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MEDCALF PROJECT

Tailings Storage Facility Prefeasibility Study Design

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REPORT

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Golder Associates

Executive Summary

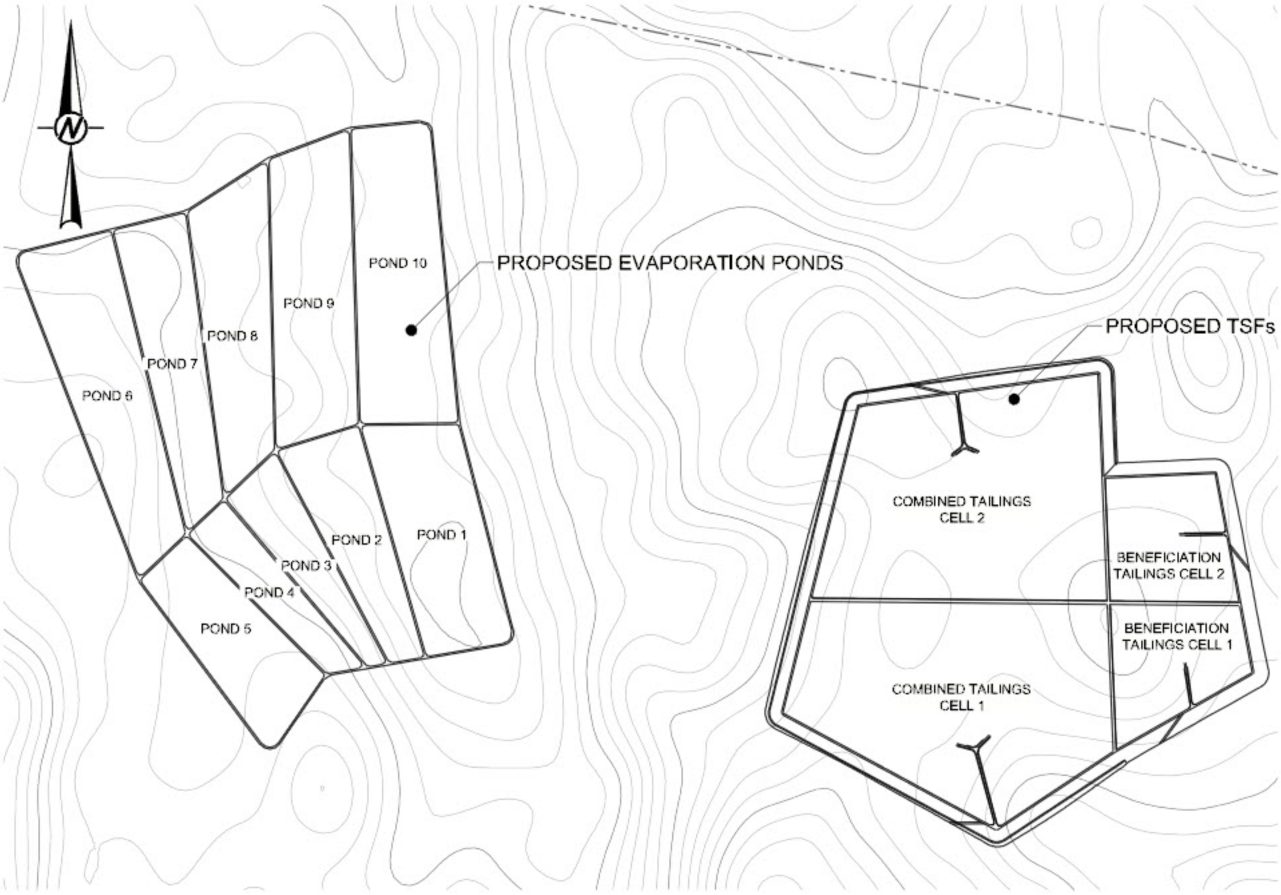
General

Golder Associates Pty Ltd (Golder) has prepared conceptual designs of tailings storage facilities (TSFs) and evaporation ponds at the Medcalf Vanadium-Titanium Project, owned by Audalia Resources Limited (Audalia). The work has been undertaken to a level of rigour typically attributed to a pre-feasibility study (PFS), although it has not been possible to undertake a site investigation, and there has only been limited representivity of samples from the anticipated tailings streams.

