pump
Spiral Heat Exchanger	HX-001	1	new					$6,000.00	Existing - refurbish	$477,408.00	$723,615.21	HPA database
Heat Exchanger No. 2	HX-002	1	new						Existing - refurbish	$21,150.00	$32,057.41	Plate 316ss
heat exchanger pump	PU-032	1	new	65mm x 65mm	3.0	2.2			Existing - refurbish	$18,313.00	$27,757.32	srl horiz vert. mech seal
Leach Residue Filter Press	FL-001	1	new	1200mm x 50 plates	1.0	0.7		$94,250.00	Existing - refurbish	$243,203.26	$377,767.56	poly plates
Screw Conveyor	CV-003	1	new		2.0			$2,000.00	Existing - refurbish	$5,160.81	$8,016.29	
COPPER & IRON REMOVAL												
Copper Removal Tank Agitator	AG-005	1	existing		5.0	3.7	7.67	-	Existing - refurbish		$21,442.12	carbon steel rubber lined
Copper Removal Tank	TK-004	1	existing				7.67	-	Existing - refurbish		$67,557.84	FRP
Iron Removal Tank 1 Agitator	AG-006	1	existing		5.0	3.7	7.67	-	Existing - refurbish		$21,442.12	carbon steel rubber lined
Iron Removal Tank 1	TK-005	1	existing	2.0m x 2.44m			7.67	-	Existing - refurbish		$67,557.84	FRP
Iron Removal Tank 2 Agitator	AG-007	1	existing		5.0	3.7	7.67	-	Existing - refurbish		$21,442.12	carbon steel rubber lined
Iron Removal Tank 2	TK-006	1	existing	2.0m x 2.44m			7.67	-	Existing - refurbish		$67,557.84	FRP
Iron Removal Tank 3 Agitator	AG-008	1	existing		5.0	3.7	7.67	-	Existing - refurbish		$21,442.12	316ss,
Iron Removal Tank 3	TK-007	1	existing	2.0m x 2.44m			7.67	-	Existing - refurbish		$67,557.84	FRP
Fe / Cu / Gypsum Filter Press Feed Tank Agitator	AG-009	1	existing				7.85	-	Existing - refurbish		$21,442.12	
Fe / Cu / Gypsum Filter Press Feed Tank	TK-008	1	existing	2.0m x 2.5m			7.85	-	Existing - refurbish		$244,054.81	FRP
Fe / Cu / Gypsum Filter Press Feed Pump	PU-004	1	new	80mm				$6,000.00	Existing - refurbish	$13,000.00	$13,000.00	AOD
Fe / Cu / Gypsum Filter Press	FL-002	1	new	1200mm x 50 plates	1.0	0.7		$94,250.00	Existing - refurbish	$243,203.26	$377,767.56	poly plates
Fe Filter Press	FL-004	1	existing	1200mm x 50 plates	1.0	0.7		$14,300.00	Existing - refurbish	$36,899.81	$57,316.46	poly plates
Iron press feed pump	PU-053	1	existing	50mm	7.5	5.6		$1,500.00	Existing - refurbish	$3,870.61	$5,866.75	Sala vert+box

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
SX Feed Tank 1	TK-009	1	existing	3.66m x 4.1m			43.14	-	Existing - refurbish	$157,120.23	$244,054.81	FRP
SX Feed Tank 2	TK-010	1	existing	3.66m x 4.1m			43.14	-	Existing - refurbish	$157,120.23	$244,054.81	FRP
SX Feed Pump 1	PU-005	1	refurbished	25mm x 40mm	3.0	2.2		$1,500.00	Existing - refurbish	$12,220.10	$15,000.00	316ss, mechseal VFD
SX Feed Pump 2	PU-006	1	refurbished	25mm x 40mm	3.0	2.2		$1,500.00	Existing - refurbish	$12,220.10	$15,000.00	316ss, mechseal VFD
SX Feed Filter Package 1	FL-003/004	1	new	600mmx2				$14,300.00	Existing - refurbish	$36,899.81	$57,316.46	FRP
Copper Removal Tank No. 1 Agitator	AG-048	1	existing		5.0	3.7			Existing - refurbish		$21,442.12	carbon steel rubber lined
Copper Removal Tank No. 1	TK-054	1	existing	2.0m x2.5m			7.85		Existing - refurbish		$66,691.53	carbon steel rubber lined
Copper Removal Tank No. 2 Agitator	AG-049	1	existing		5.0	3.7			Existing - refurbish		$21,442.12	carbon steel rubber lined
Copper Removal Tank No. 2	TK-055	1	existing	2.0m x 2.5m			7.85		Existing - refurbish		$66,691.53	carbon steel rubber lined
Copper Removal Tank No. 3 Agitator	AG-050	1	existing		5.0	3.7			Existing - refurbish		$21,442.12	carbon steel rubber lined
Copper Removal Tank No. 3	TK-056	1	existing	2.0m x 2.5m			7.85		Existing - refurbish		$66,691.53	carbon steel rubber lined
Copper Precipitation Discharge Pump	PU-054	1	existing	50mm	7.5	5.6		$1,500.00	Existing - refurbish		$5,866.75	Sala vert+box
COBALT SX CIRCUIT										$0.00	$0.00	
Cobalt Extraction Mixer - Settler No. 1 Agitator	AG-043	1	existing		3.0	2.2			Existing - refurbish	$27,114.37	$27,114.37	316ss
Cobalt Extraction Mixer - Settler No. 1	EX-004	1	existing	3.25mL x 1.0mW x 1.2mH					Existing - refurbish	$29,797.00	$46,283.00	FRP
Cobalt Extraction Mixer - Settler No.2 Agitator	AG-044	1	existing		3.0	2.2			Existing - refurbish	$27,114.37	$27,114.37	316ss
Cobalt Extraction Mixer - Settler No.2	EX-005	1	existing	3.25mL x 1.0mW x 1.2mH					Existing - refurbish	$29,797.00	$46,283.00	FRP
Cobalt Extraction Mixer - Settler No. 3 Agitator	AG-045	1	existing		3.0	2.2			Existing - refurbish	$27,114.37	$27,114.37	316ss
Cobalt Extraction Mixer - Settler No. 3	EX-006	1	existing	3.25mL x 1.0mW x 1.2mH					Existing - refurbish	$29,797.00	$46,283.00	FRP
Extraction Mixer - Settler 3 Agitator	AG-012	1	existing		3.0	2.2	3.90	-	Existing - refurbish	$27,114.37	$27,114.37	316ss
Extraction Mixer - Settler 3	EX-003	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	-	Existing - refurbish	$29,797.00	$46,283.00	FRP
Extraction Mixer - Settler 2 Agitator	AG-011	1	existing		3.0	2.2	3.90	-	Existing - refurbish	$27,114.37	$27,114.37	316ss
Extraction Mixer - Settler 2	EX-002	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	-	Existing - refurbish	$29,797.00	$46,283.00	FRP
Extraction Mixer - Settler 1 Agitator	AG-010	1	existing		3.0	2.2	3.90	-	Existing - refurbish	$27,114.37	$27,114.37	316ss

