

Appendix 1.0-N

Sedgman Canada Ltd., Coal Processing Plant Additional Background Technical Information

Decision Note

As part of the development of the Telkwa Project Coal Handling and Preparation Plant Sedgman have reviewed the option to consider an alternate flowsheet for the plant by replacing the flotation circuit with reflux classifiers.

This was done by simulating the plant yield for the following flowsheets for the overall Telkwa blend.

- DMC, Flotation
- DMC, Reflux Classifier

The desliming screen aperture was also varied to test if any improvement was gained relative to the base flotation option. The graph below represents the yield-ash curve comparing the circuits with the DMC/Flotation option being superior in all simulations with approximately a 2% yield differential in the expected 9-10% product ash range. On an annual basis equates to 4,800t additional clean coal.



The other key difference to consider between the circuits is the capital and operating costs. Both the flotation and reflux classifier options are similar from a capital perspective but the flotation option requires reagents as an additional operating cost of:

- MIBC 0.02kg/ROM t usage @ \$3.02/kg for 240,000 ROMt = \$14,496
- Diesel 0.04L/ROM t usage @ \$0.64/L for 240,000 ROMt = \$6,144

Recommendation: The additional operating cost of approximately \$20,000 is insignificant compared to the potential additional 4,800t of clean coal per year therefore Sedgman recommend staying with the DMC/Flotation plant arrangement.

This recommendation has been **approved** not approved.

Allegiance Coal Representative

[Signature]

Date:

Mar 26/18

Sedgman Limited Representative

[Signature]

Date:

Mar 26th 2018

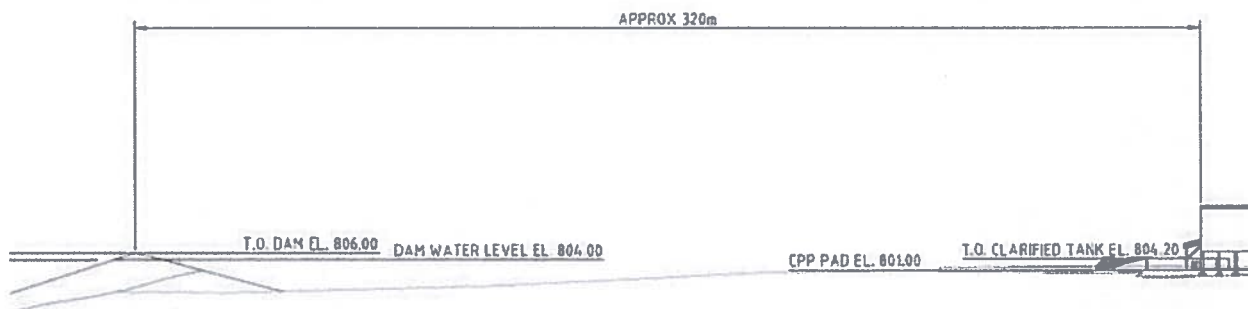
Decision Note

Raw Water Pumping

As part of the development of the Telkwa Project Coal Handling and Preparation Plant Sedgman have reviewed the options for raw water pumping to consider alternatives to the electric's pumps selected in the PFS.

This was done by testing if gravity flow from the dam or if a diesel pumping solution is an option.

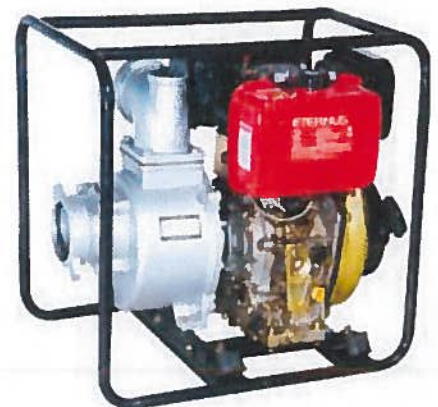
The cross section of the raw water pumping requirement was sketched as below showing that gravity is not a viable option with basically no differential in head between the dam height and the clarified water tank discharge point.



The diesel pump alternative was investigated to meet the following criteria:

- Flowrate 12-40 m3/hr
- Self-priming pump, suction hose complete with floats
- Minimum 10hrs running per day

The vendor from Cac Industrial Equipment confirmed this duty aligns well with the portable diesel powered pumps with minimal static head and mainly friction losses as the duty. Something similar to that shown will be able to be purchased for >\$2,000 and we would recommend a small tank be added so the diesel only needs to be topped up once per day.



Recommendation: Based on the small water requirements and the limited operating hours for the plant when producing 240,000t per year Sedgman recommend that the raw water pumping be by a potable diesel pump. This will remove the requirement for considerable electrical costs including the extension to HV line, heated shed and electric pumps etc and a capital costs of ~\$300,000.

This recommendation has been ☒ approved / ☐ not approved.

Allegiance Coal Representative 

Date: Mar-26/18

Sedgman Limited Representative 

Date: March 26th 2018

Decision Note

Plant Flooring and Covering Options

As part of the development of the Telkwa Project Coal Handling and Preparation Plant Sedgman have reviewed the options for the building and flooring materials to consider alternatives to the steel building and concrete floor selected in the PFS.

Initially the more economic shed and floor solution was done by optimising the layout with the reduced equipment and then investigating a canvas shed option and a plastic clip lock flooring solution.

New layout

- Plant + Filter - 13.4m wide x 34.8m long x 15m high **7000m³**

Small Plant PFS

- Plant 23m wide x 32.4m long x 16.7m high **12,450m³**
- Filter annex 17m wide x 14.5m long x 10.5m high **2,590m³**
- 15,040m³**

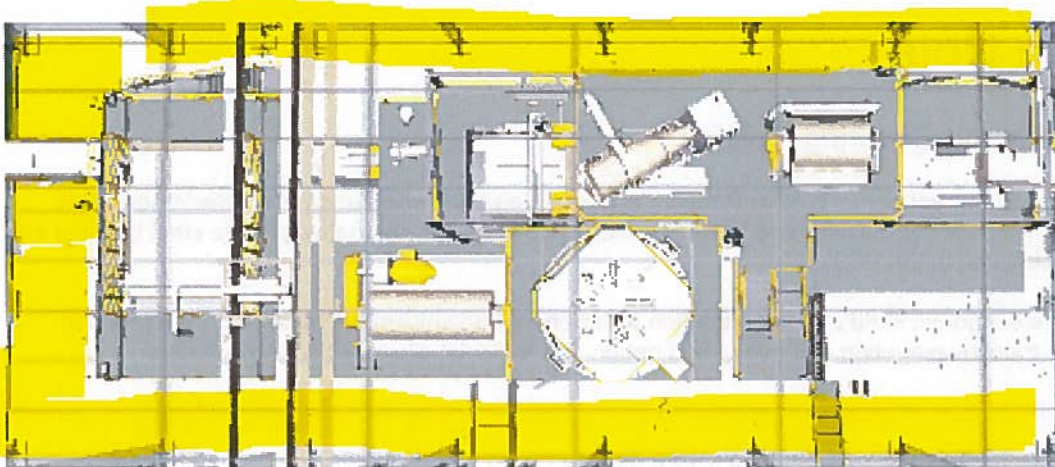
The optimised layout provided over a 50% reduction in building volume and most importantly has reduced the width of the building lower the costs of a crane.

After discussions and options from the vendors a key issue with utilising canvas is that the structures are not equipped to support a crane. This can be done but in essence it will result in the same structure being required as with the steel shed option. Another issue is that due to the way the internal structure is formed access or doors along the side is difficult and the canvas has potential for higher heat losses relative to an insulated steel structure. Below shows some photos of the canvas type structures considered in this assessment.

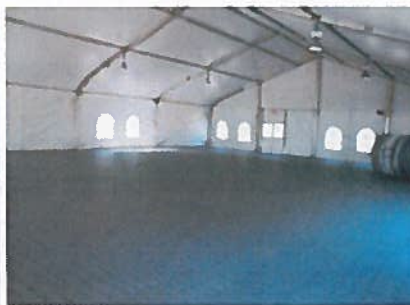
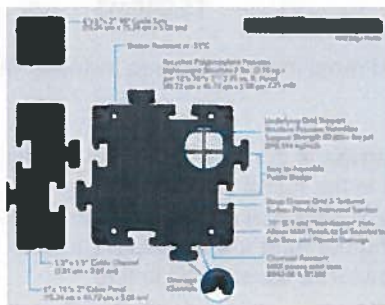


We received a price for comparison and the difference between canvas and steel is ~\$30,000 CAD lower for the canvas option but this doesn't take into account the additional flooring needed for the wider structure.

For the flooring comparison with the optimised layout also resulting in a 50% reduction of the floor area the assessment was then focused on potentially replacing the concrete between the modules and the edge of the building with a plastic clip lock system. The yellow highlight shown below identifies the area considered for this change.



The product considered from Portafloor (pictured below from Portafloor website) is matting often used in a relocatable situation for maintenance sheds in the mining industry. The only risk with its use in our application is although it withstands water it does not form an impenetrable barrier and a further layer of plastic and drainage would be required beneath it.



If we contain the CPP within a bundled slab incorporating the sump pumps to catch the worst of the wash down and spillage then we can save around 40m³ of concrete and if we pave the remaining area in Portafloor then the overall saving will be approximately \$80,000 CAD.

Recommendation: Based on the risk with the canvas shed with respect to supporting the crane and potential higher heat losses Sedgman recommend that the shed stay as a pre-engineered steel structure.

In the case of the flooring Sedgman recommend that the excess area around the modules with the exception of the sump pump be changed to a plastic matting providing a capital cost saving of ~\$80,000.

This recommendation has been **approved** not approved.

Allegiance Coal Representative

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Date:

Mar 26

Sedgman Limited Representative

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Date:

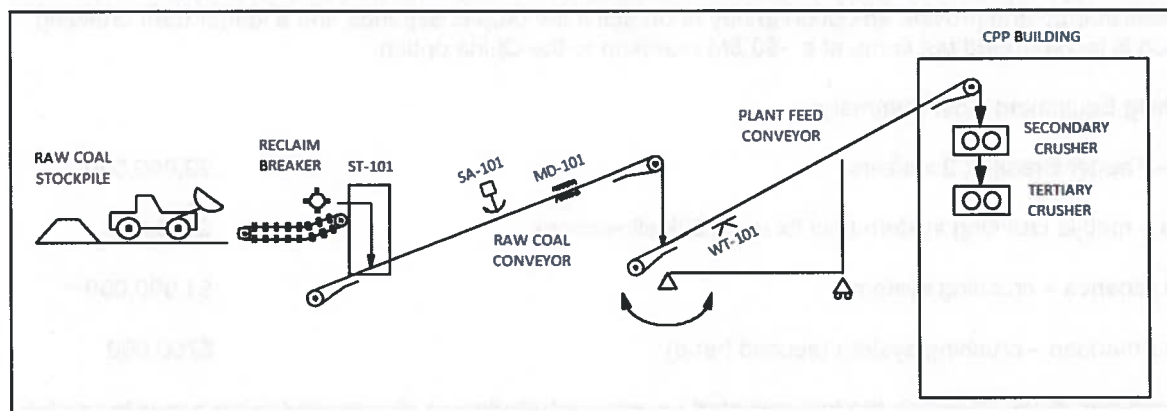
Mar 26th 2018

Decision Note

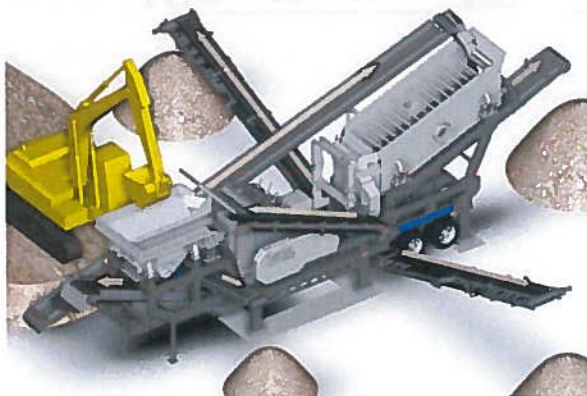
Raw Coal Crushing System Options

As part of the development of the Telkwa Project Coal Handling and Preparation Plant Sedgman have reviewed the options for the raw coal crushing system to consider alternatives to the 3 stage crushing system selected in the PFS.

The PFS crushing system included a hungry board arrangement that enabled trucks to directly dump onto the reclaim breaker or alternatively the reclaim breaker would be fed by a Front End Loader (FEL). The heavy-duty reclaim breaker then reclaims coal from the ROM coal stockpile, reduces it to a top size of 250 mm and then directs the material onto the raw coal conveyor. The raw coal conveyor which has a metal detector and a cross-belt sampler transfers material onto the plant feed conveyor. The plant feed conveyor elevates the raw coal directly into the CPP, feeding into the secondary and then tertiary sizer for reduction to a nominal - 50mm top size. Both sizers are low speed high torque centre sizing machines to minimise fines generation.



With the change to focus on the 240,000t clean coal start-up case with no expansion a lower cost, more temporary crushing solution has been investigated. Pricing for mobile crushing plants (shown below) from the China and North America market has been sought. The plant will consist of a receival hopper, 50mm screen to remove the already sized material and a high speed crusher to reduce any oversize from the screen. The sized material will then pass through a surge chute to smooth the feed prior to being conveyed to the plant. The plant feed conveyor which has a metal detector, sampler and weigher elevates the raw coal directly into the plant.



From a technical point of view this lower cost solution has the potential to produce fines by the use of a high speed crusher but this should be mitigated by the pre-screening of any right sized material. This solution can be sourced from China and the Sedgman procurement groups feedback after visiting these vendors is as long as the QA and QC is followed we can make these solutions work. What we typically find (and see from other installs) is issues like:

- No liners in chutes
- Poor chute / transfer design
- Electrical equipment not to Canadian Standards
- Mechanical set up (like conveyor bearings not completed correctly from manufacture/assembly)

To account for this in the cost comparison we have added a cost provision on top of the purchase price to resolve issues (preferably during manufacture), but note if we don't also get involved in the QA/QC then we are likely to have issues.

Alternatively there are vendors like McCloskey in North America that can provide a similar unit to that sourced in China which may reduce the risk of Canadian compliance. These units may also be able to be leased for the initial startup and provide an option to buy or on-sell if the project expands and a longer term crushing solution is incorporated but come at a ~\$0.5M premium to the China option.

Crushing Equipment Cost Summary:

PFS – Feeder Breaker, 2 x sizers	\$2,000,000 ⁶
China – mobile crushing system (incl fix up \$200k allowance)	\$550,000
North America – crushing system	\$1,000,000
North American – crushing system (second hand)	\$700,000

Recommendation: Based on the low cost start up approach Sedgman recommend using a mobile crusher sourced from China and managing the risk by having an appropriate level of QA/QC to ensure the solution is robust and meets local standard. We would also recommend at the time of purchase availability of suitable second hand options from Canada should be tested.

This recommendation has been **approved** / not approved.

Allegiance Coal Representative

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Date:

Mar 26/18

Sedgman Limited Representative

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Date:

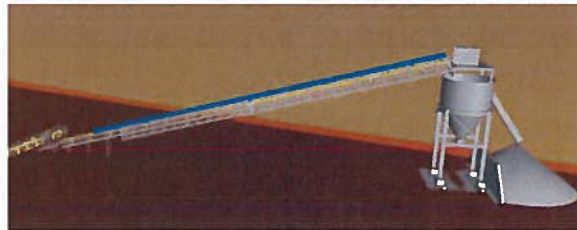
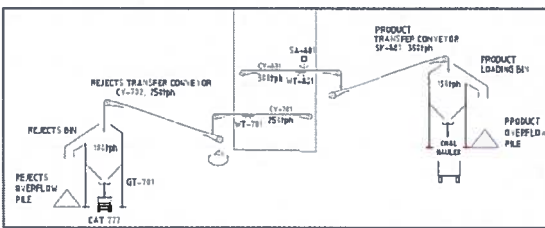
Mar 26th 2018

Decision Note

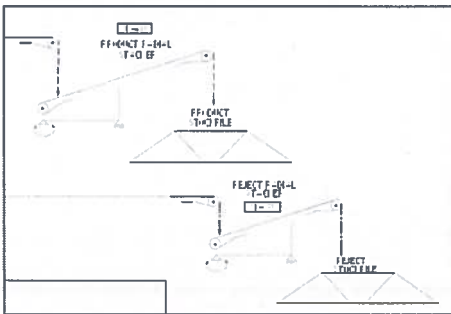
Product and Reject Placement Options

As part of the development of the Telkwa Project Coal Handling and Preparation Plant Sedgman have reviewed the options for the placement of the product and reject streams either into a bin or onto a stockpile.

The PFS system included bins to then directly transfer into haulage trucks for removal of both product and reject material. Although the option has the advantage of not requiring a front end loader to re-handle the material it provides no storage capacity at the plant. The system would provide an overflow in the case of an emergency to allow the plant to keep running but this material would have to be re-handled with a front end loader.



With the change to focus on the smaller clean coal start-up case with no expansion a lower capital cost option of stacking onto stockpiles at the plant to then remove by front end loader and trucks as required has been investigated. Although this option provides the flexibility of being able to campaign the truck cycles if required and minimizes any potential interruption to plant operation it will have an increase operating costs by front end loader usage.



As the plant is feed by mobile equipment the assumption has been that there will be a backup excavator or front end loader at the plant so it is not expected additional capital will be required for the mobile equipment to put the material into the truck. There will however be a fuel and maintenance cost for the machine of approximately \$85/hr operating for 5000hrs/yr.

The expected direct capital cost and annual operating cost difference is shown in the table below. This assessment is based on the front end loader being required for 10% of the time for the bin option and 100% for the stockpile option.

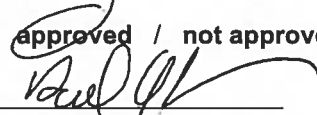
Option	Bins	Stockpile
Capital Cost	\$1,950,000	\$820,000
Operating Cost per yr	\$42,500	\$425,000

On this basis the capital differential would require at least a 3 yr period of operation before the bin option would provide a better overall outcome.

Recommendation: Based on the low cost start up approach Sedgman recommend using the stockpile option initially. To mitigate the future costs as the operation increases in operating time or tonnage the plant layout should consider the retro fitting of bins should the operating cost justify a change once in operation.

This recommendation has been approved / not approved.

Allegiance Coal Representative



Date: 28 June 2018

Sedgman Limited Representative



Date: 28 June 2018

Decision Note

Product Haulage Options

As part of the development of the Telkwa Project Coal Handling and Preparation Plant, Sedgman have reviewed the options for the transport of the product to the train loadout by either truck or an overland conveyor.

The assessment is to determine if a second hand overland conveyor option is viable and what is an appropriate amount of capital to secure the conveyor.

For the trucking option it is assumed that the material is loaded off a stockpile at the plant and transported the 17km to then be dumped on the stockpile at the train loadout area. This option allows material to be spread along the train line if the use of front end loaders to directly load trains is being utilised.

For the overland conveyor option it is assumed that the product material is transferred by truck from the plant 6km to an unloading hopper at the tail of the overland conveyor. It is then conveyed 11km overland for transport to the train loadout area. This system will then also require an unloading system incorporating a stacker at the discharge end to spread the material onto the train loadout stockpile.

Option	Overland Conveyor	Trucking
Capital Cost differential	\$12,625,000	\$800,000
Operating Cost per yr	\$1,150,500	\$2,231,250

The capex and opex in the table above were built on the following estimate basis and assumptions:

- Capital costs for constructing the road are equivalent in both options as the road is required whether or not the haul trucks transport product on it
- The overland conveyor capital cost is associated with the removal, transport and installation of a 6km overland conveyor from an existing site plus an earthworks allowance. Capital costs for design, supply and install of a new conveyor are considerably higher and at this point it has been assumed you can secure the conveyor for \$0.
- An overland conveyor direct cost of \$1100/m has been assumed and includes for direct conveyor demob, transport and installation costs plus an allowance for refurbishment costs.
- The supply cost for the hopper at the tail of the overland conveyor unloading the product from the truck to the feeder has been estimated as \$45,000. With a small stacker at the discharge end of the conveyor belt estimated at \$80,000.
- The supply cost of a 50t product haul truck has been assumed as \$400,000. The replacement period of the tractor is 5 years; replacement period on the trailer is 10 years.
- The operation will require either 4 product haul trucks for the trucking option or 1 product haul truck for the overland conveyor plus trucking option, in order to meet the product haulage demand of 750,000t/yr.
- The assessment has been done on the basis that the product haul trucks will operate at an average speed of 50km/hr.
- Based on the original PFS information a product coal road haulage rate of \$0.175/t/km has been used and includes for fuel usage, truck maintenance and road maintenance.

- Annual OLC maintenance and sustaining capital costs have been assumed at 3% of the associated capital cost

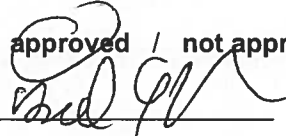
On this basis the capital differential would require at least a 10 yr period of operation before the OLC option would provide a better overall outcome.

To achieve a break-even point between the two options within a 3 yr period the relocation, reinstallation and refurbishment of the conveyor belt would need to be completed for less than \$3 million which is highly unlikely.

Recommendation: Based on the low cost start up approach Sedgman recommends using the trucking method to transport product coal to the TLO facility.

This recommendation has been approved / not approved.

Allegiance Coal Representative



Date: 28 June 2018

Sedgman Limited Representative



Date: 28 June 2018

Decision Note

Train Loadout Options

As part of the development of the Telkwa Project Coal Handling and Preparation Plant, Sedgman have reviewed options for the train loadout system by either using front end loaders or a dozer reclaim and train loadout bin.

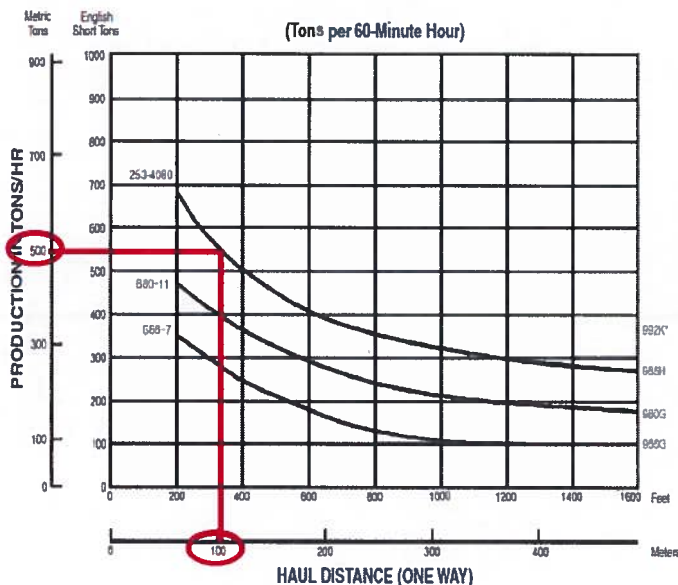
For the front end loader option, it is assumed in a worst case that the operation will require 3 x 988 Loader's to meet the required loading rate of 1,500t/hr (500t/h each loader). The front end loaders will load the product directly onto the train from a stockpile approximately 100m away. If the stockpile is closer these units can achieve approximately 600t/h – 650t/h each.

For the TLO bin option assessed, it is assumed that the operation will require a D10 dozer with a 40-50m pushing radius. The dozer will push the product onto a reclaim feeder that will elevate the material onto the train loadout conveyor and transfer it to the train loadout bin. This option will take advantage of the terrain with the stockpile sitting above the rail loop.

The machinery requirement assumptions were based on the charts below.

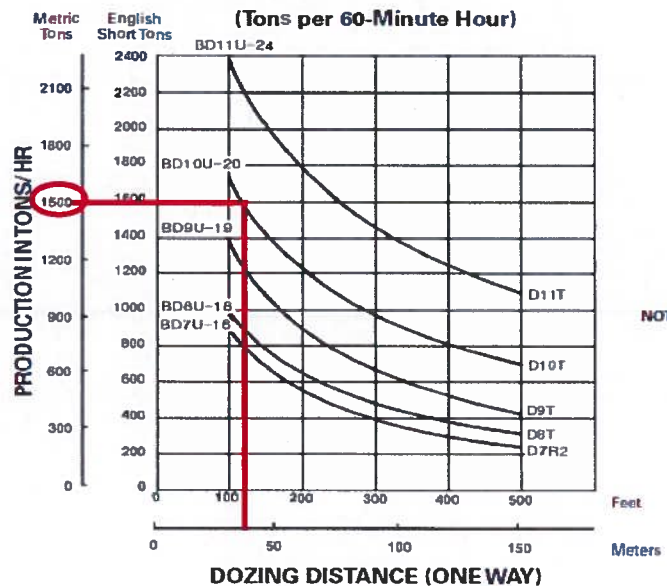
Wheel Loaders Estimated Production with Coal Bucket

- Factors:**
- Mixed Bituminous Coal
 - Storage and Reclamation
 - 0% Grade
 - 0.80 Coefficient of Traction



Track-Type Tractors Estimated Production with U-Blade (Coal Dozer)

- Factors:**
- Mixed Bituminous Coal
 - Storage and Reclamation
 - 0% Grade
 - 0.80 Coefficient of Traction



NOTE:

To assess the viability of the TLO options estimations were done for the capex and opex of each as displayed in the table below.

Option	Front End Loader	TLO Bin
Capital Cost	\$3,270,000	\$7,980,250
Operating Cost per yr	\$1,027,581	\$859,470

The capex and opex in the table above were built on the following estimate basis and assumptions:

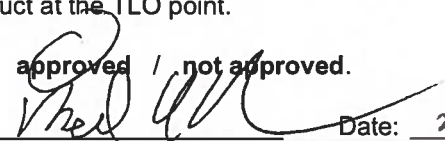
- Capital costs for the mobile equipment have been assumed based on CAT pricing as follows:
 - Front End Loader 998: \$1,090,000 per unit
 - Cat D10: \$1,980,250 per unit
- The total annual product tonnes have been assumed at 750,000 per annum.
- A smaller train load out bin including reclaim conveyor and 200t bin has been estimated to be able to be sourced at \$6,000,000.
- The train loading capacity has been assumed as 12,000t/train with a required loading time of 10hrs. With an average loading rate of 1,500t/hr this will require 500 operating hours per year of train loading, with 1.2 trains per week and an expected 8 hrs per train.
- Personnel requirements have been assumed as 3 operators for the front end loader option and 2 operators for the bin option.
- For the 750,000 product tonnes per annum, the annual requirements for dust suppression and anti-freeze have been calculated at 59t and 118t respectively.
- Power demands have been assumed as 5kW for the sprayer and 400kW for the bin option with an 11c/kWhr usage rate.

So even if a second-hand train loadout bin system can be purchased it would need to be relocated and installed for less than \$2,000,000 to make this the more viable option with a payback differential of less than 3 years.

Recommendation: Based on the low cost start up approach Sedgman recommends using the front end loader approach to load the product at the TLO point.

This recommendation has been **approved** / not approved.

Allegiance Coal Representative



Date: 28 June 2018

Sedgman Limited Representative



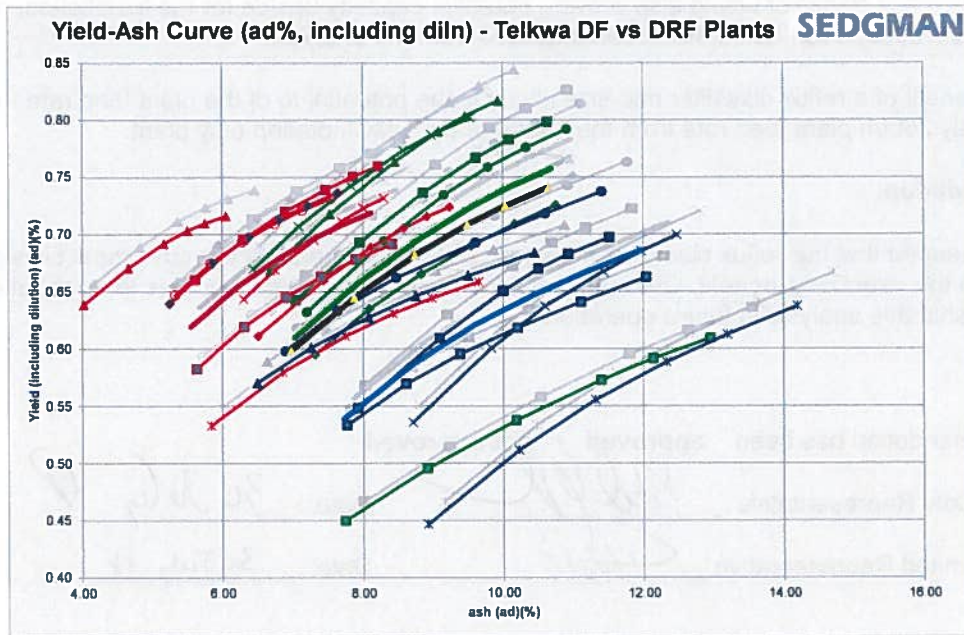
Date: 28 June 2018

Decision Note

Reflux Classifier Option

As part of the development of the Telkwa Project Coal Handling and Preparation Plant, Sedgman have reviewed the option of using a reflux classifier in conjunction with the dense medium cyclone (DMC) and flotation cell to increase the plant yield.

The figure below shows the comparison of the yield-ash curves between the DMC/Flotation plant and the DMC/Reflux/Flotation plant options (DRF in grey).



The simulations indicated that at the target ash of 9% (ad), the overall yield benefit ranges from 0.5 to 1.5% (ad) when transitioning from DF to DRF. The yield increase will vary based on the sizing of the coal, with finer seams seeing more yield benefit with a DRF circuit.

Typically the reflux classifier technology is installed in plants to address;

- New plants with difficult to wash coals where low cutpoints are required through the coarse and mid-size circuits to achieve product specification,
- In a DMC/Flotation plant where screen wear can misreport coarser material to flotation resulting in losses,
- In an existing plant which has an inefficient mid-size circuit already (such as Water Only Cyclones).
- To increase plant capacity by including a mid-size circuit.

The Telkwa coals are not indicated as being difficult to wash. Including a reflux classifier into the Telkwa plant may address issues of screen wear, but this can be effectively achieved through appropriate screen panel maintenance. With the low plant feed rate the addition of a mid-size circuit is not required to meet tonnage needs.

To determine the economic viability of adding the reflux classifier, an analysis was performed using the following assumptions:

- Cost of the reflux classifier has been estimated at \$2.43 million CAD. This includes the additional costs for the larger building which will be required to accommodate the classifier.
- Profit for coal has been estimated at \$75 USD/tonne
- Benefit for adding reflux has been estimated at 1% yield increase. Analysis performed using 75% yield for DF circuit and 76% for DRF circuit
- Raw feed estimated at 1,000,000 tonnes annually
- Annual maintenance cost for the reflux classifier has been estimated as 3% of the capital cost
- Additional power cost has been calculated as approximately \$38,000 a year

On this basis the addition of a reflux classifier would provide an increase in profit of \$652,000 annually. The inclusion of a reflux classifier would also provide potential capacity upside for the installation, but additional throughput, or reduced run hours, has been excluded from the analysis.

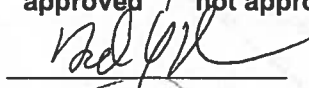
The other benefit of a reflux classifier mid-size circuit is the potential to of the plant feed rate to increase to approximately 250t/h plant feed rate from the 140t/h of the DMC/flotation only plant.

Recommendation:

It is recommended that the reflux classifier is not included at this stage as the cost impact is significant compared to the direct cost benefit. Other project cost or revenue drivers, such as throughput capacity or run hours, may shift this analysis in future operation.

This recommendation has been **approved** / **not approved**.

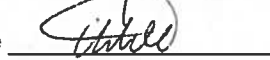
Allegiance Coal Representative



Date:

30 July 18

Sedgman Limited Representative



Date:

30 July 18

Decision Note

Additional Flotation Cell

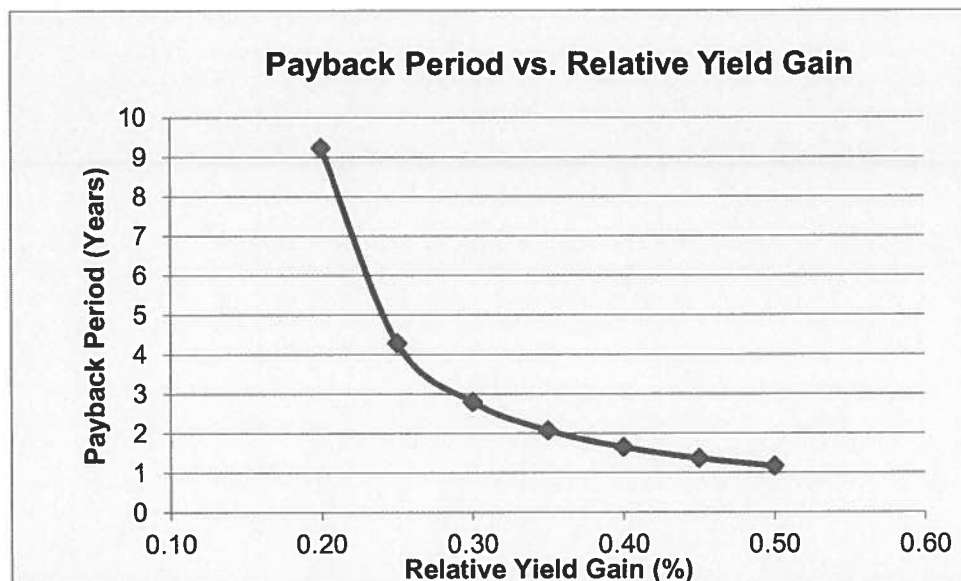
As part of the development of the Telkwa Project Coal Handling and Preparation Plant, Sedgman have reviewed the option of adding an additional flotation cell to the plant circuit in order to mitigate losses in the overall plant yield due to day to day limitations in flotation circuit performance.

Historically, most plants have struggled to maintain flotation recovery at the high levels indicated by laboratory flotation testwork. This is due to limitations in the efficiency of the flotation cells and due to restrictions in being able to achieve optimum levels of reagent addition without 'frothing out' the plant. The inclusion of a secondary stage of flotation overcomes limitations in single pass processing efficiency, and allows higher flotation reagent addition to at least the primary stage of flotation processing. As such secondary flotation is seen as mitigating any potential yield losses due to reagent limitations, operating practices and when washing coals with reduced floatability.

A cost analysis was performed using the following assumptions:

- Capital cost for the additional flotation cell is \$650,000. This includes the additional cost for the new pump and sump required.
- Annual maintenance cost assumed to be 10% of this capital cost
- Raw feed for the plant has been assumed at 1,000,000 tonnes annually
- Base plant yield using only a single flotation cell has been assumed at 75%
- Cost for additional power has been calculated as approximately \$56,350 a year

The figure below displays the payback periods which would be achievable based on a variety of yield increase percentages.



On this basis, the additional flotation cell would have a payback period of less than 3 years of operation if it maintained an additional yield of 0.3% higher than single stage flotation. Based on several projects with

similar single stage flotation circuits, a relative gain from the secondary circuit of 0.3% would be quite conservative.

Recommendation:

It is recommended that the secondary flotation cell be included at this stage. The likely benefit of the secondary cell to day to day performance and recovery from the flotation circuit is expected to be higher than then 0.3% which would justify the Capex and Opex impact.

This recommendation has been approved not approved.

Allegiance Coal Representative

Date:

30 July 18

Sedgman Limited Representative

Date:

30 July 18

Decision Note

Plant Heating Options

As part of the development of the Telkwa Project Coal Handling and Preparation Plant, Sedgman have reviewed the options for heating the plant by using either propane or electric unit heaters or waste oil with water heating. The assessment is to determine the impact each option would have on both the capital and operational expenses.

After reviewing with multiple parties in the industry the waste oil option was not fully costed due to feedback including additional capital for the conversion equipment, the requirement for filtration, it being perceived as dirty to handle and the requirement for more heating equipment maintenance. Then Tarpon Energy Services completed a design brief which estimated the capital cost and energy consumption associated with the electric and propane options. Sedgman then used the energy consumption rates to determine the annual operational expenses. For a sensitivity analysis, 2 different potential annual operating costs were calculated using different costs for electricity and propane. These results are displayed in the table below.

	Gas Option	Electric Option	Cost Differential
Capital Cost	~\$60,000	~\$45,000	\$15,000
Includes supply and installation of:	Gas makeup air unit Gas unit heaters (4) Gravity relief damper Controls Gas piping	Electric makeup air unit Electric unit heaters (4) Gravity relief damper Controls	
Annual Energy Consumption	11,500 kWh electricity 360 GJ propane gas	92,400 kWh electricity	
Annual Operating Cost (1) - \$0.11/kWh - \$0.52/L Propane	\$8,579	\$10,164	-\$1,585
Annual Operating Cost (2) - \$0.08/kWh - \$0.75/L Propane	\$11,470	\$7,392	\$4,078

8,316 at 9 cents kWh save \$250 a year

The capex and opex in the table above were built on the following estimate basis and assumptions:

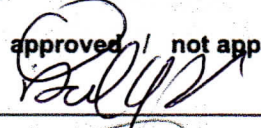
- Building dimensions used for calculations were 13.4m x 34.8m with 15.5m height. Accounted for 4 man-doors (0.9m x 2m) and 3 equipment doors (3m x 3m).
- Wall system is a 4" thermal wall with R13.3.
- Roof system is a 6" thermal roof with R20.
- A 20% safety factor as per typical design has been added to all load calculations.
- 2250 cfm of conditioned outdoor air delivered to the space to achieve 60 fpm across the 2.25 m² of free area. This will result in 0.5 air-changes per hour.
- Infiltration loss of exterior wall assumed to be 0.2 cfm/ft².
- Makeup air heating load calculated to be approximately 336 MBH, envelope heating load calculated to be approximately 153 MBH.

This analysis indicates that even without considering the added capital required for a propane storage tank, the capital differential would require a 10 yr period of operation before propane heating would become the more economic choice in the case of lower gas and higher electricity pricing. However, if a lower electricity cost rate is secured and propane costs are higher as in the second option, the electricity option will provide both a lower capital and operational cost.

Recommendation: Based on the low cost start up approach for the Telkwa project, Sedgman recommends using electricity to run the makeup air unit and unit heaters at the CHPP facility.

This recommendation has been approved / not approved.

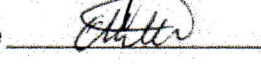
Allegiance Coal Representative



Date:

Aug 29 / 2018

Sedgman Limited Representative



Date:

29 Aug 18

Decision Note

CHPP Water Usage Reduction Options

As part of the development of the Telkwa Project Coal Handling and Preparation Plant, Sedgman have reviewed the alternatives to further reduce the water usage of the preparation plant.

Currently the circuit has been optimized to recycle water in the processing facility using the following dewatering equipment:

Dewatering Equipment	Moisture Reduction
Coarse Coal Screen/Centrifuges	76% ↓ 12% ↓ 6%
Screenbowl Centrifuges	89% ↓ 18%
Coarse Rock Screens	76% ↓ 12%
Fine Rock Filters	70% ↓ 35%

It is assumed that the ROM material will have a moisture of 5% and utilising this dewatering technology in the processing facility, the planned water usage of the facility is 135 L/ROM t. If the fine rock filters had not been incorporated in to the design the water usage would have been 200 L/ROM t (assuming 35% recovery of dam water).