Tailings and Water Management Facilities

Four tailings and other process waste streams will arise from mineral processing. Based on a plant feed rate of 1.5 Mtpa of ore, the “Base Case” for the project has a requirement to store a total tailings/process waste production of about 2.24 Mtpa for a life of mine of 15 years. An additional storage area may be required in the event that iron sulfate crystals are not able to be sold.

Beneficiation tailings (BT) are expected to be essentially benign and not require the TSF to be lined. However, the expected chemistry of neutralised tailings (NT), together with the unknown characteristics of the iron hydrolysis residue (IHR) indicate that a lined TSF should be allowed for these tailings at this stage. It is therefore planned to store the BT separately from the NT and IHR to limit the extent of the TSF that is lined. The NT and IHR are planned to be comingled into a “combined tailings” or CT and stored in an adjacent, lined TSF. The figure below shows the planned arrangement of the TSFs, together with the lined evaporation ponds that will be required to remove waste water from the system.



As the TSFs are to be located a significant distance from the mine, the use of mine waste as a construction material is not likely to be economical. It is therefore planned to use natural materials from borrow pits excavated in the basins of the TSFs and evaporation ponds to form the starter embankments. The TSFs will be raised in an upstream direction and to reduce costs it is planned to use dried BT as a construction material for the raises to the CT TSF. This will provide additional storage capacity in the BT TSF.

To facilitate construction and to defer capital expenditure as far as practicable, only CT Cell 1, BT Cell 1 and Evaporation Ponds 1 and 2 will be constructed at the outset. CT Cell 2 and BT Cell 2 will be developed after about a year, and additional evaporation ponds as required. A 1.5 m wall raise is expected to be required on each BT and CT cell every 18 months, i.e. a wall raise will take place on alternate cells every nine months.

Site Characterisation

The site has been characterised through a desktop study as comprising shallow (<5 m thick) soils with occasional bedrock outcrops, typically at higher elevations. The site is gently sloping with gradients typically between 1V:45H and 1V:500H. Sheetwash material (silt, sand and gravel) with abundant calcrete as well as ferruginous duricrust with iron-cemented reworked products are likely to be present. In the broader area, there are evaporite and alluvial deposits associated with numerous playa lakes.

The site climate is semi-arid, with an annual average rainfall of 305 mm. Evaporation exceeds rainfall by about five times. Groundwater is likely to be mainly present in the bedrock, although near-surface groundwater, which may be revealed through denser vegetation, may be present on the interface of soils and bedrock.

TSF Design Analyses and Closure Considerations

Stability analyses have been undertaken using assumed parameters and drawing upon testwork undertaken on a sample comprising the majority components of the BT. The results indicate that factors of safety well in excess of the desirable minimum of 1.5 under static loading can be achieved. A conservative stability assessment has also been carried out assuming that an earthquake of sufficient energy to liquefy the tailings occurs. Under these conditions, a factor of safety of 1.0 is indicated, which is considered to be acceptable for this level of design.

Laboratory testwork and judgement indicate that rates of rise of approximately 1 m per year and 1.5 m per year will be required for the CT and BT cells, respectively. This will allow for air drying and adequate consolidation to facilitate upstream wall raising. Under these conditions, a total consolidation settlement of between 3 and 4 m is indicated, most of which will occur during operation. No significant post-operational settlements are expected.

Taking this and the climatic conditions into account, a store and release cover has been selected for the TSFs at closure. The cover is expected to incorporate a capillary break/drainage layer and a clayey borrow mixed with stockpiled topsoil spread over the surface to encouraging plant growth. This system will inhibit water infiltration during wetter months and evapo-transpirate stored water in the drier months.

Freeboard estimates indicate that the likelihood of overtopping is negligible and that the requisite guidelines can be comfortably satisfied. Preliminary water balance calculations indicate that decant return water will be equivalent to between 25 and 35% of process water inflow to the CT TSF and between 40 and 50% of process water inflow to the BT TSF.

A dam break assessment using a risk-based approach indicates a low risk of a dam break occurring and releasing of tailings/water from the TSF.

Cost Estimates

The estimated costs associated with the Medcalf TSFs, evaporation ponds and $FeSO_4$ crystal storage facility based on the assumptions stated above are shown in Table ES1 and Table ES2. Detailed costs are presented in Appendix C. This cost estimate does not include process (pumping and piping) and maintenance costs involved in the operation of the TSFs.