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Extraction Mixer - Settler 1	EX-001	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	-	Existing - refurbish	$29,797.00	$46,283.00	FRP
Raffinate Tank	TK-011	1	existing	3.66m x 5.5m			58.00	-	Existing - refurbish	$187,655.29	$291,484.91	FRP
Raffinate Transfer Pump	PU-007	1	refurbished	40mm x 75mm	3.0	2.2		$1,500.00	Existing - refurbish	$12,220.10	$15,000.00	316ss, horiz. centr., mechanical seal
Raffinate Filter Package 2	FL-005/006	1	new	800 mm dia.				$14,300.00	Existing - refurbish	$36,899.81	$57,316.46	SS or FRP
Scrub Mixer - Settler 1 Agitator	AG-013	1	existing		3.0	2.2	3.90	-	Existing - refurbish	$27,114.37	$27,114.37	316ss
Scrub Mixer - Settler 1	SC-001	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	$1,000.00	Existing - refurbish	$29,797.00	$46,283.00	FRP
Scrub Mixer - Settler 2 Agitator	AG-014	1	existing		3.0	2.2	3.90	-	Existing - refurbish	$27,114.37	$27,114.37	316ss
Scrub Mixer - Settler 2	SC-002	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	$1,000.00	Existing - refurbish	$29,797.00	$46,283.00	FRP
Stripping Mixer - Settler 1 Agitator	AG-015	1	existing		3.0	2.2	3.90	-	Existing - refurbish	$27,114.37	$27,114.37	316ss
Stripping Mixer - Settler 1	ST-001	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	$1,000.00	Existing - refurbish	$29,797.00	$46,283.00	FRP
Stripping Mixer - Settler 2 Agitator	AG-016	1	existing		3.0	2.2	3.90	-	Existing - refurbish	$27,114.37	$27,114.37	316ss
Stripping Mixer - Settler 2	ST-002	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	$1,000.00	Existing - refurbish	$29,797.00	$46,283.00	FRP
Stripping Mixer - Settler 3 Agitator	AG-017	1	existing		3.0	2.2	3.90	-	Existing - refurbish	$27,114.37	$27,114.37	316ss
Stripping Mixer - Settler 3	ST-003	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	$1,000.00	Existing - refurbish	$29,797.00	$46,283.00	FRP
Regeneration Mixer - Settler Agitator	AG-018	1	existing		3.0	2.2	3.90	-	Existing - refurbish	$27,114.37	$27,114.37	316ss
Regeneration Mixer - Settler	RG-001	1	existing	3.25mL x 1.0mW x 1.2mH			3.90	$1,000.00	Existing - refurbish	$29,797.00	$46,283.00	FRP
Regenerated Organic Holding Tank	TK-012	1	existing	1.4m x 2m			3.08	-	Existing - refurbish		$5,549.62	
Regenerated Organic Feed Pump	PU-008	1	refurbished	25mm x 40mm	1.0			$1,500.00	Existing - refurbish		$9,000.00	
Crud Treatment Package	PK-001	1	new					$15,000.00	Existing - refurbish		$60,122.16	Possibly includes all items within "CRUD TREATMENT"
Crud Tank Agitator	AG-055	1	new		1.5	1.1			Existing - refurbish		$4,773.60	316ss
TK-031 Agitator	AG-035	1	new		3.0			$4,150.00	Existing - refurbish		$16,633.80	Not sure if TK-031 exists?
Crud Tank	TK-031	1	new	1500mm x 1500mm			2.65		Existing - refurbish		$5,549.62	polyethylene
Crud Holding Tank		1	new						Existing - refurbish		$5,549.62	
Crud Pump	PU-066	1	new						Existing - refurbish		$6,000.00	AOD

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Crud Treatment Filter Press	FL-015	1	existing	800mm x 800 x 25mm				$14,300.00	Existing - refurbish		$57,316.46	40 plates
MANGANESE REMOVAL											$0.00	
Mn Removal Tank 1 Agitator	AG-019	1	existing		3.0	2.2	3.81	-	Existing - refurbish		$27,114.37	carbon steel rubber lined
Mn Removal Tank 1	TK-013	1	existing	1.52m x 2.1m			3.81	-	Existing - refurbish		$44,396.99	FRP
Mn Removal Tank 2 Agitator	AG-020	1	existing		3.0	2.2	3.81	-	Existing - refurbish		$27,114.37	carbon steel rubber lined
Mn Removal Tank 2	TK-014	1	existing	1.52m x 2.1m			3.81	-	Existing - refurbish		$44,396.99	FRP
Mn Removal Tank 3 Agitator	AG-021	1	existing		3.0	2.2	3.81	-	Existing - refurbish		$27,114.37	carbon steel rubber lined
Mn Removal Tank 3	TK-015	1	existing	1.52m x 2.1m			3.81	-	Existing - refurbish		$44,396.99	FRP
MnO2 Filter Feed Pump	PU-009	1	new	25mm x 40mm	2.0	1.5		$1,500.00	Existing - refurbish		$15,000.00	316ss, horiz. centr., mechanical seal
MnO2 Filter Package 3	FL-007/008	1	new	250mm dia x 2				$14,300.00	Existing - refurbish		$57,316.46	CS Epoxy Painted
COBALT PRECIPITATION											$0.00	
CoCO3 Precipitation Tank 1 Agitator	AG-022	1	new		3.0	2.2	7.85	$4,300.00	Existing - refurbish		$32,823.22	316ss
CoCO3 Precipitation Tank 1	TK-016	1	new	2.0mm x 2.5mm			7.85	$2,500.00	Existing - refurbish		$87,797.28	FRP
CoCO3 Precipitation Tank 2 Agitator	AG-023	1	new		3.0	2.2	7.85	$4,300.00	Existing - refurbish		$32,823.22	316ss
CoCO3 Precipitation Tank 2	TK-017	1	new	2.0mm x 2.5mm			7.85	$2,500.00	Existing - refurbish		$87,797.28	FRP
CoCO3 Precipitation Tank 3 Agitator	AG-024	1	new		3.0	2.2	7.85	$4,300.00	Existing - refurbish		$32,823.22	316ss
CoCO3 Precipitation Tank 3	TK-018	1	new	2.0mm x 2.5mm			7.85	$2,500.00	Existing - refurbish		$87,797.28	FRP
CoCO3 Thickener Tank/Mechanism	TH-001	1	new	3.6m x 3m	0.5	0.4	31.56	$60,000.00	Existing - refurbish		$240,488.63	FRP
CoCO3 Sand Filter Feed Pump	PU-010	1	refurbished	40mm	5.0	3.7		$1,500.00	Existing - refurbish		$2,553.65	Sala vert+box
CoCO3 Thickener O'flow Filter Package 4	FL-009A/B	1	new	1100mm dia x 2	0.5			$12,910.00	Existing - refurbish		$51,745.14	CS Epoxy Painted
CoCO3 Filter Press Feed Pump	PU-011	1	new	25mm				$4,000.00	Existing - refurbish		$5,500.00	AOD, Fluoro polymer dai.
CoCO3 Filter Press	FL-010	1	existing	800mm x 50 plates	1.0	0.7		$1,000.00	Existing - refurbish		$4,008.14	poly plates
CoCO3 Bin	BI-003	1	new	750kg				$4,500.00	Existing - refurbish		$18,036.65	