Although not normally used if further water usage reduction is required some alternate technologies that could be considered include adding a coarse rock centrifuge or substituting the fine rock filters with a centrifuge or pressure filter.

In the table below these alternatives capex, operational impact and water reduction are shown. Note that based on historical data we have assumed expected moistures and the solid bowl centrifuge and plate and frame filter would require testwork to confirm these values.

Dewatering Equipment	Moisture Reduction	Water Reduction L/ROM t	Additional Capital SCAD	Operational Impact
Coarse Rock Centrifuges	12% ↓ 6%	20	\$1.2M	↑ basket costs
Fine Rock Solid bowl Centrifuges	35% ↓ 30%	11	\$0.5M	↑ basket costs, ↓ flocculant
Fine Rock Plate & Frame Filter	35% ↓ 28%	23	\$2.0M	↑ maintenance

Each option has its own limitations and associated cost impacts the key being the impact on the layout and therefore building structure. The current building arrangement and options are shown below.

Recommendation:

It is seen above that the most significant effect on water is the installation of fine rock filters which has already been incorporated in the flowsheet. If further reduction is needed then testwork will be need to quantify the true impact on the alternate technologies noting that all these options will have an increase in both capital and operating costs. Sedgman recommend to proceed with the current flowsheet.

This recommendation has been **approved** **not approved**.

Allegiance Coal Representative

Date:

Sedgman Limited Representative

Date:

CHPP Technical Specification

Tenas Project

Document No.: A570-06000-SP-001

This document has been reviewed and approved / not approved.

Telkwa Coal Representative



Date:

Oct 31 / 2018

Sedgman Limited Representative



Date:

26 Oct 18

Revision Status

Revision Number	Author	Description	Date	Approved By
0	MW	Issued for Information	22-Oct-2018	CH

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1 Principal Plant Objectives

The following principal plant objectives were applied in line with Sedgman standard engineering guidelines:

The Coal Handling and Processing Plant (CHPP) facility is designed for a nominal >20-year life¹. Regular maintenance and housekeeping and appropriate and timely capital replacement will be required to achieve this life.

- The purpose of this plant is to separate high density reject rock from the lower density coal.
- The design is modular, minimizing site labour to install and re-locate if future mine plans require the plant to move.
- The CHPP facility is based on a safe, economical, durable and functional design. The plant is built to appropriate design standards applicable governmental requirements, and also allowing possible relocation in the future.
- The CHPP facility is designed to minimize water and power consumption.
- The CHPP has been configured to enable a future increase in capacity.

1.1 General

The CPP throughput capacity is anticipated to be approximately 145 t/h (as received based moisture of approximately 5%). Both the throughput and product quality achieved is dependent upon the quality of ROM coal fed to the CPP from mining operations.

The plant is designed to operate efficiently over a range of plant feed tonnes based on a nominal design sizing and design yield range. Feed material that is excessively coarse or fine, or that has very high or very low yields may have to be processed at reduced feed rates to maintain optimal processing efficiency.

Operations manuals will be provided to familiarize personnel with the facility and how it is intended to be operated in a safe manner. They provide troubleshooting guides for investigating periods of adverse operation, but are not intended to negate the need for suitably trained and experienced operators.

The plant should only be operated with the control system in automatic mode. This provides a safe mode of operation by protecting downstream equipment should any other item fail to operate. The only exception to this requirement is when individual items require operation for maintenance purposes.

¹ Although the plant has been designed with cost-effective selection of equipment, platework including liners, and pipework, all components within a coal preparation plant suffer from abrasive and corrosive wear and will be replaced periodically.

There are three basic categories of parts:

1. Consumable spares such as screen decks and centrifuge baskets which are selectively changed each maintenance shutdown with typical item lives between four and 16 weeks.
2. Intermittent spares such as filter cloths, cyclone spigots, crusher teeth and pump glands which are replaced several times a year or when there is a catastrophic rip or failure of the item.
3. Capital spares which are replaced infrequently based on site-specific wear rates, throughput tonnage, operating conditions, and operator practices. These components include, but are not limited to, pipe spools, platework linings, pump impellers and bowls, motors, instruments, valves, and screen and centrifuge components.

To this extent all components will have a design life that is equal to or less than the entire facility life stated in Section 1. Where capital spare components are identified as having a replacement life less than preferred, alternative wear materials or thicknesses should be considered when replacing this component to extend subsequent replacement periods.

2 General Design Criteria

The following design criteria apply to the Tenas project.

2.1 General Site Conditions

- Elevation 400 m to 600 m above sea level
- Operating temperature -30°C to 30°C
- Maximum operating wind speed of 25.0 m/ s.

2.2 CHPP Process Design Criteria

For the design of the CPP facility, the following coal quality sizing and yield windows have been assumed based on a similar Canadian coals within the region and the test work completed on drill cores from the property.

Table 2-1 Process Mass percent distribution between CPP circuits

Process Circuit	Size Range	Finest (%)	Nominal (%)	Coarsest (%)
DMC Circuit	-50mm + 0.5mm w/w	78.6	85.0	90.2
Flotation Circuit	-0.5mm w/w	21.4	15.0	9.8

Table 2-2 CPP Yield Window (adb)

Process Circuit	Size Range	Min Yield (%)	Nom Yield (%)	Max Yield (%)
DMC Circuit	-50mm + 0.5mm w/w	58.0	70.0	80.0
Flotation Circuit	-0.5mm w/w	37.0	48.0	54.0

For the design on the CHPP facility, the following solids property values have been assumed.

Table 2-3: Solids Density

Density	Value	Units
ROM coal	1.40 to 1.80	t/m ³
Crushed coal	1.35 to 1.68	t/m ³
Product coal	1.30 to 1.60	t/m ³
Coarse rocks	1.60 to 2.26	t/m ³

Table 2-4: Bulk Density

Bulk Density	Volume Design	Mass Design	Units
ROM coal	0.90	0.95	t/m ³
Crushed coal	0.90	0.95	t/m ³
Product coal	0.85	0.97	t/m ³
Coarse rocks	1.10	1.30	t/m ³
Fine rock suspension	1.00	1.30	t/m ³

Table 2-5: Angles of Repose

Angles of Repose	Raw Coal	Product Coal	Rock	Units
For capacity (nominal)	36	36	36	Degrees

Table 2-6: Hardgrove Index (HGI)

Hardgrove Index	Value
Coal	70-85

Table 2-7: Ultimate Compressive Strength (UCS)

Ultimate Compressive Strength	Value	Units
Coal	<50	MPa
Dilution	≥50	MPa

Table 2-8: Particle Size

Feed Stream	Value	Units
ROM maximum lump size	500 x 500 x 500	mm
ROM nominal top size (d95)	500	mm
CPP feed nominal top size (d95)	50	mm

Table 2-9: Total Moisture

Total Moisture (as)	Value	Units
Raw coal into plant	5.0	%
Clean Coal at plant	9.0	%
Clean Coal at port	10.5	%
Tailings	35-40	%

Table 2-10: Dilution Material

Dilution Material By Volume	Value	Units
Maximum proportion in the raw coal	5 – 15%	%
Rock type	Siltstone, sandstone, mudstone	

3 Battery Limits and Scope of Work

The following section identifies the battery limits and scope of work for the Base CHP and CPP facility as described above.

3.1 Battery Limits

Civil:

The site will be cleared, prepared and graded by others to meet Specified Finished Surface Level (SFSL) profiles and minimum soil bearing capacities as shown on the Engineering drawings. A bulk earthworks plan, construction drainage and final backfill and trim based on the SFSL for the CHPP will be provided by others. Detailed excavation for plant foundations will be by Sedgman.

- Raw coal receival hopper and Feeder Breaker pad to SFSL
- CPP building and thickener area to SFSL
- Top of product and reject stockpile pads to SFSL and grade (Note: Design and construction of a suitable stockpile base for trafficking by mobile plant is by others)
- Along all conveyor routes and all transfer points, top of ground to SFSL
- CHPP infrastructure, i.e. office and workshop pads, etc., to SFSL
- Top of suitable hardstand area for construction offices, crib facilities, laydown area for equipment and module deliveries.

Mechanical / Structural:

- Raw Coal Receival
 - Raw coal receival hopper
- Product Coal Discharge to Stockpile
 - At the discharge of the product coal stacker
- Rock Discharge to Stockpile
 - At the discharge of the reject coal stacker
- Water Services
 - Raw water suction flange connection at the dam
- Train Loadout Area
 - Anti-freeze delivery point at the dosing plant
 - Dust Suppression delivery point at the dosing plant
 - Water delivery point at the dosing plant
- Other Services
 - Reagents (MIBC and diesel) delivery point at reagent storage tank unloading nozzle
 - Flocculant delivery point at flocculant package plant
 - Magnetite delivery point (by FEL) at CPP floor sump
- Electrical
 - Line side of the CHPP Motor Control Centre (MCC) incoming circuit breaker
- Fire System
 - The main fire indicator panel in the CHPP E-house/control room.

- Communications and Data Management
 - The fibre optic patch panel located at the CPP E-house/control room for the controls and communication networks.
 - Power for mobile radio and phone lines

3.2 CHPP Scope of Works

The CHPP facility includes the following:

- Raw coal feed system including:
 - On-ground receival and crushing facility to receive ROM coal from a loader (typical 988 or equivalent)
 - Raw coal conveyor complete with cross-belt sampler and metal detector capable of providing feed onto the plant feed conveyor, which includes a weigh scale
- CPP including:
 - DMC circuit
 - Flotation circuit
 - Coarse product dewatering
 - Ultrafine product dewatering
 - Ultrafine tailings dewatering
 - 16 m diameter tailings thickener
- Product handling system including:
 - Product collection conveyor with cross-belt sampler
 - Product stacker
- Fine and coarse rock handling system including:
 - Rock collection conveyor
 - Rock stacker
- Heated hydraulics for stackers
- Train loadout area including dust suppressant and anti-freeze chemical application system
- Services including:
 - Wash down water – within the CPP modules, hose points located on each floor
 - Air services - within the CPP modules
 - Flotation reagent storage and dosing system for MIBC and diesel
 - Floor sump
 - Flocculant system for anionic and cationic flocculent to suit 1 m3 bulk liquid delivery
- Buildings
 - Building for CPP modules
- CHPP electrical including:
 - Single switchroom and MCC to suit base CHPP
 - Control system to suit base CHPP
 - Operator interface in local control room (located in CHPP office)
- CHPP documentation:
 - One (1) x installation manual (incl. vendor drawings) in PDF format.
 - One (1) x operations manual (incl. vendor manuals) in PDF format.

- Certification of the design, building codes and fire systems to Canadian Standards and BC Mines and Reclamation Code and the use of Electricity in Mines.

4 Design Basis

The following design basis apply to the Tenas coal project CHPP.

4.1 Mobile Equipment Basis

The plant has been designed to interface with mobile equipment as listed below.

- Raw coal receipt into the ROM hopper is from a front end loader
- Removal of both product coal and rock from the respective stockpiles is by front end loader until bins are constructed
- Transport of product coal to train loadout area by B Double – side tipper on-highway truck
- Transport of rock by mine haul truck to disposal location
- Train loading by front end loader
 - Stacking of coal into stockpiles at the rail load out by truck and loader

4.2 Water Quality Basis

Water supply for the plant should be clean and generally have the following properties. Failure to observe these conditions may result in excess maintenance or premature failure of items in the plant.

The following is a recommended water quality specification which is attainable with relatively inexpensive filtration treatment equipment:

- pH 6.5 - 8.0
- Solids content:
 - Dissolved: 1,000 ppm (mg/L)
 - Suspended: 100 ppm (mg/L)
 - 100% of +250 mesh (60 μ m) particles removed.
- Maximum individual dissolved ions:
 - Hardness (Ca^{+} , Mg^{+}) 200 ppm (mg/L) as CaCO_3
 - Calcium Carbonate (CaCO_3) 10 ppm (mg/L)
 - Sulphate (SO_4^{-}) 50 ppm (mg/L)
 - Chloride (Cl^{-}) 1,000 ppm (mg/L).

4.3 Transport and Lifting Design Basis

For transportation, the CPP modules shall not be stacked and must be loaded on the deck of the ship and truck with nothing stacked above them.

Design parameters that pre-assembled modules may be subjected to during sea voyage and/or land transport, and during lifting:

- Sea transport
 - Transverse acceleration (generated through roll) ± 0.8 g
 - Acceleration due to heave (combined acceleration perpendicular to the ship's deck generated through direct heave and vertical component of angular acceleration) ± 0.5 g

- Longitudinal acceleration (generated through pitch) ± 0.4 g
- Wind speed = 25 m/s
- Road transport
 - Forwards acceleration (from braking) + 0.8 g
 - Rearwards acceleration (from accelerating and braking in reverse) - 0.5 g
 - Sideways acceleration (from cornering) ± 0.5 g
 - Upwards acceleration (from rough roads) ± 0.2 g.
- Lifting
 - Module lifting load factors applied to self-weight of structure and pipework, and transport mass of equipment:
 - ▶ Load factor = 1.2
 - ▶ Dynamic factor = 1.35
 - ▶ Wear and tear factor = 1.0
 - ▶ Load redistribution factor = 1.1.
 - Lifting lug design safety factors applied to hoisted mass:
 - ▶ Load factor = 1.2
 - ▶ Dynamic factor = 1.35
 - ▶ Wear and tear factor = 1.0
 - ▶ Load redistribution factor = 1.25.

4.4 Structural Design Criteria

- Normal building importance category, i.e. ultimate limit state importance factors = 1.0.
- Wind design criteria: Reference velocity pressure, $q_{50} = 0.76$ kPa, Exposure factor, $C_e = 1.0$
- Earthquake design criteria: Site Class D, Stiff Soil, $PGA = 0.12$.
- Roof snow loads : $S_s = 2.7$ kPa / $S_r = 0$ kPa, $C_b = 0.8$.
- Footing design criteria: The site shall be cleared, prepared and graded by others to meet the specified finished surface profile as shown on the bulk earthworks drawing. Minimum bearing capacity is 150 kPa (and minimum ultimate bearing capacity is 300 kPa). Total settlement, caused by the aforementioned bearing pressures, shall not exceed 20 mm. Differential settlement across the plant shall not exceed 10 mm. Finished surface level tolerance is ± 20 mm, with a surface profile tolerance of 10 mm vertical over 3 m horizontal. All reactive materials (e.g. expansive clays, etc.) shall be removed and replaced with engineered fill by others. No allowance has been made for groundwater effects.
- Design live loads for fixed platforms, walkways and stairways:
 - Stair treads = 2.5 kPa or 2.2 kN/m or 1 kN
 - Handrails and guardrails = 0.35 kN/m or 0.6 kN
 - Floor plate = 5.0 kPa or 4.5 kN
- Exposure classification = C1 (as defined by CSA A23.1)
- No provision has been made for the structure to be subject to abnormal loads such as vehicle impact, cranes or lifting gear, static line systems, etc.
- Welding to CWB certification

4.5 Safety Design Basis

Moving machine parts have been risk assessed to identify those that pose material risk to operations personnel. The machine parts that pose risk of injury to personnel have been designed

and fitted with suitable guards to ensure safe operation. Guarding of proprietary equipment is to the manufacturer's standard.

All equipment has an emergency stop button located within easy access of the equipment.

All knife-gate isolation valves are lockable. All valves are clearly labelled as to their open and shut position.

Where inspection openings are provided, they include an appropriate means of locking the hatch open or closed.

Lighting has been provided for all working areas. Emergency lighting with back-up power supply has been provided where necessary. Lighting has been mounted to fixed light mounts incorporated into the CPP plant structure.

All chute-work has been designed to minimize spillage to areas below.

Over walkways there are minimum vertical clearances of 2.1m. Access around pumps and other equipment is minimal, but sufficient to achieve the required maintenance activities. To remove specific large processing components that are very infrequently accessed, there is a requirement to remove the next levels structure (e.g., screens) above it.

All plant and facilities are designed with suitable lifting accessibility to ensure safe working procedures are practiced when lifting, removing and maintaining equipment.

Handrails and kick-plates are on all walkways and platforms where fall protection is required.

Prominent warning notices for warning of enclosed space, personal protection, ventilation requirements and other hazards are included.

Start-up warning sirens are fitted and clearly audible in all required areas when conveying equipment is started automatically or remotely from the operator interface. All conveyors are fitted with suitably located pull wire emergency stop switches.

The fire system consists of fire extinguishers located appropriately around the facility. All mobile equipment will be equipped with a dry fire suppression system.

Washdown hoses for clean-up have been provided in the CPP.

The plant has been designed to vibrate and is not designed for long-term occupation while operating. Operators may feel discomfort from working within the operating plant for long durations.

5 Specifications and Standards

The plant has been designed and selected in accordance with Sedgman's typical design processes for a design life as nominated in Section 1. The CHPP has generally been designed to the standards detailed in Table 5-1.

Table 5-1: Relevant Specifications and Standards

CHPP Specifications and Standards	
Piping	Designed generally to ASME B31.3, CSA B51-13
Conveyors	Designed generally to ASME B20
Structural	Designed generally to Canadian Standards, unless otherwise specified, including CSA S16. BC building code and NBC.
Concrete	Designed generally to Canadian Standards, unless otherwise specified, including CSA A23.1 to A23.3
Electrical	Designed to Canada and or IEEE Standards and CSA certification
General	BC Worksafe, BC Engineering Practice Guidelines, BC Reclamation and Mine Code, 2018

5.1 Paint Specifications

Table 5-2: Paint Specifications

Area	Paint System
CPP Steelwork	Two-coat system consisting of a base coat of a 75 µm zinc rich epoxy primer and a topcoat of 200 µm high build polyamide epoxy for a total DFT of 275 µm – colour cream
CPP Building	Single coat of Anti-Corrosive Primer, Behlen Grey. SSPC-SP2 steel prep prior to priming
Conveyors	Single coat of 75 µm inorganic zinc ethyl silicate primer
Platework	Two-coat system consisting of a base coat of a 75 µm zinc rich epoxy primer and a topcoat of 200 µm high build polyamide epoxy for a total DFT of 275 µm – colour cream
Pipework	Steel pipework – two-coat system consisting of a base coat of a 75 µm zinc rich epoxy primer and a topcoat of 200 µm high build polyamide epoxy for a total DFT of 275 µm – colour cream HDPE, galvanised pipe – not coated
Proprietary Equipment	Manufacturer's standard specification and colour
Guarding	Two coats of 75µm epoxy zinc phosphate primer, 75µm catalysed acrylic top coat (golden yellow)
Handrails	Two coats of 75µm epoxy adhesion promoting primer, 75µm catalysed acrylic top coat (golden yellow)

Machined surfaces, liners, HDPE and stainless steel platework are not coated with any paint systems.

5.2 Equipment

All equipment bearing life (L10) is 30,000 hours.

5.3 Abrasion Resistant Linings

Table 5-3: Abrasion Resistant Linings

Area	Lining
CPP chutework	Direct constant impact of coarse particles is lined with dry pressed alumina tiles. Constant impact of fine particles and dilute slurries is lined with 10 mm Linatex rubber (or equivalent). All other surfaces are lined with an abrasion resistant epoxy coating with a 300 µm DFT.
CHP chutework	Direct constant impact of coarse particles is lined with plug welded Bisplate 400 (or equivalent).

5.4 Fabricated Platework

All chutes, underpans, launders and other associated platework are designed to be fabricated from 6 mm carbon steel plate suitably stiffened to resist all process pressures and duties. All conveyor skirts items will be fabricated from 2 mm carbon steel plate. All carbon steel chutework is painted externally and lined or painted internally as appropriate.

Valley angles and surface slopes are sufficient to ensure free flow and complete discharge of material.

Chute profiles are suitable for the characteristics of the material being handled and designed to be self-cleaning.

5.5 Pipework

Piping has been designed as short and as straight as possible. Flanges will generally be to ANSI B16.5 Class 150 and installed square to the axis of the pipe.

Valves and fittings are designed to be removable without disturbing significant adjacent piping.

Piping around pumps and equipment requiring service is designed and supported such that the equipment can be maintained and removed with minimal pipework disturbance or interference.

Piping attached to equipment is designed and anchored such that loads that are transferred to the equipment do not exceed the manufacturer's allowable loads.

Table 5-4: Pipework

	≥ 80mm nominal bore	< 80 mm nominal bore
Pipe	API 5L gr B ERW (or equivalent) standard weight or extra strong	Galvanised steel medium weight to ASTM A53 Gr.B, screwed NPT
Joining	ANSI B16.5 Class 150 slip on flanges carbon steel	Galvanised steel, screwed NPT
Gaskets	Full face (true bore) to ANSI B16.5 Class 150, neoprene rubber <300mm dia 3mm thick full face >300mm dia 6mm thick full face	Nil
Elbows	Long radius 1.5D standard weight (shorter radii may be specified where required)	Medium weight galvanised cast iron to ASTM A126 Gr.A and ASTM A153, screwed NPT
Bolts	ASTM A307 Grade A Bolts	
Screwed Fittings	Carbon steel screwed NPT	
Miscellaneous Fittings	Standard weight or extra strong butt weld ends	Medium weight galvanised steel, screwed NPT

Reagents pipework carrying flammable or combustible liquids is in galvanized steel pipe with welded connections.

5.6 Conveyors

All belt conveyors and stackers are open-style structures and have been designed to provide reliable operation at the nominated capacities under nominated climate conditions. Conveyors have been designed based on normal operating/starting conditions.

Plant conveyors and stackers include the following:

- Three roll 35° trough idlers at nominally 1.5 m centres. Minimum roller diameter is 108 mm.
- Flat return rollers at nominally 3.0 m centres. Minimum roller diameter is 102 mm.
- 10 mm rubber lagged drive pulleys. Pulley diameters have a minimum diameter of 400 mm.
- Screw take-up on tail pulleys
- Helical bevel or helical vee belt drive gear boxes
- Modular skirt panels at loading points
- Single-staged belt scrapers
- Return belt plough
- Bolt-on guarding at drive and tail pulleys and at skirted areas
- Fabric conveyor belting with 5 x 1.5 mm 'N' grade covers.

Walkways have not been included on plant conveyors and stacker maintenance will be by elevated work platform.

Stackers are slewing machines capable of operating at set discharge heights. Positioning of the stackers is by operator controls at each machine.

5.7 Valves

Type	Knifegate - Manual/Handle (or Manual/Chain)	Knifegate - On/Off, Air Actuated	Butterfly - Float	Butterfly - Modulating Control, Air Actuated	Ball Valve - Manual	Ball Valve - On/Off Air Actuated
Valve pressure rating	850 kPa @30°C	1000 kPa @30°C	1000 kPa @30°C	1000 kPa @30°C	1500 kPa @30°C	1500 kPa @30°C
Body material	316 stainless steel full - lugged	316 stainless steel full - lugged	Ductile or cast iron	Ductile or cast iron	316 stainless steel, one-piece reduced bore.	316 stainless steel, one-piece reduced bore.
Gate material	316 stainless steel	316 stainless steel				
Deflection cone/disc material	28% chrome alloy	28% chrome alloy	316 stainless steel	316 stainless steel	316 stainless steel	316 stainless steel
Resilient seat material	316 stainless steel	316 stainless steel	Buna N or equivalent	Buna N or equivalent	Reinforced PTFE or equivalent	Reinforced PTFE or equivalent
Packing material	K-lon, Virgin PTFE or equivalent	K-lon, Virgin PTFE or equivalent			Reinforced PTFE or equivalent	Reinforced PTFE or equivalent
Flange details	Lugged to suit as ANSI B16.5, Class 150 - flat face flanges	Lugged to suit as ANSI B16.5, Class 150 - flat face flanges	General purpose wafer to suit as ANSI B16.5, Class 150 - flat face flanges	General purpose wafer to suit as ANSI B16.5, Class 150 - flat face flanges	Screwed BSP up to 50 mm. Flanged to Table D for 65 mm and above.	Screwed BSP up to 50 mm. Flanged to Table D for 65 mm and above.
Actuator	Hand wheel c/w chain	Double acting pneumatic cylinder suitable for operating valve with a minimum air supply pressure of 550 kPa	Counter weighted design with adjustable float travel and puncture proof float.	Pneumatic double acting cylinder suitable for operating valve with a minimum air supply pressure of 550 kPa.	Stainless steel, vinyl covered handle	Double acting pneumatic actuator for operating valve with a minimum air supply of 550 kPa.
Positioner/ solenoid Valves		Five-way two-position, spring return with manual override (namur mounted).		Electro-pneumatic double acting with span and zero adjustments, pressure gauges, direct and reverse action with 4-20 mA DC input control signal.		Five-way, two-position, spring return with manual override (namur mounted).
Duty	Pump isolation	Thickener isolation	Sump level control	Density control	Air injection isolation, hose point isolation, pipe drain isolation	Flushing, fluidising water isolation

5.8 Earthworks

Bulk earthworks are assumed to be completed by others but for the basis of this specification it is expected that the plant areas will be handed over as level construction pads at the standard design assumption bearing pressures below:

- 450 kPa – Thickener footings (potential for piling depending on ground investigation findings)
- 250 kPa – CPP building modules and CPP infrastructure facilities
- 250 kPa – Material handling scope
- Long term differential settlements to be <20 mm.

5.9 Structures

For the design life nominated in Section 1 to be achieved, it will be necessary for continual and regular maintenance to be undertaken to protect the integrity of the structure. This may consist of regular inspections and audits, prompt repair, repainting and replacement to damaged and corroded sections of plant, structure and foundations as required during the design life.

- Concrete strength grade = 32 MPa (28-day cylinder strength).
- Reinforcing steel grade 500 deformed bar, normal ductility conforming to CSA standard G30.18)
- Structural steel grades - Designed to be fabricated from Chinese steel grades Q235B and Q345B, using Chinese section sizes, or equivalent to meet CSA and CWB requirements.
- Weld quality equivalent to the relevant part of CWB W59, CWB W48.
- Structural steel connecting bolts are galvanised 8.8 grade conforming to ASTM A2329 and ASTM A325M. All bolts in modules or module components subject to vibration are pre-tensioned.
- Chemical anchors (Ramset 101 or Hilti HIT-HY 200) with galvanised threaded studs (430N/mm² minimum tensile strength and 310 N/mm² minimum yield strength) installed in accordance with manufacturers specifications.
- Engineered fill –as noted on drawings, compacted to 95% Standard maximum dry density.
- Flooring is 6 mm thick mild steel pattern floor plate.
- Stair treads are folded 6mm thick mild steel pattern floor plate.
- Handrails for stairs are circular steel sections. Guardrails for floors are steel angle sections.

5.10 Electrical

The electrical design, installation and equipment will conform to Canadian CSA or applicable CEC and IEEE Standards. Placement of equipment within the shipped modules including power and control cabling routing along with mechanical protection shall be a key part of the design.

Field control devices are constructed for operation in a harsh mining environment. All field instrument transmitters are minimum NEMA 4X rated. Electrical equipment is strategically located with due consideration to shipping modules.

The electrical installation complies with the CSA C22 Canadian Electrical Code (CEC) and CSA M421 Electricity in mines.

The supply transformer, which is outside the battery limits of this specification, will be equipped with a resistively grounded neutral point limiting the current to 5A continuously. The process plant electrical system is designed based on this premise.

The grounding system includes equipotential bonding of all electrical motors. All CHPP motors are connected to a common MCC earth by an earth core integral to the motor cable and a visible ground connected to a dedicated ground cable mounted within the cable tray.

The CHPP includes a series of emergency stop buttons used to stop the plant. The e-stop system is designed to SIL2 as per IEC61508.

Conveyor emergency stop circuits are rated SIL2 as per IEC61508.

The Motor Control Centre (MCC) Switchboard will be an indoor type housed inside a premanufactured switchroom. The MCC and switchroom will meet the latest CSA, UL and NFPA codes.

The MCC houses VVVF drives for selected equipment.. The harmonic levels caused by the drives at the point of common coupling will comply with the requirements of IEEE 519. The point of common coupling for the measurement of harmonics will be the incoming terminals of the MCC board provided as part of processing plant scope.

MCC busbar ground fault protection will be provided by upstream feeder breaker located at the Main intake switchboard. Individual motor starter will be provided with ground fault protection relays.

Single-phase small power and lighting circuits are fitted with 30mA sensitive ground leakage protection.

UPS or battery supplies are included in the MCC to power electrical protection circuits as required.

All power cabling runs directly from the MCC to the motors without interruption. Power cabling to the motors is Teck cable manufactured to CEC standards. Cables between MCCs and to the stackers within the CHPP arrangement are laid on the ground surface using 241 trailing cable so that no trenching is required.

The CPP structure incorporates lightning air terminal, down comer and site-installed earth rods tied into the building earth system. The lightning protection system is designed with a 45 m rolling sphere design method. Local climatic conditions need to be considered during installation.

Outdoor panels located near equipment will be used for motor control of selected equipment.

Lighting will be designed to achieve levels of illuminance generally in accordance with, and no lower than, the values given in the International Commission on Illumination (CIE) Document: CIE 129 – 1998 Guide for Lighting Exterior Work Areas. Lighting is provided on equipment that is accessed from within the plant building. Yard equipment accessed from natural ground level does not include task lighting. Emergency lights are provided to allow stair locations and exits to be identified in the event of plant evacuation. Maintained emergency lights shall only be used if the predicted lamp life is greater than 20,000 hours.

The lighting design incorporated the following design factors:

- Fitting cleaning cycle of two months
- Lamp life of 10,000 hours.

The cabling system is designed with consideration of cable voltage drop and will be in accordance with CSA C22.1 (CEC).

Air conditioning is provided to cool or heat the MCC switchroom as required, however there is no provision for anti-condensation heaters inside the MCC switchboards.

The CPP has some hazardous areas. Hazardous areas are limited to inside raw coal chutes, inside raw coal hoppers and flotation reagent areas if included. Installation of electrical equipment in hazardous areas is avoided. Other areas are not considered hazardous for dust ignition and do not have combustible dust rated equipment based on the assumption the plant is regularly maintained to avoid dust layering.

Electrical equipment in the MIBC reagent area is hazardous area rated, and includes screened cable and thermal protection of motors.

Proprietary plant equipment included within the CHPP may have an on board electrical installation built to the equipment manufacturer's standard.

5.11 Supply and Voltage

The plant design is based on a 600V supply voltage with the following specification:

- Maximum voltage fluctuation $\pm 5\%$
- Average voltage imbalance 0.5%
- Maximum frequency fluctuation $\pm 1.0\%$
- Maximum voltage sag starting 1%

The following voltages are used within the installation:

- Incoming supply voltage
Resistor supply 600V 3 phase 4 wire 60 Hz Neutral Grounded
- Low voltage MCCs
Resistor 600 V 3 phase 4 wire 60 Hz - Neutral Grounded
- General purpose power 120 V single phase 60 Hz – Neutral solidly grounded
- Lighting supplies 347 V single phase 60 Hz - Neutral solidly grounded
- Instrument supplies 24 VDC Negative ground
- Control Circuits 24 VDC Negative ground
- Solenoids 24 VDC Negative ground
- PLC Inputs 24 VDC Negative ground
- Motor contactors 120Vac - Neutral grounded

The MCC and all installed equipment are rated to a minimum of 42kA for one-second three-phase fault level. The maximum current rating of the MCC at the power supply connection point is 2000A.

The main connection point is designed to suit a maximum connection of 9 x 500MCM cable per phase.

5.12 Electrical Materials of Construction

Cable selection complies with CSA C22.1 (CEC).

Motor starter equipment including circuit breakers and contactors is generally selected to comply to respective UL standards for switchgear and switchboards.

The cable ladder is of aluminium construction. Gland plates are a minimum of 3 mm brass or aluminium with a gasket seal.

Motor efficiency calculation shall be performed in accordance with NEMA MG1.

The plant lighting is mounted to steel spigots or mounting plate welded directly to structural steel.

Light fittings are constructed of cast aluminium or polycarbonate construction.

Junction boxes are of polycarbonate or metal construction.

Marshalling boxes used to mount terminals and field I/O modules are of 1 mm thick painted mild steel construction.

Table 5-5: Instrumentation

	Description
Correct Medium Density Control	nucleonic density gauge
Correct Medium Sump Level	ultrasonic level sensor
Sump Levels	Float valve control
Cyclone Pressure	Manual pressure sensor
Thickener U/Flow	Flow meter
Conveyors	In accordance with ASME B20
Equipment Protection	As per manufacture requirements

5.13 Control System

A modern control system is provided to control and monitor the CHPP. Plant control and monitoring is implemented using a Programmable Logic Controller (PLC).

Panel mount operator interfaces are used to start and stop the plant in sequence or individual equipment. The operator interface system communicates with the PLC to allow control and monitoring of all items of plant and equipment from a central point. The operator interface system uses a SCADA package specifically configured for the plant. This is the only place that equipment items can be started from.

System integrity and reliability is maintained by ensuring correct selection and installation of network equipment and cabling.

The control system PLC is integrated into the MCCs. Additional distributed I/O is mounted in field mounted I/O boxes local to the process to reduce the requirement for on-site connection of field instrumentation.

As required each drive has its field or MCC devices wired to the programmable controller for monitoring and control. Stop buttons, motor overloads and personnel protection devices (such as conveyor lanyards) are hardwired in a “failsafe” manner into the MCC control circuits for the safety of personnel.

Within the programmable controller I/O racks, modules of each type are grouped together, i.e. discrete inputs, discrete outputs, analogue inputs, analogue outputs. In some locations, remote I/O blocks may be used to reduce control cabling.

All digital and analogue control logic will reside in the programmable controllers. This includes:

- The sequential control and interlocking of all drives

- Analogue control of process variables
- Monitoring of digital and analogue field variables
- Alarm and message generation.

All control functions are performed by the PLC controller.

Windows-based PLC programming software is used for the generation of the PLC code.

The SCADA interface is installed on a panel mount display. This interface is capable of being installed on a windows based PC if required.

Motor currents of selected equipment are monitored by the control system.

5.14 Control System Specifications and Standards

PLC code shall be generated using control language consistent with that specified in IEC61131.

The proposed I/O connection types to be used are:

- Discrete inputs 24 VDC, common negative
- Discrete outputs relay, isolated
- Analogue inputs 4-20 mA
- Analogue outputs 4-20 mA

OIS displays are logically organised to follow the process flow through the plant. The displays contain a mixture of mimic and tabular information.

The displays and functions provided include:

- An overview mimic configured to contain the basic plant operating parameters, and KPIs allowing plant-wide performance to be monitored from a single display.
- Graphical displays configured to mimic the plant. These graphic displays operate and control the process equipment and instrument devices.
- Facility to monitor parameters via trend displays.
- Provision to log alarms.
- The control system is capable of interfacing and sharing data with other enterprise business packages. This connection and configuration is not a standard included.

The control system communicates between the PLC and operator interface hardware via an Ethernet Network. The Ethernet network connects all MCCs via a cabled connection and is capable of being connected to a third party network for monitoring and support if required.

The control system is not intended to be connected to existing Ethernet networks without using equipment that restricts network traffic which turn may affect control system performance.

5.15 HVAC, Dust and Cold Weather Protection

5.15.1 Raw coal

The raw coal will be naturally low in moisture, with no additional surface moisture from processing. It will handle well through mobile crushing system, no matter what climatic conditions are encountered. As shown in the subsequent Table 5-6 , a heating system will be included in the mobile crushing system.

5.15.2 CPP Building

Electric heating systems will be provided inside the CPP building shed to keep the temperature above freezing. Heating will not be designed for comfort levels, but for the purpose of running the facilities above 0°C, to ensure the process slurry and added reagents will not freeze.

The building will have the following cladding selections:

- Wall system is a 4" thermal wall with R13.3
- Roof system is a 6" thermal roof with R20

A ventilation system will also be installed inside CPP which will provide 0.5 air changes per hour in order to keep airborne dust levels down, as well as ensuring adequate air quality for personnel to be inside the building on a continuous basis. The ventilation system will also be used during hotter ambient temperatures to provide airflow and keep the CPP temperatures down to an acceptable level.

5.15.3 Washed product coal and rock

The washed coal products and rock after dewatering in the CPP, will retain a certain level of surface moisture, and when exposed to the sub-zero temperatures will likely freeze together into conglomerated lumps. Once frozen, the washed products and rock are expected to handle easily, as long as frozen lumps are broken up and the bulk coal stays frozen.

Washed product coal leaves the CPP on product transfer conveyor which will be covered and transfer onto the product stacker for discharge to the stockpile. Once the washed product coal is stockpiled, it can be allowed to freeze before being trucked to the train loadout area.

Rock leaves the CPP on rock transfer conveyor which will be covered and transfer onto a stacker for discharge to the stockpile. Once the washed rock is stockpiled, it can be allowed to freeze before being trucked to the designated disposal area.

5.15.4 System heating and dust summary

Table 5-6 following outlines which structures require heating.

Table 5-6: HVAC and cladding specification

Element	Enclosure	Heating	Personnel occupancy
Mobile Crushing System	Open mobile unit	Heating temperature about 1degC	Limited daily inspection during running
Plant feed conveyor	Open conveyor. Only belt has conveyor hoods.	Nil	Limited daily inspection during running
Coal Processing Plant building	Insulated cladding used to fully enclose the building.	Heated building via electrical systems. Ventilation for summer. Heating temperature above 1degC. Air curtains required for man doors, vehicle doors and 3 x conveyor entries. Explosion venting allowances for wall cladding. Air change rate of 0.5 changes per hour.	Typical shift consists of 4 operators, with only two operators expected in CPP building
Tailings Thickeners	Open thickener	Heating temperature above 1degC in covered area.	Limited daily inspection during running
Washed product transfer conveyor	Open conveyor. Only belt has conveyor cover.	Heated from the CPP air.	
Washed product stacker	Open conveyor.	Nil	
Rejects conveyor leaving plant	Insulated cladding used to fully enclose the conveyor.	Heated from the CPP air.	
Rejects stacker	Open conveyor.	Nil	

5.16 Noise Emissions

All process equipment used inside the CPP building is designed for a maximum noise level of 85 dB(A) at 1m (SPL). The CPP building cladding will provide further noise insulation. The mobile sizing plant located outside the building will have noise levels of up to 99dB within 1m (SPL) and reduce to 85dB at the 10m distance.

CAT 988 front end loaders are used at the CPP as well as the TLO to handle material. These front end loaders have a sound power level of 114 dB(A) for the standard machine configuration at 1m, with an operator sound power level of 76 dB(A). At 15m the exterior sound power level is 81 dB(A).

Train locomotives are used at the TLO to move rail cars. These locomotives have a sound power level of 115 dB(A) for the standard machine configuration at 1m, with an operator sound power level of 76 dB(A). At 15m the exterior sound power level is 80 dB(A).

Nomenclature

Measurement Units

The International System of Units (SI) is used exclusively, including the following compound units.

Top Size, Nominal

The size of aperture of the finest sieve through which a minimum of 95% of the mass of material passes.