Table ES1: Estimated Capital Costs

Item	Cost
CT Cell 1 Starter	$42.3 million
BT Cell 1 Starter	$3.0 million
Evaporation Pond 1	$6.1 million
Total Capital for Base Case	**$51.4 million**
$FeSO_4$ Crystal Pad (allowance)	$9.6 million
Total Capital for Alternative Case	$61.0 million

Table ES2: Estimated Deferred Costs

Item	Cost
CT Cell 2 and Wall Raises	$106.0 million
BT Cell 2 and Wall Raises	$4.7 million
Evaporation Ponds 2-10	$47.7 million
Total Deferred	$158.4 million over ~14 years

Based on the Bill of Quantities a total capital cost of $51.4 million is estimated for the Base Case. Should a facility be required to store the $FeSO_4$ crystals, an additional $9.6 million will need to be provided for. Deferred costs in the order of $160 million over 14 years are estimated for ongoing development of the facilities.

An allowance of $10/m^2 has been allowed for closure of the TSFs and evaporation ponds, based on experience with similar facilities in regional Western Australia. Based on a footprint area of 455 ha and including a 10% allowance for additional disturbed areas (access road, seepage interception drains, etc.), this equates to a closure cost in the order of $50 million

Opportunities

Six opportunities for cost reduction have been identified as follows:

1) Elimination of the HDPE liner on the upstream batter of the starter embankment, with the potential to save ~$0.5 million in capital costs and ~$0.4 million in deferred capital.

2) Elimination of the HDPE liner across the basin of the CT TSF, and the associated overliner drainage system, with the potential to save ~$34 million in capital costs and ~$20 million in deferred capital.

3) Sourcing of the materials required for the overliner drainage system locally, with the potential to save between $10 and $15 million in capital costs for the CT TSF and between $9 and $14 million in deferred capital.

4) Elimination of the HDPE liner across the basin of the evaporation ponds, with the potential to save ~$3 million in capital costs for the evaporation ponds and ~$2 million per pond in deferred capital costs.

5) Reduction in the evaporative area if a higher evaporation factor can be justified or a portion of the waste water can be used for dust suppression purposes. An increase in the evaporation factor by 0.05 (i.e. from 0.6 to 0.65 could result in a cost saving of ~$6 million.

In addition to the above, additional minor opportunities exist to refine the cost estimate by confirming ground conditions across the TSF and evaporation pond sites.

Future Work

The feasibility study for the project should be staged to prioritise key activities, with the initial stage comprising geochemical characterisation of the waste streams, field investigations and preliminary seepage modelling. The primary objective of this would be identify the potential for elimination of the liner.

The following stage of the feasibility study would include:

- Supplementary geotechnical and geochemical laboratory testing of the waste streams and the RO brine
- Laboratory testing of the samples collected during the field investigations
- Updates to the design of the TSF, taking cognisance of the supplementary laboratory testing, field investigations and preliminary seepage modelling
- Updated cost estimate, with quantities estimated from three-dimensional design models based on ground survey for the proposed sites
- Updated reports, figures and drawings presenting the design and suitable for use as supporting documentation for the approvals process

The extent of work required for the feasibility study is strongly dependent on the outcomes of the proposed initial stage of work. For budgeting purposes, it is estimated that the geochemical characterisation of the waste streams, field investigations (geotechnical and the hydrogeological component associated with the TSFs and evaporation ponds) and preliminary seepage modelling will incur costs in the order of $150 000 to $250 000, including allowance for engagement of a suitable drill rig. This work would likely require about four to six months to complete.

The remaining tasks for the feasibility study, as listed above, would likely incur costs in the order of $200 000 to $350 000 and require an additional four to six months to complete. It is recommended that a budget of $600 000, and a schedule of at least 12 months, be allowed for the TSF and evaporation pond feasibility-level design.

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1.0 INTRODUCTION

1.1 General background

Audalia Resources Limited (Audalia) has commissioned Golder Associates Pty Ltd (Golder) to assist with the prefeasibility study (PFS) for the design and cost estimation for a tailings storage facility (TSF) and associated waste water evaporation ponds at its Medcalf Project (Medcalf). Medcalf is located about 470 km east of Perth, near Lake Johnston in Western Australia. Access to the site is planned to be via the Coolgardie-Esperance Highway, with an intersection located about 40 km south of Norseman. Medcalf is expected to be a vanadium and titanium producer and has a resource of at least 29 Mt (at 0.51% vanadium oxide and 9.38% titanium oxide), contained in the Vesuvius and the Fuji ore bodies.