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
CoCO3 Seed Recycle Pump	PU-047	1	new	25mm	1.5	1.1			Existing - refurbish		$20,000.00	Peristaltic
NICKEL REMOVAL											$0.00	
NiCO3 Precipitation Tank 1 Agitator	AG-025	1	existing		5.0	3.7	15.43	-	Existing - refurbish		$40,672.22	carbon steel rubber lined
NiCO3 Precipitation Tank 1	TK-019	1	existing	2440mm x 3300mm			15.43	-	Existing - refurbish		$131,697.90	FRP
NiCO3 Precipitation Tank 2 Agitator	AG-026	1	existing		5.0	3.7	15.43	-	Existing - refurbish		$40,672.22	carbon steel rubber lined
NiCO3 Precipitation Tank 2	TK-020	1	existing	2440mm x 3300mm			15.43	-	Existing - refurbish		$131,697.90	FRP
NiCO3 Precipitation Tank 3 Agitator	AG-027	1	existing		5.0	3.7	15.43	-	Existing - refurbish		$40,672.22	carbon steel rubber lined
NiCO3 Precipitation Tank 3	TK-021	1	existing	2440mm x 3300mm			15.43	-	Existing - refurbish		$131,697.90	FRP
NiCO3 Thickener Tank/Mechanism	TH-002	1	new	3.6m x 3m			12.05	$60,000.00	Existing - refurbish		$240,488.63	FRP
NiCO3 Sand Filter Feed Pump	PU-012	1	new	40mm	3.0	2.2		$1,500.00	Existing - refurbish		$2,553.65	Sala vert + box APV 180-1.5"
NiCO3 Thickener O'Flow Filter Package 5	FL-011A/B	1	new	1200 dia x 2				$21,010.00	Existing - refurbish		$84,211.10	CS Epoxy Painted
NiCO3 Filter Press Feed Pump	PU-013	1	new	25mm				$4,000.00	Existing - refurbish		$5,500.00	AOD
NiCO3 Filter Press	FL-012	1	existing	1200mm x 46 plates	1.0	0.7		$1,000.00	Existing - refurbish		$4,008.14	poly plates
NiCO3 Bin	BI-004	1	new	200kg				$1,100.00	Existing - refurbish		$4,408.96	
NiCO3 Seed Recycle Pump	PU-048	1	new	25mm		1.5	1.10		Existing - refurbish		$20,000.00	peristaltic
NiCO3 Transfer Pump	PU-055	1	existing	50mm	7.5	5.6		$1,500.00	Existing - refurbish		$5,866.75	Sala vert + box
HDS CIRCUIT											$0.00	
HDS Reactor Tank 1 Agitator	AG-028	1	new		5.0	3.7	17.18	$6,000.00	Existing - refurbish		$28,263.67	
HDS Reactor Tank 1	TK-022	1	new	2700mm x 3000mm			17.18	$9,000.00	Existing - refurbish		$35,200.48	polyethylene
HDS Reactor Tank 2 Agitator	AG-029	1	new		5.0	3.7	17.18	$6,000.00	Existing - refurbish		$28,263.67	
HDS Reactor Tank 2	TK-023	1	new	2700mm x 3000mm			17.18	$9,000.00	Existing - refurbish		$140,466.63	polyethylene
HDS Clarifier Tank c/w Mechanism	TH-003	1	existing	5200mm diameter	0.5	0.4		$2,000.00	Existing - refurbish		$8,016.29	carbon steel
HDS Clarifier Underflow Pump	PU-040	1	new	32mm	2.0	1.5		$1,500.00	Existing - refurbish		$9,859.06	peristaltic
HDS Clarifier Underflow Disposal Pump	PU-057	1	new	32mm	2.0	1.5			Existing - refurbish		$35,000.00	peristaltic

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Treated Effluent Overflow Tank	TK-049	1						-	Existing - refurbish		$24,477.30	
Treated Effluent Transfer Pump	PU-018	1	refurbished	50mm	1.0	0.7		$1,500.00	Existing - refurbish		$2,553.65	Sala vert + box
CYANIDE LEACH CIRCUIT												
Cyanide Leach Tank 1 Agitator	AG-030	1	new		5.0	3.7	22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 1	TK-024	1	new	2.7m x 3.9m			22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 2 Agitator	AG-031	1	new		5.0	3.7	22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 2	TK-025	1	new	2.7m x 3.9m			22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 3 Agitator	AG-032	1	new		5.0	3.7	22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 3	TK-026	1	new	2.7m x 3.9m			22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 4 Agitator	AG-033	1	new		5.0	3.7	22.33		Not included	Not included	Not included	carbon steel
Cyanide Leach Tank 4	TK-027	1	new	2.7m x 3.9m			22.33		Not included	Not included	Not included	carbon steel
Cyanide Residue Filter Press Feed Tank Agitator	AG-034	1	new		2.0		5.34		Not included	Not included	Not included	
Cyanide Residue Filter Press Feed Tank	TK-028	1	new	1.8m x 2.1m			5.34		Not included	Not included	Not included	
Cyanide Residue Filter Press Feed Pump	PU-014	1	new						Not included	Not included	Not included	AOD
Cyanide Residue Filter Press	FL-013	1	new	1200mm x 50 plates	1.0				Not included	Not included	Not included	
Cyanide Residue Repulper	PP-001	1	existing	2m3/hour	5.0	3.7			Not included	Not included	Not included	
Residue Repulper #2	PP-002	1	existing	2m3/hour	5.0	3.7			Not included	Not included	Not included	
Residue Transfer Pump	PU-015	1	new		5.0				Not included	Not included	Not included	
MERRILL-CROWE & CN DETOX												
Cyanide Destruction Cells	FC-001/A/B/C	1	existing		22.0	16.4			Not included	Not included	Not included	Wouldn't really do this though
Cyanide Destruction Feed Tank Agitator	AG-056	1	existing		5.0	3.7			Not included	Not included	Not included	carbon steel rubber lined
Cyanide Destruction Feed Tank	TK-046	1	existing	2.45m x 3m			14.14		Not included	Not included	Not included	HDPE
Cyanide Destruction Feed Pump	PU-071	1	new	50mm x 50mm	2.0	1.5			Not included	Not included	Not included	SRL
Ag Barren Transfer Pump	PU-017	1	refurbished		1.0				Not included	Not included	Not included	