Mass and mass flow rate

Kg/m ³	Kilograms per cubic metre
Mg/L	milligrams per litre
Mt	Million tonnes
Mt/a	Million tonnes per annum
t/h	Tonnes per hour

Length

Ø	Diameter
ft	feet
g	Gravitational acceleration
m	metre
µm	Micrometre
mm	millimetre

Density

m/s	Metres per second
t/m ³	Tonnes per cubic metre

Key Terms, Symbols and Abbreviations

The following terms and abbreviations are used:

CSA	Canadian Standards	Ppm	Parts per million
CCTV	Closed circuit television	RMP	Relocatable modular plant
CHP	Coal handling plant	ROM	Run of mine
CHPP	Coal handling and preparation plant	RORO	Roll On Roll Off
CPP	Coal preparation plant	SAA	Standards Association of Australia
D&C	Design and construct	SCADA	Supervisory Control and Data Acquisition
DFT	Dry film thickness	SIL	Safety Integrity Level
DMC	Dense medium cyclone	UCS	ultimate compressive strength
ERW	Electric resistance welded	ww	wedge wire screen mesh (parallel aperture)
HDPE	High-density polyethylene	(ad)	air dry
HGI	Hardgrove Grindability Index	(as)	as sampled (equivalent to “as mined” or “as received”)
IEC	International Electrotechnical Commission	TM or Mas	total moisture or moisture as sampled
I/O	Input/Ouptut		
IP	Ingress protection		
KPI	Key performance indicators		
MIBC	Methyl Isobutyl Carbinol		
MCC	Motor control centre		
PLC	Programmable logic controller		

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Telkwa Coal Project

Coal Quality Summary

Telkwa Coal Limited

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1 Introduction

The Tenas Project is a greenfield metallurgical coal project being developed by Telkwa Coal Limited (TCL) which is a wholly owned subsidiary of Allegiance Coal Limited (ACL). The Tenas Project is located approximately 10 km to the SW of the township of Telkwa, British Columbia. The Tenas Project has had several drilling or bulk sample programs run between 1990 and 2018, including a total of 182 cores and 2 bulk sample programs used for coal quality previously and 7 large diameter core samples taken in 2018 used as part of this study phase. Initial focus for mining is on Tenas Pit, seams designated 1, 1U and C, which have subsequently been renamed to 1L (previously Seam 1), 1U and C for this study. The Tenas surface pit is located on the far south west corner of the tenements owned.

There is a section of the resource where Seam 1L and 1U combine to form 1 Seam, however as the data around this sub-area of the mine is limited, this seam shall be treated as a combined 1U and 1L for coal quality purposes (i.e. a blend of the 1U/1L coal quality data). This assumption aligns with the limited existing data available for the combined seam.

Two major bulk sample programs were carried out throughout 1997 and 1998 which provided in-seam coal quality data for the Tenas pit deposit. These bulk samples recovered seams 1L, 1U and C-seam and provided a total of 20 working sections for coal quality review. In 2018, a coal quality program was run using PQ and Large Diameter 6 inch cores which yielded 7 working sections for coal quality review and a range of product composites at 1.55 or 1.60 wash densities..

Dilution was based on the following assumptions:

- Ash of 80%
- Density of 2.50 t/m³
- Dilution sizing is the same as the coal sizing (conservative assumption as coal is generally softer than surrounding rock).
- The amount of dilution and coal loss are based on mining tonnages (As per Appendix 1) such that Seam 1L has 5.81% dilution by weight (including coal loss), Seam 1U has 8.4% dilution by weight and Seam 1A (previously Seam C) has 14.7% dilution by weight

Previous study working sections were pre-treated using Australian Standard procedures at the time (1996-1998) for wet tumble attrition, followed by float / sink analysis. The 7 working sections drilled specifically for this phase of work have been prepared using appropriate drop shatter, dry and wet tumble attrition procedures followed by float / sink or floatation tree analysis. This report focuses on the washability and sizing data to define a yield and sizing window for the Tenas Project's feasibility study (2018).

2 Basis of Simulation

In the previous study, seam washability and sizing data were provided for 20 working sections from the 1996 and 1997 bulk samples, each of which intersected all target seams in Tenas pit; 1L (Previously Seam 1), 1U and C Seams. In this phase of works, a drill program was completed in the winter of 2018 and yielded 7 additional working sections which were pre-treated via drop shatter, dry and wet tumble as per industry best practice (described in Section 2.1.1).

Sizing data was supplied for roof and floor however the attrition process was inconsistent due to the sample size being too small so the roof/floor sizing was assumed to be the same as the coal. This assumption is backed up by the dilution lithologies, which primarily consisted of mudstone, siltstone and sandstone which suggests that the dilution will not be significantly coarser than the coal as seen in other deposits.

Dilution samples were collected with the current phase of drilling however the sample mass required for a representative analysis was not achieved. Due to this, the current samples had a non-linear Rosen-Rammler curve which is unable to be used without introducing error.

2.1 Samples Used

Table 2-1 is a list of the samples used for washability analysis and which drilling program they came from.

Table 2-1: List of Washability Samples for the 2018 Feasibility Study

Hole ID	Sample ID	Seam ID	Report Date	Drill Program
Bulk Sample	61273	Seam 1L	30 August 1996	1996 Bulk Sample Program
Bulk Sample	61268	Seam 1U	30 August 1996	1996 Bulk Sample Program
Bulk Sample	61272	Seam C	30 August 1996	1996 Bulk Sample Program
Bulk Sample	72553	Seam 1U	14 April 1997	1996 Bulk Sample Program
Bulk Sample	72551	Seam 1U	14 April 1997	1996 Bulk Sample Program
Bulk Sample	84469	Seam C	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84472	Seam 1U	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84474	Seam 1L	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84477	Seam C	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84479	Seam 1U	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84480	Seam 1L	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84483	Seam C	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84486	Seam 1U	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84487	Seam 1L	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84494	Seam C	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84497	Seam 1U	6 November 1996	1998 Bulk Sample Program

Bulk Sample	84499	Seam 1L	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84502	Seam C	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84505	Seam 1U	6 November 1996	1998 Bulk Sample Program
Bulk Sample	84507	Seam 1L	6 November 1996	1998 Bulk Sample Program
T18-01D PQ	181661	Seam C	20 March 2018	2018 Feasibility Study Drill Program
T18-02D PQ	181662	Seam C	17 May 2018	2018 Feasibility Study Drill Program
T18-02D PQ	181663	Seam 1U	17 May 2018	2018 Feasibility Study Drill Program
T18-02D PQ	181664	Seam 1L	17 May 2018	2018 Feasibility Study Drill Program
T18-03D PQ	181643	Seam 1L	20 March 2018	2018 Feasibility Study Drill Program
T18-03D PQ	181734	Seam 1U	20 March 2018	2018 Feasibility Study Drill Program
T18-05D PQ	182370	Seam C	1 June 2018	2018 Feasibility Study Drill Program

2.2 Borehole Core Pre-Treatment

In this study we have two sets of data which had different treatment regimes, which is due to the industry standard being adjusted between the sample sets. The key differences in the two coal quality sampling programs (2018 versus 1996/1997) are summarised in 2.2.1 and 2.2.2 below.

In the 2018 sample program, 32mm core was used for the coal quality sampling which is considered appropriate for usage although industry best practice is to use 150mm diameter core (3x expected plant top size). Reviewing the resultant sizing from the 32mm core to the bulk samples in the 1997 program, it does not appear to have had an impact on the amount of fines in the washability analysis.

2.2.1 Samples collected for the Feasibility Study (2018)

Borehole core treatment and sample analysis can be summarised in the following steps:

- Drop-shatter from 2m height (15 drops)
- Dry screen to 2mm bottom size
- Dry tumble for 5min (50kg batches)
- Dry size (to 2mm) and wet screen down to 38 micron bottom size
- Wet tumble with steel cubes for 5min (50kg batches)
- Wet screen to 38 micron bottom size
- Complete raw coal analysis including Inherent Moisture, Ash, Volatile Matter, Fixed Carbon, Total Sulphur, Calorific Value, FSI, S.G. and Equilibrium Moisture.
- Float/sink analysis:
 - The following size fractions were subjected to float / sink analysis: -32mm +2mm, -2mm +0.25mm
 - ▶ Cutpoint densities for in-seam material: 1.30, 1.35, 1.40, 1.45, 1.50, 1.55, 1.60 1.70, and 1.80
- Froth Flotation:
 - The following size fractions were tested via froth flotation: -0.25mm

- All float/sink and froth-flotation products were tested for Inherent Moisture, Total Sulphur, FSI, Calorific Value, Volatile Matter and Ash

2.2.2 Samples used in the PFS study

The key components of the bore core pre-treatment process can be summarised as follows (Manalta,1997):

- Wet tumbling (Australian Method)
- Dry screened at 50,25,12,6 and 0.6mm
- Further wet screened at 0.15mm
- Samples were then riffled down separately to obtain a representative sample
- Float/sink analysis:
 - The following size fractions were subjected to float / sink analysis: -50 +12mm, -12 +6.0 mm, -6.0mm +0.6mm, -0.6mm +0.15mm
 - ▶ Cutpoint densities for in-seam material: 1.30, 1.40, 1.50, 1.55, 1.60, and 1.80
- Froth Flotation:
 - The following size fractions were tested via froth flotation: -0.15mm
- All float/sink and froth-flotation products were tested for Total Sulphur, FSI, Calorific value and ash

2.3 Working Sections

Out of seam dilution was blended with each working section to represent the as-mined feed quality. Washability and wet tumbled sizing data for roof and floor material was supplied however upon review, the attrition method completed in 1996 and 1997 was simplified and the tumble times or methodology had a large variance. Without knowing the specific details of why the attrition process was carried out this way, it was considered more reliable to use the coal sizings as the dilution sizing, which is conservative (as coal is generally more friable than dilution in most deposits) and to evaluate/confirm this assumption in the next round of testwork.

Coal loss and dilution rates were applied according to the assumptions outlined in Table 2-2.

Table 2-2: Mining Data Used to Define Workings Sections

Aspect	Assumption			
Dilution Density	2.50 t/m ³			
Dilution Ash	80%			
Dilution Sizing	Same sizing profile as coal			
Seam Dilution and Coal loss	Dilution % (total)	Coal Loss (t)*	Dilution Addition (t)*	Total In Situ (t)*
Seam 1U	8.40%	195,889	516,981	5,835,190
Seam 1L	5.81%	257,243	670,586	11,132,665
Seam C	17.51%	258,881	615,708	3,159,172

To calculate the dilution % the formula is used:

$$\text{Dilution \%} = \frac{\text{Dilution Addition (t)}}{(\text{In-situ Coal (t)} - \text{Coal loss(t)} + \text{Dilution Addition (t)})}$$

*Based on data directly from SRK file name "Telkwa_Tenas_pit 48 reserves _20170316_GGC_rev03 no clean coal.xlsx" and full data set included in Appendix A.

Based on the total combined dilution, coal loss and in-situ tonnages, the mine blend was created with proportions as shown in Table 2-3.

Table 2-3: Mining Tonnages used in Overall Mine Blend

Seam Name	Total Rom Tonnage (Air Dried, 1% inherent) Life of Mine	Proportion in Total Mine Blend (LOM Blend)
Seam 1U	6,156,282	29.0%
Seam 1L	11,546,008	54.4%
Seam C	3,515,998	16.6%
Total (Mine Blend)	21,218,288	100.0%

2.4 Simulations

Limn™ software was used to conduct the simulations outlined in this report. This section provides background to the software and outlines key modelling assumptions used in the simulations.

2.4.1 Limn™ Software

Limn™ is the standard simulation tool used by Sedgman. It has gained widespread use in the Australian and Canadian coal industries and is increasingly accepted internationally. Limn™ operates within the Excel spreadsheet environment, and a component of Limn™ called the 'Coal Wizard' is specifically customised for simulations of coal preparation processes.

2.4.2 Modelling Assumptions

Basic assumptions in the Limn™ coal preparation simulation package include:

- The size by density components of the feed sample are unchanged during the process and that degradation that would be seen during the process (through breakage in pumps, screens etc) is effectively captured by the wet attrition processes applied to the coal samples. The plant feed used in the Limn model is the wet sizing and the washability which are post wet-tumbling attrition processes.
- Gravity processes, such as dense medium cyclones, can be represented accurately by standard "rho50 / Ep" models which are in widespread use in the industry; and
- Screens can be represented accurately by generic minerals industry "probability" models which have been refined in-house to match coal preparation plant data, and classifying cyclones can be represented accurately by the JKMRC Lynch & Rao "classification" model with adjustment for particle density.

Specific parameters have been derived from published Australian Coal Preparation Society (ACPS) data and Sedgman in-house operations experience, and are benchmarked against plant data obtained from a wide number of plant audits at a number of different sites representing 'good practice' plant design, maintenance and operating practice. Partition numbers and other model parameters are calculated in standard spreadsheet tables by built-in or user defined functions.

2.4.3 Simulation Flowsheets

The flowsheet for the DMC / Flotation (DF) circuit simulated in Limn™ is shown in Figure 2-1

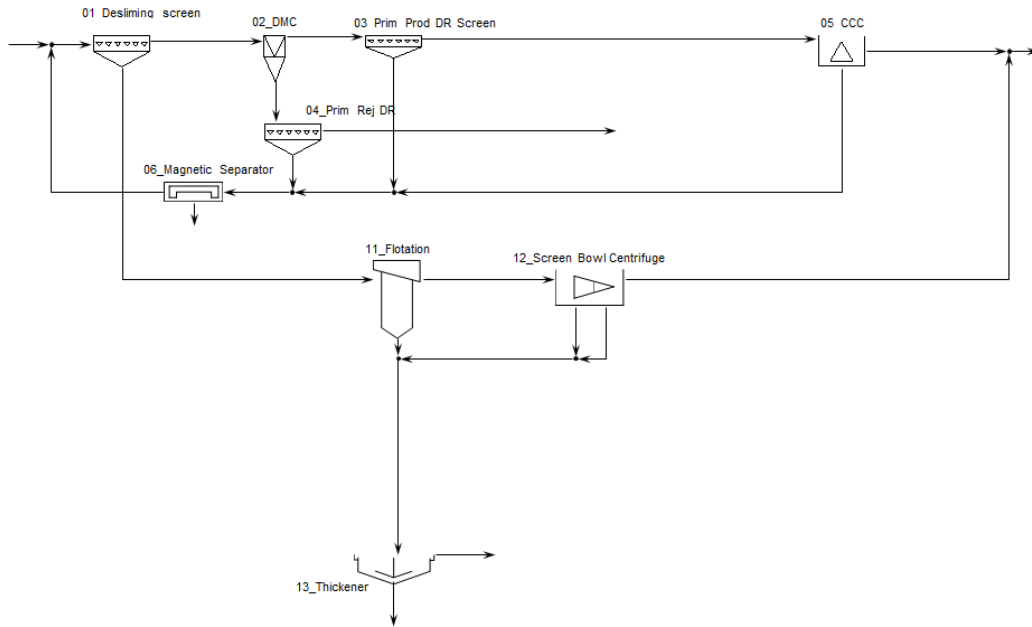


Figure 2-1: LIMN Flowsheet for DF process plant

Simulations were conducted across a DMC cutpoint range between 1.40 to 1.70 relative density to estimate product yield and ash, DMC and RX unit yields, and tailings and reject quantities. Flotation was modelled as column flotation based on Sedgman data collected from commissioning and operations.

The simulations were conducted for all 27 working sections. Seam blends were created using a geometric average approach, as there was no data specifying how many tonnes could be attributed to each sample. A life of mine (LOM) blend was modelled and simulated using a weighted tonnages approach based on the supplied mining tonnages (See Table 2-3).

3 Design Window

3.1 Sizing

A nominal top size of 50 mm is used for the finest, nominal and coarsest feeds. Drop shattered data defines plant feed sizing while wet tumbled data defines the process, or 'in-plant', sizing which was one of the goals of the 2018 drilling

Figure 3-1 shows the PFS range of working sections for the Tenas PFS in grey, the 2018 Tenas working sections in green and the proposed process sizing envelope that will be used for the feasibility study highlighted in red.

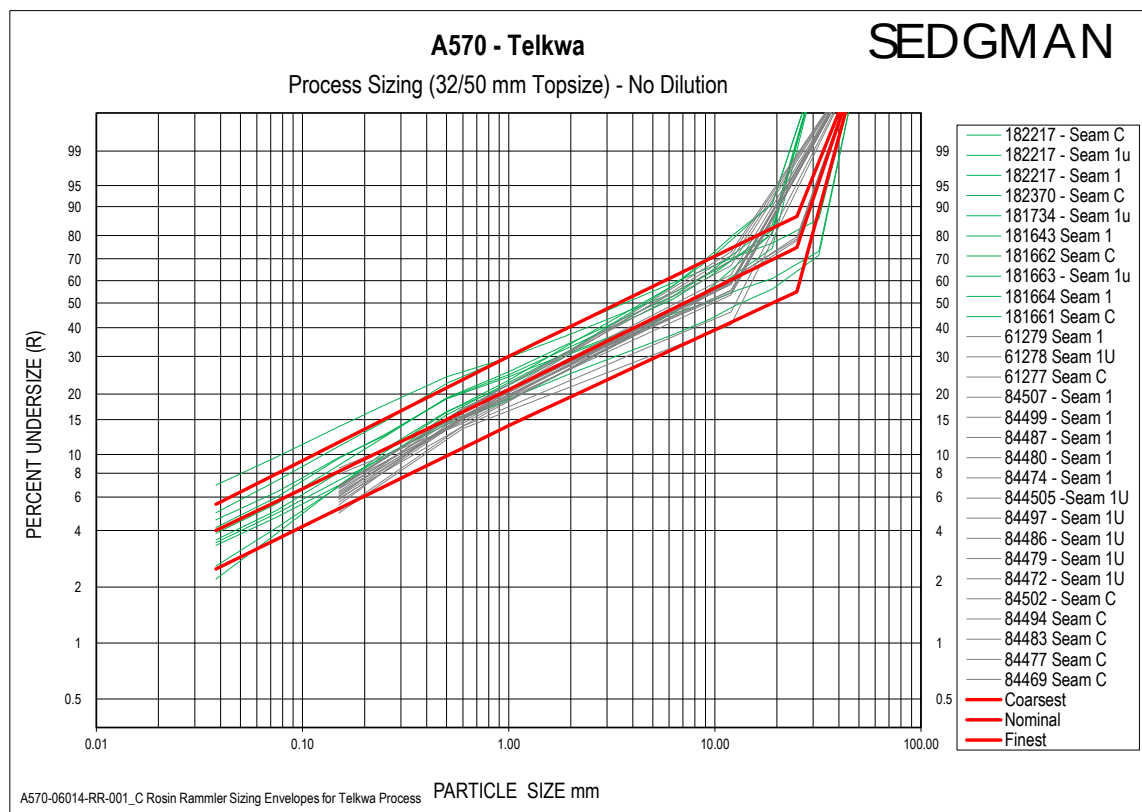


Figure 3-1: Process Feed Sizing Envelope

The process feed sizing envelope indicates the coal is relatively coarse compared to benchmark coking coals worldwide and that the breakage is fairly uniform across size ranges. In most deposits, the breakage characteristics are similar between the dry sizing and wet sizing, Figure 3.2 shows the benchmarked plant feed (dry) sizing envelope which would indicate the sizing of material entering the plant on the ROM feed conveyor in blue and the process feed sizing (after wet breakage from pumps etc) is shown in red.

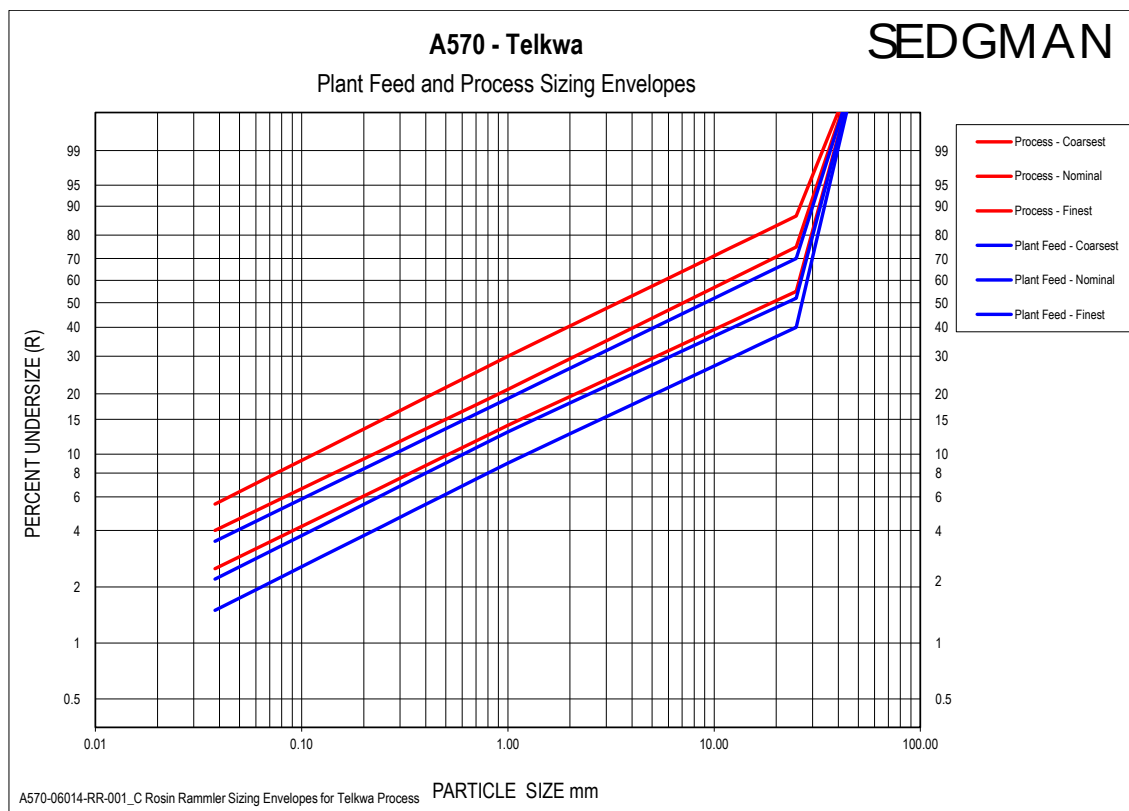


Figure 3-2: Plant and Process Feed Sizing Envelopes

As the plant has only DMC and flotation circuits, the process circuit size fractions are summarized in Table 3-1. If in the future other circuits are added then the circuit sizing splits percentages will change.

Table 3-1: DMC Flotation Process Circuit Sizing Split Percentages

CPP Circuit	Finest	Nominal	Coarsest
Coarse Circuit – DMC (-50 mm + 0.5 mm)	78.6	85.0	90.2
Fine Circuit - Flotation (- 0.5 mm + 0 mm)	21.4	15.0	9.8

3.2 Yield Window – DMC/Flotation

The design yield window calculated from the Limn simulations is shown in Table 3-2.

Table 3-2: CPP Process Equipment Yield Envelope Percentages

CPP Circuit	Minimum	Nominal	Maximum
Coarse Circuit – DMC (-50 mm + 0.5 mm w/w)	58	75	82
Fine Circuit - Flotation (- 0.5 mm w/w + 0 mm)	37	49	60

The Tenas DMC Flotation yield window is based around a DMC cut-point of 1.6 which results in an average product ash life of mine (LOM) of 9.0%. The yield window minimum and maximum limits were tested against DMC cut points of 1.55 and 1.65 which resulted in an average product ash over the mine's life of 8.3% and 9.5% respectively.

4 Linear Regressions

From the coal quality works undertaken, a linear regression of feed ash to product yield (air dried basis), at different DMC cut-points was produced to allow yield to be calculated from the mine model. Linear regressions were produced at 1.55, 1.60 and 1.65 cut-points to allow for some flexibility with the product ash required and to align with the yield window used in the process calculations and equipment selection.

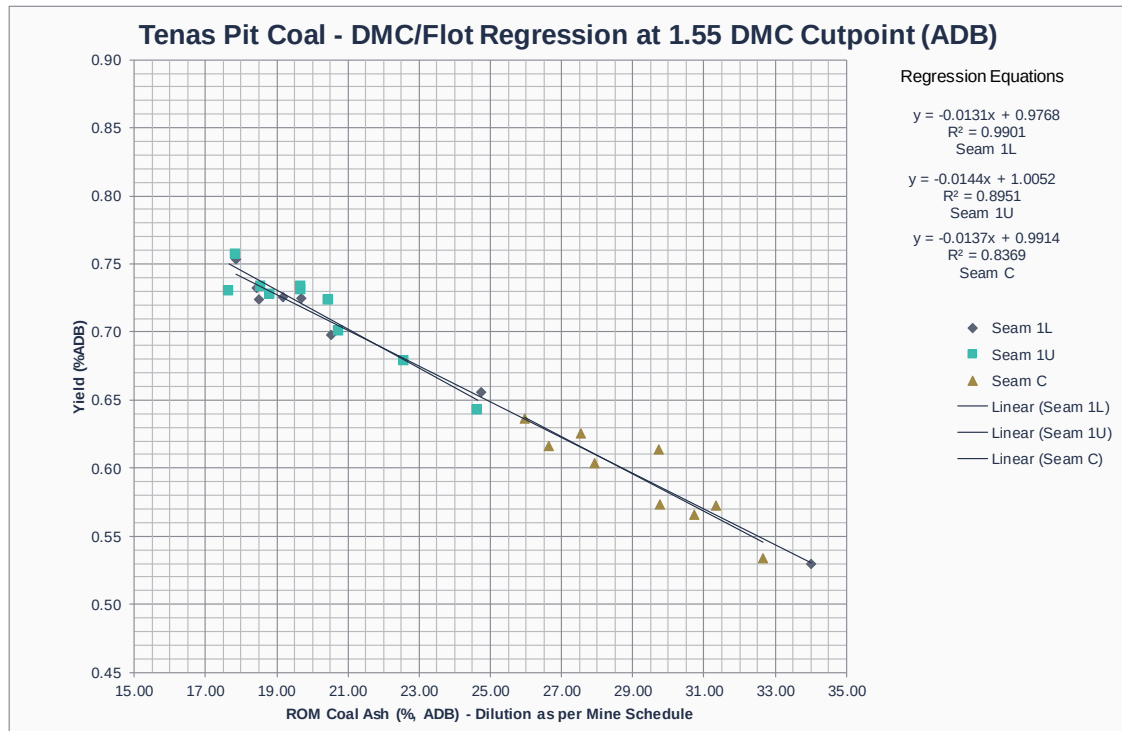


Figure 4-1: Linear Regression of yield and raw coal ash for Telkwa Coal samples at a 1.55 DMC cut-point (ADB, DMC/Flot plant)

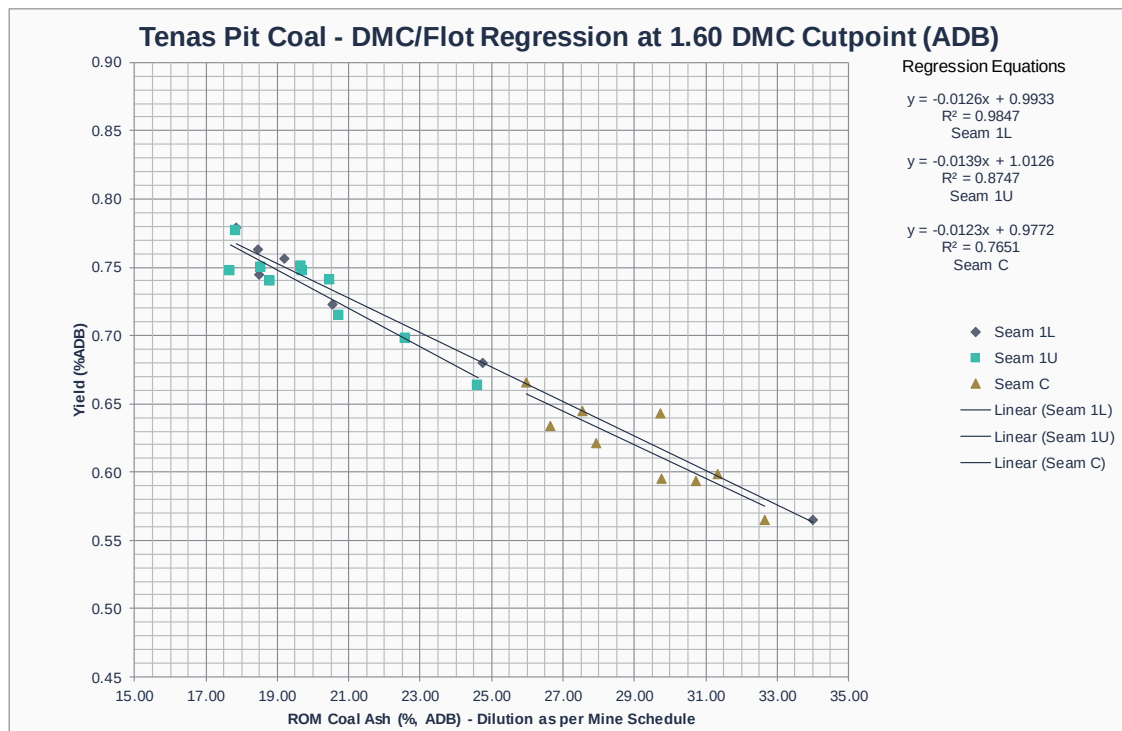


Figure 4-2: Linear Regression of yield and raw coal ash for Telkwa Coal samples at a 1.60 DMC cut-point (ADB, DMC/Flot plant)

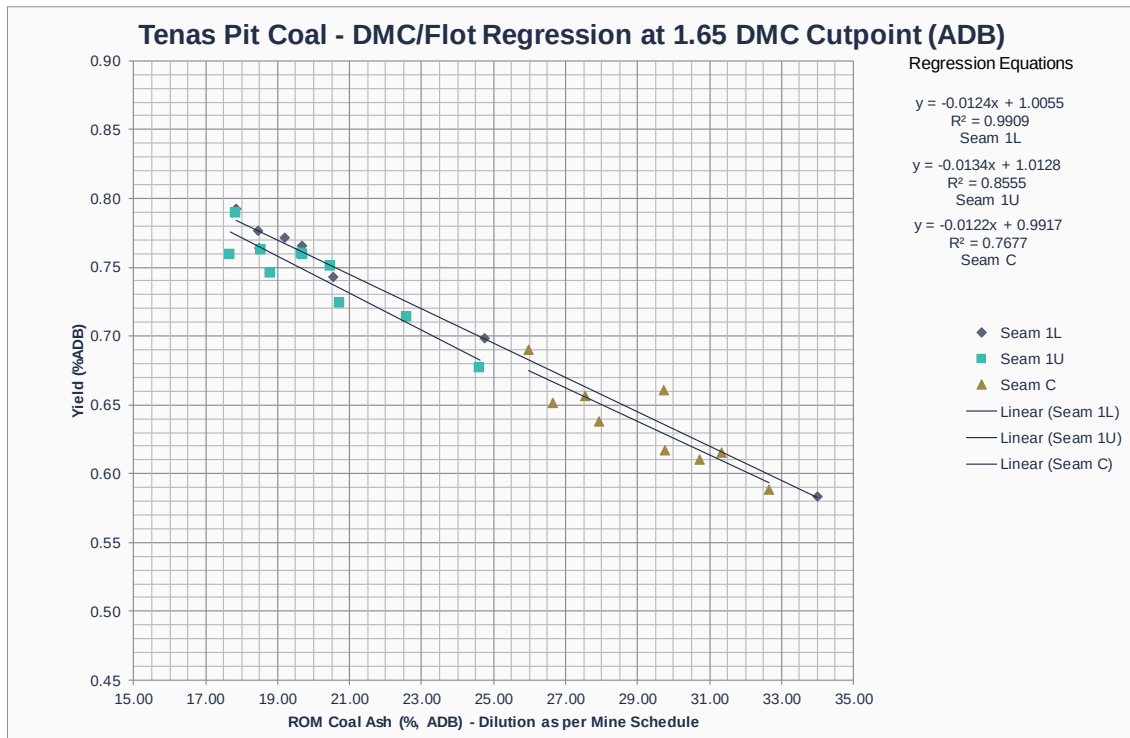


Figure 4-3: Linear Regression of yield and raw coal ash for Telkwa Coal samples at a 1.65 DMC cut-point (ADB, DMC/Flot plant)

A summary of the coal simulations was also produced, which shows the different seam blends and the overall mine blend at various cut-points for the DMC-flot plant.

DMC Cut-point	Seam	PRODUCT ASH (adb)	TS (adb)	FSI	CV (kcal/kg)	VM (%)	Yield (% ADB)
1.7	1L	10.5	0.7	3.0	7368	23.8	75.3%
	1U	8.1	1.7	4.3	7631	26.1	75.4%
	C	12.1	1.6	3.8	7244	23.9	65.5%
	Mine Blend	10.1	1.2	3.5	7423	24.4	72.9%
1.65	1L	9.9	0.7	3.1	7426	23.9	73.7%
	1U	7.7	1.6	4.3	7671	26.1	74.4%
	C	11.3	1.5	3.8	7323	24.0	63.6%
	Mine Blend	9.5	1.1	3.5	7480	24.5	71.4%
1.6	1L	9.4	0.7	3.1	7483	24.0	72.0%
	1U	7.3	1.6	4.4	7709	26.2	73.3%
	C	10.6	1.5	3.9	7397	24.1	61.8%
	Mine Blend	9.0	1.1	3.6	7534	24.6	69.9%
1.55	1L	8.6	0.7	3.2	7557	24.1	69.3%
	1U	6.9	1.5	4.4	7756	26.3	71.6%
	C	9.8	1.5	4.0	7476	24.3	59.3%
	Mine Blend	8.3	1.1	3.6	7601	24.7	67.5%
1.5	1L	7.8	0.7	3.3	7642	24.3	65.6%
	1U	6.3	1.5	4.5	7814	26.4	68.9%
	C	8.9	1.4	4.1	7566	24.4	55.9%
	Mine Blend	7.5	1.1	3.7	7680	24.9	64.2%
1.45	1L	6.9	0.7	3.4	7728	24.5	61.0%
	1U	5.6	1.5	4.7	7881	26.6	65.2%
	C	7.9	1.4	4.3	7667	24.7	51.2%
	Mine Blend	6.7	1.0	3.9	7762	25.1	59.9%

Figure 4-4: Summary table of Telkwa simulation data. *Note FSI is not additive and this is indicative model data only

Appendix A – Mine Tonnages used for Feasibility Study dilution calculation – File name ‘TelkwaFS_in-situ coal reserves_20181102 SRK.xlsx’

			In-Situ Coal		Ash	TTHK	ADM	Density	Dilution	Coal Loss	Dilution Added	Coal Lost	Dilution Added	Coal Lost	Recovered Tonnes (ADM)	
	ARD Zone	Material	Tonnes	Volume	%	m	%	t/m3	%	%	m3	m3	tonnes	tonnes	Volumes	ROM Tonnes
C Seam Blasted		Seam C	984,847	680,571	19.16	1.57	1.01	1.45	16%	13%	108,316	86,653	270,790	125,395	702,234	1,130,243
Not Blasted	Coal	Seam 1	5,804,568	4,085,496	16.23	5.55	1.20	1.42	3%	2%	110,349	73,566	275,872	104,521	4,122,279	5,975,920
		Seam 1L	7,359,696	5,093,142	18.92	3.89	1.16	1.45	4%	3%	196,508	131,005	491,269	189,305	5,158,645	7,661,660
		Seam 1U	3,803,591	2,676,805	16.30	2.39	1.23	1.42	6%	4%	168,170	112,114	420,426	159,307	2,732,862	4,064,710
		Seam C	2,174,325	1,498,200	19.57	1.63	1.17	1.45	9%	6%	137,967	91,978	344,917	133,487	1,544,189	2,385,755
Grand Total			20,127,027	14,034,215	17.73	3.69	1.18	1.43	5%	4%	722,853	496,475	1,807,132	712,014	14,260,593	21,222,146

*Seam 1 was split into a blend of Seam 1L and seam 1U for coal quality purposes, as per the proportions given from the in-situ coal proportions (approximately 65%/35%).

Project Implementation Plan

Tenas Project

Document No.: A570-D02-04010-RT-003

This document has been reviewed and **approved** / not approved.

Telkwa Coal Representative

Date:

Sedgman Limited Representative

Date:

Revision Status

Revision Number	Author	Description	Date	Approved By
0	MW	Issued for Information	22-Oct-2018	CH

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1 Introduction

The Project Implementation Plan documents the strategic approach to be taken for the execution of the works. It describes the approach to design, fabrication, procurement, installation and start-up of the facility including commissioning and operational readiness.

2 Project Responsibilities

The following table details the responsible party for key implementation activities for the project.