This report presents design concepts and a capital cost estimate for a TSF, which has been designed to accommodate the anticipated life of mine (LoM) tailings at Medcalf, as well as evaporation ponds to store and remove waste water generated over the life of the project.

1.2 Study objectives

The objectives of this study were to identify a preferred location and a conceptual design configuration for the Medcalf TSF and associated evaporation ponds, with the aim of preparing a capital cost estimate of the civil works to a level of confidence that may typically be attributed to a PFS.

1.3 Scope of study

This report presents a summary of the tailings and waste water management storage concepts and includes:

- Basis of design, including preliminary tailings characterisation testwork
- Design concepts and associated preliminary design studies
- Qualitative risk assessment
- Bill of quantities and capital cost estimate

1.4 Study limitations

There was insufficient information available at the time of undertaking this PFS to enable the TSF and/or evaporation pond design to be progressed to a level of confidence that would preclude re-visiting the assumptions, design approach, facility configuration and their progressive development at the next stage of design. Golder has applied its professional and experience-based judgement to the basis of design and to the establishment of preliminary design parameters in order to develop design concepts that can be considered to be appropriate for the project, as it is currently interpreted. The designs as presented should therefore be considered as preliminary, or “conceptual”.

The battery limits for the scope of work covered by Golder and documented in this report are the discharge points for tailings slurry and waste water, and exclude all pumping and piping requirements for the tailings and water between the process plant and TSF, as well as between the TSF and the process plant and/or evaporation ponds. The facilities have been designed for the currently anticipated life of the project and have incorporated closure considerations.

2.0 BASIS OF DESIGN

2.1 Design codes and guidelines

The TSF has been designed to be consistent with the requirements of the Department of Mines and Petroleum (DMP) *Code of Practice for Tailings Storage Facilities*[1]. We have also taken cognisance of the Australian National Committee on Large Dams (ANCOLD) – *Guidelines on Tailings Dams; Planning Design, Construction, Operation and Closure*[2].

2.2 Environmental compliance criteria

The environmental compliance criteria (ECC) for the TSF are influenced by the selected TSF location and the local receptors. It is anticipated that there will be a need to limit seepage from the TSF and evaporation ponds and that there will be groundwater quality targets and a maximum groundwater elevation that must be adhered to, at a monitoring point (or points) to be confirmed (possibly the lease boundary). Surface water quality (including sediment loading) will likely also require control measures in order to meet identified compliance criteria. For the purpose of the PFS design, the TSF and evaporation ponds have assumed that the following ECC, or similar, will need to be satisfied.

1) There will be no detrimental effect on groundwater quality beyond the lease boundary such that current and/or future users would be compromised.
2) There will be no adverse effects on native vegetation surrounding the TSF and evaporation ponds at a distance greater than 50 m from the perimeter of the facilities.
3) There will be no release of tailings solids or contact water to the surrounding ground surface.
4) Solid particles that erode through wind and/or rainfall from the confining embankments and/or soil covers will report to the surrounding ground surface at a rate that can be accommodated by the receiving environment such that vegetation quality will not be compromised.
5) The final structures will seek to mimic natural landforms in the vicinity of the site as far as practicable.
6) The final land use will not be significantly different from that prevailing prior to mining.
7) The landforms will meet these criteria for a period of at least 300 years after cessation of operations.

2.3 Tailings and process waste production schedule

Simulus Pty Ltd (Simulus) provided Golder the life of mine tailings production schedule that has been adopted for this PFS in an email dated 28 October 2015. Simulus informed Golder that four tailings and other process waste streams will arise from mineral processing. A summary of the tailings and waste production is provided in Table 1, which is based on a plant feed rate of 1.5 Mtpa of ore.

Table 1: Anticipated tailings and process waste production

Tailings/Process Waste Stream	Tonnage per Year
Beneficiation tailings (BT)	670 070
Neutralised tailings (NT)	995 790
Iron hydrolysis residue (IHR)	571 540
Iron sulfate ($FeSO_4$) crystals	535 889

1 Department of Mines and Petroleum (2013). Tailings storage facilities in Western Australia – Code of Practice.

2 Australian National Committee on Large Dams (ANCOLD) (2012). Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure. ANCOLD, May 2012.