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Ag Barren Storage Tank	TK-030	1	existing	1.8m x 2.4m			6.11		Not included	Not included	Not included	
Merrill-Crowe Package Plant	PK-002	1	new	1.5m3/hour	25.0	18.7			Not included	Not included	Not included	
Sand Filter	FL-014/015	1	new						Not included	Not included	Not included	
Sand Filter Feed Pump	PU-016	1	refurbished	25mm x 40mm	1.0	0.7			Not included	Not included	Not included	316ss, horiz. centr., mechanical seal
Cyanide PLS Storage Tank	TK-029	1	existing	1.8m x 2.4m			6.11		Not included	Not included	Not included	carbon steel
REAGENTS - H2SO4 STORAGE												
Sulphuric Acid Storage Tank	TK-032	1	new	3500mm x 4200mm			40.41	$15,000.00	Existing - refurbish	$10,992.83	$28,331.40	carbon steel
Sulphuric Acid Transfer Pump	PU-019	1	refurbished	25mm	1.0	0.7		$1,500.00	Existing - refurbish	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
Dilute Acid Mixing Tank	TK-033	1	existing	1.52m x 2.5m			4.54	-	Existing - refurbish	$31,752.42	$49,321.02	FRP
Dilute Acid Transfer Pump	PU-020	1	refurbished	25mm x 40mm	1.0	0.7		$1,500.00	Existing - refurbish	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
Strip Acid Day Tank	TK-034	1	existing	1500mm x 2500mm			4.42	-	Existing - refurbish	$31,246.16	$48,534.65	FRP
Strip Acid Feed Pump	PU-021	1	refurbished	25mm x 40mm	1.0	0.7		$1,500.00	Existing - refurbish	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
Regeneration Solution Tank	TK-035	1	existing	1500mm x 2500mm			4.42	-	Existing - refurbish	$31,246.16	$48,534.65	FRP
Regeneration Solution Feed Pump	PU-022	1	refurbished	25mm x 40mm	1.0	0.7		$1,500.00	Existing - refurbish	$5,901.87	$9,000.00	316ss, horiz. centr., mechanical seal
REAGENTS - ORGANIC & NA2CO3												
Organic Drum Pump	PU-024	1	existing					$1,450.00	Existing - refurbish	Existing - refurbish	$5,811.81	
Organic Mix Tank Agitator	AG-036	1	new		0.3	0.2	1.58	$1,650.00	Existing - refurbish	Existing - refurbish	$11,701.26	316ss
Organic Mix Tank	TK-036	1	existing	1.2m x 1.4m			1.58	-	Existing - refurbish	Existing - refurbish	$26,181.40	FRP
Organic Transfer Pump	PU-023	1	refurbished		3.0			$1,500.00	Existing - refurbish	Existing - refurbish	$15,000.00	
Soda Ash Solution Mix Tank Agitator	AG-037	1	new		2.0	1.5	7.27	$4,000.00	Existing - refurbish	Existing - refurbish	$17,632.32	carbon steel rubber lined
Soda Ash Solution Mix Tank	TK-037	1	new	2.1m x 2.1m			7.27	$6,100.00	Existing - refurbish	Existing - refurbish	$6,100.87	carbon steel
Soda Ash Solution Transfer Pump	PU-025	1	new	25mm x 40mm	1.0	0.7		$4,060.00	Existing - refurbish	Existing - refurbish	$9,000.00	316ss, horiz. centr., mechanical seal
Soda Ash Solution Sand Filters	FL-016/017	1	new					$9,460.00	Existing - refurbish	Existing - refurbish	$37,917.04	
Soda Ash Solution Day Tank	TK-038	1	new	2.4m x 3.8m			17.19	$6,100.00	Existing - refurbish	Existing - refurbish	$140,515.69	polyethylene

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Soda Ash Solution Dist. Pump	PU-026	1	refurbished	25mm	1.0	0.7		$1,500.00	Existing - refurbish	Existing - refurbish	$9,000.00	316ss, horiz. centr., mechanical seal
Barren Organic Holding Tank	TK-012A	1	existing	1.4m x 2m			3.08		Existing - refurbish	Existing - refurbish	$7,728.07	FRP
Barren Organic Holding Tank	TK-012B	1	new	1.6m x 2.5m			5.03		Existing - refurbish	Existing - refurbish	$7,728.07	FRP
Barren Organic Feed Pump #1	PU-008A	1	existing	25mm x 40mm	1.0	0.7			Existing - refurbish	Existing - refurbish	$9,000.00	316ss, horiz. centr., mechanical seal
Barren Organic Feed Pump #2	PU-008B	1	existing	25mm x 40mm	1.0	0.7			Existing - refurbish	Existing - refurbish	$9,000.00	316ss, horiz. centr., mechanical seal
REAGENTS - NaSH												
NaSH Mix Tank Agitator	AG-038	1	new		5.0	3.7	9.76	$4,150.00	Existing - refurbish	Existing - refurbish	$26,495.95	carbon steel rubber lined
NaSH Mix Tank	TK-039	1	existing	2.13m x 2.74m			9.76	-	Existing - refurbish	Existing - refurbish	$7,280.17	carbon steel
NaSH Transfer Pump	PU-027	1	refurbished	25mm x 40mm	1.0	0.7		$1,500.00	Existing - refurbish	Existing - refurbish	$9,000.00	
NaSH Day Tank	TK-040	1	new	2.4m x 2.4m			10.86	$5,000.00	Existing - refurbish	Existing - refurbish	$106,673.66	FRP
NaSH Distribution Pump	PU-028	1	refurbished		3.0			$1,500.00	Existing - refurbish	Existing - refurbish	$15,000.00	
Ferric Sulphate Storage Tank, Stainless Steel	TK-041	1	existing	4.6m x 7.0m			116.33	-	Existing - refurbish	Existing - refurbish	$49,859.49	stainless steel
Ferric Sulphate Dist. Pump	PU-029	1	refurbished	25mm x 40mm	3.0	3.2		$1,500.00	Existing - refurbish	Existing - refurbish	$15,000.00	316ss, horiz. centr., mechanical seal
REAGENTS - NaOH											$0.00	
Caustic Storage Tank	TK-042	1	existing	3.5m x 4.2m			40.41	-	Existing - refurbish	Existing - refurbish		carbon steel
Caustic Transfer Pump	PU-030	1	refurbished	25mm x 40mm	5.0	3.7		$1,500.00	Existing - refurbish	Existing - refurbish	$15,000.00	316ss, horiz. centr., mechanical seal
Diluted Caustic Storage Tank	TK-043	1	existing	2.5m x 2.69m			13.20	-	Existing - refurbish	Existing - refurbish	$8,726.01	carbon steel
Diluted Caustic Feed Pump	PU-031	1	refurbished	25mm x 40mm	3.0	2.2		$1,500.00	Existing - refurbish	Existing - refurbish	$15,000.00	SRL, horiz. centr., mechanical seal
Caustic Heater	HE-001	1	existing						Existing - refurbish	Existing - refurbish	$3,525.00	elements - fused 30A
PROCESS WATER												
Lake Water Pump 1	PU-040	1	existing		125.0			-	Existing - refurbish	Existing - refurbish	$33,304.00	Horizontal
Lake Water Pump 2	PU-041	1	existing		125.0			-	Existing - refurbish	Existing - refurbish	$33,304.00	Horizontal
Process Water Tank	TK-044	1	existing	5m x 7m			137.44	-	Existing - refurbish	Existing - refurbish	$55,106.23	carbon steel
Process Water Distribution Pump 1	PU-32	1	refurbished					$1,500.00	Existing - refurbish	Existing - refurbish	$14,372.00	