Table 2-1 Project Responsibilities

Description	Party	Review	Comments / Actions
Approvals & Client Data			
Mine Lease	TCL		
Environmental Assessment Study	TCL		
Cultural Heritage	TCL		
Water Authority Take-off	TCL		
Surface Lease for items of the Mine Lease	TCL		
Site Aerial Survey	TCL		
Clearance of Site for Geotech	TCL		
Contracting strategy	TCL		
Provide all available data and information about the existing services at site	TCL	SDM	
Project Insurance	TCL	SDM	
Accommodation & Messing for Construction			
Nominate and allow for messing CHPP construction manning levels	SDM	TCL	
Nominate and allow for messing Infrastructure and mining construction manning levels	TCL		
Nominate mining and maintenance manning levels	SRK	TCL	
Nominate principal and support manning levels	TCL		
Nominate CHPP operations manning levels	TCL	SDM	
Supply of construction accommodation	TCL		
supply of onsite construction huts & services CHPP	SDM	TCL	
supply of onsite construction huts and services - MIA and Mine development	TCL		need to come up with a common strategy for the estimate between all parties
Bulk Earthworks, Roads, Dams and Drainage			
Bulk Earthworks			
MIA	TCL	SDM	
CHPP	SDM		SDM to work with TCL to nominate RL's for final FSL
TLO stockpile and loading area	SDM		SDM to work with TCL to nominate RL's for final FSL
Rail Siding	TCL		
Main Electrical Substation	TCL	SDM	see battery limits for Raw Water, CHPP and MIA interfaces below
Nominate all-weather preassembly pads and laydown areas	TCL		SDM to nominate arrangement of laydown areas for CHPP(roads etc)
Ditches for mining area	TCL		
Access Roads			
Nominate frequency of mine vehicles (construction)	TCL		
Nominate frequency of CHPP vehicles (construction)	SDM	TCL	
Light vehicle access roads CHPP	TCL		TCL/SDM to work through layouts and interfaces
Mine to ROM bin and raw coal stockpile	TCL		TCL/SDM to work through layouts and interfaces
Access road	TCL		TCL to work through gate house and access locations
Site Dams			
Sedimentation dams	TCL		site drainage plans etc to be worked through
Final site profiling and foundations			
MIA	TCL		
CHPP	SDM		
Product stockpile	TCL	SDM	
TLO	TCL	SDM	
Water Supply, Management and Reticulation			
Raw Water			
Nominate CHPP construction water requirement	SDM		
Nominate Infrastructure requirements	TCL		
Nominate mining requirements	TCL		
Nominate CHPP operating makeup water requirements	SDM		
Availability of process water from main supply line	TCL		
Raw Water line from pump suction to nominated take-off point	SDM	TCL	TCL/SDM to work through dam pipe through the dam wall
Water for mining activities	TCL		
Potable Water			
Nominate mining requirements	TCL		
Nominate CHPP operation manning levels	SDM		
Site potable water plant	TCL		Potable Water Plant: not required on site
Waste Water			
Nominate mining and MIA requirements	TCL		
Nominate CHPP operation requirements	SDM		
Site sewage			buildings to discharge into localised tank, pumping or cartage by others
Fire Water			
Nominate mining requirements	N/A		Not Required

Nominate MIA requirements	N/A	Not Required
Nominate CHPP water requirements	N/A	Not Required
Design & Reticulation of fire water around MIA area	N/A	Not Required
Design & Reticulation of fire water around CHPP	N/A	Not Required
Fire water tanks and pumps	N/A	TCL to confirm with insurance requirements
Sedimentation Dam		
Reticulation of sedimentation pond at plant	TCL	
Electrical and Controls		
Electrical		
Nominate CHPP electrical load	SDM	TCL
Power System connection and distribution to CHPP	TCL	SDM
HV reticulation to the raw water substation	?	SDM to interface with the line feeder Decision on diesel or power to be confirmed
ROM area fixed lighting towers	TCL	Stockpiles will initially be lit by mobile lighting plants
Product stockpile lighting towers	TCL	Stockpiles will initially be lit by mobile lighting plants
MIA area lighting and workshop	TCL	
CHPP construction power	SDM	
Infrastructure construction power	TCL	
TLO construction power	NOR	
	M	
Controls		
CHPP SCADA control system	SDM	
Site water management SCADA control system	TCL	to include in power and water corridors
Telecommunications		
Nominate mining and water mgt requirements	TCL	
Nominate CHPP construction requirements	SDM	
Nominate CHPP operation requirements	SDM	
Reticulation around MIA	TCL	
Provision of telecommunication, internet and data facilities to a MIA	TCL	
Supply of phone sets site (MIA, CPP and TLO)	TCL	
Mine two-way system	TCL	
Fire System Network		
Fire system network reticulated around the CHPP and remote TLO area	TCL	refer PFD and design specification
Fire system network reticulated around the MIA (including offices and workshops)	TCL	refer PFD and design specification
Rail Loop Interfaces		
interfaces at main connection to rail system	TCL	
TLO Bin		not applicable
Rail weighbridge	TCL	
rail siding or loop	TCL	
management of easements and rail corridors	TCL	
Workshop & Office Facilities		
MIA	TCL	
Administration building	TCL	
Bathhouse / Dry complex	TCL	
Emergency response	TCL	
Central warehouse	TCL	
Workshops both for heavy and light vehicles	TCL	
CHPP, Workshop, offices and washrooms	TCL	to be part of the MIA
Mining and Haulage to ROM stockpiles		
ROM raw coal stockpile area	TCL	management under plant
Raw Coal area Hardstands as required by mining	TCL	
Commissioning and Start-up Costing		
Commissioning of CHPP	SDM	assumption of cost estimate to be up to and including commissioning prior to operations handover
Commissioning of the mining and Infrastructure works	TCL	assumption of cost estimate to be up to and including commissioning prior to operations handover
Commissioning of raw water system	SDM	based on tie-ins as nominated on battery limit PFD
Commissioning of Sedimentation dam/s system	TCL	
Strategic spares for CHPP	SDM	to be reviewed with Operations. Sedgman to provide Nom capex figure at this stage
Strategic spares for Mining	TCL	
Strategic spares for Infrastructure	TCL	
Provision of process consumables (flocculant, magnetite, frother (MIBC), and diesel for commissioning.		consumption figures only provided
First fill lubricants and greases for plant	SDM	included, ongoing costs contained in defined operating costs
First fill for site fuel and lube systems	TCL	
First fill for equipment	TCL	

3 Constructability and Procurement

A high-level constructability analysis of the processing facility has been completed, using knowledge from projects recently completed or currently in construction. A summary of some of the activities utilised in our construction estimate build-up are outlined below.

A significant portion of CHPP equipment will be procured in China and will be pre-assembled in plant equipment modules before coming to site. Where major equipment cannot be installed due to weight or size it will be shipped with its associated module.

Major electrical equipment (inc MCC's, Transformers, cables etc.) will be procured/manufactured in Canada to ensure compliance to the appropriate standards.

3.1.1 Construction Layout

During the course of the feasibility study, Sedgman completed a high-level constructability and implementation strategy of:

- Civil Installation
- Structural, Mechanical and Piping installation
- Electrical installation
- Heating system installation
- Fire system installation.

Constructability reviews were undertaken both internally and externally with an electrical and mechanical constructor that has previously worked in this region. The construction focus was on constructing the project in the two phases as described herein.

Below is an overview of some of the crane and laydown area planning that was completed.

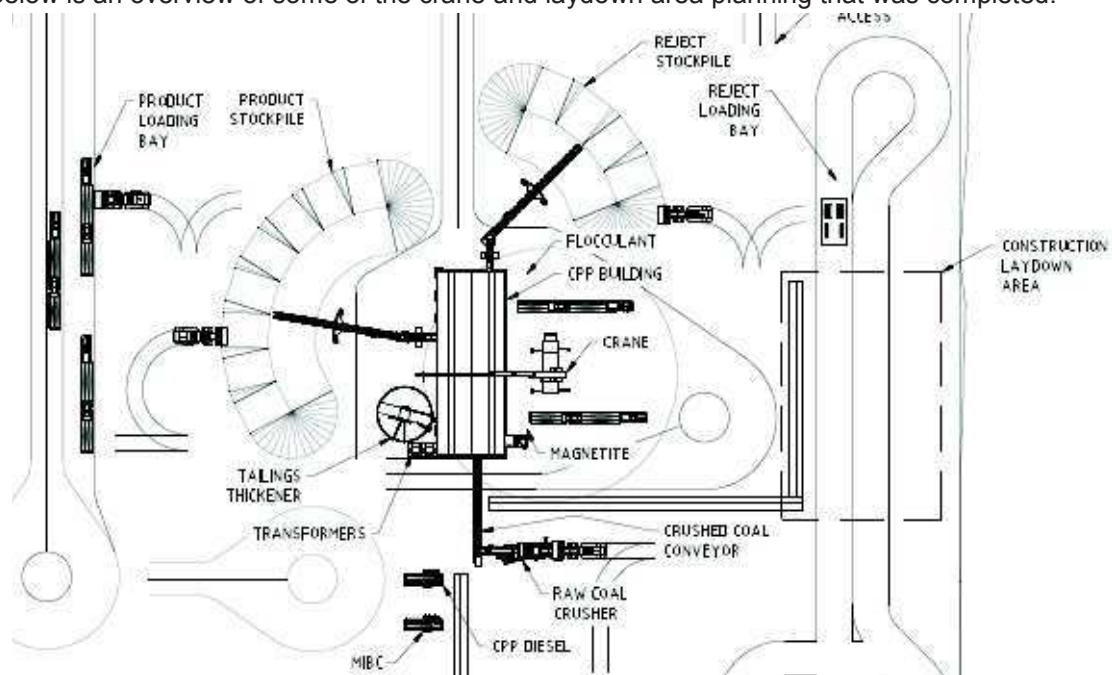


Figure 3-1: Preliminary Crane Planning

3.1.2 CPP Assemblies

Using a bolted construction design basis, the installation of the pre-assembled modules will use a combination of multi axle trailers to manoeuvre the modules close enough for a crane to lift the modules in place.

The plant modules will be fabricated and pre-assembled in China. Once completed, the modules will be trial assembled and then readied for transportation to site. The modules will have equipment and pipework already pre-assembled. Where equipment cannot be installed due to weight or size it will be shipped separately to the site with the corresponding module.

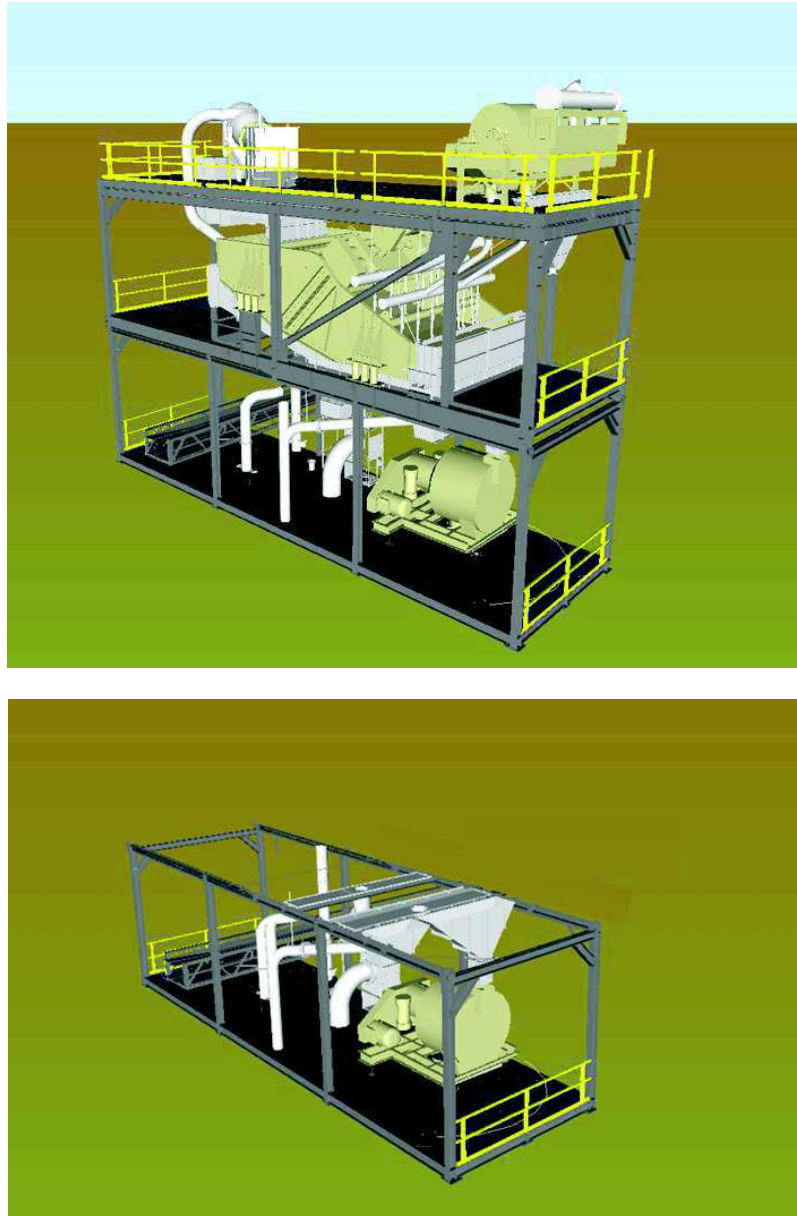


Figure 3-2: CPP Structure Models

In general, the CPP modules will be less than 4.5m x 4.5m x 9.1m.

3.1.3 Conveyors

The conveyors will typically be made up of standard low-level modules, the structural steel for the conveyor gantries including trestles would be fabricated in packages which will be drilled, numbered and painted then packaged for transport to site. Conveyor hardware such as idlers, pulley's drives, and belts will be procured separately to the fabricated steelwork. These items will be fitted onsite prior to installing the conveyor modules or where possible fitted in a workshop.

The radial stackers will be pre-assembled units and will be delivered to site ready for installation with only minor site construction.

3.1.4 Precast Concrete Elements

To minimise the volume of cast in-situ concrete and the associated labour costs, suitable concrete sections will be cast off site. These precast sections will be trucked to site and installed concurrently with the in-situ concrete works. The primary concrete items that will be precast are under the CPP modules.

To minimise concrete Porta-Floor will be utilised between the building edge and the structural plant modules inside the CHPP building.

3.1.5 Construction Site Requirements

As part of the study Sedgman have reviewed typical site provisions required during the construction phase. These include power, fuel and waste removal as described below.

Construction power has not been included in the capital estimate however for a project of this size it is expected to be:

- ~75kw for the offices, ablutions, lunch rooms etc
- ~ 100kw for the plant works area's construction general power requirements
- ~100kw for the infrastructure area for the building's construction general power requirements

Typically, also during the construction phase waste removal is a key element and typical requirement would be:

- General new equipment unpacking waste, which would be timber, plastic, strapping etc ~5tons
- General fabricated items unpacking waste, which would be timber, strapping etc ~5tons
- General construction waste timber cable drums, off cuts of light steel for brackets etc, concrete formwork, strapping etc ~8tons
- Site offices prep and general weekly waste from running ~2 ton

Generally during plant construction, the following fuel usage is also expected:

- Diesel for general plant for construction is typically ~10 litres an hour for mobile plant such as zoom booms, loaders, cranes, estimating an average of ~10 pieces a day consuming fuel for the construction window.

- Petrol for site vehicles will also be required estimated as 40 litres per day across 6 vehicles.

4 Transport and Logistics

As part of the strategy of off-shore fabrication, previously completed project scenarios were reviewed including modularisation and pre-assembly, to provide the most economic benefit to the Project. The following strategies were adopted for this Project:

- Off-shore fabrication of structural steel, platework, chutes and launders, piping.
- Off-shore assembly of plant modules incorporating structural steel including grating and floor plate, platework, piping and equipment, disassembly and packing for shipment.
- Plant modules pre-assembled will be standardised in design and tailored to the limits of the road corridor survey.

Off-shore fabrication methodologies do not come without risk and project delivery complexity. Assessment of transport logistics with appropriate input from experienced logistics groups evaluated:

- China internal transport
- Shipping
- Key area's in the US where some of the processing equipment would be manufactured
- Key area's in Canada including British Columbia and Alberta.

The assessment considered the transportation of processing equipment and fabricated items from shipping, unloading and inland transport to site. A more detailed study will be required prior to execution of the works.

4.1.1 Taxes and Import duties

Relevant taxes, import duties and any other fees and charges will need to be considered by Telkwa Coal. This process can be managed through utilising a project logistics company who have the protocols in place to manage this process successfully. Customs and transport approvals will also need to be assessed and managed.

4.1.2 Offshore Structural Steel Supply:

Current project data and pricing from the US, Canada and international markets were considered for fabrication pricing.

The evaluation process concluded that the most feasible option was to use the Chinese pricing for the Structural Steel, Platework and potentially Mexico pricing for the conveyor gantries portions of work. This assessment included the overall competitiveness, shipping time and overseas supervision/management.

To manage quality control Sedgman would utilise their in-house China based resources.

4.1.3 Freight/Transport

A high-level shipping and road transport route survey was completed. The route survey sizing window feedback allows plant modules as well as elevated gantries to be transported in the selected sections up to Smithers.

The shipping assessment also considered a combination of break-bulk pricing and use of dedicated ships. Further detail will be required to best breakdown this against the final execution schedule.



Figure 4-1: Example of recent project offshore fabrication ship layout with CPP modules

An estimate of the number of truck delivery loads is as follows:

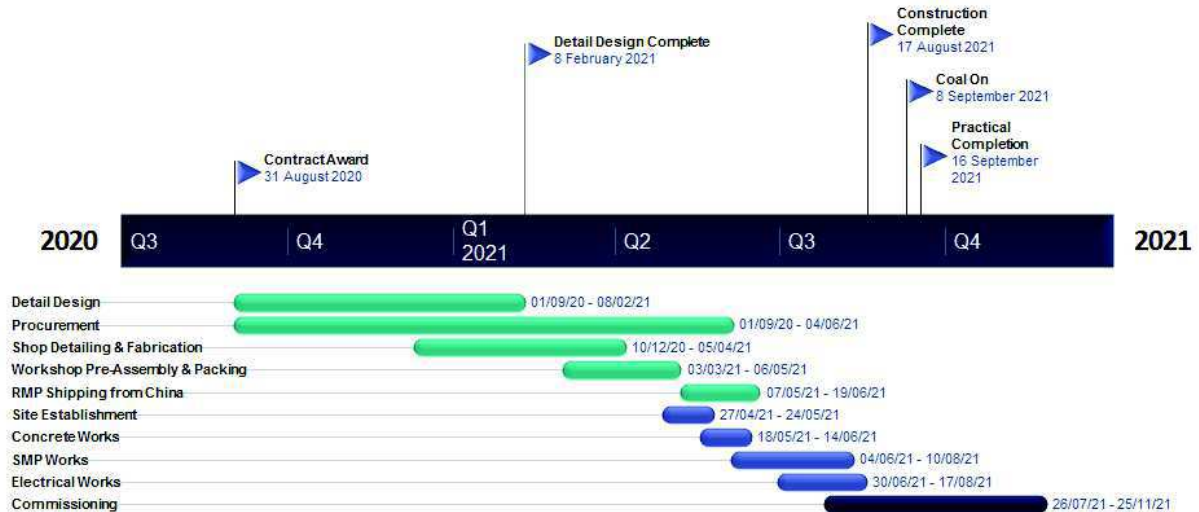
- 3 x Escort Drop Deck Wide
- 28 x Drop Deck Wide
- 14 x Drop Deck Semi
- 22 x Standard Deck Semi

5 Project Schedule

Below is the summary level schedule detailing the dates and sequencing of the Tenas project.

A570 Tenas RMP Project

SEDGMAN



Target duration for the project is approximately 12 months; the current schedule is showing project completion at 55 weeks including the effect of holidays like Christmas and Chinese New Year. The contract start has been aligned to achieve production by October 2021. Note no inclement weather has been included in the construction schedule but erection is currently scheduled for warmer months between May and October. On this basis if the start date moved to cause erection during the winter months there would be an impact on both the construction costs and time.

Detailed design and shop detailing would be undertaken by Sedgman's resources in Vancouver, Brisbane and Shanghai.

The CPP modules will be fabricated and pre-assembled in one of Sedgman's pre-qualified workshops in Shanghai prior to delivery. A 10 week shipping/transport window for direct shipment to Smithers has been included.

We have scheduled the concrete construction to lead into the mechanical erection which will coincide with the receipt of the modules and direct equipment deliveries.

The CPP will be erected without the shed to allow clear crane access around all parts of the modules and thickener area.

5.1 Key Project Milestones

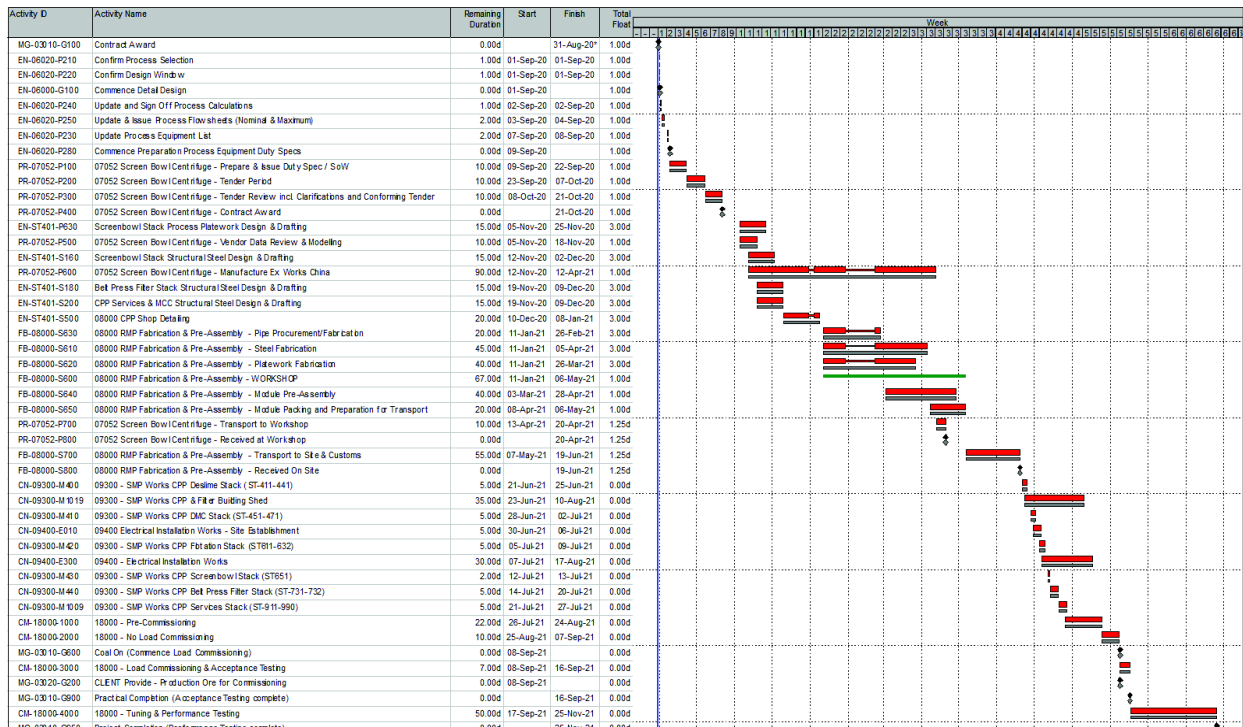
The table below outlines start and finish dates for the key project milestones.

Table 5-1 Project Key Milestones

Activity Name	Milestones
Contract Award	31-Aug-20*
Commence Site Establishment	27-Apr-21
CSMPE Construction Completion	17-Aug-21
Coal On (Commence Load Commissioning)	08-Sep-21
Practical Completion (Acceptance Testing complete)	16-Sep-21
Project Completion (Performance Testing complete)	25-Nov-21

5.2 Critical Path

The critical path for the project runs through the procurement of the screenbowl centrifuge from a design perspective requiring vendor data and also through manufacture and delivery to the China workshop for installation. The chart below details this critical path.



5.2 Figure 5-1 Project Schedule Critical Path

There are 2 calendars assumed in the project schedule:

- **Engineering and Procurement:** This is a Monday to Friday, 5 day a week calendar (with public statutory holidays and a 2 week shutdown over Christmas included) used for all engineering and associated office-based project and procurement activities.

- Construction (14 days on, 4 days off): This is a (10 hour productive work day) rolling construction roster calendar used for site based work (site will operate continuously). This calendar includes a 2 week break over Christmas; note there are no construction activities during this period.

5.2.2 Expected On-site Manpower Histograms

Using the schedule outlined in Figure 5-1, below in Figure 5-2 and Figure 5-3 is a bell curve with the construction manhours distributed over the assessed duration. This identifies the peak on site manning levels to be 37-40.

To establish the total on-site manhour bell curve, the following has been included:

- SMP field supervision
- Civils field supervision
- Electrical field supervision
- Civils field construction manhours
- SMP field construction manhours
- Electrical field construction manhours
- HVAC manhours
- Building manhours (which are included within the SMP manhours)
- Commissioning manhours including field trades
- On-site construction support manhours

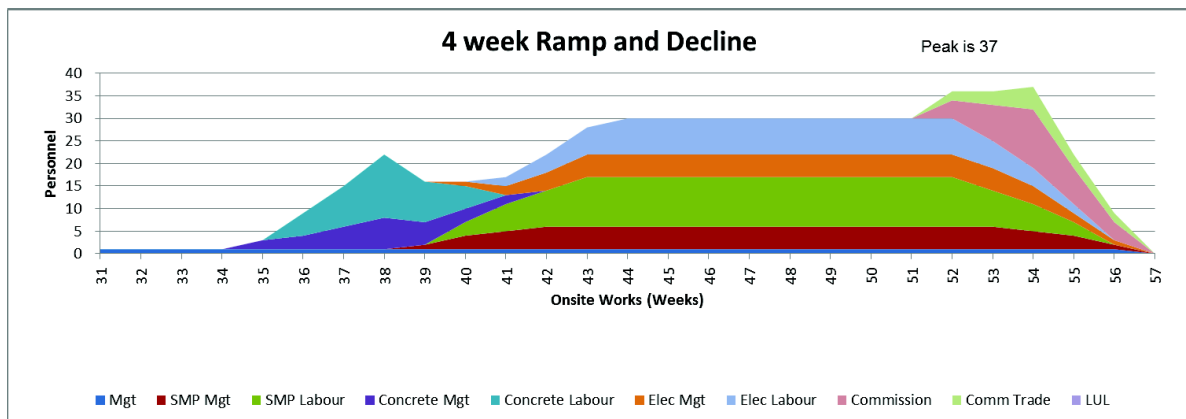


Figure 5-2 High Level Summary Histogram

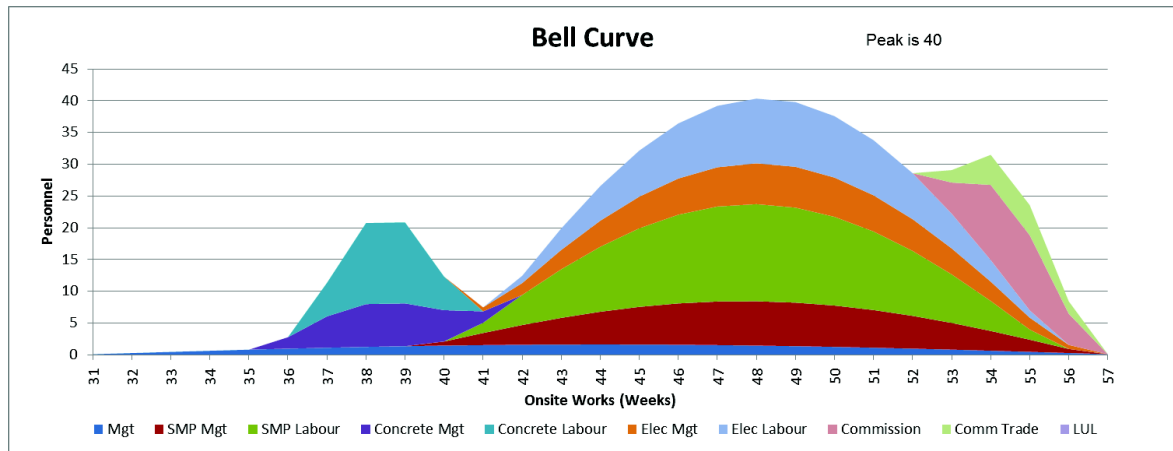


Figure 5-3 High Level Summary Histogram

6 Cashflow

A monthly invoice cashflow is detailed in Figure 6-1 below. The initial payment for the project is 20% to secure all procurement items and meet the project timeline.

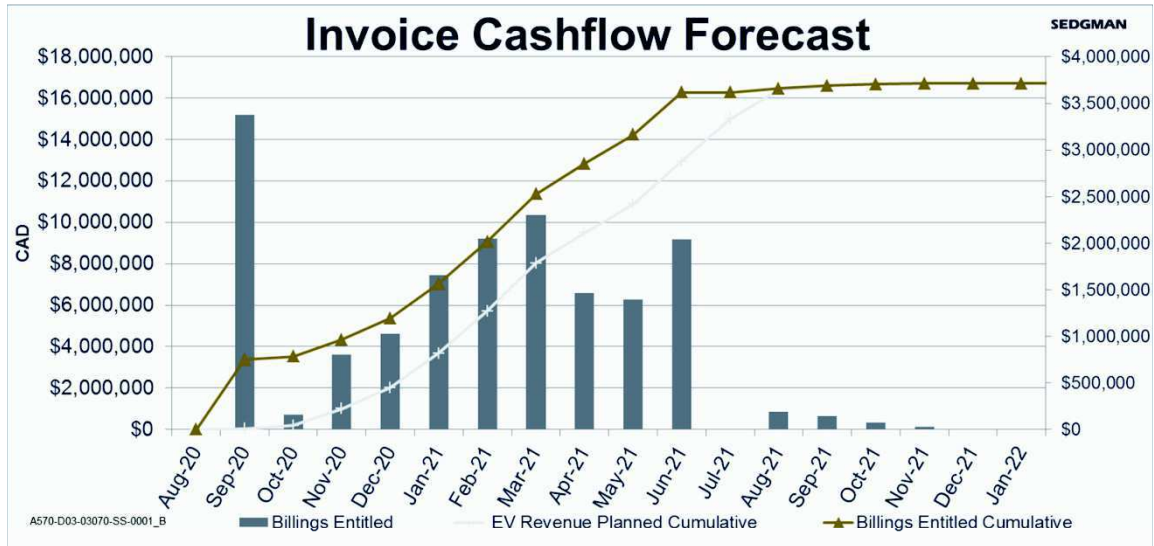


Figure 6-1 Tenas project cashflow

Table 6-1 Monthly Invoice Values

Month	Invoice Value
Aug-20	\$0
Sep-20	\$3,312,000
Oct-20	\$153,700
Nov-20	\$792,600
Dec-20	\$1,008,200
Jan-21	\$1,628,800
Feb-21	\$2,007,600
Mar-21	\$2,261,200
Apr-21	\$1,439,000
May-21	\$1,369,500
Jun-21	\$2,005,700
Jul-21	\$0
Aug-21	\$185,300
Sep-21	\$139,100
Oct-21	\$73,100
Nov-21	\$30,000
Dec-21	\$0
TOTAL	\$16,405,800

7 Proposed Organisational Structure

The resources identified in Figure 7-1 are required to deliver the project and includes senior leaders and technical advisors identified for the project. These senior resources coupled with our experienced team of engineers/expeditors including our established procurement hub within China will be allocated to the project at the implementation phase.

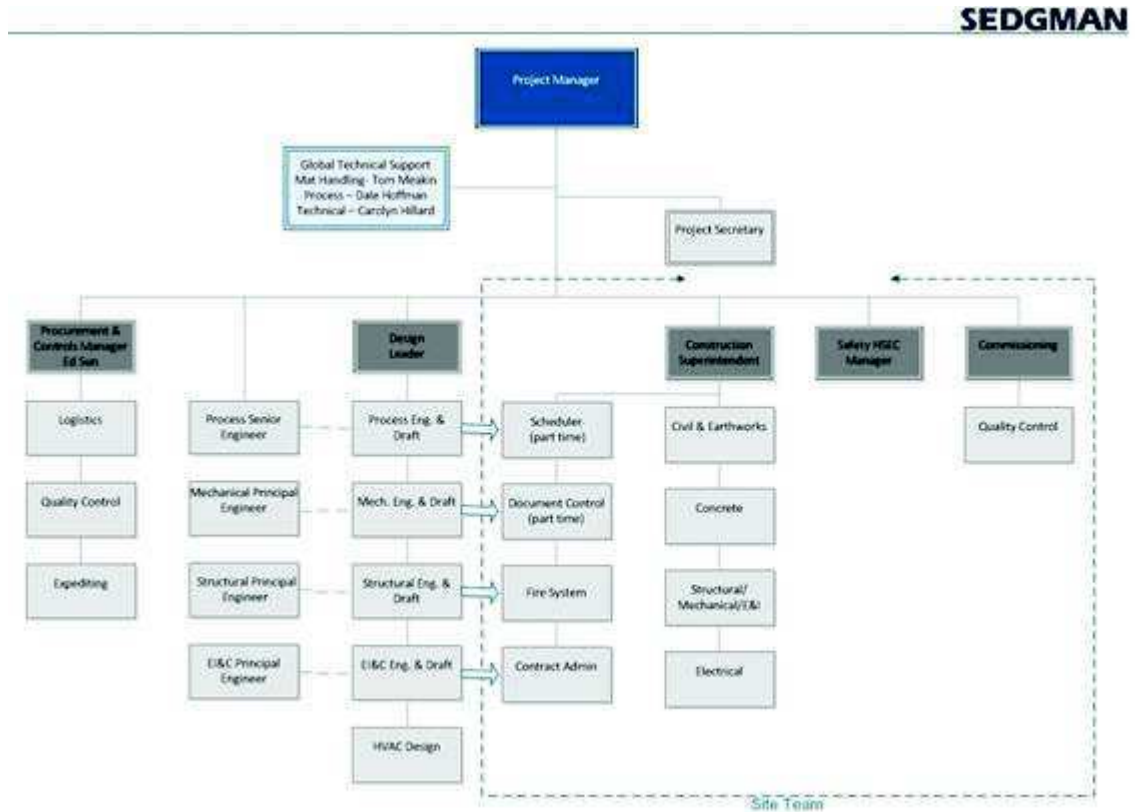


Figure 7-1: Project Org Chart

7.1.1 Project Systems

Sedgman uses a suite of systems that successfully integrate into client systems. We will map with Telkwa Coal's requirements and configure our systems to provide efficient transfer of information in a format that can be integrated for your requirements. These systems and procedures have evolved over time and have been successfully used to deliver an extensive number of projects by Sedgman. They have been "tried and tested" and developed to easily integrate with our client's management systems to allow a focus on the key area's that add the most value to safely deliver a project.

The Sedgman Project Controls Group Systems and Tools can be mapped to Telkwa's subsequent delivery systems.

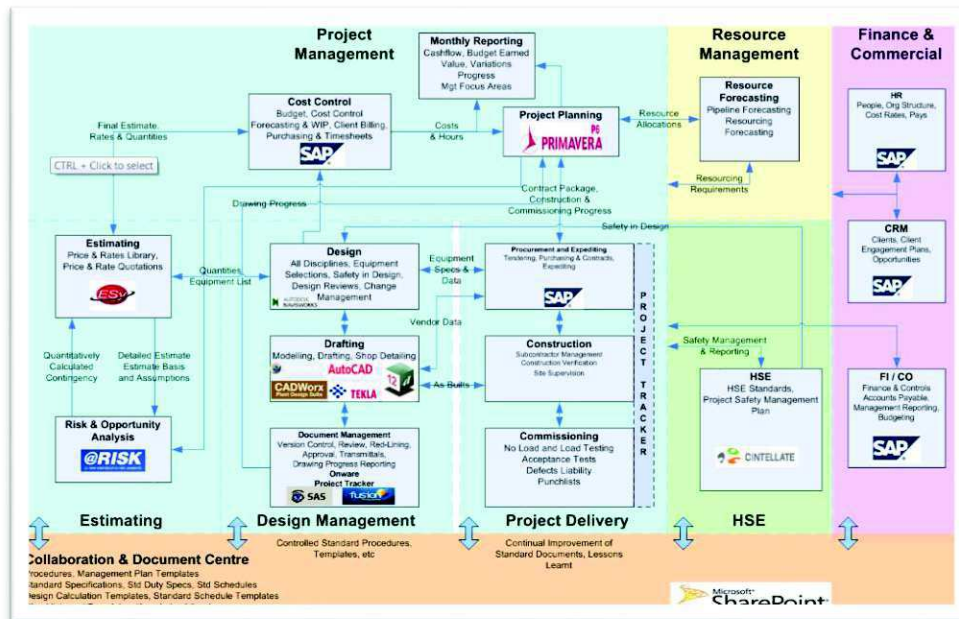


Figure 7-2: Systems Integration Map

8 Commissioning

The following sections are provided as a summary of the works that will be undertaken as part of the commissioning of the Works. Detailed documentation and testing will be provided as part of the Construction and Commissioning Plans as identified in a project execution plan.

8.1.1 Construction Verification

The project will use construction verification prior to commissioning any works which is the preparation of equipment so that it is in a safe and proper condition and ready for commissioning and operation.

The verification process includes all aspects of plant operation such as safety, electrical equipment, mechanical equipment and instrumentation.

Construction verification of equipment shall include but not be limited to the following:

- Checking completeness of installation (from construction ITPs and MDRs provided)
- Mechanical pre-start checks according to vendor requirements including drive alignment checks
- Checking conformance of equipment to specification
- First fill of lubricants (supplied by the TCL, installed by Sedgman), ensuring all equipment is correctly lubricated and lubrication reservoirs are charged with adequate quantities of a suitable lubricant
- Electrical point to point, continuity, and insulation checks
- Checking clearance endplay and operation of major bearings
- Checking alignment of drive systems
- Checking tightness of all parts.
- Correct springs are installed on respective screens
- Guarding is in place.
- Signage

Where construction verification reveals deficiencies in design or other faults, they shall be rectified and the outcomes recorded in the manuals and “as built” drawings.

8.1.2 Commissioning the Plant

During commissioning, Telkwa (or its appointed operator) will operate the plant under the direction of Sedgman’s Commissioning Manager.

Sedgman shall use all reasonable endeavours to maximise plant availability and throughput during the commissioning period.

8.1.2.1 *Pre-commissioning*

Sedgman shall carry out pre-commissioning activities progressively as access to equipment, drives and MCC’s becomes available. Where necessary, construction works may continue in parallel with pre-commissioning activities.

Pre-commissioning of equipment shall follow the completion of construction verification for that equipment. Pre-commissioning of individual items of equipment may be undertaken as appropriate while construction in that area continues providing that the results of the pre-commissioning are not reversed or altered.

Appropriate risk control measures, will be identified and implemented to effectively separate pre-commissioning and ongoing construction activities.

Pre-commissioning will include introduction of hazardous energy and shall include, but not limited to, the following activities:

- Functional checking of safety interlocks and electrical protection devices
- Checking the direction (bumping) of rotation and performance of electric motors
- Extended motor runs with drives (belts) disconnected and measurement/recording of motor no load operating parameters as appropriate
- Monitoring by observation of temperature build-up in bearings, gearboxes etc.
- Monitoring by observation the vibration of buildings and installed equipment
- Human Machine Interface (HMI) function checks
- Calibration of instruments (without media)
- Dry running of equipment capable of such operation and measurement and recording of operating parameters as appropriate
- Adjustment of equipment where possible in dry running mode
- Set up and adjustment of instrumentation and recording of parameters as appropriate
- Power-off sequence starts/stops and trips to verify control system logic
- Activation of alarms by inducing (or simulating where not practical) actual fault conditions.

Any buried system pipework will be pressure tested, signed with buried tape, and surveyed prior to closing any trenches. Buried services shall have appropriate permanent above surface signage installed

8.1.2.2 *No Load Commissioning*

The objective of the no load commissioning will be to ensure that the equipment is operational, reliable and ready to begin feeding coal into the plant and the loading of trains. The following activities are completed during no load commissioning:

- Final calibration of all instruments
- Completion of equipment commissioning checklists
- Testing and commissioning of equipment, electric, instrumentation and control systems, alarm annunciation, set points etc.
- Completeness checks of entire installation, paying particular attention to integration of individual equipment:
 - Energise substations:
 - PLC functionality checks
 - Motor rotation checks for all drives
 - No-load motor run tests
 - Valve operational checks
 - Pump Checks

- Pressure and test Water Lines
- Conveyor and associated equipment no load run tests
- Stacker full operational checks including conveyor
- Screen harmonics tests
- Bearing temperature checks will be performed in accordance with the Commissioning Plan requirements.
- Functional checks on interlocks and control systems
- Leak testing of piping
- Functional and sequence tests (starting, stopping tripping)
- Testing of feedback, control and overload equipment, including safety checks
- Collection and recording of operating parameters
- Operation of equipment not able to be run during pre-commissioning (e.g. extended pump runs)
- Adjustment and tuning of conveyor systems (belt tracking, scrapers, spray bars).

The no load commissioning testing sequence will be defined in the commissioning schedule and by the P&ID diagrams.

8.1.2.3 *Load (Coal On) Commissioning*

Load (coal on) commissioning is the process when coal will be introduced to the plant and the loading of trains has commenced.

Once coal is introduced production is expected to align with the mining schedule.

All relevant operating parameters will be recorded and collected for presentation at completion of commissioning.