Golder has been advised by Audalia that the iron sulfate crystals are intended to be sold as a by-product and there is no need to accommodate them in the TSF. Consequently, there will be a requirement to store a total tailings/process waste production of about 2.24 Mtpa for a life of mine of 15 years. This is considered to be the “Base Case” for the project. In the event that the iron sulfate crystals are not able to be sold, a storage area would be required. A preliminary cost for this has been included as an alternative to the Base Case.

Based on discussions with Simulus, the BT are expected to be essentially benign. The expected chemistry of the NT and the unknown characteristics of the IHR indicate that it is advisable to provide for these tailings to be stored in a lined facility at this stage. It is therefore planned to store the BT separately from the NT and IHR. The NT and IHR are planned to be comingled are henceforth referred to as “combined tailings” or CT.

2.4 Tailings characterisation

A limited amount of preliminary testwork has been undertaken on a reasonably representative tailings sample of the BT to help substantiate the assignment of parameters for use in the PFS (see Section 4.0, starting on page 10). The parameters (measured or assumed) that formed the basis of design are summarised in Table 2.

Table 2: Tailings parameters adopted for PFS design

Tailings Stream	Parameter	Value	Source
Beneficiation Tailings	Average porosity	0.58	Calculated
	Solids specific gravity	3.42	Measured by Golder
	Average dry density	1.5 t/m^3	Based on testwork (see Section 4.0)
	Maximum rate of rise	1.5 m/year	Based on Golder experience
Neutralised Tailings	Average porosity	0.6	Assumed from experience
	Solids specific gravity	2.74	Provided by Simulus
	Average dry density	0.9 t/m^3	Calculated from the above
	Maximum rate of rise	1.0 m/year	Based on Golder experience
Iron Hydrolysis Residue	Average porosity	0.6	Assumed from experience
	Solids specific gravity	3.7	Provided by Simulus
	Average dry density	1.3 t/m^3	Calculated from the above
	Maximum rate of rise	1.0 m/year	Based on Golder experience

The above parameters were used to establish approximate dimensions of the TSFs, as summarised in in Table 3.

Table 3: Approximate TSF dimensions

Facility	Footprint Area (ha)	Maximum Height (m)
Combined tailings (CT) TSF	160	20
Beneficiation tailings (BT) TSF	30	20

Based on an options assessment (discussed in Section 5.1) two facilities, each with two cells will be required, assuming that the upstream method of wall construction is adopted. The area requirements, the number of cells and the separation of BT and CT helped to direct the TSF configuration at the identified site location.

2.5 TSF location

The TSF location has been selected through discussions with Audalia, taking cognisance of lease boundaries, site topography, site geology, infrastructure layouts and other areas of significance. The TSF location is discussed further in Section 3.0.

2.6 TSF Hazard Rating

The DMP and ANCOLD design codes and guidelines have been referenced to establish the consequence categories for the TSF, assuming the dimensions established from the above. The consequence categories assigned to the TSF and the justifications for selection are presented in Table 4.

Table 4: Consequence categories

Guideline	Consequence Category	Justification
DMP (2013)	Category 1, Medium	■ Height greater than 15 m ■ No loss of life expected but the possibility recognised ■ No potential for human exposure ■ No potential for loss of livestock ■ Economic repairs can be made ■ Loss of capacity possible, repairs possible ■ Temporary environmental damage possible ■ Limited adverse effects on flora and fauna ■ No potential for damage to items of heritage value
ANCOLD (2012)	Significant (Major Severity Level and <1 PAR*)	■ Minor damage to property & road infrastructure (<$10M) ■ Significant impacts to business ■ Limited public health risks ■ Limited social dislocation ■ Small impact area (<5 km^2) and short impact duration (<5 years) ■ Limited effects on rural land and local flora and fauna

Note: *PAR – population at risk

The consequence category, under both the DMP code of practice and the ANCOLD guidelines is similar, mainly due to the economic impacts associated with failure of the TSF, including reputational damage to Audalia. The outcomes of this consequence category assessment have been used to indicate freeboard and stability requirements.

2.7 Water management

The removal of the supernatant water and the management of incident rainfall of the TSF will be consistent with the following:

- ***Water return facilities.*** The recovered water from the TSF will be pumped during normal operations to the process plant or to the evaporation ponds.