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Process Water Distribution Pump 2	PU-33	1	refurbished					$1,500.00	Existing - refurbish	Existing - refurbish	$14,372.00	
Process Water Filter Package 8	FL-018/019	1	new	2m dia				$115,000.00	Existing - refurbish	Existing - refurbish	$270,751.64	CS Epoxy Painted
Filtered Water Tank	TK-045	1	existing	1.6m x 3.75			15.16	-	Existing - refurbish	Existing - refurbish	$9,481.80	carbon steel
Filtered Water Distribution Pump 1	PU-034	1	refurbished		30.0			$1,500.00	Existing - refurbish	Existing - refurbish	$14,372.00	Horizontal
Filtered Water Distribution Pump 2	PU-035	1	refurbished		30.0			$1,500.00	Existing - refurbish	Existing - refurbish	$14,372.00	Horizontal
Potable Water Pump No. 1	PU-069	1	existing		7.5	5.6			Existing - refurbish	Existing - refurbish	$5,866.75	Horizontal
Potable Water Pump No. 2	PU-070	1	existing		7.5	5.6			Existing - refurbish	Existing - refurbish	$5,866.75	Horizontal
Cooling Water Tank	TK-061	1	new	2.4m x 3.8m			17.19		Existing - refurbish	Existing - refurbish	$35,200.48	polyethylene
Vent Cooling Water Feed Pump	PU-074	1	new		25.0	18.5			Existing - refurbish	Existing - refurbish	$0.00	Horizontal
FLOCCULANT												
Flocculant Venturi Mixer	MX-001	1	new					$200.00	Existing - refurbish	Existing - refurbish	$801.63	
Flocculant Mix Tank Agitator	AG-039	1	new		0.25		3.53	$1,650.00	Existing - refurbish	Existing - refurbish	$17,632.32	
Flocculant Mix Tank	TK-046	1	existing	1.5m x 2m			3.53	-	Existing - refurbish	Existing - refurbish	$42,409.52	polyethylene
Flocculant Transfer Pump	PU-036	1	new					$4,190.00	Existing - refurbish	Existing - refurbish	$8,094.31	
Flocculant Solution Day Tank	TK-047	1	existing	1.5m x 2m			3.53	-	Existing - refurbish	Existing - refurbish	$3,954.91	
Flocculant Solution Distribution Pump	PU-037	1	new					$4,190.00	Existing - refurbish	Existing - refurbish	$8,094.31	
Flocculant Pump No. 1	PU-059	1	new						Existing - refurbish	Existing - refurbish	$6,210.00	metering pump
Flocculant Pump No. 2	PU-060	1	new						Existing - refurbish	Existing - refurbish	$6,210.00	metering pump
Flocculant Pump No. 3	PU-061	1	new						Existing - refurbish	Existing - refurbish	$6,210.00	metering pump
Flocculant Pump No. 4	PU-067	0							Existing - refurbish	Existing - refurbish	$0.00	
Flocculant Pump No. 5	PU-072	0							Existing - refurbish	Existing - refurbish	$0.00	
LIME STORAGE & SLURRY												
Limestone Slurry Preparation & Distribution Package	PK-004	1	existing		20.0	14.9		$10,000.00	Existing - refurbish	Existing - refurbish	$40,081.44	
Lime Silo	BI-003	1	existing						Existing - refurbish	Existing - refurbish	$0.00	
Lime Transfer Screw Conveyor	CV-003	1	existing						Existing - refurbish	Existing - refurbish	$0.00	