- The following activities would expected to be completed during load commissioning:
 - Load commissioning will introduce feed material to the plant
 - Throughput will commence at approximately 50% of nominal plant capacity and then be increased in a controlled manner to the full design capacity
 - Plant feed rate will be increased to the design feed rate to confirm operational stability. If modifications are determined to be necessary, the plant will be shut down and modifications made before the operation of the facility is re-commenced; in general the plant will be shut down at Sedgman's discretion with close communication with Telkwa Coal
 - Equipment, operational and safety checks will be performed as feed material is introduced
 - Reagent dose rates will be confirmed and adjusted as required
 - PID loops will be tuned
 - Any equipment or instrument calibration that was not able to be checked during prior stages of commissioning will be conducted and checked where required
 - All relevant operating parameters will be recorded and collected for presentation to Telkwa Coal daily
 - Load (feed on) commissioning will continue until the requirements for commencing the Acceptance tests is met.

8.1.3 **Plant Tuning**

Following Mechanical Completion, plant commissioning will move into plant tuning mode. During this period the Sedgman shall address any minor operating issues and optimise plant sequences

and controls. The plant will be fully operational and under Telkwa Coal control with Sedgman providing operational support with mechanical and electrical supervision and engineering staff.

8.2 Operator Training and Manuals

8.2.1 Vendor Manuals

Inclusions

The Contractor shall be responsible for providing one (1) electronic PDF copy of the vendor's standard operating and maintenance manuals for all major equipment.

8.2.2 Operations Manuals

Inclusions:

The Contractor shall provide the following operations manuals for the CHPP:

- Volume 1: Control System Interface
- Volume 2: Plant Description
- Volume 3: Plant Operation
- Volume 4: Equipment Circuit Troubleshooting
- Volume 5: Reference.

8.2.3 Operator Training

Sedgman shall provide training in the operation of the CHPP to Telkwa's personnel (or personnel appointed by Telkwa).

The training shall be provided at the time of CHPP commissioning and shall involve a combination of classroom type tuition, plant walk-arounds, familiarisation and hands-on operating instructions.

The approach would be one (1) day of training to two (2) separate groups of over a one (1) week period. An additional single day of training would be provided familiarise the electrical personnel with the installed electrical equipment. A part of this day will be in the class-room and will explain the new facility to provide the operators with an understanding of the plant and the manner in which it operates.

The class-room tuition shall consist of PowerPoint presentations, one on each section of the Coal Handling Plant. The handouts for the operators shall consist of handouts from the PowerPoint presentations.

It is suggested that the senior management team from Telkwa including the process superintendent, process engineer and maintenance support person spend a training session in Australia as a similar plant configuration that Sedgman operates or can facilitate training with. It is expected that one month rotation would be required. This cost has been included as an add on.

Plant Walk-Arounds

As part of the class-room tuition the Sedgman's commissioning personnel shall accompany the plant operators on tours through the plant emphasizing points necessary for the correct and safe operation of the plant.

Hands-On Experience

The operators shall be made available to assist during the commissioning of the CHPP. Sedgman will actively involve the operators in the commissioning of the CHPP as part of their training, so they gain familiarisation and skills to operate and maintain the CHPP.

This level of training will not cover off:

- “Competency Based Training” as detailed in the relevant statutory requirements
- Specific mechanical, electrical or control system training necessary for plant maintenance technicians and personnel
- Conduct formal assessment of training provided or otherwise verify operator competency. Any assessment associated with Training Session.

Operations Implementation Plan

Tenas Project

Document No.: A570-04010-RT-004

This document has been reviewed and approved / not approved.

Telkwa Coal Representative



Date:

Oct 31/18

Sedgman Limited Representative



Date:

26 Oct 18

Revision Status

Revision Number	Author	Description	Date	Approved By
0	MW	Issued for Information	22-Oct-2018	CH

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1 Introduction

The Operations Implementation Plan documents the strategic approach to be taken for the operational phase of the Tenas CHPP. It describes the approach to manning, mobile equipment, procurement, maintenance and operation of the facility.

2 Operating Basis

The operating implementation plan is based on the following assumptions and operating basis.

Table 2-1: Production Quantities and Operating Hours Assumptions

Period	ROM Tonnage (t/a)	Clean Coal Tonnage (t/a)	Plant Feed Rate (t/h)	Operating Hrs (hrs/a)
Initial Operation	1,050,000	777,000 (74% wet yield)	145	7,200
Potential Future	1,370,000	1,028,000 (75% wet yield)	190	7,200

*Based on a 9.4% ash product

The operating hours is based on operating 365 days per year, 24 hours per day including statutory holidays. There are an estimated 13 days for maintenance and no days lost due to weather, lack of supplies or personnel. There are a further 2 days for other activities.

2.1 Battery Limits

The CHPP and TLO operating cost estimate is based on the following battery limits.

2.1.1 Material Processing

- ROM coal pad (within 100m of the ROM mobile crushing station, reclaim by FEL included)
- Discharge of product coal into train cars by FEL and including stockpiling and clean up functions
- Discharge of combined coarse and fines rock material into mining trucks
- Discharge of product coal into B-Double trucks for haulage to the TLO

2.1.2 Services

- Raw water flange connection at raw water pump
- Reagents delivery point at storage tank feed flange/coupling connections
- Flocculant delivery point at CPP
- Magnetite delivery point at CPP
- Electrical at line side of the CHPP motor control centre (MCC) incoming circuit breaker
- Communications at the fibre optic patch panel located at the CHPP control room for the controls and communication networks

2.2 Labour

The workforce for this operation is expected to be based locally, with the site labour able to drive or take a company bus or van between site and their place of residence within fatigue management guidelines.

Management of the facility will be provided by a Plant Superintendent, Process Engineer and Administrative Assistant. The site manpower requirements are summarised in Table 2-2. Management will work a 4 day on, followed by 3 day off schedule with the Plant Superintendent and Process Engineer. The work day will be 10 hours and it is expected the Plant Superintendent and Process Engineer will work opposite shifts to provide 7 day a week coverage.

Operating labour for CHPP production has been assumed to occur on an even time roster, with 4 crew panels working 12 hour day and night shifts to provide 24/7 coverage. Each crew consists of a shift supervisor (with operator skills) and 3 three operators. The main operator tasks include:

- ROM loader operation
- Control room
- Process monitoring, adjustments and inspections
- Loading product and rock material into trucks
- Planned and breakdown maintenance support
- Covering rail loadout on days where trains are on site

Train loading will be carried out by two (2) operators, one of which will come from the CHPP crew, and the other will be sourced from the mining crews. It is anticipated that each train will take approximately 12 hours to load with the stockpiles requiring preparation before each train arrives (estimated at an additional 12 hours).

All plant operators will be adequately trained to perform all required operator functions including operation of specified mobile equipment if and when required. Plant operators will also be trained to undertake pms and running repairs for the CHPP and TLO.

With the crew manning levels proposed it is expected that contractors will need to be engaged to provide leave relief which has been fixed at 3 weeks per year. It will therefore be necessary to establish a relationship with a reputable labour services company to provide the appropriate personnel who are both inducted and competent to provide relief coverage. The labour rates for wages personnel will be based on relevant available Enterprise Agreements. Staff remuneration will be based on market sentiment and on the assumption that competitive salary packages will be offered.

Table 2-2: CHPP Manpower Estimate

Role	Number per Crew	Number of Crews	Total Number
Plant Superintendent	1	1	1
Process Engineer	1	1	1
Admin Assistant	1	1	1
Crew Supervisor	1	4	4
Operators	3	4	12
Total			19

2.2.1 Technical support

The operations will need to be supported by a range of technical and managerial support. Depending on the cost effectiveness, it may be worth establishing remote access to allow specific technical personnel to monitor the process in real time but most of these activities will be undertaken by the staff. Table 2-3 contains a list of typical support activities.

Table 2-3: Typical Support Activities

Process Engineering
• Daily/weekly SCADA data reviews • Regular checks of production settings, trends and consumable usage • Performing process model simulations of predicted ROM feed material to establish resultant processing performance • Product quality and resource analysis • Facility process performance review and optimisation activities
Maintenance Specialists
• Assembly of facility maintenance life cycle models for cost and performance prediction • Failure analysis and reporting for equipment failures • Assembly of facility maintenance plans and documentation • Facility maintenance performance review and reporting (reliability, availability) • Maintenance system reviews, audits and reporting. • Lubrication and condition monitoring services
Electrical and Controls Engineers
• SCADA and PLC maintenance and backups • Optimisation of facility automated operating systems • Optimisation of plant sequencing to reduce start-up and downtime • PLC control loop tuning • Remote troubleshooting and technical support for electrical and controls issues • Scoping of electrical component and automation system upgrades.
Safety Specialists
• Second party auditing functions against statutory or site-specific standards • Facilitation of risk assessment processes • Facilitation of ICAM incident investigation processes • Development of training materials to Competency Standards • Training and assessing activities • Facilitation of change management activities.

2.3 Mobile Equipment

The mobile equipment detailed in Table 2-4 is proposed as the permanent fleet on site to service the CHPP and train loadout requirements. The operating costs associated with this equipment will be inclusive of maintenance, tires, lubes, GET, and fuel. Additional equipment will be required from time to time (e.g. mobile cranes) and these would be hired from local providers as required.

It is proposed that one of the front end loaders will be permanently stationed at the TLO, with the other two at the CPP. When a train requires loading, one of the CPP loaders will need to be transported to the TLO. It is assumed that mining can provide a float to perform this service or that it will be acceptable to drive it along the access road.

Table 2-4: Mobile Equipment Summary

Description	Qty	Usage	Function
Front End Loader (Cat 988 size)	3	9,500 hrs/a at CPP 3,150 hrs/a at TLO	- ROM loading - Product & Rock loading - Train loading
Integrated Tool Carrier (Cat 938 size)	1	750 hrs/a	- Stores management - Maintenance activities - Clean-up
Skid Steer Loader	1	500 hrs/a	- Clean-up
Light Vehicles	2	10,000 km/a (each)	- Transport around site and to/from TLO

2.4 Maintenance Approach

Scheduled maintenance will be programmed to achieve a minimum mechanical/electrical availability of > 90%, while also taking advantage of mining delays or power outages to perform unscheduled maintenance. It is anticipated that scheduled maintenance will occur on a week day at the start or end of a production run to maximise supervision, labour and parts availability. A comprehensive programmed maintenance schedule will be developed to minimise plant breakdowns during scheduled operating time.

The maintenance plan developed during operations readiness will be continuously refined as the nature of the plant's maintenance requirements becomes refined.

A common approach will be taken to maintenance of all fixed and mobile equipment engaged across the business which looks at preventing, predicting and correcting real and potential faults, preventive maintenance and condition monitoring strategies in conjunction with spares management and collaboration with OEM partners for brand specific machines and equipment.

Part of the on-going maintenance approach is optimisation of the strategy with respect to:

- Component and consumable wear rates
- Condition monitoring data and analysis
- Failure mode analysis
- Equipment and circuit performance data trends
- Equipment life cycle operational cost performance
- Remote monitoring data analysis.

Planned maintenance may be carried out at nominated times utilising a combination of site resources, OEM, subcontractors and operational support personnel. Maintenance shift scheduling will be as opportunistic as possible to maximise plant utilisation.

Plant operation la hours area calculated as follows:

Available operational days per year	365 days	
Less public holidays	2 days	
Less Planned Maintenance (fortnightly 12 hour shifts)	<u>13 days</u>	
Scheduled operational days	350 days	= 8,400 hrs
Plant Utilization 95% (no coal, power or water)		7,980 hrs
Plant Availability 90% (unplanned CHPP downtime)		7,200 hrs

2.4.1 Condition Monitoring

Ideally condition monitoring activities will commence during the commissioning stage of the project. Initial readings and measurements at this stage provide an important baseline for monitoring the condition of fixed (and mobile) plant as the plant ages. The following activities will be implemented as soon as practicable:

- Oil Analysis
- Vibration Analysis (Rotating Equipment)
- Crack Detection
- Thermal Imaging (Mechanical – Rotating Equipment)
- Thermal Imaging (Electrical Components, Mechanical Components and MCC)
- Motion Analysis for Screens and Feeders
- Structural Vibration Assessment
- Failure Analysis Investigation and Reporting.

2.4.2 Subcontractor Management

For major plant maintenance tasks, only subcontractors with a proven track record and a demonstrated commitment to safety will be engaged.

All employees of contractors and their subcontractors will be required to meet all site safety requirements. This will include a site safety induction course before beginning work at the CHPP. All contractors shall comply with all site safety rules and the provisions of all statutory regulations.

2.4.3 Unplanned maintenance

The plant operators will handle unplanned maintenance and breakdowns initially, so long as the tasks fall within their authorised capabilities. Operators will include mechanical and electrical tradespeople and will be equipped to handle breakdown repairs and preventative maintenance activities. For more major breakdown repair work, the nominated maintenance subcontractors will be called in to assist in order to minimise the unscheduled down time.

2.5 Consumables

Consumption rates and assumed costs for process consumables are shown in Table 2-5. These usage rates are considered to be industry benchmarks and appropriate for the processes to be used at for the Tenas project.

Cost rates which include transport to site are based on a combination of vendor pricing and client advice.

Appendix A contains documentation which describes the technical details of each consumable.

Table 2-5: Process Consumables Rates

Description	Cost Rate (\$ CDN)	Usage Rate
Magnetite	\$275 /t	1.000 kg/ROM t
Frother (MIBC)	\$3.25 /kg	0.020 kg/ROM t
Diesel (Flotation)	\$0.80 /ltr	0.040 L/ROM t

Diesel (Mobile Fleet)	\$0.80 /ltr	From OEM Manuals
Flocculant	\$5.39 /kg	0.027 kg/ROM t
Coagulant	\$2.22 /kg	0.006 kg/ROM t
TLO Dust Suppressant	\$3.69 /kg	8.25 kg/ rail car
TLO Anti-freeze*	\$1.55 /kg	33.03 kg/rail car
Product Trucks Anti-freeze*	\$1.55/kg	29 kg/ truck
Electricity	\$0.11/kWh	10.90 kWh/ROMt
Propane (Option)	\$0.70/ltr	Currently not used initially

* Anti-freeze assumed only necessary for 6 months each year

2.6 Sampling and Analyses

Coal samples will be collected from the various sampler locations and transported to the local laboratory for analysis. The sample frequency and analyses required are contained in Table 2-6. The laboratory will be manned on dayshift seven days a week with these costs being covered in general administration.

Table 2-6: Sample Frequency & Analyses

Sample Stream	Frequency	Analysis							CV
		RA	SA	VM	IM	TM	FSI	TS	
Plant Feed	12hr	N	Y	N	N	Y	N	Y	Y
Plant Product	4hr	Y	N	N	N	Y	Y	Y	Y
Product Composite	24hr	N	Y	Y	Y	Y	Y	Y	Y
Trains	Train	N	Y	Y	Y	Y	Y	Y	Y
Ships	Hold	N	Y	Y	Y	Y	Y	Y	Y
Ship Composite	Ship	N	Y	Y	Y	Y	Y	Y	Y

* RA = Rapid Ash, SA = Standard Ash, VM = Volatile Matter, IM = Inherent Moisture, TM = Total Moisture, FSI = Free Swelling Index, TS = Total Sulphur, CV = Calorific Value

Other analysis conducted for ship composite:

- Ultimate Analysis
- Mineral Ash
- Petrographic
- Fluidity

Annual audits will be conducted of the DMC and flotation circuits to ensure separation efficiencies are within an acceptable tolerance of that predicted by process modelling.

2.7 CHPP Infrastructure

2.7.1 Power

HV power will be supplied from the grid with the CHPP transformer converting from 25kV down to 600V for reticulation to the various CHPP substations/MCCs.

2.7.2 Water

Raw water will be sourced from the sedimentation pond and will be routed to the clarified water tank adjacent to the CHPP.

2.7.3 Buildings

The CHPP will have access to the following buildings erected as part of the project:

- Offices/crib rooms/change rooms/washrooms
- Maintenance workshop
- Stores facility

3 Operations Readiness

This section summarises the key activities that need to be undertaken in the lead-up to operations commencement (3-6 months prior to first coal). A detailed list of the operations transition and mobilisation activities is shown in Table 3-1.

3.1 Operating Systems

3.1.1 HSE management

A safety management and reporting system is vital for statutory compliance and will be purchased and customised prior to operations commencement. The system will need to be able to manage the following information and processes:

- Incidents and Events (Actual and Potential)
- ICAM management
- Action assignment
- Risk Management
- Inspections and Audits
- Resource Consumption
- Waste Management.

A chemical register and database of all chemicals, substances and any other hazardous product will also be established. The system will be able to produce a range of reports such as:

- Material Safety Data Sheets (MSDS)
- Hazardous substance report
- Dangerous goods report
- Risk assessments
- Stock reports
- Labels for substances.

3.1.2 Training

One of the critical success factors for this operation is the early engagement and development of personnel by endeavouring to recruit early and invest in training to ensure that the appropriate skill set is in place upon commencement of operations.

New recruits will preferably have a trade background but may not have had prior experience in the mining industry or in coal processing plants.

The training will be competency based and will consist of a mixture of classroom learning, practical training and assessment.

3.1.3 Historian Software

An historian software package will be developed which will interface with the site SCADA system and provide the following benefits:

- Production quantity recording which can track coal types and campaigns, report on processed quantities by time period and track stockpile quantities.
- Product quality management will enable tracking of coal quality from the ROM to the TLO.
- Delay recording and reporting to manage availability and assist with downtime investigations.
- Reporting capability to summarise production, quality and operational data

3.1.4 Enterprise Resource Planning

An Enterprise Resource Planning (ERP) system will be developed to manage such aspects of the operation as Human Resources, Finance, Maintenance and Procurement.

3.2 Recruitment

The recruitment requirements for all personnel will be based on the functional requirements for all roles as detailed in the relevant position descriptions. Factors to be considered include:

- Quantification of absolute workforce numbers
- Trade-qualified versus non-trade operators
- Industrial instrument options
- Recruiting strategy
- Shift profiling
- Skills matrix.

3.3 Procurement & Spares

The logistics supply chain for critical items needs to be fully understood and developed well before operations commencement. These items can include:

- Process consumables such as reagents
- Maintenance consumables – spare assemblies and parts
- Strategic and critical spares.

Discussion with vendors should involve location of spares and whether stock can be held on consignment to minimise initial spend.

It is critical that the actual location of parts and material is established, procurement and supply costs are developed, the realistic delivery time to site is determined and evaluated, and any delivery constraints are factored to ensure appropriate site holding requirements are maintained.

A strategic/critical spares analysis needs to be performed which should consider such things as spares availability, delivery times and maximum downtime duration that may be tolerated.

Table 3-1: Operations Transition and Mobilisation Activities

HSE	People	Commercial	Engineering	Operations	
• Safety and Health Management System (SHMS) mapping • Site specific SHMS development • Risk register • Isolation assessment • HAZOP Study • TARP's – Site specific • SWI / SWMS – Site Specific • SOP's – Site specific • JSEA's – Site specific • JSO's – Site specific • Permits and Approval Process • HSE KPI's • Emergency Preparedness – Emergency response – Emergency evacuation planning • Approval and Permits Procedure • PPE / safety requirement review – Clothing type – Additional PPE required • Change management process • HSE audits – Site chemicals – Environmental – Safety equipment supply • Signage audit • Relevant Acts and Regs • Contracts Rights and Obligations review	General • Manning strategy development • Organisational structure development • Role development & Position description • Recruitment – Pre-employment requirements – Functional Capacity assessment – Medicals – Contract offer – Employment advice new starter / IT setup • Site roster development • On-boarding employees to site • PPE issues • Site induction requirements permanent / visitors • Staff Travel Requirements and Strategy Training • HSE induction • Training Needs Analysis (TNA) • Skills Matrix developed • Site training packages – fixed & mobile plant • Timeline for core training to be developed • Supervisor competencies • Job Safety Observation training • Compass • Site authorisations / competencies ER/IR • ERMP development • Enterprise agreement • Common law contracts • Performance plan • Site Access ("Right of Entry")	• Budget structure review and setup • Forecast spend • Contract requirements and obligations • Risk review – Commercial • Bank guarantee • Insurance certificates • Vendor setup/qualifications • KPI's • Client meeting schedules/requirements • Procurement – Mobile equipment – Maintenance spares – Strategic/Critical spares – Operational / Maintenance tooling, equipment & consumables Systems • ERP – Site employee profiles setup as per position description – Cost & profit centre – Asset structure – Preventive maintenance, Statutory & Condition monitoring • Citect – Onsite & remote access • Cintellate site setup • Chemalert site setup • Historian – Production, quality – Delay hierarchy – Reporting config • Site file structure • IT infrastructure	Process • Coal quality data base review – Yield, sizing envelopes – Process model • Product control strategies • Commissioning process plans – Dry, Wet & Feed On • Laboratory requirements – Contract requirements – Sampling requirement and frequency – KPI's obligations • Processing consumables contracts • Full plant process audit – Benchmarking • Start up and shut down procedures • Process monitoring and adjustment procedures • Plant monitoring procedures Maintenance & Reliability • Inspection documentation – Preventive maintenance, Statutory & Condition monitoring • Spares Review / Gap Analysis – Maintenance spares list – Strategic spares list – Critical spares list • Lubrication schedule • Condition monitoring program • Develop registers (crane, reg machinery etc.) • Isolation matrix • Develop BOM's by equipment • Annual Maintenance Plan – Mobile Equipment Regime	Electrical & Controls • Site Electrical Systems Review – Electrical Drawings – Electrical Equipment & Cable Schedules – Instrument and Device Settings – Installation and Equipment Standard Specifications • Site Control System Systems Review – Control System & Plant Control Network Drawings – Control System Manuals , Guidelines and Specifications – Software Management Plan – Control System Support – Control System Disaster Recovery plan – Establish Site Network Connection for Online Remote Support • Electrical and Controls Change Management System • Site Electrical Report review – Power, Fault, and Arc Flash study – Hazardous Area Classification/Dossier – Functional Safety report • Spares Review / Gap Analysis – Critical Spares list – Strategic Spares list – Maintenance Spares list • Statutory Compliance & Audits	• Site utilities / services – Electrical, process/raw/potable water, sewage & air • Site commissioning plan – Dry, Wet & Feed On • Mobile equipment justification – Light Vehicles, loader, dingo, skidsteer, track dozer, etc. • Site radio communications • Identify required procedures via risk assessment • Site shift log sheets • Operator inspection sheets • Reporting and document control • Monthly safety and performance reporting requirements • Logistic supply chain • Accommodation and transportation to site • Risk review – Operational • Site office facility preparation and setup • IT infrastructure and system setup/testing • Process area preparation and setup • Workshop / tooling area preparation and setup • Laydown yard setup and preparation • Lubrication / chemical area preparation and setup • Workshop / maintenance tooling requirements • Operational / maintenance / workshop / office consumables requirements • Asset register development • Operational handover

4 Operations Management

4.1 HSE Management

Operational safety systems and training material will be developed to provide operational teams with the appropriate skills to safely operate this style of infrastructure.

Procedures will be developed in line with the over-arching HSE system and policies and will address such issues as site access and security, drug and alcohol testing, and standard operating procedures.

4.1.1 Environmental management

An Environmental Management Plan will be developed and implemented (to be included in the site HSE plan). The plan will address issues detailed in the Environmental Authority (EA) and will assist with compliance to all of the EA conditions relevant to the works, particularly the following:

- Storage and handling of combustible Liquids.
- Storage and handling of gases, solids and liquids
- Air - dust nuisance.
- Water - release of water and water management.
- Noise and vibration.
- Waste management including recycling.
- Community Complaints,
- Working Groups.

4.1.2 Water management

A Water Management Plan (part of the site HSE plan) shall address the use of all potable water and raw water (including hose water) within the CHPP. The plan will include a method of metering the use of all water within the CHPP, the procedures detailing water recycling, and the disposal of contaminated water.

4.1.3 Training

Training in safe working procedures, plant processes, mobile equipment and other areas is vital to ramp up the operation safely and successfully. Training will meet the needs of the endorsed components of the industry training package as they relate to Canadian and provincial legislation.

Training will be focused around the basic core competencies associated with facility operation and are tailored to each employee's skills, demonstrated capabilities and training requirements. Basic classroom theoretical training is supplemented by practical training in the field. Training documentation and assessments will be compiled to appropriate regulatory requirements of the region and involve determining a participant's theoretical underpinning knowledge as well as demonstrating practical competence.

The training modules developed will include safety training, plant orientation and formative assessment. All training packages will be developed complete with assessment tools, training material, and supporting documentation.

4.2 Production Methodology

A weekly meeting between the Mining and CHPP groups will reconfirm the forecast production and quality requirements. The production plan will primarily be led by mining production and product blending requirements, but will also take into account influences from marketing, coal quality and railings schedules.

The plan will be updated as circumstances dictate and re-confirmed at each shift handover to ensure every production crew is aligned with the targets and maintaining consistent operating conditions.

Site operators will regularly check production settings, trends and consumables usage, with support from technical personnel (either on-site or off-site). Any irregularities will be promptly investigated and rectified to return the system to optimal operating conditions.

The historian system will assist with tracking production campaigns and the status of product stockpile quantity, quality and composition.

4.3 Product Quality Control

Product quality control is achieved by managing a combination of factors, namely:

- Equipment inspections
- Process and circuit efficiency
- Process control and procedures
- Stockpile management and blending
- Testing

4.3.1 Equipment Inspections

Maintenance Period Process Engineering Checks

These inspections generally coincide with maintenance day periods. During these site inspections the process engineer will work with the site based maintenance and operations teams to ensure that the equipment in the process plant are maintained to achieve maximum metallurgical efficiency. From these inspections, predictions into the replacement strategy are made to assist the operations and maintenance teams to maintain the asset to achieve maximum product recovery. An example of the database to be maintained by the process engineer can be seen in Figure 4-1.

Process Inspection Data	
Today's Date	16-June-2016
Inspector	
Inspection Date:	
CHPP Feed Totaliser	t
Update 3W Inspection Update 12W Inspection	
3W Process Inspections	
CCC Basket Width	mm
FCC Basket Width	mm
DMC Spigot Diameter	mm
Desliming Cyclone Spigot Diameter	mm
1st Sievebend Apperture	mm
2nd Sievebend Apperture	mm
Wing Tank Orifice Plate	mm
Comments:	

Figure 4-1: Example of maintenance day inspections completed by process engineers

Operating Process Engineering Checks

During the site inspections, when the process plant is operating the process engineering team will take a series of routine process engineering specific samples and inspections to evaluate the operation of the process plant. These samples enable actual operating data to be easily recorded and reviewed to establish the operation of the process plant under varying feed types and sources. These samples act as a process engineering database of information on how the process plant operates under varying operating conditions. The information will be compared against industry standard operating practices and simulations of the process plant performance. These databases will be routinely utilised to establish the impacts to process plant operation of changes in feed type and quality or operating standards.

Marcy Samples Data Input	
Today's Date	16-June-2016
Inspector	
Inspection Date:	
Time:	t
CHPP Feed Totaliser	Ratio
Feed Source (Primary)	
Feed Source (Blended)	
Feed Rate SP	t/h
Update Marcy Data Instructions Tab Key: Fill in these cells only Calculation	
View Medium Data View Thickener Data	
Operating Conditions	DMC Medium Sample
DMC Feed Pressure	kPa
DMC Feed Pressure	D
Correct Medium SP	RD
Avg Whole fo CHPP Yield	% (ar)
Comments:	
Avg Correct Medium Density Avg DMC OF Medium Density Avg DMC UF Medium Density LOW OF MEDIUM DENSITY - CHECK FOR SURGING!	
Comments:	

Figure 4-2: Example of operational samples completed by process engineers

4.3.2 Process and circuit efficiency

Production sampling is undertaken on a shift basis to track equipment performance and ensure the risk of delivering non-conforming product is minimised. Quality guidelines for each circuit are specified to make certain process plant recovery is optimised while maintaining overall plant product specification.

The laboratory will need to be accredited to guarantee a high standard of analysis. All laboratory staff are required to be trained and deemed competent to complete the task required of a laboratory technician. Quality control samples are analysed alongside plant samples to ensure confidence in results and any deviation must be reported.

All laboratory generated data is checked by the site management and the process engineer to validate the data generated by the laboratory. If abnormalities are detected then further enquiries are made with the laboratory and the site management team to follow and rectify the issue quickly and efficiently.

Regular process audits will also be conducted to provide evidence that at that particular point in time, the plant was performing according to design expectations and that plant yield had been maximised when compared to theoretical models.

Regular samples will be sent to off-site labs to ensure accuracy of data produced by the lab.

4.3.3 Process control and procedures

The process engineer will establish a series of guidelines for the operating team to operate the whole process and individual circuits of the process plant. These include:

- DMC Circuit operating parameters
- Flotation circuit parameters
- Thickener operating parameters.
- Belt Filter Press operating parameters

The operating guidelines will be routinely updated to refine the operation of the process plant with the operations team. Information from the process engineering maintenance period and operational checks will be used to improve the operating guidelines. These updates focus on metallurgical efficiency of the circuits in conjunction with the operability of the plant as a whole. An example of the operating guidelines can be seen in Figure 4-3 & Figure 4-4.

Coal Type A								
Suggested Settings	DMC		Spirals			Flotation		
	Medium-SP	1.35 - 1.56	%	SP401- (ROM)	SP402- (OFFICE)	%	FC501	FC502
			No. Spirals Operating	24	21	Wash Water (m ³ /h)	100 - 120	
	Target Feed Pressure (D)	7 - 8				Vacuum Pressure (kPa)	-5 to -10	
			Prod-Cutter Position	1 - 6		Cell Level (mm)	150 - 250	
						Air Flow (m ³ /h)	700 - 800	
	Feed Pressure (kPa)	150 - 170	Middlings to	Reject		Diesel (g/t)	250 - 350	
			Water Addition	Keep SM405 level below 70%		MIBC (PPM)	10 - 14	

Figure 4-3: Example of summary operating guideline charts

Coarse and Medium Circuit					
	Coal Type A	Coal Type B	Coal Type C	Coal Type D	Comments
DMC					
Primary DMC sg starting	1.35 to 1.56 SG (Refer to summary charts for previous wash parameters)	1.35 to 1.56 SG (Refer to summary charts for previous wash parameters)	1.35 to 1.56 SG (Refer to summary charts for previous wash parameters)	1.38 to 1.50 SG (Refer to summary charts for previous wash parameters)	On start up or coal type change conduct a 1 hour product ash sample on start up to determine product ash (if required). Check cumulative ash calculations to ensure ash is within target. Adjust as per the following: - If campaign ash is within +/- 0.3%, leave density as is; - If campaign ash is within +/- 0.4% to +/- 1.0%, change density by 0.01 SG; - If campaign ash is greater than +/- 1.0%, change density by 0.02 SG, plus another 0.01 SG for every 1% beyond +/-1.0%. If changes to density are no longer changing product ash, the following can be looked at: 1. Change spiral cutter position; 2. Change flotation settings - diesel, MIBC, cell height, air volume Note: Wait for two consecutive results outside of the ash target before making a change unless instructed by the client.
Primary DMC operating head	Target 7D-8.5D				Typically need to run at 104%-108% VSD setting to achieve the 7D-8.5D. (higher density will equate to lower operating D at the same pump speed, and vice versa) - MAX VSD setting is 108%. Minimum operating pressure is 70kPa. Standard Checks 1. Check DMC pump current versus full load current when any change to density or VSD settings have been made 2. Check that the head pressure is maintained when the density is changed
Medium Circuit					
Bleed valve	50% (20% - 65%)				Aim to run bleed as low as possible to achieve water addition on density control valve between 20-30% There is a condition when feed is off the bleed valve automatically goes to 20%, when feed goes back on the bleed valve will return to previous setting.

Figure 4-4: Example of plant operational guidelines

The operator guidelines include how to 'chase' product specifications if the results are not at desired specifications. An example can be seen in Figure 4-5.

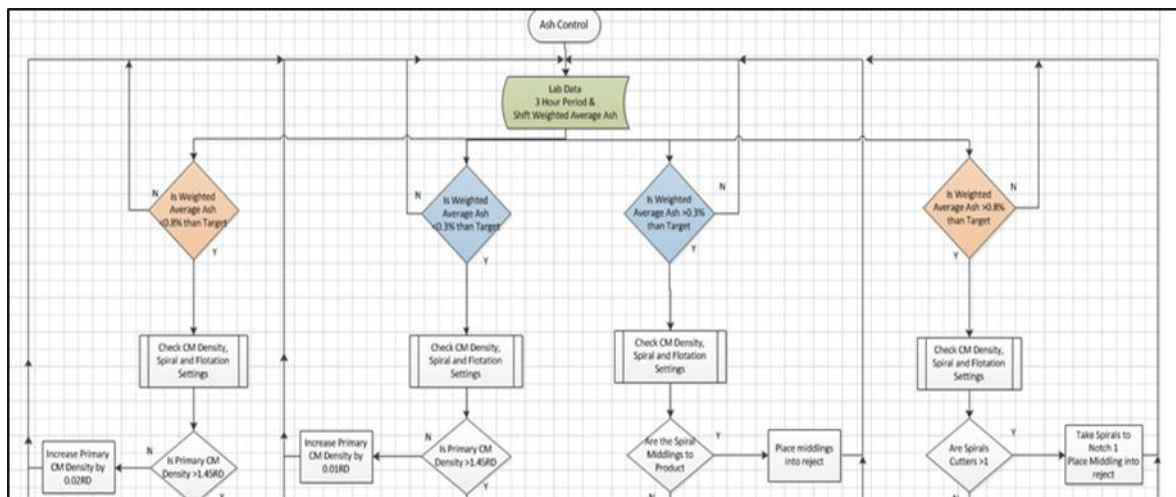


Figure 4-5: Example for ash control guidelines for operating crews

4.3.4 Stockpile management and blending

As the raw coal will be campaigned through the plant the seams will be blended on the product stockpiles. At any point in time, the quantity and quality of the product coal stockpiles will be known based on the cumulative weighted average of ash and sulphur measurements as taken of the CPP product samples. This data will be used to manage and blend certain piles to ensure that railed product is as close to that required for the particular cargo being assembled.

ROM stockpiles will be managed to ensure they are maintained in a safe condition within RL constraints, such that both further dumping of ROM material, and reclaim by the CHPP loader can be conducted in a safe manner.

CPP product and rock piles will be loaded out as required with haul trucks able to drive adjacent to them for loading. Should there be periods of haulage delays, the piles will be spread out using the front end loaders to ensure the product coal and rock stackers do not become stockpile bound.

The train loadout stockpile will be formed by paddock dumping product coal adjacent to the rail siding. Two (2) front end loaders have been allocated to prepare the piles prior to each train arriving to minimise tramming distance during train loading.

4.4 Operating Procedures

Site-specific operating procedures will be developed to enable the plant operators to optimise the product recovery process. These procedures will include but are not limited to:

- Standard operating procedures
- Start-up and shutdown procedures
- Process monitoring procedures
- Process adjustment procedures
- Inspection schedules
- Lubrication schedules

Recording of significant plant changes during a shift will be documented on production reports, delay sheets, and logbooks which are generated by the plant supervisory system and by the plant operators as appropriate.

4.5 Reporting

The data collated by the historian system will be utilised by the site management team to report on the performance of the plant with daily, weekly, monthly or annual reports able to be configured. The following items can be included in the various report as appropriate to the time scale:

- ROM and product tonnage breakdown
- ROM and Product quality by stockpile and railed and shipped
- Product recovery
- Consumable Usage
- Availability measures and delay analysis
- Maintenance activities

4.6 Interface Management

4.6.1 Mining Services

The Mining team will deliver ROM coal to the ROM pad and will maintain separate coal stockpiles as required to manage different coal types. ROM pad dust suppression and grading will also be the responsibility of the mining group.

The mining team will also provide a TLO operator to assist with train loading as required, and facilitate the transport of one of the front end loaders to the TLO facility prior to train arrivals and return upon completion.

4.6.2 Rail Services

The product coal produced by the Tenas Project will be loaded onto 116 car unit trains supplied by Canadian National Railway. CN will drop off rail cars and will pick them up when the train is loaded by Telkwa Coal Limited. TCL will be responsible for the supply of leased cars for this use.

Depending on the turn around time required and if the train is required by other coal producers, either CN will provide locomotive power or TCL will provide locomotive power. The current target time for loading a 116 car unit train is between 10 and 12 hours. Telkwa coal will be responsible for moving the train around the loop and ensuring that the rail cars are not overloaded. Furthermore, TCL will be responsible for the addition of chemical topper agents to prevent fugitive dust and side release chemicals to assist with dumping the coal out of the rail cars. CN will provide the following:

- Scale weights for the trains,
- Link to see location of train within the CN network
- Crews to drop train off and pick train up from the rail loop in Telkwa, BC

4.6.3 Port Services

The product coal produced by the Tenas Project will be loaded at Ridley Terminals in Price Rupert. Ridley Terminals will be responsible for unloading, stockpiling, loading of vessels and stockpile surveys.

At the port a 3rd party will be contracted to undertake the following tasks:

- Draft surveys for tonnages
- Hold inspections prior to loading
- Coal Sampling
- Coal Quality Test work



Appendix A

Consumable Data Sheets

1. Supply Description: Coal Washery Magnetite

- A high purity magnetic iron oxide
- Chemical Formula Fe_3O_4

2. Typical Specifications for Coal Washery Magnetite

Microns	Grade					
	Maxifine	Ultrafine	Superfine	Fine	Medium	Coarse
+150	0.0	0.0	0.2	0.3	1.1	15.6
+75	0.4	0.7	1.6	3.9	12.1	33.7
+63	0.7	1.5	3.2	7.0	17.9	38.3
+53	1.2	2.4	5.4	10.7	23.3	44.7
+45	1.9	4.4	9.7	16.0	29.0	46.0
+38	7.5	9.9	18.2	25.7	39.1	54.7
+28	27.9	32.0	38.2	45.3	53.4	69.0
+21	43.5	48.4	53.2	60.0	67.4	76.0
+15	59.1	63.1	66.3	72.5	77.9	82.1
+10	70.6	73.7	75.8	80.8	84.8	87.1
+7	78.2	80.5	81.7	85.7	88.8	90.0
Nominal - 53µm						
Range	98-100%	95-99%	92-95%	85-90%	65-75%	50-60%
Nominal - 45µm						
Range	94-99%	92-96%	86-92%	80-86%	60-72%	45-55%
Wet sieve analysis to 38 micron. Finer sizing by Cyclosizer.						

3. Typical Chemical Analysis

SiO_2	1.4%
Al_2O_3	0.8%
Total Fe	69.5%
Fe_3O_4	95.0%
Free Fe_2O_3	1.0%
S	0.2%
P	0.02%
Cu	0.005%
H_2O (110°C)	10.0% maximum
	7.0% typical

4. Typical Magnetic Properties

- Saturation Moment > 80 e.m.u./g, (83.5 typical)
- Susceptibility @ 800 Oersteds > 0.050 e.m.u./oe/g, (0.053 typical)
- Coercive Force < 40 Oersteds, (33.0 typical)
- The above figures are as determined by Acirl Ltd on the 45 x 38 micron fraction

5. Typical Physical Properties

Specific gravity	4.9 minimum
	5.0 typical
Magnetic content: (Davis Tube, 700 gauss)	96% minimum
	98% typical
Packing density:	
Compacted (kg/m^3)	2,800
Loose (kg/m^3)	1,600



SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name MAGNETITE
Synonym(s) COAL WASHING MAGNETITE • IRON OXIDE BLACK

1.2 Uses and uses advised against

Use(s) HEAVY MEDIUM FOR COAL WASHING

1.3 Details of the supplier of the product

Supplier name MT MOSS MINING PTY LTD
Address 22 Ross Street, South Townsville, QLD, 4810, AUSTRALIA
Telephone (07) 4777 5041
Fax (07) 4777 5045
Email main@curtainbros.com.au
Website <http://www.mtmossmining.com.au>

1.4 Emergency telephone number(s)

Emergency (07) 4750 6222

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO AUSTRALIAN WHS REGULATIONS

2.2 Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
MAGNETITE	73905-81-4	-	96%
QUARTZ (CRYSTALLINE SILICA)	14808-60-7	238-878-4	1.4%
CALCIUM OXIDE	1305-78-8	215-138-9	0.42%
NON HAZARDOUS INGREDIENTS	Not Available	Not Available	Remainder
MAGNESIUM OXIDE	1309-48-4	215-171-9	0.11%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water.

PRODUCT NAME MAGNETITE

Ingestion	For advice, contact a Poison Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.
First aid facilities	Eye wash facilities and safety shower are recommended.

4.2 Most important symptoms and effects, both acute and delayed

Symptoms and effects are generally associated with chronic exposure and not acute. May cause damage to lungs through prolonged or repeated inhalation.

4.3 Immediate medical attention and special treatment needed

None known. Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture

Non flammable. May evolve iron oxides when heated to decomposition.

5.3 Advice for firefighters

Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code

None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Avoid generating dust. Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS.

6.2 Environmental precautions

Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (soil, sewers, waterways or air).

6.3 Methods of cleaning up

Collect spilled material and return to process if possible. If dusty process use personal protective equipment.

6.4 Reference to other sections

See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities

No special requirements for the storage of this product, however ensure that product is stored in such a way that dust generation is minimised.

7.3 Specific end use(s)

No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m ³	ppm	mg/m ³
Calcium oxide	SWA (AUS)	--	2	--	--
Iron oxide fume (Fe ₂ O ₃) (as Fe)	SWA (AUS)	--	5	--	--
Magnesium oxide (fume)	SWA (AUS)	--	10	--	--
Quartz (respirable dust)	SWA (AUS)	--	0.1	--	--

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain dust levels below the recommended exposure standard.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	Not required under normal conditions of use.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.



9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	BLACK POWDER
Odour	ODOURLESS
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	NOT AVAILABLE
Melting point	NOT AVAILABLE
Evaporation rate	NOT AVAILABLE
pH	NOT AVAILABLE
Vapour density	NOT AVAILABLE
Specific gravity	4.9 (Approximately)
Solubility (water)	INSOLUBLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Non-reactive.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with strong acids (e.g. nitric acid).

10.6 Hazardous decomposition products

May evolve iron oxides when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity	Information available for the product: No known toxicological effects from this product. Based on available data, the classification criteria are not met.
Skin	This product may cause mechanical skin irritation.
Eye	This product may cause mechanical eye irritation.
Sensitization	Not classified as causing skin or respiratory sensitisation.
Mutagenicity	Not classified as a mutagen.
Carcinogenicity	This product contains crystalline silica which is classified as carcinogenic to humans (IARC Group 1). However, there is sufficient information to conclude that the relative risk of lung cancer is increased in persons with silicosis. Therefore, preventing the onset of silicosis will also reduce the cancer risk.
Reproductive	Not classified as a reproductive toxin.
STOT – single exposure	No data were identified for this product or its constituents.
STOT – repeated exposure	Product may contain a form of crystalline silica which is known to cause organ damage by prolonged or repeated exposure. Respiratory exposure to crystalline silica can cause silicosis, a condition of progressive fibrosis (scarring) in the lung parenchyma. Long term inhalation of high concentrations of iron oxide dusts can result in a benign pneumoconiosis (siderosis) detectable on chest x-rays.
Aspiration	This product is a solid and aspiration hazards are not expected to occur.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Fish: There are no fish studies available of sufficient quality and reliability.

Invertebrates: Daphnia magna EC50 (48 h): > 10000 mg iron oxide (Fe₃O₄) /L (nominal) based on mobility (OECD 202). There are no long-term studies available of sufficient quality and reliability.

Algae and Plants: There are no algae studies available of sufficient quality and reliability.

12.2 Persistence and degradability

Not relevant for naturally-occurring inorganic compounds.

12.3 Bioaccumulative potential

The material and its components are not expected to bioaccumulate.

12.4 Mobility in soil

Not relevant for naturally-occurring inorganic compounds.

12.5 Other adverse effects

None known.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Reuse where possible. No special precautions are normally required when handling this product.

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None Allocated	None Allocated	None Allocated
14.2 Proper Shipping Name	None Allocated	None Allocated	None Allocated
14.3 Transport hazard class	None Allocated	None Allocated	None Allocated
14.4 Packing Group	None Allocated	None Allocated	None Allocated

14.5 Environmental hazards No information provided

14.6 Special precautions for user

Hazchem code None Allocated

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule	A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).
Classifications	Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals. The classifications and phrases listed below are based on the Approved Criteria for Classifying Hazardous Substances [NOHSC: 1008(2004)].
Hazard codes	None allocated.
Risk phrases	None allocated.
Safety phrases	None allocated.
Inventory listing(s)	AUSTRALIA: AICS (Australian Inventory of Chemical Substances) All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information	RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary. EXPOSURE STANDARDS - TIME WEIGHTED AVERAGE (TWA) or WES (WORKPLACE EXPOSURE STANDARD) (NZ): Exposure standards are established on the premise of an 8 hour work period of normal intensity, under normal climatic conditions and where a 16 hour break between shifts exists to enable the body to eliminate absorbed contaminants. In the following circumstances, exposure standards must be reduced: Strenuous work conditions; hot, humid climates; high altitude conditions; extended shifts (which increase the exposure period and shorten the period of recuperation). PERSONAL PROTECTIVE EQUIPMENT GUIDELINES: The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.
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HEALTH EFFECTS FROM EXPOSURE:

It should be noted that the effects from exposure to this product will depend on several factors including: frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a ChemAlert report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m ³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

Prepared by

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[End of SDS]

Safety Data Sheet



Hazardous Substance, Dangerous Goods

1. MATERIAL AND SUPPLY COMPANY IDENTIFICATION

Product name: Methyl Isobutyl Carbinol

Recommended use: Ore flotation (Copper, zinc, lead), coal dust flotation, paints and varnish, organic synthesis.

Supplier: Interchem Pty Ltd

ABN: 74 057 313 630

Street Address: 20 Harper Street
PO Box 101
Abbotsford VIC 3067
Australia

Telephone: +61 3 9270-9600

Facsimile: +61 3 9270-9666

Email: info@interchem.com.au

Website: www.interchem.com.au

Emergency telephone number: Australia: 1800 033 111, +61 3 9663-2130
New Zealand: 0800 734 607, +64 4 473 4607

2. HAZARDS IDENTIFICATION

This material is hazardous according to health criteria of Safe Work Australia.



Signal Word

Warning

Hazard Classifications

Flammable Liquids - Category 3

Serious Eye Damage/Irritation - Category 2A

Specific Target Organ Toxicity (Single Exposure) - Category 3 Respiratory Tract Irritation

Hazard Statements

H226 Flammable liquid and vapour.
H319 Causes serious eye irritation.
H335 May cause respiratory irritation.

Prevention Precautionary Statements

P102 Keep out of reach of children.
P103 Read label before use.
P210 Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233 Keep container tightly closed.
P240 Ground/bond container and receiving equipment.
P241 Use explosion-proof electrical, ventilating, lighting and all other equipment.
P242 Use only non-sparking tools.
P243 Take precautionary measures against static discharge.
P261 Avoid breathing dust, fume, gas, mist, vapours or spray..
P264 Wash hands, face and all exposed skin thoroughly after handling.
P271 Use only outdoors or in a well-ventilated area.
P280 Wear protective clothing, gloves, eye/face protection and suitable respirator.

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Response Precautionary Statements

- P101 If medical advice is needed, have product container or label at hand.
- P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
- P304+P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
- P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- P312 Call a POISON CENTER or doctor/physician if you feel unwell.

Storage Precautionary Statements

- P403+P233 Store in a well-ventilated place. Keep container tightly closed.
- P405 Store locked up.

Disposal Precautionary Statement

- P501 Dispose of contents/container in accordance with local, regional, national and international regulations.

Poison Schedule: Not Applicable

DANGEROUS GOOD CLASSIFICATION

Classified as Dangerous Goods by the criteria of the "Australian Code for the Transport of Dangerous Goods by Road & Rail" and the "New Zealand NZS5433: Transport of Dangerous Goods on Land".

Dangerous Goods Class: 3

3. COMPOSITION INFORMATION

CHEMICAL ENTITY	CAS NO	PROPORTION
2-Pentanol, 4-methyl- Ingredients determined to be non-hazardous	108-11-2	>98-5 % (w/w) Balance 100%

4. FIRST AID MEASURES

If poisoning occurs, contact a doctor or Poisons Information Centre (Phone Australia 131 126, New Zealand 0800 764 766).

Inhalation: Remove victim from exposure - avoid becoming a casualty. Remove contaminated clothing and loosen remaining clothing. Allow patient to assume most comfortable position and keep warm. Keep at rest until fully recovered. Seek medical advice if effects persist.

Skin Contact: If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. If swelling, redness, blistering or irritation occurs seek medical assistance. For gross contamination, immediately drench with water and remove clothing. Continue to flush skin and hair with plenty of water (and soap if material is insoluble). For skin burns, cover with a clean, dry dressing until medical help is available. If blistering occurs, do NOT break blisters. If swelling, redness, blistering, or irritation occurs seek medical assistance.

Eye contact: If in eyes, hold eyelids apart and flush the eyes continuously with running water. Continue flushing until advised to stop by the Poisons Information Centre or a Doctor; or for at least 15 minutes and transport to Doctor or Hospital.

Ingestion: Rinse mouth with water. If swallowed, do NOT induce vomiting. Give a glass of water to drink. Never give anything by the mouth to an unconscious patient. If vomiting occurs give further water. Seek medical

Safety Data Sheet



advice.

Notes to physician: Treat symptomatically.

5. FIRE FIGHTING MEASURES

Hazchem Code: •3Y

Suitable extinguishing media: If material is involved in a fire use alcohol resistant foam or dry agent (carbon dioxide, dry chemical powder).

Specific hazards: Flammable liquid and vapour. May form flammable vapour mixtures with air. Flameproof equipment necessary in area where this chemical is being used. Nearby equipment must be earthed. Electrical requirements for work area should be assessed according to AS3000. Vapour may travel a considerable distance to source of ignition and flash back. Avoid all ignition sources. All potential sources of ignition (open flames, pilot lights, furnaces, spark producing switches and electrical equipment etc) must be eliminated both in and near the work area. Do NOT smoke.

Fire fighting further advice: Heating can cause expansion or decomposition leading to violent rupture of containers. If safe to do so, remove containers from path of fire. Keep containers cool with water spray. On burning or decomposing may emit toxic fumes. Fire fighters to wear self-contained breathing apparatus and suitable protective clothing if risk of exposure to vapour or products of combustion or decomposition.

6. ACCIDENTAL RELEASE MEASURES

SMALL SPILLS

Wear protective equipment to prevent skin and eye contamination. Avoid inhalation of vapours or dust. Wipe up with absorbent (clean rag or paper towels). Collect and seal in properly labelled containers or drums for disposal.

LARGE SPILLS

If safe to do so, shut off all possible sources of ignition. Clear area of all unprotected personnel. Slippery when spilt. Avoid accidents, clean up immediately. Wear protective equipment to prevent skin and eye contamination and the inhalation of vapours. Work up wind or increase ventilation. Contain - prevent run off into drains and waterways. Use absorbent (soil, sand or other inert material). Use a spark-free shovel. Collect and seal in properly labelled containers or drums for disposal. If contamination of crops, sewers or waterways has occurred advise local emergency services.

Dangerous Goods – Initial Emergency Response Guide No: 17

7. HANDLING AND STORAGE

Handling: Avoid eye contact and repeated or prolonged skin contact. Avoid inhalation of vapour, mist or aerosols.

Storage: Store in a cool, dry, well-ventilated place and out of direct sunlight. Store away from foodstuffs. Store away from incompatible materials described in Section 10. Store away from sources of heat and/or ignition. Store locked up. Keep container standing upright. Keep containers closed when not in use - check regularly for leaks.

This material is classified as a Class 3 Flammable Liquid as per the criteria of the "Australian Code for the Transport of Dangerous Goods by Road & Rail" and/or the "New Zealand NZS5433: Transport of Dangerous Goods on Land" and must be stored in accordance with the relevant regulations.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Safety Data Sheet



National occupational exposure limits:

	TWA		STEL		NOTICES
	ppm	mg/m3	ppm	mg/m3	
Methyl isobutyl carbinol 108-11-2	25	104	40	167	Sk

As published by Safe Work Australia.

TWA - The time-weighted average airborne concentration over an eight-hour working day, for a five-day working week over an entire working life.

STEL (Short Term Exposure Limit) - the average airborne concentration over a 15 minute period which should not be exceeded at any time during a normal eight-hour workday.

'Sk' Notice - absorption through the skin may be a significant source of exposure. The exposure standard is invalidated if such contact should occur.

These Exposure Standards are guides to be used in the control of occupational health hazards. All atmospheric contamination should be kept too as low a level as is workable. These exposure standards should not be used as fine dividing lines between safe and dangerous concentrations of chemicals. They are not a measure of relative toxicity.

If the directions for use on the product label are followed, exposure of individuals using the product should not exceed the above standard. The standard was created for workers who are routinely, potentially exposed during product manufacture.

Biological Limit Values: As per the "National Model Regulations for the Control of Workplace Hazardous Substances (Safe Work Australia)" the ingredients in this material do not have a Biological Limit Allocated.

Engineering Measures: Ensure ventilation is adequate to maintain air concentrations below Exposure Standards. Use only in well ventilated areas. Use with local exhaust ventilation or while wearing appropriate respirator. Vapour heavier than air - prevent concentration in hollows or sumps. Do NOT enter confined spaces where vapour may have collected.

Personal Protection Equipment: SAFETY SHOES, OVERALLS, GLOVES, CHEMICAL GOGGLES, RESPIRATOR.

Wear safety shoes, overalls, gloves, chemical goggles, respirator. Use with adequate ventilation. If inhalation risk exists wear organic vapour/particulate respirator meeting the requirements of AS/NZS 1715 and AS/NZS 1716. Available information suggests that gloves made from nitrile rubber should be suitable for intermittent contact. However, due to variations in glove construction and local conditions, the user should make a final assessment. Always wash hands before smoking, eating, drinking or using the toilet. Wash contaminated clothing and other protective equipment before storing or re-using.

Hygiene measures: Keep away from food, drink and animal feeding stuffs. When using do not eat, drink or smoke. Wash hands prior to eating, drinking or smoking. Avoid contact with clothing. Avoid eye contact and repeated or prolonged skin contact. Avoid inhalation of vapour, mist or aerosols. Ensure that eyewash stations and safety showers are close to the workstation location.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form: Liquid
Colour: Colourless
Odour: Characteristic

Solubility: Soluble in water
Specific Gravity (20 °C): 0.808
Relative Vapour Density (air=1): 3.52
Vapour Pressure (20 °C): 3.7 hPa @ 20 oC

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Flash Point (°C):	41
Flammability Limits (%):	1 - 5.5
Autoignition Temperature (°C):	335
Melting Point/Range (°C):	-90
Boiling Point/Range (°C):	131.6
pH:	N App
Viscosity:	4.074 mPa.s @ 25 oC
Evaporation Rate (n-Butyl acetate=1):	0.26
Total VOC (g/Litre):	N Av

(Typical values only - consult specification sheet)
N Av = Not available, N App = Not applicable

10. STABILITY AND REACTIVITY

Chemical stability: This material is thermally stable when stored and used as directed.

Conditions to avoid: Elevated temperatures and sources of ignition.

Incompatible materials: Oxidising agents.

Hazardous decomposition products: Oxides of carbon and nitrogen, smoke and other toxic fumes.

Hazardous reactions: No known hazardous reactions.

11. TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with this Safety Data Sheet and the product label. Symptoms or effects that may arise if the product is mishandled and overexposure occurs are:

Acute Effects

Inhalation: Material is an irritant to mucous membranes and respiratory tract.

Skin contact: Contact with skin may result in irritation.

Ingestion: Swallowing can result in nausea, vomiting and irritation of the gastrointestinal tract.

Eye contact: An eye irritant.

Acute toxicity

Inhalation: This material has been classified as non-hazardous. Acute toxicity estimate (based on ingredients): >20 mg/L

Skin contact: This material has been classified as non-hazardous. Acute toxicity estimate (based on ingredients): >2,000 mg/Kg

Ingestion: This material has been classified as non-hazardous. Acute toxicity estimate (based on ingredients): >2,000 mg/Kg

Corrosion/Irritancy: Eye: this material has been classified as a Category 2A Hazard (reversible effects to eyes). Skin: this material has been classified as not corrosive or irritating to skin.

Sensitisation: Inhalation: this material has been classified as not a respiratory sensitiser. Skin: this material has been classified as not a skin sensitiser.

Aspiration hazard: This material has been classified as non-hazardous.

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Specific target organ toxicity (single exposure): This material has been classified as a Category 3 Hazard. Exposure via inhalation may result in respiratory irritation.

Chronic Toxicity

Mutagenicity: This material has been classified as non-hazardous.

Carcinogenicity: This material has been classified as non-hazardous.

Reproductive toxicity (including via lactation): This material has been classified as non-hazardous.

Specific target organ toxicity (repeat exposure): This material has been classified as non-hazardous.

12. ECOLOGICAL INFORMATION

Avoid contaminating waterways.

Acute aquatic hazard: This material has been classified as non-hazardous. Acute toxicity estimate (based on ingredients): >100 mg/L

Long-term aquatic hazard: This material has been classified as non-hazardous. Non-rapidly or rapidly degradable substance for which there are adequate chronic toxicity data available OR in the absence of chronic toxicity data, Acute toxicity estimate (based on ingredients): >100 mg/L, where the substance is not rapidly degradable and/or BCF < 500 and/or log K_{ow} < 4.

Ecotoxicity: No information available.

Persistence and degradability: No information available.

Bioaccumulative potential: No information available.

Mobility: No information available.

13. DISPOSAL CONSIDERATIONS

Persons conducting disposal, recycling or reclamation activities should ensure that appropriate personal protection equipment is used, see "Section 8. Exposure Controls and Personal Protection" of this SDS.

If possible material and its container should be recycled. If material or container cannot be recycled, dispose in accordance with local, regional, national and international Regulations.

14. TRANSPORT INFORMATION

ROAD AND RAIL TRANSPORT

Classified as Dangerous Goods by the criteria of the "Australian Code for the Transport of Dangerous Goods by Road & Rail" and the "New Zealand NZS5433: Transport of Dangerous Goods on Land".



UN No:	2053
Dangerous Goods Class:	3
Packing Group:	III
Hazchem Code:	•3Y
Emergency Response Guide No:	17

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Proper Shipping Name: METHYL ISOBUTYL CARBINOL

Segregation Dangerous Goods: Not to be loaded with explosives (Class 1), flammable gases (Class 2.1), if both are in bulk, toxic gases (Class 2.3), spontaneously combustible substances (Class 4.2), oxidising agents (Class 5.1), organic peroxides (Class 5.2), toxic substances (Class 6.1), infectious substances (Class 6.2) or radioactive substances (Class 7). Exemptions may apply.

MARINE TRANSPORT

Classified as Dangerous Goods by the criteria of the International Maritime Dangerous Goods Code (IMDG Code) for transport by sea.



UN No: 2053
Dangerous Goods Class: 3
Packing Group: III

Proper Shipping Name: METHYL ISOBUTYL CARBINOL

AIR TRANSPORT

Classified as Dangerous Goods by the criteria of the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air.



UN No: 2053
Dangerous Goods Class: 3
Packing Group: III

Proper Shipping Name: METHYL ISOBUTYL CARBINOL

15. REGULATORY INFORMATION

HSNO Group Standard: HSR002495 - Additives, Process Chemicals and Raw Materials (Flammable) Group Standard 2006

This material is not subject to the following international agreements:

Montreal Protocol (Ozone depleting substances)
The Stockholm Convention (Persistent Organic Pollutants)
The Rotterdam Convention (Prior Informed Consent)
International Convention for the Prevention of Pollution from Ships (MARPOL)

This material is subject to the following international agreements:

Basel Convention (Hazardous Waste)
• Organic solvents excluding halogenated solvents

This material/constituent(s) is covered by the following requirements:

• All the constituents of this material are listed on the *Australian Inventory of Chemical Substances* (AICS).

16. OTHER INFORMATION

Literary reference

This MSDS has been prepared by Chemical Data Services Pty Ltd (chemdata.com.au) on behalf of its client.

Reason for issue: First issue

Material Safety Data Sheets are updated frequently. Please ensure that you have a current copy.

This MSDS summarises at the date of issue our best knowledge of the health and safety hazard information of the product, and in particular how to safely handle and use the product in the workplace. Since Interchem Pty Ltd cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, review this MSDS in the context of how the user intends to handle and use the product in the workplace.

If clarification or further information is needed to ensure that an appropriate assessment can be made, the user should contact this company.

Our responsibility for product as sold is subject to our standard terms and conditions, a copy of which is sent to our customers and is also available upon request.

SAFETY DATA SHEET

Automotive Diesel Fuel



Section 1. Identification

GHS product identifier	Automotive Diesel Fuel
Other means of identification	G10, BP 10 ppm diesel fuel, Ultra Low Sulphur diesel Fuel, Automotive Diesel Fuel AD 20, AD40, ALPINE DIESEL, Biodiesel B5
Product code	0000002718
SDS no.	0000002718
Historic SDS no.	AD0K1
<u>Relevant identified uses of the substance or mixture and uses advised against</u>	
Use of the substance/ mixture	Fuel for compression ignition diesel engines.
Manufacturer	
Supplier	BP Australia Pty Ltd Level 17, 717 Bourke Street Docklands, Victoria 3008 ABN 53 004 085 616 www.bp.com.au Technical Helpline Number: 1300 139 700
EMERGENCY TELEPHONE NUMBER	1800 638 556

Section 2. Hazard(s) identification

Classification of the substance or mixture	FLAMMABLE LIQUIDS - Category 4 ACUTE TOXICITY (inhalation) - Category 4 SKIN CORROSION/IRRITATION - Category 2 CARCINOGENICITY - Category 2 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (bone marrow, liver and thymus) - Category 2 ASPIRATION HAZARD - Category 1
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GHS label elements

Hazard pictograms



Signal word

DANGER

Hazard statements

H227 - Combustible liquid.
H332 - Harmful if inhaled.
H315 - Causes skin irritation.
H351 - Suspected of causing cancer.
H304 - May be fatal if swallowed and enters airways.
H373 - May cause damage to organs through prolonged or repeated exposure. (bone marrow, liver, thymus)

Precautionary statements

General

P103 - Read label before use.
P102 - Keep out of reach of children.
P101 - If medical advice is needed, have product container or label at hand.

Product name Automotive Diesel Fuel

Product code 0000002718

Page: 1/13

Version 1 **Date of issue** 07/04/2016

Format Australia

Language ENGLISH

(Australia)

(ENGLISH)

Section 2. Hazard(s) identification

Prevention	P201 - Obtain special instructions before use. P260 - Do not breathe vapour. P280 - Wear protective gloves. Wear eye or face protection. Wear protective clothing. P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. P241 - Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. P273 - Avoid release to the environment.
Response	P314 - Get medical attention if you feel unwell. P308 + P313 - IF exposed or concerned: Get medical attention. P304 + P340 + P312 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or physician if you feel unwell. P301 + P310 + P331 - IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting. P302 + P352 + P362-2 + P363 - IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing. Wash contaminated clothing before reuse. P332 + P313 - If skin irritation occurs: Get medical attention.
Storage	P405 - Store locked up. P403 - Store in a well-ventilated place. P235 - Keep cool.
Disposal	P501 - Dispose of contents and container in accordance with all local, regional, national and international regulations.
Supplemental label elements	Not applicable.
Other hazards which do not result in classification	This material may contain significant quantities of polycyclic aromatic hydrocarbons, some of which have been shown by experimental studies to induce skin cancer. Note: High Pressure Applications Injections through the skin resulting from contact with the product at high pressure constitute a major medical emergency. See 'Notes to physician' under First-Aid Measures, Section 4 of this Safety Data Sheet.

Section 3. Composition and ingredient information

Substance/mixture	Mixture	
May contain Fatty Acid Methyl Esters (FAME). May also contain small quantities of proprietary performance additives. Contains small quantities of polycyclic aromatic hydrocarbons (PAHs).		
Ingredient name	% (w/w)	CAS number
Fuels, diesel	> 95	68334-30-5
Alkanes, C10-20-branched and linear	0 - 20	928771-01-1

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Check for and remove any contact lenses. Get medical attention.
Inhalation	If inhaled, remove to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention.

Product name	Automotive Diesel Fuel	Product code	0000002718	Page:	2/13
Version	1	Date of issue	07/04/2016	Format	Australia
					(Australia)
				Language	ENGLISH
					(ENGLISH)

Section 4. First aid measures

Skin contact

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Clean shoes thoroughly before reuse. Drench contaminated clothing with water before removing. This is necessary to avoid the risk of sparks from static electricity that could ignite contaminated clothing. Contaminated clothing is a fire hazard. Contaminated leather, particularly footwear, must be discarded. Get medical attention.

Ingestion

Do not induce vomiting. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Aspiration hazard if swallowed. Can enter lungs and cause damage. Get medical attention immediately.

Most important symptoms/effects, acute and delayed

See Section 11 for more detailed information on health effects and symptoms.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician

Treatment should in general be symptomatic and directed to relieving any effects. Product can be aspirated on swallowing or following regurgitation of stomach contents, and can cause severe and potentially fatal chemical pneumonitis, which will require urgent treatment. Because of the risk of aspiration, induction of vomiting and gastric lavage should be avoided. Gastric lavage should be undertaken only after endotracheal intubation. Monitor for cardiac dysrhythmias.

Note: High Pressure Applications

Injections through the skin resulting from contact with the product at high pressure constitute a major medical emergency. Injuries may not appear serious at first but within a few hours tissue becomes swollen, discoloured and extremely painful with extensive subcutaneous necrosis.

Surgical exploration should be undertaken without delay. Thorough and extensive debridement of the wound and underlying tissue is necessary to minimise tissue loss and prevent or limit permanent damage. Note that high pressure may force the product considerable distances along tissue planes.

Specific treatments

No specific treatment.

Protection of first-aiders

No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Section 5. Firefighting measures

Extinguishing media

Suitable extinguishing media

In case of fire, use water fog, foam, dry chemical or carbon dioxide extinguisher or spray.

Unsuitable extinguishing media

Do not use water jet.

Specific hazards arising from the chemical

Combustible liquid. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. Runoff to sewer may create fire or explosion hazard.

Hazardous thermal decomposition products

Combustion products may include the following:
carbon dioxide
carbon monoxide
other hazardous substances.

Section 5. Firefighting measures

Special protective actions for fire-fighters

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters

Fire-fighters should wear positive pressure self-contained breathing apparatus (SCBA) and full turnout gear.

Hazchem code

3z

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

Immediately contact emergency personnel. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilt material. No flares, smoking or flames in hazard area. Avoid breathing vapour or mist. Provide adequate ventilation. Put on appropriate personal protective equipment. Floors may be slippery; use care to avoid falling. Eliminate all ignition sources.

For emergency responders

Entry into a confined space or poorly ventilated area contaminated with vapour, mist or fume is extremely hazardous without the correct respiratory protective equipment and a safe system of work. Wear self-contained breathing apparatus. Wear a suitable chemical protective suit. Chemical resistant boots. See also the information in "For non-emergency personnel".

Environmental precautions

Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities.

Methods and material for containment and cleaning up

Small spill

Eliminate all ignition sources. Stop leak if without risk. Move containers from spill area. Absorb with an inert material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. The method and equipment used must be in conformance with appropriate regulations and industry practice on explosive atmospheres.

Large spill

Eliminate all ignition sources. Stop leak if without risk. Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Dike spill area and do not allow product to reach sewage system and surface or ground water. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Use spark-proof tools and explosion-proof equipment. Contaminated absorbent material may pose the same hazard as the spilt product. The method and equipment used must be in conformance with appropriate regulations and industry practice on explosive atmospheres. Dispose of via a licensed waste disposal contractor.

Section 7. Handling and storage

Precautions for safe handling

Protective measures

Put on appropriate personal protective equipment (see Section 8). Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Avoid contact of spilt material and runoff with soil and surface waterways. Empty containers retain product residue and can be hazardous. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Do not reuse container. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Do not breathe vapour or mist. Avoid exposure -

Section 7. Handling and storage

Advice on general occupational hygiene

obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not swallow. Aspiration hazard if swallowed. Can enter lungs and cause damage. Never siphon by mouth.

Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Wash thoroughly after handling. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities

Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Eliminate all ignition sources. Separate from oxidising materials. Keep container tightly closed and sealed until ready for use. Store and use only in equipment/containers designed for use with this product. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

As a precaution, tank headspaces should always be regarded as potentially flammable and care should be taken to avoid static electrical discharge and all ignition sources during filling, ullaging and sampling from storage tanks. Do not enter storage tanks. If entry to vessels is necessary, follow permit to work procedures. When the product is pumped (e.g. during filling, discharge or ullaging) and when sampling, there is a risk of static discharge. Ensure equipment used is properly earthed or bonded to the tank structure. Electrical equipment should not be used unless it is intrinsically safe (i.e. will not produce sparks). Explosive air/vapour mixtures may form at ambient temperature. If product comes into contact with hot surfaces, or leaks occur from pressurised fuel pipes, the vapour or mists generated will create a flammability or explosion hazard. Product contaminated rags, paper or material used to absorb spillages, represent a fire hazard, and should not be allowed to accumulate. Dispose of safely immediately after use. Entry into a confined space or poorly ventilated area contaminated with vapour, mist or fume is extremely hazardous without the correct respiratory protective equipment and a safe system of work.

Section 8. Exposure controls and personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Fuels, diesel	ACGIH TLV (United States). Absorbed through skin. TWA: 100 mg/m ³ , (measured as total hydrocarbons) 8 hours. Issued/Revised: 1/2007 Form: Inhalable fraction and vapor

Appropriate engineering controls

All activities involving chemicals should be assessed for their risks to health, to ensure exposures are adequately controlled. Personal protective equipment should only be considered after other forms of control measures (e.g. engineering controls) have been suitably evaluated. Personal protective equipment should conform to appropriate standards, be suitable for use, be kept in good condition and properly maintained.

Your supplier of personal protective equipment should be consulted for advice on selection and appropriate standards. For further information contact your national organisation for standards.

Provide exhaust ventilation or other engineering controls to keep the relevant airborne concentrations below their respective occupational exposure limits.

The final choice of protective equipment will depend upon a risk assessment. It is

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Section 8. Exposure controls and personal protection

Environmental exposure controls

important to ensure that all items of personal protective equipment are compatible.

Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures

Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

Chemical splash goggles.

Skin protection

Hand protection

Wear chemical resistant gloves.

Protective gloves must give suitable protection against mechanical risks (i.e. abrasion, blade cut and puncture). Protective gloves will deteriorate over time due to physical and chemical damage. Inspect and replace gloves on a regular basis. The frequency of replacement will depend upon the circumstances of use.

Recommended: Nitrile gloves.

Skin protection

Use of protective clothing is good industrial practice.

Cotton or polyester/cotton overalls will only provide protection against light superficial contamination that will not soak through to the skin. Overalls should be laundered on a regular basis. When the risk of skin exposure is high (e.g. when cleaning up spillages or if there is a risk of splashing) then chemical resistant aprons and/or impervious chemical suits and boots will be required.

Wear suitable protective clothing.

Footwear highly resistant to chemicals.

When there is a risk of ignition from static electricity, wear anti-static protective clothing. For greatest effectiveness against static electricity, overalls, boots and gloves should all be anti-static.

When there is a risk of ignition wear inherently fire resistant protective clothes and gloves.

Work clothing / overalls should be laundered on a regular basis. Laundering of contaminated work clothing should only be done by professional cleaners who have been told about the hazards of the contamination. Always keep contaminated work clothing away from uncontaminated work clothing and uncontaminated personal clothes.

When the risk of skin exposure is high (from experience this could apply to the following tasks: cleaning work, maintenance and service, filling and transfer, taking samples and cleaning up spillages) then a chemical protective suit and boots will be required.

Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Recommended: overall

Other skin protection

Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection

Use with adequate ventilation.

In case of insufficient ventilation, wear suitable respiratory equipment.

If there is a requirement for the use of a respiratory protective device, but the use of breathing apparatus (independent of ambient atmosphere) is not required, then a suitable filtering device must be worn.

The filter class must be suitable for the maximum contaminant concentration (gas/vapour/aerosol/particulates) that may arise when handling the product.

The correct choice of respiratory protection depends upon the chemicals being handled, the conditions of work and use, and the condition of the respiratory

Section 8. Exposure controls and personal protection

equipment. Safety procedures should be developed for each intended application. Respiratory protection equipment should therefore be chosen in consultation with the supplier/manufacturer and with a full assessment of the working conditions.

Recommended: If ventilation is inadequate, use respirator that will protect against organic vapour and dust/mist.

[Refer to standards:](#)

Respiratory protection:AS/NZS 1715 and AS/NZS 1716

Gloves:AS/NZS 2161.1

Eye protection:AS/NZS 1336 and AS/NZS 1337

Section 9. Physical and chemical properties

[Appearance](#)

Physical state	Liquid.
Colour	Water white to straw including fluorescent green, blue or yellow.
Odour	Mild
Odour threshold	Not available.
pH	Not available.
Melting point	Not available.
Boiling point	180 to 380°C (356 to 716°F)
Flash point	Closed cup: >61.5°C (>142.7°F) [Pensky-Martens.]
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable. Based on - Physical state
Lower and upper explosive (flammable) limits	Lower: 0.5% Upper: 7.5%
Vapour pressure	0.1 kPa (0.755 mm Hg)
Vapour density	Not available.
Relative density	0.83
Density	820 to 850 kg/m ³ (0.82 to 0.85 g/cm ³) at 15°C
Solubility	Not available.
Partition coefficient: n-octanol/water	Not available.
Auto-ignition temperature	240°C (464°F)
Decomposition temperature	Not available.
Viscosity	Kinematic: 2 to 4.5 mm ² /s (2 to 4.5 cSt) at 40°C

Section 10. Stability and reactivity

Reactivity	No specific test data available for this product. Refer to Conditions to avoid and Incompatible materials for additional information.
Chemical stability	The product is stable.
Possibility of hazardous reactions	Under normal conditions of storage and use, hazardous reactions will not occur. Under normal conditions of storage and use, hazardous polymerisation will not occur.
Conditions to avoid	Avoid all possible sources of ignition (spark or flame). Avoid excessive heat.
Incompatible materials	Reactive or incompatible with the following materials: oxidising materials.
Hazardous decomposition products	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Fuels, diesel	LC50 Inhalation Dusts and mists	Rat	4.1 mg/l	4 hours
	LD50 Dermal	Rabbit	>4300 mg/kg	-
	LD50 Dermal	Rabbit	>4300 mg/kg	-
	LD50 Oral	Rat	17900 mg/kg	-
	LD50 Oral	Rat	7600 mg/kg	-

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
Fuels, diesel	Skin - Irritation	Rabbit	-	-	-
	Skin - Irritation	Rabbit	-	-	-
	Eyes - Non-irritating to the eyes.	Rabbit	-	-	-
	Eyes - Non-irritating to the eyes.	Rabbit	-	-	-

Skin

Causes skin irritation.

Sensitisation

Product/ingredient name	Route of exposure	Species	Result
Fuels, diesel	skin	Guinea pig	Not sensitising
	skin	Guinea pig	Not sensitising

Mutagenicity

Product/ingredient name	Test	Experiment	Result
Fuels, diesel	OECD 471	Experiment: In vitro Subject: Non-mammalian species	Positive
	Equivalent to OECD 476	Experiment: In vitro Subject: Mammalian-Animal Cell: Germ	Negative
	not guideline	Experiment: In vivo Subject: Unspecified Cell: Somatic	Negative

Conclusion/Summary

Not classified. Based on available data, the classification criteria are not met.

Carcinogenicity

Product/ingredient name	Result	Species	Dose	Exposure
Fuels, diesel	Positive - Dermal - Unspecified	Mouse	-	2 years

Conclusion/Summary

Suspected of causing cancer.

Reproductive toxicity

Product/ingredient name	Maternal toxicity	Fertility	Developmental toxin	Species	Dose	Exposure
Fuels, diesel	-	-	Negative	Rat	Dermal	20 days
	-	-	Negative	Rat	Dermal	10 days
	-	-	Negative	Rat	Dermal	10 days

Conclusion/Summary

Development: Not classified. Based on available data, the classification criteria are not met.

Fertility: Not classified. Based on available data, the classification criteria are not met.

Effects on or via lactation: Not classified. Based on available data, the classification criteria are not met.

Section 11. Toxicological information

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
Fuels, diesel	Category 2	Not determined	bone marrow, liver and thymus

Aspiration hazard

Name	Result
Fuels, diesel	ASPIRATION HAZARD - Category 1
Alkanes, C10-20-branched and linear	ASPIRATION HAZARD - Category 1

Information on likely routes of exposure

Routes of entry anticipated: Oral, Dermal, Inhalation.

Potential acute health effects

Eye contact	No known significant effects or critical hazards.
Inhalation	Harmful if inhaled.
Skin contact	Causes skin irritation.
Ingestion	Irritating to mouth, throat and stomach. Aspiration hazard if swallowed -- harmful or fatal if liquid is aspirated into lungs.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact	Adverse symptoms may include the following: pain or irritation watering redness
Inhalation	Adverse symptoms may include the following: nausea or vomiting headache drowsiness/fatigue dizziness/vertigo unconsciousness
Skin contact	Adverse symptoms may include the following: irritation redness
Ingestion	Adverse symptoms may include the following: nausea or vomiting

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Eye contact	Vapour, mist or fume may cause eye irritation. Exposure to vapour, mist or fume may cause stinging, redness and watering of the eyes.
Inhalation	Vapour, mists or fumes may contain polycyclic aromatic hydrocarbons some of which are known to produce skin cancer. Vapour, mists or fumes may contain polycyclic aromatic hydrocarbons some of which are known to produce skin cancer. Vapour, mist or fume may irritate the nose, mouth and respiratory tract.
Skin contact	As with all such products containing potentially harmful levels of polycyclic aromatic hydrocarbons, prolonged or repeated skin contact may eventually result in dermatitis or more serious irreversible skin disorders including cancer.
Ingestion	If swallowed, may irritate the mouth, throat and digestive system. If swallowed, may cause abdominal pain, stomach cramps, nausea, vomiting, diarrhoea, dizziness and drowsiness.
General	May cause damage to organs through prolonged or repeated exposure. Vapour, mists or fumes may contain polycyclic aromatic hydrocarbons some of which are known to produce skin cancer. Vapour, mists or fumes may contain polycyclic aromatic hydrocarbons some of which are known to produce skin cancer.