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Lime Slurry Storage Tank Agitator	AG-052	1	existing		5.0	3.7		$4,150.00	Existing - refurbish	Existing - refurbish	$26,495.95	carbon steel rubber lined
Lime Slurry Storage Tank	TK-057	1	existing	3.6m x 2.5m			25.45		Existing - refurbish	Existing - refurbish	$0.00	carbon steel
Lime Slurry Mix Tank Agitator	AG-051	1	new		2.0	1.5			Existing - refurbish	Existing - refurbish	$0.00	carbon steel rubber lined
Lime Slurry Mix Tank	TK-049	1	existing	1.32m x 1.4m			1.92		Existing - refurbish	Existing - refurbish	$5,549.62	polyethylene
Lime Slurry Distribution Pump	PU-062	1	existing	50mm	5.0	3.7		$0.00	Existing - refurbish	Existing - refurbish	Not included	
PLANT AIR SYSTEM												
Plant Air Compressor 1	CO-001	1	existing	265 cfm	75.0	56		-	Existing - refurbish	Existing - refurbish	$51,000.00	From database
Plant Air Compressor 2	CO-003	1	existing	265 cfm	75.0	56			Existing - refurbish	Existing - refurbish	$51,000.00	From database
Plant Air Receiver	CO-002	1	existing					-	Existing - refurbish	Existing - refurbish	$11,280.00	200 psi @ 450F
Low Pressure Blower	BL-001	1	new	1000cfm	50.0	37.3		$30,000.00	Existing - refurbish	Existing - refurbish	$120,244.32	
Instrument Air Dryer	DR-001	1	existing		1.0	0.7		-	Existing - refurbish	Existing - refurbish	$10,575.00	
STEAM, OXYGEN & OZONE SYSTEM												
Boiler Package	PK-006	1	existing		15.0	11.2		-	Existing - refurbish	Existing - refurbish	$208,503.15	
Oxygen Plant	PK-003	1	existing		40.0	29.8		-	Existing - refurbish	Existing - refurbish	$150,000.00	
Ozone Generator	PK-005	1	new					$88,200.00	Existing - refurbish	Existing - refurbish	$353,518.29	
EXHAUST FANS AND HEATERS (GAS)												
Gas Fired Unit Heater	UH-1	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-10	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-11	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-12	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-13	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-14	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-15	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Gas Fired Unit Heater	UH-16	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-2	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-3	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-4	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-5	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-6	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-7	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-8	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Gas Fired Unit Heater	UH-9	1	existing	60 - 250 MBH					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Makeup Air Unit	MAU-1	1	existing	200MBH heating					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Four Way Propeller Fan	EF-3	1	existing	11768 cfm	3.0	2.2			Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Inline Fan	EF-10	1	existing	5000 cfm	1.5	1.1			Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Makeup Air Unit	MAU-2	1	existing	9000 - 12000 cfm					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Roof Exhauster	EF-1	1	existing	14000 cfm	3.0	2.2			Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Roof Exhauster	EF-2	1	existing	14000 cfm	3.0	2.2			Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Roof Exhauster	EF-4	1	existing	14000 cfm					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Roof Exhauster	EF-5	1	existing	14000 cfm					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Rooftop Unit, Gas/Electric	AC-1	1	existing	12.5-ton cooling					Existing - refurbish	Existing - refurbish	Included in refurbish allowance	

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Side Wall Exhauster	EF-8	1	existing	1000 cfm	0.1	0.1			Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Side Wall Exhauster	EF-9	1	existing	1000 cfm	0.1	0.1			Existing - refurbish	Existing - refurbish	Included in refurbish allowance	
Exhaust Fan		1	new					$2,000.00	Existing - refurbish	Existing - refurbish	$8,016.29	
Gas Scrubber	VE-004 (SB-001)	1	new		5.0			$10,000.00	Existing - refurbish	Existing - refurbish	$40,081.44	carbon steel - caustic bath
Gas Scrubber	VE-005	1	new		5.0			$10,000.00	Existing - refurbish	Existing - refurbish	$40,081.44	
MOBILE EQUIPMENT												
Front End Loader (John Deere # 544B)	N/A	1	Sold						Existing - refurbish	Existing - refurbish	Not included	
Forklift (Clark)		1		3500 lbs					Existing - refurbish	Existing - refurbish	Not included	
1998 Chevrolet 4X4		1							Existing - refurbish	Existing - refurbish	Not included	white
1995 Chevrolet Van (8 passenger) GONE		1	Sold						Existing - refurbish	Existing - refurbish	Not included	white
Meyer Snow Plow for 4x4 with Hydraulic lift		1		Model E-47					Existing - refurbish	Existing - refurbish	Not included	
Set of forks for loader		1	Sold						Existing - refurbish	Existing - refurbish	Not included	
Grieve dryer		1							Existing - refurbish	Existing - refurbish	Not included	
Self-dumping bins		2							Existing - refurbish	Existing - refurbish	Not included	
Trash pumps		9							Existing - refurbish	Existing - refurbish	Not included	
Flygt pumps		3							Existing - refurbish	Existing - refurbish	Not included	
RETREATMENT												
retreatment tank agitator	AG-042	1	existing		10.0	7.5			Existing - refurbish	Existing - refurbish	$39,133.86	
retreatment tank	TK-050	1	existing	4.5m x 6.4m			101.79		Existing - refurbish	Existing - refurbish	$55,106.23	carbon steel
retreatment tank pump	PU-043	1	new		7.5	5.6			Existing - refurbish	Existing - refurbish	$5,866.75	SRL
LEACH SLURRY												
leach slurry o/f tank agitator	AG-054	1	existing		5.0	3.7			Existing - refurbish	Existing - refurbish	$40,672.22	carbon steel rubber lined
leach slurry o/f tank	TK-059	1	existing	2.4m x 3.66m			16.56		Existing - refurbish	Existing - refurbish	$40,672.22	carbon steel rubber lined
leach slurry o/f pump	PU-037	1	existing	50mm x 50mm	5.0	3.7			Existing - refurbish	Existing - refurbish	Not included	SRL
METABISULPHITE												
Metabisulphite Mix Tank Agitator	AG-046	1	new		0.8	0.6			Not included	Not included	Not included	316ss

Equipment description	Equipment no.	Qty.	Status	Size	Motor hp	Motor kw	Volume	Unit cost	Base (12 tpd)	24 tpd	50 tpd	Remarks
Metabisulphite Mix Tank	TK-051	1	existing	1.22m x 2.14m			2.50		Not included	Not included	Not included	polyethylene
Metabisulphite Distribution Pump	PU-044	1	existing	25mm x 40mm	1.0	0.7			Not included	Not included	Not included	316ss, horiz. centr., mechanical seal
PRECOAT												
Pre-Coat Tank Agitator	AG-053	1	existing		0.3	0.2			Existing - refurbish	Existing - refurbish	$6,496.08	carbon steel
Pre-Coat Tank	TK-058	1	existing	1220mm x 2135mm			2.50		Existing - refurbish	Existing - refurbish	$5,549.62	polyethylene
SPENT REGENERANT											$0.00	
Spent Regenerant Tank	TK-060	1	new	1.07m x 0.9m			0.81		Existing - refurbish	Existing - refurbish	$5,549.62	PE - square
Spent Regenerant Pump	PU-073	1	existing		1.0	0.7			Existing - refurbish	Existing - refurbish	$9,000.00	316ss, horiz. centr., mechanical seal
COPPER SULPHATE												
Copper Sulphate Mix Tank Agitator	AG-047	1	new		0.3	0.2			Not included	Not included	Not included	316ss
Copper Sulphate Mix Tank	TK-052	1	new	1.0m x 1.0m			0.79		Not included	Not included	Not included	polyethylene
Copper Sulphate Pump	PU-045	1	new	25mm	1.5	1.1			Not included	Not included	Not included	peristaltic
COOLANT												
Spent Coolant Tank	TK-053	1	existing	1.5m x 2.0m			3.53		Existing - refurbish	Existing - refurbish	$27,114.37	carbon steel
Spent Coolant Pump	PU-049	1	new	50mm x 75mm	3.0	2.2			Existing - refurbish	Existing - refurbish	Not included	Cast Iron, horiz. Centr., packed gland
SUMPS												
General Floor Sump No. 1	PU-063	1	existing		5.0	3.7			Existing - refurbish	Existing - refurbish	$15,032.40	
General Floor Sump No.2	PU-064	1	existing		5.0	3.7			Existing - refurbish	Existing - refurbish	$15,032.40	
HOOTENANNY?												
Hootenanny	XX-001	1	new						Not included	Not included	Not included	suction device
Total equipment supply									$0.00	$2,552,968.98	$22,986,238.55	