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Section 11. Toxicological information

Carcinogenicity	Suspected of causing cancer. Risk of cancer depends on duration and level of exposure.
Mutagenicity	No known significant effects or critical hazards.
Teratogenicity	No known significant effects or critical hazards.
Developmental effects	No known significant effects or critical hazards.
Fertility effects	No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Route	ATE value
Inhalation (dusts and mists)	1.895 mg/l

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
Fuels, diesel	EL50 >1000 mg/l Nominal Fresh water	Micro-organism	40 hours
	NOELR 3.217 mg/l Nominal Fresh water	Micro-organism	40 hours
	Acute EL50 22 mg/l Nominal Fresh water	Algae	72 hours
	Acute EL50 210 mg/l Nominal Fresh water	Daphnia	48 hours
	Acute EL50 68 mg/l Nominal Fresh water	Daphnia	48 hours
	Acute ErL50 78 mg/l Nominal Fresh water	Algae	72 hours
	Acute LL50 65 mg/l Nominal Fresh water	Fish	96 hours
	Acute LL50 21 mg/l Nominal Fresh water	Fish	96 hours
	Acute NOELR 10 mg/l Nominal Fresh water	Algae	72 hours
	Acute NOELR 1 mg/l Nominal Fresh water	Algae	72 hours
	Acute NOELR 46 mg/l Nominal Fresh water	Daphnia	48 hours
	Chronic NOEL 0.083 mg/l Nominal Fresh water	Fish	14 days
	Chronic NOELR 0.2 mg/l Nominal Fresh water	Daphnia	21 days

Conclusion/Summary	Toxic to aquatic life with long lasting effects.
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Persistence and degradability

Partially biodegradable.

Product/ingredient name	Test	Result	Dose	Inoculum
Fuels, diesel	OECD 301 F	60 % - Readily - 28 days	30 mg/l	-
	OECD 301 F	57.5 % - Not readily - 28 days	25 mg/l	-
	Equivalent to EPA OTS 796.3100	35 % - Not readily - 28 days	5 mg/l	-

Conclusion/Summary	Non-persistent per IMO criteria
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Section 12. Ecological information

Bioaccumulative potential

This product is not expected to bioaccumulate through food chains in the environment.

Mobility in soil

Soil/water partition
coefficient (K_{oc})

Not available.

Mobility

Spillages may penetrate the soil causing ground water contamination. This material may accumulate in sediments.

Other ecological information

Spills may form a film on water surfaces causing physical damage to organisms. Oxygen transfer could also be impaired.

Section 13. Disposal considerations

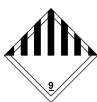
Disposal methods

The generation of waste should be avoided or minimised wherever possible. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapour from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Special Precautions for Landfill or Incineration

Empty packages may contain some remaining product. Hazard warning labels are a guide to the safe handling of empty packaging and should not be removed.

Section 14. Transport information

	ADG	IMDG	IATA
UN number	Not regulated.	UN3082	UN3082
UN proper shipping name	-	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (Fuels, diesel)	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (Fuels, diesel)
Transport hazard class(es)	-	9 	9 
Packing group	-	III	III
Environmental hazards	No.	Yes.	Yes.

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Section 14. Transport information

Additional information	Remarks Combustible liquid Class C1 (AS 1940). Hazchem code 3Z Initial emergency response guide 47	This product is not regulated as a dangerous good when transported in sizes of ≤5 L or ≤5 kg, provided the packagings meet the general provisions of 4.1.1.1, 4.1.1.2 and 4.1.1.4 to 4.1.1.8. Emergency schedules (EmS) F-A, S-F	This product is not regulated as a dangerous good when transported in sizes of ≤5 L or ≤5 kg, provided the packagings meet the general provisions of 5.0.2.4.1, 5.0.2.6.1.1 and 5.0.2.8.
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Special precautions for user Not available.

Transport in bulk according to Annex II of Marpol and the IBC Code **Proper shipping name** MARPOL Annex 1 rules apply for bulk shipments by sea.
Category: gas oils, including ship's bunkers

Section 15. Regulatory information

Standard Uniform Schedule of Medicine and Poisons

Not scheduled

Consumer products - This product is exempt per Appendix A of the SUSMP.

Industrial Products - Labelling requirements for SUSMP do not apply to a poison that is packed and sold solely for industrial, laboratory or manufacturing use. However, this product is labelled in accordance with NOSHC National Code of Practice for labelling of workplace substances.

Model Work Health and Safety Regulations - Scheduled Substances

No listed substance

International lists

National inventory

REACH Status

For the REACH status of this product please consult your company contact, as identified in Section 1.

Australia inventory (AICS)

All components are listed or exempted.

Canada inventory

All components are listed or exempted.

China inventory (IECSC)

Not determined.

Japan inventory (ENCS)

Not determined.

Korea inventory (KECI)

Not determined.

Philippines inventory (PICCS)

Not determined.

Taiwan Chemical Substances Inventory (TCSI)

All components are listed or exempted.

United States inventory (TSCA 8b)

All components are listed or exempted.

Section 16. Any other relevant information

History

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Date of issue/Date of revision	07/04/2016
Date of previous issue	07/04/2016
Version	1

Product Stewardship

Key to abbreviations

ADG = Australian Dangerous Goods
ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
NOHSC = National Occupational Health and Safety Commission
STEL = Short term exposure limit
SUSMP = Standard Uniform Schedule of Medicine and Poisons
UN = United Nations
TWA = Time weighted average
VOC = Volatile Organic Compound
SADT = Self-Accelerating Decomposition Temperature
Varies = may contain one or more of the following 101316-69-2, 101316-70-5, 101316-71-6, 101316-72-7, 64741-88-4, 64741-89-5, 64741-95-3, 64741-96-4, 64741-97-5, 64742-01-4, 64742-44-5, 64742-45-6, 64742-52-5, 64742-53-6, 64742-54-7, 64742-55-8, 64742-56-9, 64742-57-0, 64742-58-1, 64742-62-7, 64742-63-8, 64742-64-9, 64742-65-0, 64742-70-7, 72623-85-9, 72623-86-0, 72623-87-1, 74869-22-0, 90669-74-2

Procedure used to derive the classification

Classification	Justification
Flam. Liq. 4, H227 Acute Tox. 4, H332 Skin Irrit. 2, H315 Carc. 2, H351 STOT RE 2, H373 (bone marrow, liver and thymus) Asp. Tox. 1, H304	On basis of test data Calculation method Calculation method Calculation method Calculation method Calculation method

Indicates information that has changed from previously issued version.

Notice to reader

All reasonably practicable steps have been taken to ensure this data sheet and the health, safety and environmental information contained in it is accurate as of the date specified below. No warranty or representation, express or implied is made as to the accuracy or completeness of the data and information in this data sheet.

The data and advice given apply when the product is sold for the stated application or applications. You should not use the product other than for the stated application or applications without seeking advice from BP Group.

It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. The BP Group shall not be responsible for any damage or injury resulting from use, other than the stated product use of the material, from any failure to adhere to recommendations, or from any hazards inherent in the nature of the material. Purchasers of the product for supply to a third party for use at work, have a duty to take all necessary steps to ensure that any person handling or using the product is provided with the information in this sheet. Employers have a duty to tell employees and others who may be affected of any hazards described in this sheet and of any precautions that should be taken. You can contact the BP Group to ensure that this document is the most current available. Alteration of this document is strictly prohibited.

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Safety data sheet

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BASF Safety data sheet
Date / Revised: 28.05.2016
Product: **Magnafloc® 336**

Version: 3.0

(30507508/SDS_GEN_AU/EN)

Date of print 29.05.2016

1. Substance/preparation and manufacturer/supplier identification

Magnafloc® 336

Use: flocculation agent

Manufacturer/supplier:

BASF Australia Limited (ABN 62 008 437 867)
Level 12, 28 Freshwater Place Southbank
Victoria 3006, AUSTRALIA
Telephone: +61 3 8855-6600
Telefax number: +61 3 8855-6511

Emergency information:

BASF Emergency Advice Number: 1800 803 440 (24h) [within Australia]
BASF Emergency Advice Number: + 61 3 8855 6666 [outside Australia]

2. Hazard identification

Classification of the substance and mixture:

No need for classification according to GHS criteria for this product.

Label elements and precautionary statement:

The product does not require a hazard warning label in accordance with GHS criteria.

Other hazards which do not result in classification:

Very slippery when wet.

3. Composition/information on ingredients

Chemical nature

polyacrylamide, anionic

4. First-Aid Measures

General advice:

Remove contaminated clothing.

If inhaled:

If difficulties occur after dust has been inhaled, remove to fresh air and seek medical attention.

On skin contact:

Wash thoroughly with soap and water.

On contact with eyes:

Wash affected eyes for at least 15 minutes under running water with eyelids held open.

On ingestion:

Rinse mouth and then drink plenty of water. Check breathing and pulse. Place victim in the recovery position, cover and keep warm. Loosen tight clothing such as a collar, tie, belt or waistband. Seek medical attention. Never induce vomiting or give anything by mouth if the victim is unconscious or having convulsions.

Note to physician:

Symptoms: The most important known symptoms and effects are described in the labelling (see section 2) and/or in section 11., Further important symptoms and effects are so far not known.

Hazards: No hazard is expected under intended use and appropriate handling.

Treatment: Treat according to symptoms (decontamination, vital functions), no known specific antidote.

5. Fire-Fighting Measures

Suitable extinguishing media:

dry powder, foam

Unsuitable extinguishing media for safety reasons:

water jet

Additional information:

If water is used, restrict pedestrian and vehicular traffic in areas where slip hazard may exist.

Specific hazards:

carbon oxides, nitrogen oxides

The substances/groups of substances mentioned can be released in case of fire. Very slippery when wet.

Special protective equipment:

Wear a self-contained breathing apparatus.

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Further information:

The degree of risk is governed by the burning substance and the fire conditions. Contaminated extinguishing water must be disposed of in accordance with official regulations.

6. Accidental Release Measures

Personal precautions:

Use personal protective clothing.

Environmental precautions:

Do not discharge into drains/surface waters/groundwater.

Methods for cleaning up or taking up:

For small amounts: Pick up with suitable appliance and dispose of.

For large amounts: Contain with dust binding material and dispose of.

Avoid raising dust.

Additional information: Avoid dispersal of dust in the air (i.e., clearing dust surfaces with compressed air). Avoid the formation and build-up of dust - danger of dust explosion. Dust in sufficient concentration can result in an explosive mixture in air. Handle to minimize dusting and eliminate open flame and other sources of ignition. Forms slippery surfaces with water.

7. Handling and Storage

Handling

Breathing must be protected when large quantities are decanted without local exhaust ventilation. Handle in accordance with good industrial hygiene and safety practice. Forms slippery surfaces with water.

Protection against fire and explosion:

Avoid dust formation. Dust in sufficient concentration can result in an explosive mixture in air. Handle to minimize dusting and eliminate open flame and other sources of ignition. Dry powders can build static electricity charges when subjected to the friction of transfer and mixing operations. Provide adequate precautions, such as electrical grounding and bonding, or inert atmospheres.

Storage

Further information on storage conditions: Store in unopened original containers in a cool and dry place. Avoid wet, damp or humid conditions, temperature extremes and ignition sources.

Storage stability:

Avoid extreme heat.

8. Exposure controls and personal protection

Components with occupational exposure limits

Observe occupational exposure limit for inert dust.

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Particles, not otherwise specified, inhalable

TWA value 10 mg/m³ (ACGIHTLV), Inhalable particles

Particles, not otherwise specified, respirable

TWA value 3 mg/m³ (ACGIHTLV), Respirable particles

Personal protective equipment

Respiratory protection:

Suitable respiratory protection for lower concentrations or short-term effect: Particle filter with medium efficiency for solid and liquid particles (e.g. EN 143 or 149, Type P2 or FFP2)

Hand protection:

Chemical resistant protective gloves

Suitable materials also with prolonged, direct contact (Recommended: Protective index 6, corresponding > 480 minutes of permeation time according to EN 374):

e.g. nitrile rubber (0.4 mm), chloroprene rubber (0.5 mm), polyvinylchloride (0.7 mm) and other

Supplementary note: The specifications are based on tests, literature data and information of glove manufacturers or are derived from similar substances by analogy. Due to many conditions (e.g. temperature) it must be considered, that the practical usage of a chemical-protective glove in practice may be much shorter than the permeation time determined through testing.

Manufacturer's directions for use should be observed because of great diversity of types.

Eye protection:

Safety glasses with side-shields.

Body protection:

light protective clothing

General safety and hygiene measures:

Handle in accordance with good industrial hygiene and safety practice. Ensure adequate ventilation.

Wearing of closed work clothing is recommended. No eating, drinking, smoking or tobacco use at the place of work.

9. Physical and Chemical Properties

Form:	powder to fine granules
Colour:	off-white
Odour:	odourless
Odour threshold:	No applicable information available.
pH value:	6 - 8 (10 g/l) The product has not been tested. The statement has been derived from substances/products of a similar structure or composition.

BASF Safety data sheet
Date / Revised: 28.05.2016
Product: **Magnafloc® 336**

Version: 3.0

(30507508/SDS_GEN_AU/EN)

Date of print 29.05.2016

Melting point:	The substance / product decomposes therefore not determined.
Boiling point:	not applicable
Flash point:	not applicable
Evaporation rate:	The product is a non-volatile solid.
Flammability (solid/gas):	not flammable
Self ignition:	not self-igniting
Self heating ability:	It is not a substance capable of spontaneous heating.
Explosion hazard:	not explosive
Fire promoting properties:	not fire-propagating
Vapour pressure:	The product has not been tested.
Bulk density:	approx. 750 kg/m ³
Solubility in water:	Forms a viscous solution.
Partitioning coefficient n-octanol/water (log Pow):	Study scientifically not justified.
Viscosity, dynamic:	40 - 56 mPa.s (0.5 %(m), 25 °C, 100 1/s)

Other Information:

If necessary, information on other physical and chemical parameters is indicated in this section.

10. Stability and Reactivity

Conditions to avoid:

Avoid extreme temperatures. Avoid humidity.

Substances to avoid:

strong acids, strong bases, strong oxidizing agents

Corrosion to metals: No corrosive effect on metal.

Hazardous reactions:

The product is not a dust explosion risk as supplied; however the build-up of fine dust can lead to a risk of dust explosions.

Hazardous decomposition products:

No hazardous decomposition products if stored and handled as prescribed/indicated.

11. Toxicological Information

Acute toxicity

Experimental/calculated data:

LD50 rat (oral): > 5,000 mg/kg (OECD Guideline 401)

Irritation

Experimental/calculated data:

Skin corrosion/irritation rabbit: non-irritant (OECD Guideline 404)

Serious eye damage/irritation rabbit: non-irritant

Respiratory/Skin sensitization

Assessment of sensitization:

Based on the ingredients, there is no suspicion of a skin-sensitizing potential.

Germ cell mutagenicity

Assessment of mutagenicity:

Based on the ingredients, there is no suspicion of a mutagenic effect.

Carcinogenicity

Assessment of carcinogenicity:

The whole of the information assessable provides no indication of a carcinogenic effect.

Reproductive toxicity

Assessment of reproduction toxicity:

Based on the ingredients, there is no suspicion of a toxic effect on reproduction.

Developmental toxicity

Assessment of teratogenicity:

Based on the ingredients, there is no suspicion of a teratogenic effect.

Repeated dose toxicity and Specific target organ toxicity (repeated exposure)

Assessment of repeated dose toxicity:

Based on our experience and the information available, no adverse health effects are expected if handled as recommended with suitable precautions for designated uses. The product has not been tested. The statement has been derived from the properties of the individual components.

Aspiration hazard

No aspiration hazard expected.

Other relevant toxicity information

The product has not been tested. The statements on toxicology have been derived from products of a similar structure and composition.

12. Ecological Information

Ecotoxicity

Toxicity to fish:

LC50 (96 h) > 100 mg/l, *Oncorhynchus mykiss* (static)
(under static conditions in the presence of 10 mg/L humic acid)

Aquatic invertebrates:

LC50 (48 h) > 100 mg/l, *Daphnia magna*

Mobility

Information on: Anionic polyacrylamide

Assessment transport between environmental compartments:

Adsorption to solid soil phase is expected.

Persistence and degradability

Assessment biodegradation and elimination (H₂O):

Not readily biodegradable (by OECD criteria).

Bioaccumulation potential

Assessment bioaccumulation potential:

Based on its structural properties, the polymer is not biologically available. Accumulation in organisms is not to be expected.

Additional information

Other ecotoxicological advice:

The product has not been tested. The statements on ecotoxicology have been derived from products of a similar structure and composition.

13. Disposal Considerations

Must be disposed of or incinerated in accordance with local regulations.

Contaminated packaging:

Packs that cannot be cleaned should be disposed of in the same manner as the contents.

Uncontaminated packaging can be re-used.

14. Transport Information

Domestic transport:

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Date / Revised: 28.05.2016
Product: **Magnafloc® 336**

Version: 3.0

(30507508/SDS_GEN_AU/EN)

Date of print 29.05.2016

Not classified as a dangerous good under transport regulations

Sea transport
IMDG

Not classified as a dangerous good under transport regulations

Air transport
IATA/ICAO

Not classified as a dangerous good under transport regulations

15. Regulatory Information

Other regulations

If other regulatory information applies that is not already provided elsewhere in this safety data sheet, then it is described in this subsection.

Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP): Not Scheduled

Registration status:

AICS, AU

released / listed

16. Other Information

Vertical lines in the left hand margin indicate an amendment from the previous version.

The data contained in this safety data sheet are based on our current knowledge and experience and describe the product only with regard to safety requirements. This safety data sheet is neither a Certificate of Analysis (CoA) nor technical data sheet and shall not be mistaken for a specification agreement. Identified uses in this safety data sheet do neither represent an agreement on the corresponding contractual quality of the substance/mixture nor a contractually designated use. It is the responsibility of the recipient of the product to ensure any proprietary rights and existing laws and legislation are observed.

Safety data sheet

Page: 1/8

BASF Safety data sheet
Date / Revised: 13.10.2015
Product: **Magnafloc® 1425**

Version: 3.0

(50136070/SDS_GEN_AU/EN)

Date of print 14.10.2015

1. Substance/preparation and manufacturer/supplier identification

Magnafloc® 1425

Use: Coagulant

Manufacturer/supplier:

BASF Australia Limited (ABN 62 008 437 867)
Level 12, 28 Freshwater Place Southbank
Victoria 3006, AUSTRALIA
Telephone: +61 3 8855-6600
Telefax number: +61 3 8855-6511

Emergency information:

BASF Emergency Advice Number: 1800 803 440 (24h) [within Australia]
BASF Emergency Advice Number: + 61 3 8855 6666 [outside Australia]

2. Hazard identification

Classification of the substance and mixture:

Hazardous to the aquatic environment - acute: Cat. 3
Hazardous to the aquatic environment - chronic: Cat. 3

Label elements and precautionary statement:

Hazard Statement:

Harmful to aquatic life. Harmful to aquatic life with long lasting effects.

Precautionary Statements (Prevention):

Avoid release to the environment.

Precautionary Statements (Disposal):

Dispose of contents/container to hazardous or special waste collection point.

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Date / Revised: 13.10.2015
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(50136070/SDS_GEN_AU/EN)

Date of print 14.10.2015

Other hazards which do not result in classification:
If applicable information is provided in this section on other hazards which do not result in classification but which may contribute to the overall hazards of the substance or mixture.

3. Composition/information on ingredients

Chemical nature

Aqueous solution based on: homopolymer, cationic

Hazardous ingredients

2-Propen-1-aminium, N,N-dimethyl-N-2-propenyl-, chloride, homopolymer
Content (W/W): $\geq 10\%$ - $\leq 50\%$ Aquatic Chronic: Cat. 3
CAS Number: 26062-79-3 Aquatic Acute: Cat. 3

4. First-Aid Measures

General advice:
Remove contaminated clothing.

If inhaled:
If difficulties occur after vapour/aerosol has been inhaled, remove to fresh air and seek medical attention.

On skin contact:
Wash thoroughly with soap and water.

On contact with eyes:
Wash affected eyes for at least 15 minutes under running water with eyelids held open.

On ingestion:
Rinse mouth and then drink plenty of water.

Note to physician:
Symptoms: The most important known symptoms and effects are described in the labelling (see section 2) and/or in section 11., Further important symptoms and effects are so far not known.
Hazards: No hazard is expected under intended use and appropriate handling.
Treatment: Treat according to symptoms (decontamination, vital functions), no known specific antidote.

5. Fire-Fighting Measures

Suitable extinguishing media:
water spray, dry powder, foam

Additional information:
If water is used, restrict pedestrian and vehicular traffic in areas where slip hazard may exist.

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Version: 3.0

(50136070/SDS_GEN_AU/EN)

Date of print 14.10.2015

Specific hazards:

harmful vapours

Evolution of fumes/fog. The substances/groups of substances mentioned can be released in case of fire. Do not release chemically contaminated water into drains, soil or surface water. Sufficient measures must be taken to retain the water used for extinguishing. Dispose of contaminated water and soil according to local regulations.

Special protective equipment:

Wear self-contained breathing apparatus and chemical-protective clothing.

Further information:

Contaminated extinguishing water must be disposed of in accordance with official regulations.

6. Accidental Release Measures

Personal precautions:

Use personal protective clothing.

Environmental precautions:

Contain contaminated water/firefighting water. Do not discharge into drains/surface waters/groundwater.

Methods for cleaning up or taking up:

For large amounts: Pump off product.

For residues: Pick up with suitable absorbent material. Dispose of absorbed material in accordance with regulations.

Additional information: High risk of slipping due to leakage/spillage of product.

7. Handling and Storage

Handling

No special measures necessary provided product is used correctly.

Protection against fire and explosion:

No special precautions necessary.

Storage

Further information on storage conditions: Keep container tightly closed and in a cool place. Avoid extremes of temperature, especially frost and freezing conditions.

Storage stability:

Storage temperature: > 0 °C

Avoid freezing.

8. Exposure controls and personal protection

Components with occupational exposure limits

No occupational exposure limits known.

Personal protective equipment

Respiratory protection:

Wear respiratory protection if ventilation is inadequate.

Hand protection:

Chemical resistant protective gloves

Suitable materials also with prolonged, direct contact (Recommended: Protective index 6, corresponding > 480 minutes of permeation time according to EN 374):

e.g. nitrile rubber (0.4 mm), chloroprene rubber (0.5 mm), polyvinylchloride (0.7 mm) and other

Supplementary note: The specifications are based on tests, literature data and information of glove manufacturers or are derived from similar substances by analogy. Due to many conditions (e.g. temperature) it must be considered, that the practical usage of a chemical-protective glove in practice may be much shorter than the permeation time determined through testing.

Manufacturer's directions for use should be observed because of great diversity of types.

Eye protection:

Safety glasses with side-shields.

Body protection:

light protective clothing

General safety and hygiene measures:

Handle in accordance with good industrial hygiene and safety practice. Wearing of closed work clothing is recommended. No eating, drinking, smoking or tobacco use at the place of work.

9. Physical and Chemical Properties

Form:	liquid
Colour:	straw yellow
Odour:	amine-like, slight odour
Odour threshold:	No applicable information available.
pH value:	approx. 5.5
Boiling point:	> 100 °C
Flash point:	> 120 °C A flash point determination is unnecessary due to the high water content.
Evaporation rate:	Value can be approximated from Henry's Law Constant or vapor pressure.

BASF Safety data sheet
Date / Revised: 13.10.2015
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Version: 3.0

(50136070/SDS_GEN_AU/EN)

Date of print 14.10.2015

Flammability (solid/gas): not flammable
Lower explosion limit: For liquids not relevant for classification and labelling., The lower explosion point may be 5 - 15 °C below the flash point.
Upper explosion limit: For liquids not relevant for classification and labelling.
Ignition temperature: not determined
Thermal decomposition: No decomposition if stored and handled as prescribed/indicated.
Self ignition: not self-igniting
Self heating ability: It is not a substance capable of spontaneous heating.
Explosion hazard: not explosive
Fire promoting properties: not fire-propagating
Vapour pressure: approx. 32 mbar (25 °C)
Density: approx. 1.1 g/cm³ (20 °C)
Solubility in water: miscible
Miscibility with water: miscible
Partitioning coefficient n-octanol/water (log Pow): Study scientifically not justified.
Viscosity, dynamic: not determined

Other Information:

If necessary, information on other physical and chemical parameters is indicated in this section.

10. Stability and Reactivity

Conditions to avoid:

Avoid excessive temperatures. Avoid freezing.

Thermal decomposition:

No decomposition if stored and handled as prescribed/indicated.

Substances to avoid:

strong acids, strong bases, strong oxidizing agents

Corrosion to metals: No corrosive effect on metal.

Hazardous reactions:

No hazardous reactions when stored and handled according to instructions.

Hazardous decomposition products:

No hazardous decomposition products if stored and handled as prescribed/indicated.

11. Toxicological Information

Acute toxicity

Experimental/calculated data:

LD50 rat (oral): > 5,000 mg/kg

Irritation

Experimental/calculated data:

Skin corrosion/irritation rabbit: non-irritant (OECD Guideline 404)

Serious eye damage/irritation rabbit: non-irritant (OECD Guideline 405)

Respiratory/Skin sensitization

Assessment of sensitization:

Based on the ingredients, there is no suspicion of a skin-sensitizing potential.

Germ cell mutagenicity

Assessment of mutagenicity:

Based on the ingredients, there is no suspicion of a mutagenic effect.

Carcinogenicity

Assessment of carcinogenicity:

Based on the ingredients there is no suspicion of a carcinogenic effect in humans.

Reproductive toxicity

Assessment of reproduction toxicity:

Based on the ingredients, there is no suspicion of a toxic effect on reproduction.

Developmental toxicity

Assessment of teratogenicity:

Based on the ingredients, there is no suspicion of a teratogenic effect.

Repeated dose toxicity and Specific target organ toxicity (repeated exposure)

Assessment of repeated dose toxicity:

(50136070/SDS_GEN_AU/EN)

Date of print 14.10.2015

Based on our experience and the information available, no adverse health effects are expected if handled as recommended with suitable precautions for designated uses. The product has not been tested. The statement has been derived from the properties of the individual components.

Aspiration hazard

No aspiration hazard expected.

Other relevant toxicity information

The product has not been tested. The statements on toxicology have been derived from products of a similar structure and composition.

12. Ecological Information

Ecotoxicity

Assessment of aquatic toxicity:

The product has not been tested. The statement has been derived from substances/products of a similar structure or composition.

Toxicity to fish:

LC50 (96 h) 10 - 100 mg/l, Fish

Aquatic invertebrates:

EC50 (48 h) 10 - 100 mg/l, Daphnia magna

Mobility

Assessment transport between environmental compartments:

No data available.

Information on: 2-Propen-1-aminium, N,N-dimethyl-N-2-propenyl-, chloride, homopolymer

Assessment transport between environmental compartments:

Adsorption to solid soil phase is expected.

Persistence and degradability

Assessment biodegradation and elimination (H₂O):

Not readily biodegradable (by OECD criteria).

Bioaccumulation potential

Bioaccumulation potential:

Based on its structural properties, the polymer is not biologically available. Accumulation in organisms is not to be expected.

13. Disposal Considerations

Must be disposed of or incinerated in accordance with local regulations.

BASF Safety data sheet
Date / Revised: 13.10.2015
Product: **Magnafloc® 1425**

Version: 3.0

(50136070/SDS_GEN_AU/EN)

Date of print 14.10.2015

Contaminated packaging:
Uncontaminated packaging can be re-used.
Packs that cannot be cleaned should be disposed of in the same manner as the contents.

14. Transport Information

Domestic transport:

Not classified as a dangerous good under transport regulations

Sea transport IMDG

Not classified as a dangerous good under transport regulations

Air transport IATA/ICAO

Not classified as a dangerous good under transport regulations

15. Regulatory Information

Other regulations

If other regulatory information applies that is not already provided elsewhere in this safety data sheet, then it is described in this subsection.

Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP): Not Scheduled

Registration status:

AICS, AU released / listed

16. Other Information

Vertical lines in the left hand margin indicate an amendment from the previous version.

The data contained in this safety data sheet are based on our current knowledge and experience and describe the product only with regard to safety requirements. The data do not describe the product's properties (product specification). Neither should any agreed property nor the suitability of the product for any specific purpose be deduced from the data contained in the safety data sheet. It is the responsibility of the recipient of the product to ensure any proprietary rights and existing laws and legislation are observed.

Design Basis Memo

Tenas Project

Document No.: A570-04010-RT-005

This document has been reviewed and approved / not approved.

Telkwa Coal Representative

Paul GTR

Date:

Oct 31 / 2018

Sedgman Limited Representative

SLD

Date:

26 Oct 18

Revision Status

Revision Number	Author	Description	Date	Approved By
0	MWa	Issued for Information	09-Oct-2018	CH
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1 Introduction

The Design Basis Memorandum documents the approach and criteria used to design the Tenas Coal Handling and Preparation Plant (CHPP). The CHPP will initially be designed and constructed to process 145 t/h ROM raw coal, using a DMC/flotation plant configuration. The initial design will include necessary space/structure to allow for a potential future expansion to 190 t/h.

2 Site Locations and Conditions

2.1 CHPP Facility Location

The CHPP facility is located on the Telkwa Coal Property, located in north west-central British Columbia approximately 20 km south of the city of Smithers and about 15.0 km southwest of the community of Telkwa. The location of the CHPP facility is shown on Figure 2-1 below.

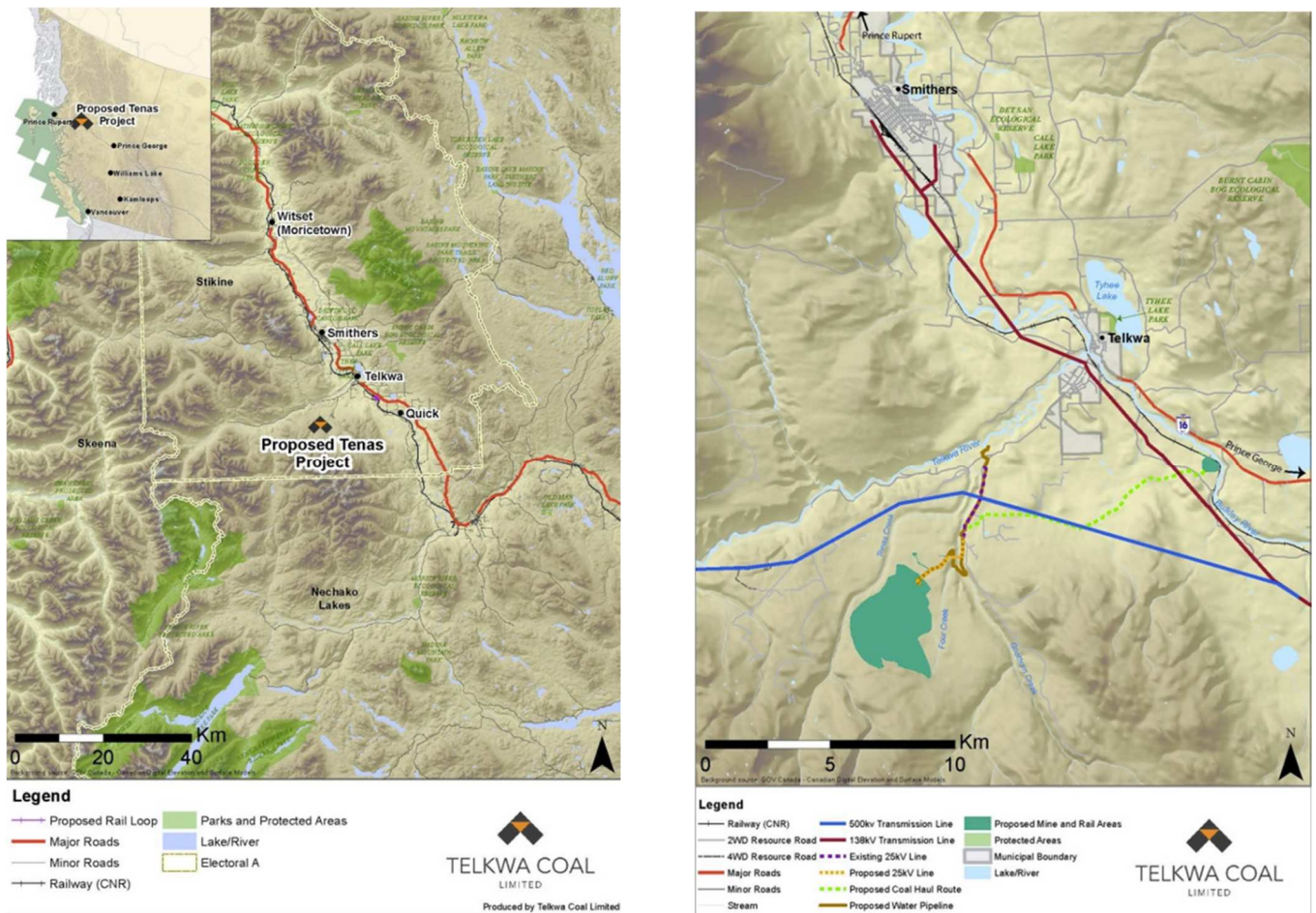


Figure 2-1 Telkwa Coal Property Location

Figure 2-2 shows the site plan for the Tenas CHPP facility. The pre-engineered steel CPP building covers the majority of the process equipment, with the thickener tank sitting outside. The raw coal stockpile is located near the raw coal crusher, from where it is directly fed onto the crushed coal conveyor. Product and rock material leave via conveyors to radial stackers, which deposit them on their respective stockpiles. Heavy vehicles roads are used to access both the product and rock loading areas. An administrative office is located south of the CPP building, with a light vehicle workshop attached.

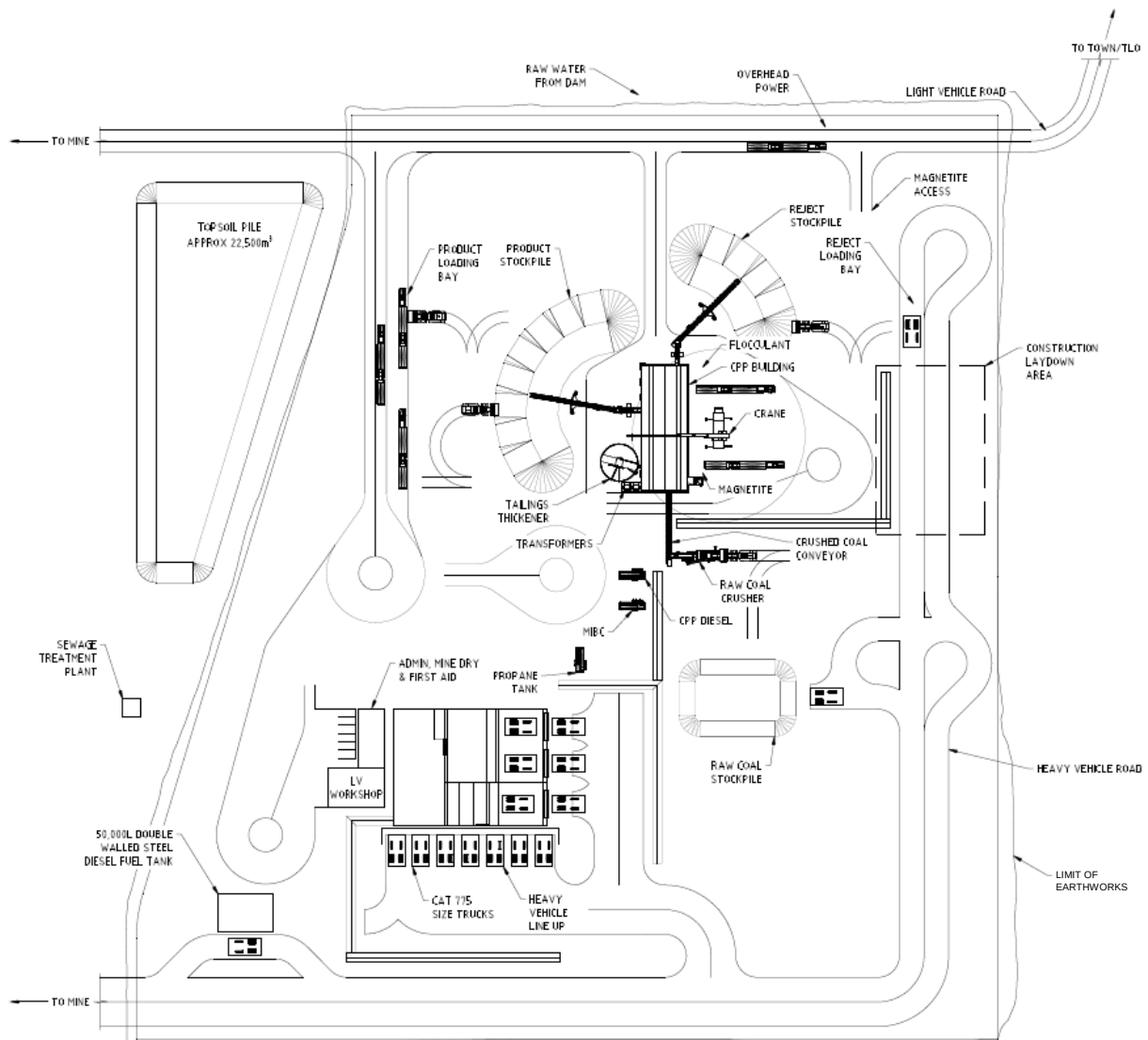


Figure 2-2 Tenas CHPP Site Plan

2.2 General Site Conditions

The following site conditions are observed for the Telkwa, B.C. area.

- Altitude 400 m to 600 m above sea level
- Operating temperature -30°C to 30°C
- Maximum operating wind speed of 25.0 m/s
- Prevailing wind direction is to the north-east

2.3 Precipitation Loads

Statistics for the historical rain and snow loads in Smithers, B.C. are displayed in Table 2-1. Statistics are provided by The Weather Network and cover the past 30 years of data. Monthly rainfall peaks in October at 58 mm, while December historically sees the most snow with 55 cm.