Table 8-2 - Mechanical Equipment list with restart capital cost values

APPENDIX C CAPITAL COST ESTIMATE DETAILS

	Supply	Installation hours	Installation costs	Freight	Total
Total direct cost of equipment	8,640,000	17,300	1,730,000	864,000	11,234,000
Concrete	905,968	18,200	1,820,000	90,597	2,808,500
Earthworks	362,387	7,300	730,000	36,239	1,123,400
Structural steel	1,703,226	34,100	3,410,000	170,323	5,280,000
Piping	3,197,385	6,400	640,000	319,738	4,156,600
Electrical	1,641,923	3,300	330,000	164,192	2,134,500
Instrumentation and Control	1,209,846	2,500	250,000	120,985	1,572,800
Architecture and auxiliary buildings, minor infrastructure	1,296,231	2,600	260,000	129,623	1,685,100
Total direct cost of plant	**18,956,965**	**91,700**	**9,170,000**	**1,895,697**	**29,994,900**
Construction Equipment					1,199,800
Vendor representatives					337,100
Commissioning and start-up					561,700
Spares					337,100
First fills					899,900
Owner's costs					1,799,700
EPCM					5,399,100
Construction camp, temporary facilities etc					0
Total indirect cost for the plant					**10,534,400**
Sub-total	**18,956,965**	**91,700**	**9,170,000**	**1,895,697**	**40,529,300**
Project Contingency	5,687,090	27,510	2,751,000	568,709	12,158,790
Total installed capital cost for plant	**24,644,055**	**119,210**	**11,921,000**	**2,464,405**	**52,688,090**

Table 8-3 – Replacement capital cost estimate for 12 tpd option

	Supply	Installation hours	Installation costs	Freight	Subtotal cost
Total direct cost of equipment	**13,835,000**	27,700	2,770,000	1,383,500	17,988,500
Concrete	1,450,710	29,100	2,910,000	145,071	4,497,200
Earthworks	580,290	11,700	1,170,000	58,029	1,798,900
Structural steel	2,727,290	54,600	5,460,000	272,729	8,454,600
Piping	5,119,846	10,300	1,030,000	511,985	6,655,800
Electrical	2,629,154	5,300	530,000	262,915	3,417,900
Instrumentation and Control	1,937,231	3,900	390,000	193,723	2,518,400
Architecture and auxiliary buildings, minor infrastructure	2,075,615	4,200	420,000	207,562	2,698,300
Total direct cost of plant	**30,355,136**	**146,800**	**14,680,000**	**3,035,514**	**48,029,600**
Construction Equipment					1,921,200
Vendor representatives					539,700
Commissioning and start-up					899,500
Spares					539,700
First fills					1,440,888
Owner's costs					2,881,800
EPCM					8,645,400
Construction camp, temporary facilities etc					0
Total indirect cost for the plant					**16,868,188**
Sub-total	**30,355,136**	**146,800**	**14,680,000**	**3,035,514**	**64,897,788**
Project Contingency	**9,106,541**	**44,040**	**4,404,000**	**910,654**	**19,469,336**
Total installed capital cost for plant	**39,461,677**	**190,840**	**19,084,000**	**3,946,168**	**84,367,124**

Table 8-4 Replacement capital cost estimate for 24 tpd option

	Supply	Installation hours	Installation costs	Freight	Subtotal cost
Total direct cost of equipment	**21,960,893**	44,000	4,400,000	2,196,089	28,556,982
Concrete	2,303,000	46,100	4,610,000	230,300	7,139,300
Earthworks	921,194	18,500	1,850,000	92,119	2,855,700
Structural steel	4,329,613	86,600	8,660,000	432,961	13,421,800
Piping	8,127,769	16,300	1,630,000	812,777	10,566,100
Electrical	4,173,769	8,400	840,000	417,377	5,425,900
Instrumentation and Control	3,075,385	6,200	620,000	307,538	3,998,000
Architecture and auxiliary buildings, minor infrastructure	3,509,238	7,100	710,000	350,924	4,562,010
Total direct cost of plant	**48,400,861**	**233,200**	**23,320,000**	**4,840,086**	**76,525,792**
Construction Equipment					3,061,100
Vendor representatives					856,800
Commissioning and start-up					1,427,900
Spares					856,800
First fills					2,295,800
Owner's costs					4,591,600
EPCM					13,774,700
Construction camp, temporary facilities etc					0
Total indirect cost for the plant					**26,864,700**
Sub-total	**48,400,861**	**233,200**	**23,320,000**	**4,840,086**	**103,390,492**
Project Contingency	**14,520,258**	**69,960**	**6,996,000**	**1,452,026**	**31,017,148**
Total installed capital cost for plant	**62,921,119**	**303,160**	**30,316,000**	**6,292,112**	**134,407,640**

Table 8-5 Replacement capital cost estimate for 45 tpd option

	Supply	Installation hours	Installation costs	Freight	Subtotal cost
Total direct cost of equipment	**23,394,000**	46,800	4,680,000	2,339,400	30,413,400
Concrete	2,452,710	49,100	4,910,000	245,271	7,603,400
Earthworks	981,097	19,700	1,970,000	98,110	3,041,400
Structural steel	4,611,065	92,300	9,230,000	461,106	14,294,300
Piping	8,656,154	17,400	1,740,000	865,615	11,253,000
Electrical	4,445,077	8,900	890,000	444,508	5,778,600
Instrumentation and Control	3,275,308	6,600	660,000	327,531	4,257,900
Architecture and auxiliary buildings, minor infrastructure	3,509,238	7,100	710,000	350,924	4,562,010
Total direct cost of plant	**51,324,648**	**247,900**	**24,790,000**	**5,132,465**	**81,204,010**
Construction Equipment					3,248,200
Vendor representatives					912,500
Commissioning and start-up					1,520,700
Spares					912,500
First fills					2,436,200
Owner's costs					4,872,300
EPCM					14,616,800
Construction camp, temporary facilities etc					0
Total indirect cost for the plant					**28,519,200**
Sub-total	**51,324,648**	**247,900**	**24,790,000**	**5,132,465**	**109,723,210**
Project Contingency	**15,397,394**	**74,370**	**7,437,000**	**1,539,739**	**32,916,963**
Total installed capital cost for plant	**66,722,042**	**322,270**	**32,227,000**	**6,672,204**	**142,640,173**

Table 8-6 Replacement capital cost estimate for 50 tpd option

	Supply	Installation hours	Installation costs	Freight	Subtotal cost
Total direct cost of equipment	432,000	900	90,000	43,200	565,200
Concrete	0	0	0	0	0
Earthworks	0	0	0	0	0
Structural steel	181,194	3,700	370,000	18,119	561,700
Piping	1,296,231	2,600	260,000	129,623	1,685,100
Electrical	691,385	1,400	140,000	69,138	898,800
Instrumentation and Control	1,209,846	2,500	250,000	120,985	1,572,800
Architecture and auxiliary buildings, minor infrastructure	172,846	400	40,000	17,285	224,700
Total direct cost of plant	**3,983,501**	**11,500**	**1,150,000**	**398,350**	**5,508,300**
Construction Equipment					220,400
Demolition of existing facility					337,100
Vendor representatives					17,000
Commissioning and start-up					28,300
Spares					17,000
First fills					165,300
Owner's costs					330,500
EPCM					661,000
Construction camp, temporary facilities etc					0
Total indirect cost for the plant					**1,776,600**
Sub-total	**3,983,501**	**11,500**	**1,150,000**	**398,350**	**7,284,900**
Project Contingency	**1,195,050**	**3,450**	**345,000**	**119,505**	**2,185,470**
Total installed capital cost for plant	**5,178,552**	**14,950**	**1,495,000**	**517,855**	**9,470,370**

Table 8-7 Restart capital cost estimate for 12 tpd option

	Supply	Installation hours	Installation costs	Freight	Subtotal cost
Total direct cost of equipment	2,984,969	6,000	600,000	298,497	3,883,466
Concrete	0	0	0	0	0
Earthworks	0	0	0	0	0
Structural steel	580,274	11,700	1,170,000	58,027	1,798,850
Piping	3,459,327	7,000	700,000	345,933	4,497,125
Electrical	1,660,477	3,400	340,000	166,048	2,158,620
Instrumentation and Control	1,937,223	3,900	390,000	193,722	2,518,390
Architecture and auxiliary buildings, minor infrastructure	276,746	600	60,000	27,675	359,770
Total direct cost of plant	**10,899,016**	**32,600**	**3,260,000**	**1,089,902**	**15,216,221**
Construction Equipment					608,700
Demolition of existing facility					337,100
Vendor representatives					116,600
Commissioning and start-up					194,200
Spares					116,600
First fills					456,487
Owner's costs					913,000
EPCM					1,826,000
Construction camp, temporary facilities etc					0
Total indirect cost for the plant					**4,568,687**
Sub-total	**10,899,016**	**32,600**	**3,260,000**	**1,089,902**	**19,784,908**
Project Contingency	3,269,705	9,780	978,000	326,970	5,935,472
Total installed capital cost for plant	**14,168,721**	**42,380**	**4,238,000**	**1,416,872**	**25,720,380**

Table 8-8 Restart capital cost estimate for 24 tpd option

	Supply	Installation hours	Installation costs	Freight	Subtotal cost
Total direct cost of equipment	**19,764,803**	39,600	3,960,000	1,976,480	25,701,284
Concrete	829,097	16,600	1,660,000	82,910	2,570,200
Earthworks	248,742	5,000	500,000	24,874	771,100
Structural steel	2,072,710	41,500	4,150,000	207,271	6,425,400
Piping	7,315,000	14,700	1,470,000	731,500	9,509,500
Electrical	3,558,692	7,200	720,000	355,869	4,626,300
Instrumentation and Control	2,570,154	5,200	520,000	257,015	3,341,200
Architecture and auxiliary buildings, minor infrastructure	1,977,077	4,000	400,000	197,708	2,570,200
Total direct cost of plant	**38,336,275**	**133,800**	**13,380,000**	**3,833,627**	**55,515,184**
Construction Equipment					2,220,700
Demolition of existing facility					561,700
Vendor representatives					771,100
Commissioning and start-up					1,285,100
Spares					771,100
First fills					1,665,500
Owner's costs					3,331,000
EPCM					9,992,800
Construction camp, temporary facilities etc					0
Total indirect cost for the plant					**20,599,000**
Sub-total	**38,336,275**	**133,800**	**13,380,000**	**3,833,627**	**76,114,184**
Project Contingency	**11,500,882**	**40,140**	**4,014,000**	**1,150,088**	**22,834,255**
Total installed capital cost for plant	**49,837,157**	**173,940**	**17,394,000**	**4,983,716**	**98,948,439**

Table 8-9 Restart capital cost estimate for 45 tpd option

	Supply	Installation hours	Installation costs	Freight	Subtotal cost
Total direct cost of equipment	**21,054,600**	42,200	4,220,000	2,105,460	27,380,060
Concrete	883,258	17,700	1,770,000	88,326	2,738,100
Earthworks	265,000	5,300	530,000	26,500	821,500
Structural steel	2,208,097	44,200	4,420,000	220,810	6,845,100
Piping	7,792,846	15,600	1,560,000	779,285	10,130,700
Electrical	3,791,154	7,600	760,000	379,115	4,928,500
Instrumentation and Control	2,738,077	5,500	550,000	273,808	3,559,500
Architecture and auxiliary buildings, minor infrastructure	2,106,231	4,300	430,000	210,623	2,738,100
Total direct cost of plant	**40,839,263**	**142,400**	**14,240,000**	**4,083,926**	**59,141,560**
Construction Equipment					2,365,700
Demolition of existing facility					561,700
Vendor representatives					821,500
Commissioning and start-up					1,369,100
Spares					821,500
First fills					1,774,300
Owner's costs					3,548,500
EPCM					10,645,500
Construction camp, temporary facilities etc					0
Total indirect cost for the plant					**21,907,800**
Sub-total	**40,839,263**	**142,400**	**14,240,000**	**4,083,926**	**81,049,360**
Project Contingency	**12,251,779**	**42,720**	**4,272,000**	**1,225,178**	**24,314,808**
Total installed capital cost for plant	**53,091,041**	**185,120**	**18,512,000**	**5,309,104**	**105,364,168**

Table 8-10 Restart capital cost estimate for 50 tpd option