Table 2-1 Smithers historical rain and snow loads

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly rainfall (mm)	11	6	6	16	36	49	45	43	51	58	25	9
Monthly snowfall (cm)	52	27	17	6	0	0	0	0	0	7	38	55
Mean daily snow depth (cm)	34	36	21	2	0	0	0	0	0	0	6	21
Median daily snow depth (cm)	34	36	22	0	0	0	0	0	0	0	5	20
Mean Daily Max Temp C	-4.9	-0.4	5.1	10.8	15.7	18.9	21.6	21.2	15.8	8.8	0.8	-3.8
Mean Daily Min Temp C	-12.7	-9.4	-5.1	-1.3	2.8	6.3	8.4	7.9	4	0.1	-5.4	-11.1
Average Temp C	-8.9	-4.9	-0	4.8	9.3	12.6	15	14.6	9.9	4.5	-2.3	-7.5

Telkwa Coal Limited has also constructed a site specific meteorological weather station on site. Over the past two years the information gathered from this station is provided in Table 2-2 below

Table 2-2 Telkwa Coal Limited historical rain, snow and temperatures

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly rainfall (mm)	7	7	4	16	108	72	45	26	102	114	0	0
Monthly snowfall (cm)	38	8	11	3	2	0	0	0	0	33	134	10
Mean Daily Max Temp C	-4.3	-2.8	-1.6	8.2	12.5	14.8	16.3	18.3	13.3	6.7	-3.0	-6.0
Mean Daily Min Temp C	-10.6	-10.8	-6.2	-2.1	2.2	4.0	5.1	6.4	3.6	-2.0	-8.6	-11.9
Average Temp C	-7.5	-6.8	-2.3	3.1	7.4	9.4	10.8	12.3	8.5	1.9	-5.6	-8.9

3 Plant Design Criteria

This plant design criteria for the Tenas CHPP facilities are detailed in the sections below.

3.1 Principal Design Objectives

The key principal CHPP design objectives for the Tenas Coal Project include:

- The facility will be designed for a >20 year plus operating life
- The facility will be designed for an annual operating run time of 7,200 hrs
- The CPP plant module will be designed to receive and process 145 t/h as received(ar) of ROM coal
- The CPP plant will be designed to allow the addition of extra process modules to expand the processing capacity to 190 t/h (ar) of ROM coal
- The CHPP will be designed for a safe and economical operation suited to the seasonal weather conditions

3.2 Material Properties and Characteristics

The following solids property values have been utilized for the CHPP design.

Table 3-1 Solids Density

Density	Value	Units
ROM coal	1.40 to 1.80	t/m ³
Crushed coal	1.35 to 1.68	t/m ³
Product coal	1.30 to 1.60	t/m ³
Coarse rock	1.60 to 2.26	t/m ³
Fine rock	1.60 to 2.26	t/m ³

Table 3-2 Bulk Density

Bulk Density	Volume Design	Mass Design	Units
ROM coal	0.90	0.95	t/m ³
Crushed coal	0.90	0.95	t/m ³
Product coal	0.85	0.97	t/m ³
Coarse rock	1.10	1.30	t/m ³
Fine rock suspension	1.00	1.30	t/m ³

Table 3-3 Angles of Repose

Angles of Repose	Raw Coal	Product Coal	Reject	Units
For capacity (nominal)	36	36	36	Degrees

Table 3-4 Hardgrove Index (HGI)

Hardgrove Index	Value
Coal	65-85

Table 3-5 Ultimate Compressive Strength (UCS)

Ultimate Compressive Strength	Value	Units
Coal	<50	MPa
Dilution	>=50	MPa

Table 3-6 Particle Size

Feed Stream	Value	Units
ROM maximum lump size	500 x 500 x 500	mm
ROM nominal top size (d95)	500	mm
CPP feed nominal top size (d95)	50	mm

Table 3-7 Total Moisture

Total Moisture (as)	Value	Units
Raw coal into plant	5.0	%
Clean Coal at plant	9.0	%
Clean Coal at port	10.5	%
Tailings	35-40	%

Table 3-8 Dilution Material

Dilution Material by Volume	Value	Units
Maximum proportion in the raw coal	5 – 15%	%
Rock type	Siltstone, sandstone, mudstone, shale	N/A

3.3 Water Properties

CPP raw water quality data has been assessed, based on the local water chemistry information, it is believed there will be no adverse or corrosive effects on process plant equipment.

The study has assumed that the CPP will be supplied water of a suitable quality with no specific water treatment required.

The following is the recommended water quality specification:

- pH 6.5 - 8.0
- Solids content:
 - Dissolved: 1,000 ppm (mg/L)
 - Suspended: 100 ppm (mg/L)
 - 100% of +250 mesh (60 µm) particles removed.
- Maximum individual dissolved ions:
 - Hardness (Ca⁺, Mg⁺) 200 ppm (mg/L) as CaCO₃
 - Calcium Carbonate (CaCO₃) 10 ppm (mg/L)
 - Sulphate (SO₄⁻) 50 ppm (mg/L)
 - Chloride (Cl⁻) 1,000 ppm (mg/L).

3.4 CHPP Process Design Criteria

For the design of the CPP facility, the following coal quality sizing and yield windows have been assumed based on a similar Canadian coal within the region.

Table 3-9 Process Mass Percent Distribution Between CPP Circuits

Process Circuit	Size Range	Finest (%)	Nominal (%)	Coarsest (%)
DMC Circuit	-50mm + 0.5mm w/w	79.1	84.2	88.4
Flotation Circuit	-0.5mm w/w	20.9	15.8	11.6

Table 3-10 CPP Yield Window (adb)

Process Circuit	Size Range	Min Yield (%)	Nom Yield (%)	Max Yield (%)
DMC Circuit	-50mm + 0.5mm w/w	56.0	75.0	80.0
Flotation Circuit	-0.5mm w/w	41.0	70.0	75.0

3.5 Capacity and Operating Data

The capacity and operating criteria for the Tenas CHPP are outlined below

Table 3-11 Capacity and Operating Data

Criteria	Value
General	
ROM coal capacity (nominal)	145 t/h
Clean coal capacity (nominal)	110 t/h
Raw Coal Handling	
ROM nominal top size (d95)	500 mm
Raw coal CPP feed nominal top size (d95)	250 mm
CPP feed conveyor nominal capacity	145 t/h
ROM coal truck specification	100 t truck
Raw coal feed loader specification	6.4-7.7 m ³ loader
Coal Preparation Plant	
CPP capacity	145 t/h
Tailings filter design capacity	12 t/h
CPP raw water make-up required	130L/ROM t
Clean Coal Handling	
Clean coal conveyor capacity	120 t/h
Clean coal stockpile capacity	8,400 t
Clean coal truck specification	B Double – side tipper
Clean coal haulage to TLO distance	17.5 km
Fine and Coarse Rock Handling	
Fine and Coarse Rock conveyor capacity	46 t/h
Fine and Coarse Rock stockpile capacity	6,600 t
Rock truck specification	100 t truck
Train Loadout	
Rail configuration	Loop
Loadout stockpile	Direct dump by haulage trucks
Loadout stockpile management	Front End Loader
Train loading method	Front End Loader
Train loading rate	1,000 t/h

Train size	116 aluminium side dump rail cars
Car size	110 tonnes

4 Process Description

4.1 Raw Coal Handling

Run-of-Mine (ROM) coal will be delivered from the mine pit to ROM coal stockpiles located directly outside the Coal Preparation Plant (CPP). Raw coal from the ROM coal stockpile will then be reclaimed by a Front End Loader (FEL) and transferred to a Mobile Crushing and Screening Plant. This crushing and screening plant reduces the raw coal up to a top size of 50mm and then directs this material onto the raw coal conveyor. The raw coal conveyor will have a ferrous and non-ferrous metal detector to trip the conveyor and prevent damage to downstream equipment in the CPP. A cross-belt sampler will also be installed on this conveyor to allow for raw coal sample collection, as well as a weigh scale to control the feed rate.

4.2 Coal Handling and Preparation Plant

The CPP will be a Dense Medium Cyclone (DMC)/ Flotation plant, with ultrafine rock dewatering by a Belt Press Filter.

The block flow diagram in Figure 4-1 provides a high level CPP process overview.

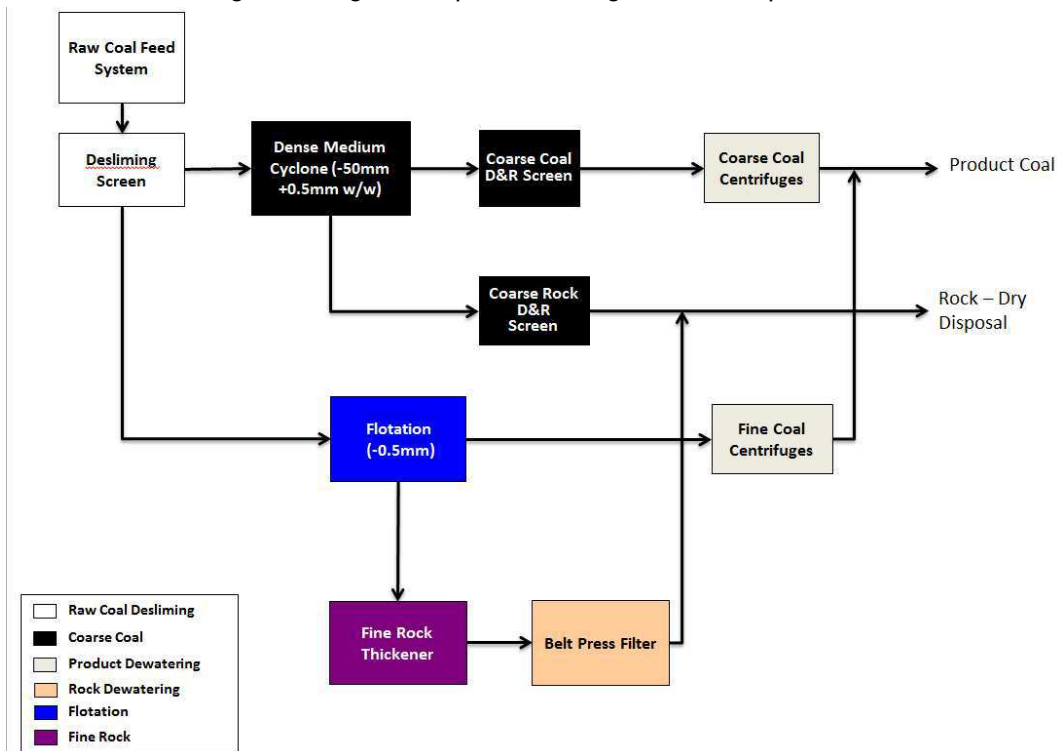


Figure 4-1 DMC/Flotation CPP Block Flowsheet Schematic

The plant process circuits will consist of:

- DMC -50 mm + 0.5 mm weight by weight (w/w)
- Flotation -0.5 mm w/w

The coal processing plant will reside inside a fully enclosed, heated and insulated CPP building. This building will incorporate a 5 tonne capacity overhead travelling crane to service the main CPP process modules.

4.2.1 Plant Feed, Desliming(screening) and Coarse Coal Circuit

Raw coal will be fed to the CPP via a multi-slope desliming screen. High flow rate sprays will assist the desliming operation and the undersize material and water will be collected in the desliming screen underpan and piped into the flotation feed sump. Oversize will discharge from the end of the desliming screen and will be flushed with correct medium into the DMC feed sump.

The DMC feed sump will be of a wing tank design with a constant sump level maintained through excess medium overflow to the correct medium sump. Mixed dense medium and coarse coal will be pumped from the DMC feed sump into a DMC cyclone.

DMC overflow containing medium and product coal will discharge directly to a screen feed box which will distribute the slurry onto the product side of the partitioned multi-slope drain and rinse screen. Product coal will discharge from the end of the screen into the product centrifuge for dewatering.

DMC underflow containing medium and reject coal and rock will discharge directly into a feed box which will distribute the slurry onto the reject side of the partitioned multi-slope drain and rinse screen. Coarse rock material will directly discharge onto a conveyor from the end of the screen.

Medium drained from the partitioned screen drain section will be returned directly to the DMC feed sump. Adhering medium will be rinsed from the product coal and coarse rock material by clarified water sprays on the rinse section of the screen. Underflow from the screen rinse section will be piped to the dilute medium sump for magnetite recovery via a high intensity magnetic separator.

Figure 4-2 shows a simplified schematic of the coarse coal circuit.

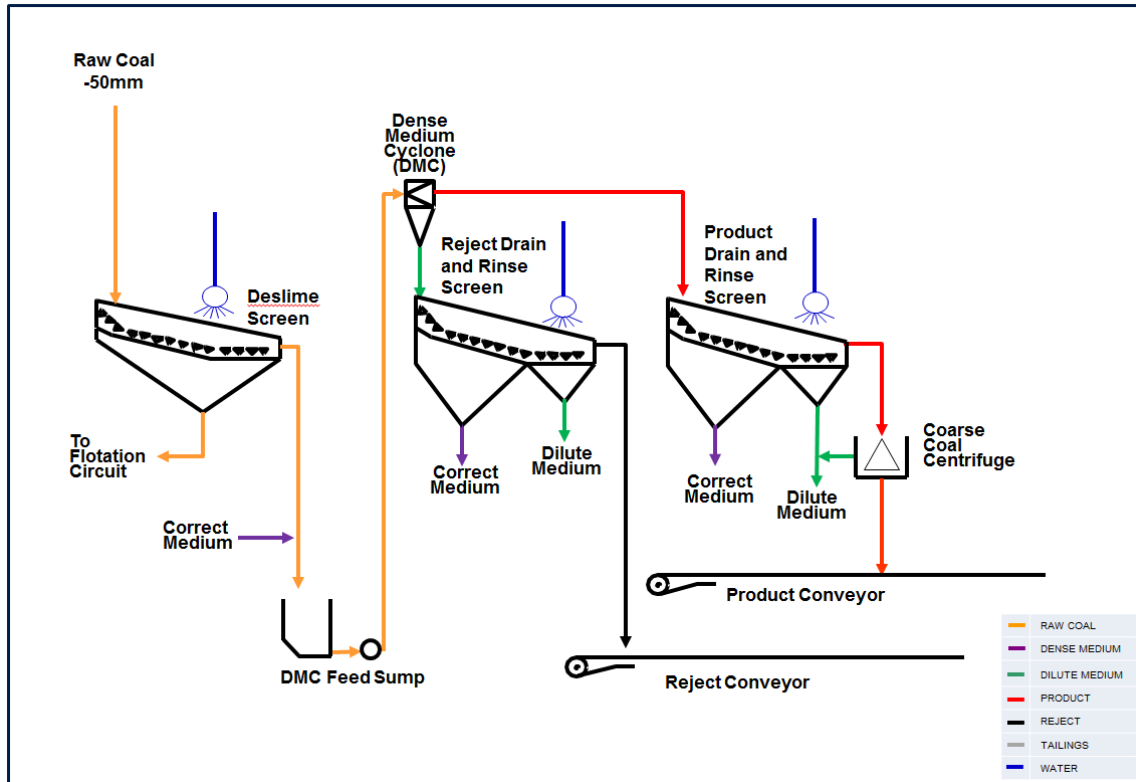


Figure 4-2 CPP Coarse Coal Circuit Schematic

4.2.2 Correct Medium Circuit

The correct medium circuit will be controlled by maintaining over-dense medium in the correct medium sump and injecting clarified water into the suction of the correct medium pump to maintain the target operating density. To maintain over-dense medium in the correct medium sump, a bleed of medium from the screen drain section will be directed to the dilute medium sump where it, together with dilute medium, will be pumped to a magnetic separator and returned to the correct medium sump as a magnetite concentrate with a typical relative density of 2.20 to 2.40.

4.2.3 Flotation Circuit

The flotation circuit will initially consist of a single air-induced flotation cell. Deslime screen underflow will be piped to the flotation feed sump where collector reagents will be added. The frother agent is injected into the flotation feed pump suction line. The collector reagent used in this process is diesel while the frother reagent is MIBC. This fine material will then be pumped to the flotation cell. Flotation tailings will report to a flotation underflow box, where the tailings will be split. A portion of the tailings will be recirculated to the flotation feed sump and the rest will be fed to the tailings thickener.

Flotation concentrate product will gravitate to the screenbowl centrifuge feed sump. The concentrate is then pumped from the screenbowl feed sump to the screenbowl centrifuge for dewatering. Dewatered ultrafine product coal will be discharged from the screenbowl centrifuge onto the product coal conveyor. The centrifuge effluent will be collected in the filtrate sump and will be pumped to the fine rock thickener.

Figure 4-3 shows a simplified schematic of the flotation circuit.

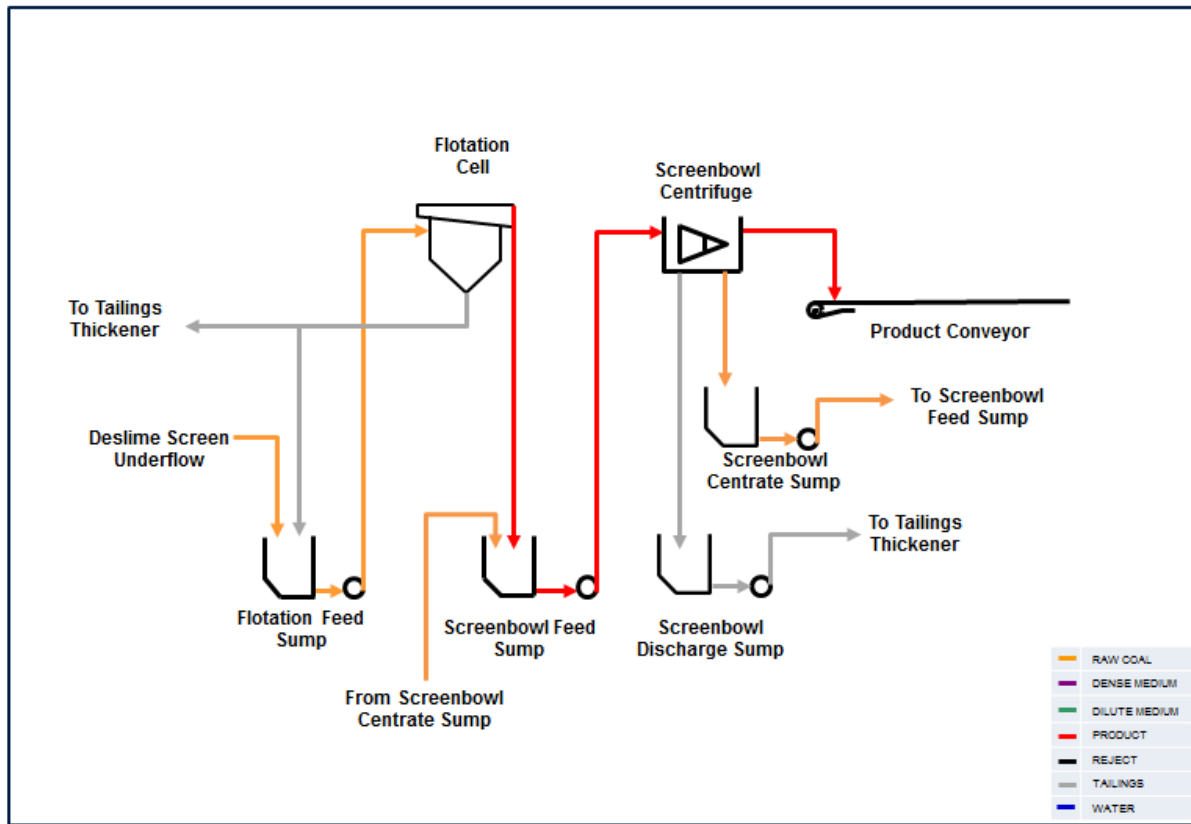


Figure 4-3 CPP Flotation Circuit Schematic

4.2.4 Fine Rock Thickener

Flotation sinks, screenbowl effluent and belt press filter will be fed into the fine rock thickener. Both anionic and cationic flocculant will be added to the thickener feed launder to assist with solids settling within the thickener.

Thickener underflow will be pumped to the belt press filter feed sump at approximately 30% w/w solids. Clarified water will overflow the thickener into a clarified water tank and will be recirculated through the plant for process water requirements.

4.2.5 Belt Press Filter

Thickened fine rock in the belt press filter feed sump will be pumped up to a single belt press filter by a dedicated feed pump. Both anionic and cationic flocculants will be used to achieve the required tailings dewatering performance.

Belt press filter cake with approximately 40% w/w solid will discharge directly onto the coarse rock conveyor and belt press filter effluent will report to the filtrate sump and will be pumped back to the fine rock thickener.

Figure 4-4 provides a schematic of the tailings and belt press filter circuit.

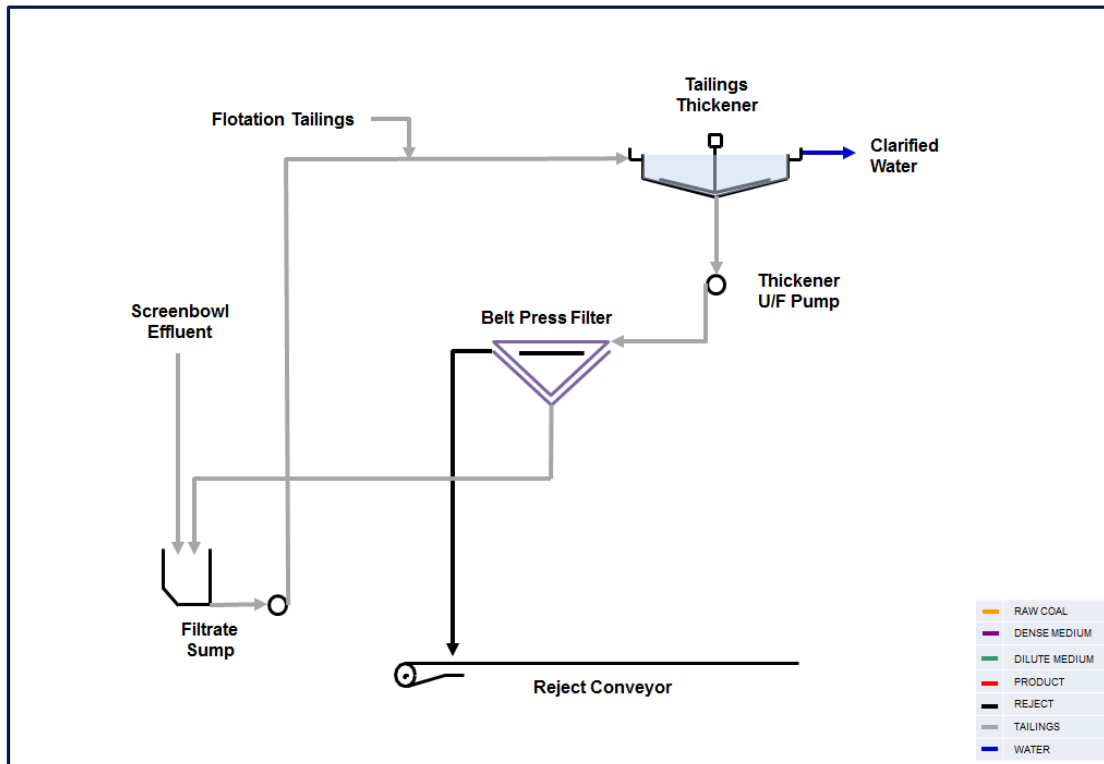


Figure 4-4 CPP Tailings Circuit Schematic

4.2.6 Rock Handling

Coarse and fine rock material will be combined on the rock conveyor and will be discharged from the CPP onto a radial stacker. The radial stacker will distribute the rock into a stockpile. Coarse and fine rock material will be reclaimed by a FEL and loaded onto trucks for co-emplacement back in the pit, or into dedicated piles.

There will be a weigh scale installed on the rock conveyor to record the instantaneous and cumulative tonnes of the CPP rock separated from the coal.

4.2.7 Product Coal Handling

Coarse and fine product coal will be combined on the product conveyor and will be discharged from the CPP onto a radial stacker. The radial stacker will distribute the product onto a stockpile. Product will be reclaimed by a FEL and loaded onto trucks, to be hauled to the train loadout location approximately 18 km away. The product will be stockpiled and then loaded onto the trains by the use of front end loaders.

A cross-belt sampler and weigh scale will be installed on the product conveyor to allow for product coal sample collection and the instantaneous product rate and cumulative tonnes to be monitored and recorded.

5 Process Reagents

5.1 Diesel

Used as a flotation collector. Diesel will be stored inside double-walled 18,000 L capacity tanks. Dosing pumps will transfer the diesel from storage tanks to the required dosing points within the flotation circuit.

5.2 Methyl Isobutyl Carbinol (MIBC)

Used as a flotation frother (surfactant). MIBC is an organic chemical compound, and a liquid derivative of acetone. MIBC will be stored inside double-walled 18,000 L capacity tanks. Dosing pumps will transfer the MIBC from storage tanks to the required dosing points within the flotation circuit.

5.3 Magnetite

An iron ore with magnetic properties. It is mixed with water to create a solution which is used to separate coal from rock. The lighter particles (coal) will float to the top of the solution while the heavier rocks sink to the bottom. Magnetite will be added to make-up for DMC circuit medium losses by hosing bulk magnetite into the coarse circuit process sump. The magnetite will be remotely stored outside on a designated stockpile area (~40t) and transported by a skid steer loader to the floor sump for hosing into the circuit.

5.4 Flocculant

Used as a clarifying agent to cause the solid particles to aggregate. Both anionic and cationic flocculant is dosed at the tailings thickener and the belt press filter. The CPP plant will be fitted with small vendor supplied flocculant preparation and dosing plants. Due to the anticipated dosing rates, anionic and cationic flocculant will be delivered to site in liquid form and stored within 1.0m³(1,000 litre) totes. Anionic flocculant is a polymer flocculent with negative charge and cationic (coagulant) flocculant is a polymer flocculent with positive charge.

5.5 Dust Suppressant

Floset DC09 (or equivalent) is a concentrated dust suppressant product designed for Railcar Topcoat applications in dry climates/environments. The product is a synthetic homo polymer that contains no nonyl-phenol ethoxylates, and which is not regulated under TDG or DOT. Furthermore, it is not considered hazardous under OSHA 29CFR 1910.1200.

5.6 Antifreeze

Flopolymer H44W (or equivalent) is a cold weather dust suppressant/release agent designed for road, conveyor belt, coal truck, and coal car applications. The product has a freeze point of -36 C, and can therefore be stored outdoors in unheated tanks. Flopolymer H44W is a vegetable derived product, which is suitable to use in even sensitive environmental situations. The majority of the product is Glycerol, CAS number 56-81-5.

5.7 Radiation Sources

There will be a source of radiation within the CPP. These radiation sources will be used for accurate density measurement of slurries in the coarse circuit (to measure correct medium density) as well as on the thickener underflow. These radiation sources will be as per regulation and have all appropriate marked off sections as per CSA standards. The active source will be Cesium-137 or Cobalt-60 as per CSA standards.

6 CPP Modular Construction

6.1 CPP Modular Layout

The design for the Tenas CHPP will use a pre-assembled modular approach for the CPP and tailings dewatering areas, as compared to the traditional stick build construction methodology. The pre-assembled modular strategy offers the following benefits, which have been incorporated into the study schedule and capital cost estimate:

- Maximising the offsite pre-assembly of the modules which reduces the onsite construction duration, particularly with respect to the low productivity winter months
- Reducing onsite durations reduces site construction costs
- Controlling supply and fabricated items together with quality inspections prior to delivery, lowers erection and re-work risks on site
- Allows easier expansion capability through the addition of pre-fabricated process modules

Typical CPP modular arrangements are shown in Figure 6-1 and Figure 6-2 below.

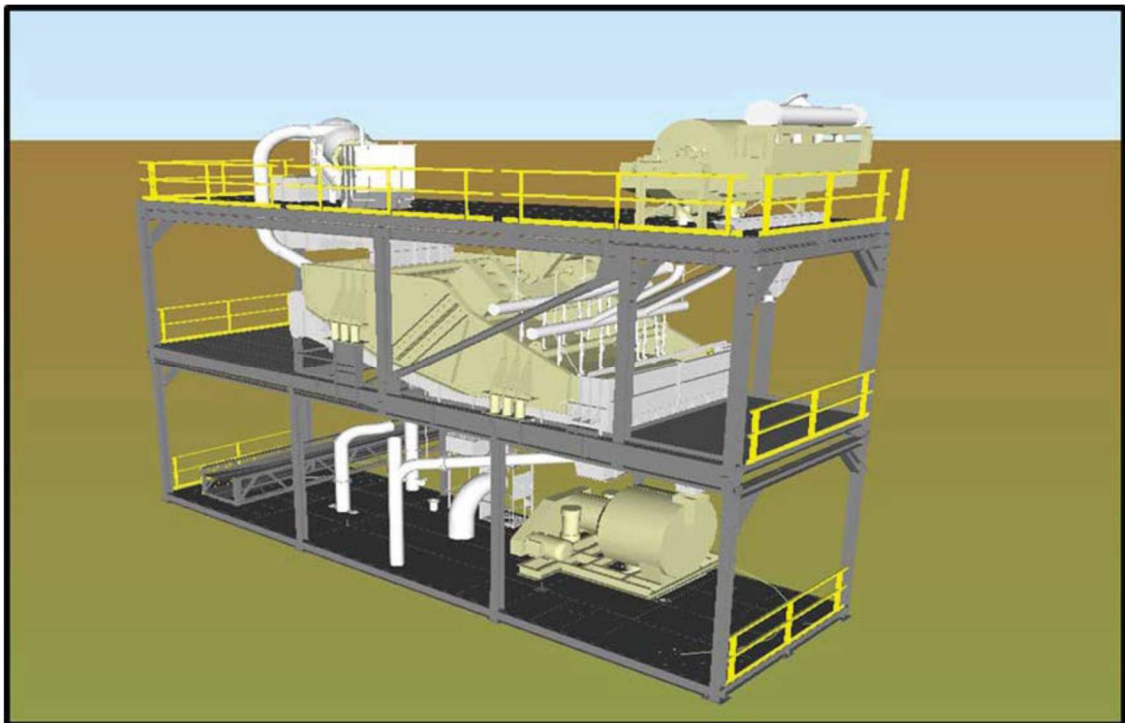


Figure 6-1 CPP Typical Modular Arrangement

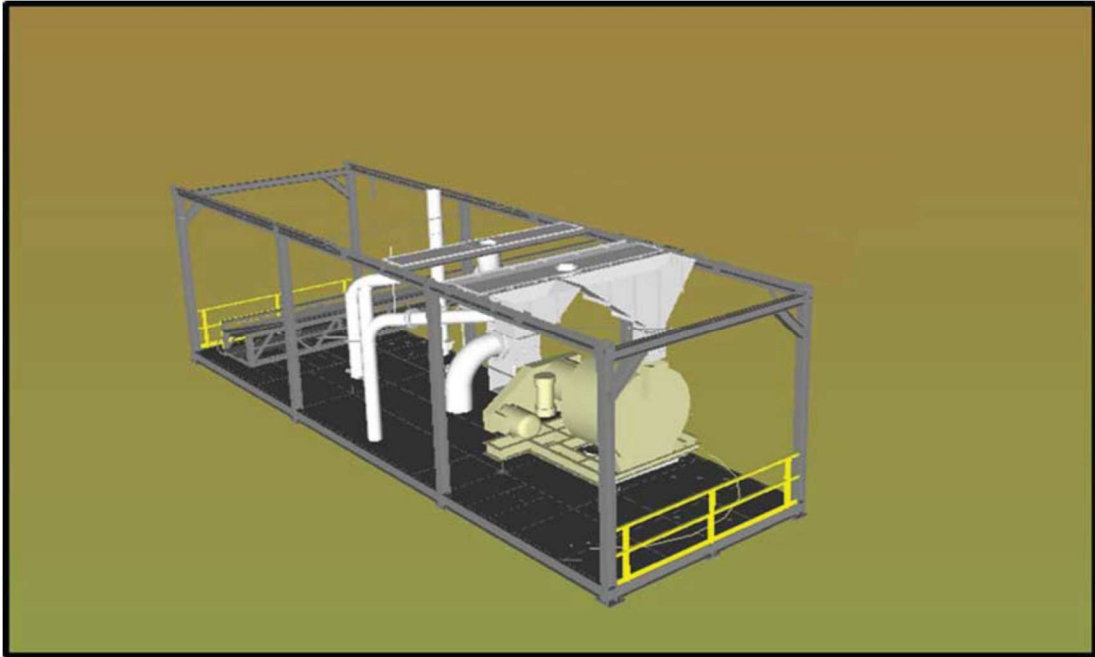


Figure 6-2 CPP Typical Module General Arrangement



Figure 6-3 Overland transportation of CHPP module



Figure 6-4 Crane lifting module for installation

Once on-site, the modules site on a concrete foundation to facilitate hosing and clean-up. The plant modules stack on top of each other in a modular format with locating pins to guide and secure final placement. Once the plant modules are stacked in the required arrangement, inter-connecting services are connected between the modules.

Whilst compact, the CPP layout still allows for good access for inspection and maintenance activities. The CPP modules will be enclosed by a pre-engineered steel building which supports the overhead crane.

6.2 CPP Building

The CPP and tailing dewatering modules will be enclosed by the CPP building. Whilst the CPP is of modular design and construction and will be predominantly preassembled off site, the shed for the CPP and the belt press filters will be a pre-engineered steel building delivered as stick steel and requiring onsite assembly

The foundation materials on site will be blasted rock placed in compacted lifts on existing ground conditions. The ground will have all topsoil and vegetation salvaged and removed prior to construction starting.

The building features include:

- HVAC (Heating and ventilation)

- Overhead maintenance crane
- Sufficient space for clear avenues for maintenance activities
- Access doors for maintenance vehicles, equipment maintenance and personnel

The CPP building will be able to be extended for the future process modules required to expand the capacity of the CPP.

6.3 Foundation Design Criteria

The CHPP will be built on a concrete foundation with shallow footings. All concrete will be designed to Canadian Standards, including CSA A23.1 to A23.3.

Footing design criteria:

- Minimum allowable bearing capacity for underside of foundations to be 150 kPa
- Total settlement, caused by the aforementioned bearing pressures, shall not exceed 20 mm. Differential settlement across the plant shall not exceed 10 mm.
- Finished surface level tolerance is ± 20 mm, with a surface profile tolerance of 10 mm vertical over 3.0 m horizontal.
- All reactive materials (e.g. expansive clays, etc.) shall be removed and replaced with engineered fill by others. The engineered fill shall be free from organic material, rubbish, large stones, excessive clay or silt. See Table 6-1 and Table 6-2 below for quantitative specifications. Engineered fill shall be placed, compacted and tested (every 400 m²) to achieve 98% of modified maximum dry density in layers no thicker than 230 mm

Table 6-1 Engineering Fill Specifications

Property	Depth below the working platform	
	$\leq 150\text{mm}$	$> 150\text{mm}$
Laboratory CBR (%)	≥ 10	≥ 10
Max. aggregate size (mm)	75	75
Weighted plasticity index (WPI)	$< 1,200$	$< 2,200$
Swell (%)	≤ 0.5	≤ 2.5
Plasticity index (PI)	> 4	> 4

Note: WPI is the product of the PI and the % passing 0.425 mm sieve

Table 6-2 AS Sieve Sizing

AS Sieve Size (mm)	Percent (by mass) Passing Sieve	
	Gravel	Loam
37.5	100	100
9.5	60 - 85	100
2.36	25 - 70	70 - 100
0.425	10 - 40	10 - 40
0.075	3 - 30	3 - 30
Other Properties - Linear Shrinkage	≤ 8	≤ 6

Where “Non-Select Fill” is specified, its material properties shall be defined as a material with a CBR between 5 to 15 with no particles larger than 150 mm and also suitable for compaction in 300 mm layers.

- No allowance has been made for groundwater effects.
- Foundation design will meet the minimum requirements outlined by the British Columbia Building Code based on the site classification and the following the seismic parameters :
 - $S_a(0.2) = 0.11$;
 - $S_a(0.5) = 0.08$;
 - $S_a(1.0) = 0.053$;
 - $S_a(2.0) = 0.034$; and
 - $PGA = 0.059$
- Freezing Index in Smithers B.C. is 823 degree-days below °C. This equates to frost penetration of 60 inches or 1.5 meters. Footings will be founded below the depth of frost penetration and detailed to limit adfreeze stresses and/or insulated appropriately for the conditions. Enclosed building foundations (CPP) will be protected by perimeter insulation

6.4 CHPP Electrical Description

The electrical design, installation and equipment will conform to Canadian Standards with CSA certification. The following description defines the basis of the capital estimate for the electrical requirements.

All electrical, instrumentation and controls will be provided to service the CHPP facility.

All motors within the CHPP facility will be powered from a common central MCC located close to the main plant building.

The control circuit design will hardwire the essential personnel and equipment safety devices in failsafe mode for enhanced security.

Local isolation for equipment will be via the MCC switchboard located in the adjacent switchroom and each motor will be fitted with a field mounted E-stop.

Lighting and general purpose power will be provided to service the CPP facility.

A modern control system will be provided to control and monitor the CPP. Plant control and monitoring will be implemented using a programmable logic controller (PLC).

The operator interface system will communicate with the PLC to allow control and monitoring of all items of plant and equipment from a central point. The operator interface system will use a SCADA package specifically configured for the plant.

Estimated total installed power for the Tenas CHPP and TLO areas are shown in Table 6-3.

Table 6-3 Tenas Estimated Power

CHPP Area	Installed Power (kW)	Operating Power (kW)
CHPP Installed Power	1,894	1364
CHPP Infrastructure Installed Power*	20	18
TLO Installed Power	13	11
TOTAL	1,927	1393

Note: As advised by Telkwa Coal*

7 Equipment List

Area	Cost Centre	Equipment	Installed Power (kW)
Raw Coal Handling	MP-101	Mobile Sizing Plant	400
	CV-101	Raw Coal Conveyor	18.5
CPP	SC-401	Desliming Screen	30
	PP-402	Flotation Feed Pump	75
	PP-401	DMC Feed Pump	132
	CY-401	Dense Medium Cyclone	0
	SC-402	Drain & Rinse Screen	22
	CF-401	Coarse Coal Centrifuge	56.55
	PP-403	Correct Medium Pump	18.5
	PP-404	Dilute Medium Pump	45
	MS-401	Magnetic Separators	5.5
	FC-601	Flotation Cell	0
	PP-603	Screenbowl Feed Pump	15
	CF-651	Screenbowl Centrifuge	402.2
	CA-651	Air Cannon	5
	PP-651	Screenbowl Discharge Pump	30
	PP-711	Filtrate Pump	30
	PF-701	Belt Press Filter	5.5
	DP-731	BPF Anionic Dosing Pump	0.37
	DP-732	BPF Cationic Dosing Pump	0.37
CPP Services	PP-701	Thickener Underflow Pump	55
	PP-901	Clarified Water Pump	110
	PP-902	Gland Water Pump	55
	DP-901	Thickener Anionic Dosing Pump	0.37
	DP-921	Thickener Cationic Dosing Pump	0.37
	FL-901	Cationic Flocculant System	0
	FL-902	Anionic Flocculant System	0
	AC-901	Air Compressor	5
	DP-960	Collector Dosing Pump	0.5
	DP-961	Frother Dosing Pump	0.5
	PP-904	Floor Pump	37
	PP-914	Floor Pump	37
Product Handling	CV-801	Product Transfer Conveyor	15
	SA-801	Product Coal Sampler	0
	SK-801	Product Stacker	18.5
Rock Handling	TH-701	Tailings Thickener	5.5
	CV-701	Rock Conveyor	15
	SK-701	Rock Stacker	18.5
Loadout	PP-801	TLO Potable Water Pump	0.55
	ST-804	Train Wagon Spray System	6.55
	ST-804b	Anti-Freeze Dosing Pump	3
	ST-804c	Water Pump	1.5
	ST-804e	Dustbinder Dosing Pump	0.55
	ST-804f	Compressor	1.5