- ***Incident rainfall management.*** The embankment crest will be constructed with an inwardly-directed crossfall towards the tailings beach. Rainfall runoff from the crest and incident rainfall on the tailings beach will be collected and managed with the supernatant water. Rainfall runoff from the external TSF slopes will be encouraged to flow towards toe drains. Additional surface water management measures to control sediment are to be incorporated into the design, as required to meet the ECC in Section 2.2 on page 2.

- ***Freeboard requirements.*** The freeboard requirements for the TSF are set down in the codes and guidelines identified in Section 2.1. The TSF is classified as a **Category 1, Medium Hazard** facility according with the DMP Code of Practice and as **Significant** under the ANCOLD guidelines. Based on the hazard ratings the freeboard requirements following storm events are summarised below in Table 5.

Table 5: Freeboard requirements

Event	Duration	Basis	Rainfall (mm)	Freeboard (mm)
1 in 100 AEP*	72-hour	DMP's and ANCOLD's recommended minimum value	144	0.5
1 in 1000 AEP*	72-hour	Taking cognisance of ANCOLD (2012)	780	Contained

Notes: *AEP – Annual Exceedance Probability

These requirements have been incorporated into the design and are discussed further in Section 6.5 on page 26.

3.0 SITE SETTING

3.1 Location

For logistical reasons, Audalia has made the decision to locate the process plant close to the Kalgoorlie to Esperance road and rail links, which places it some 40 km to the east of the mineralised zones. The tailings and water management facilities will be located close to the process plant, as shown on Figure 1.

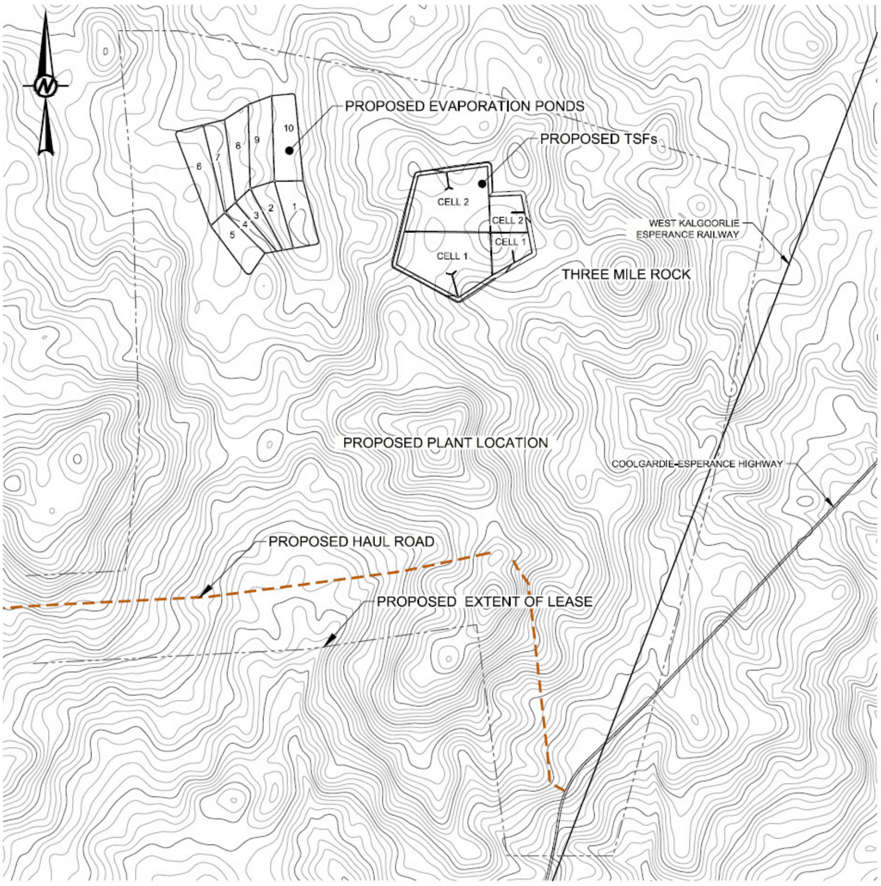

Figure 1: Planned location of processing and associated waste facilities

3.2 TSF and evaporation pond layout

The parameters and requirements described in the Basis Of Design chapter above (Section 2.0), together with interpretation of site topography, geology and other relevant factors were used to size and orientate the TSF cells and evaporation ponds as shown on Figure 2.

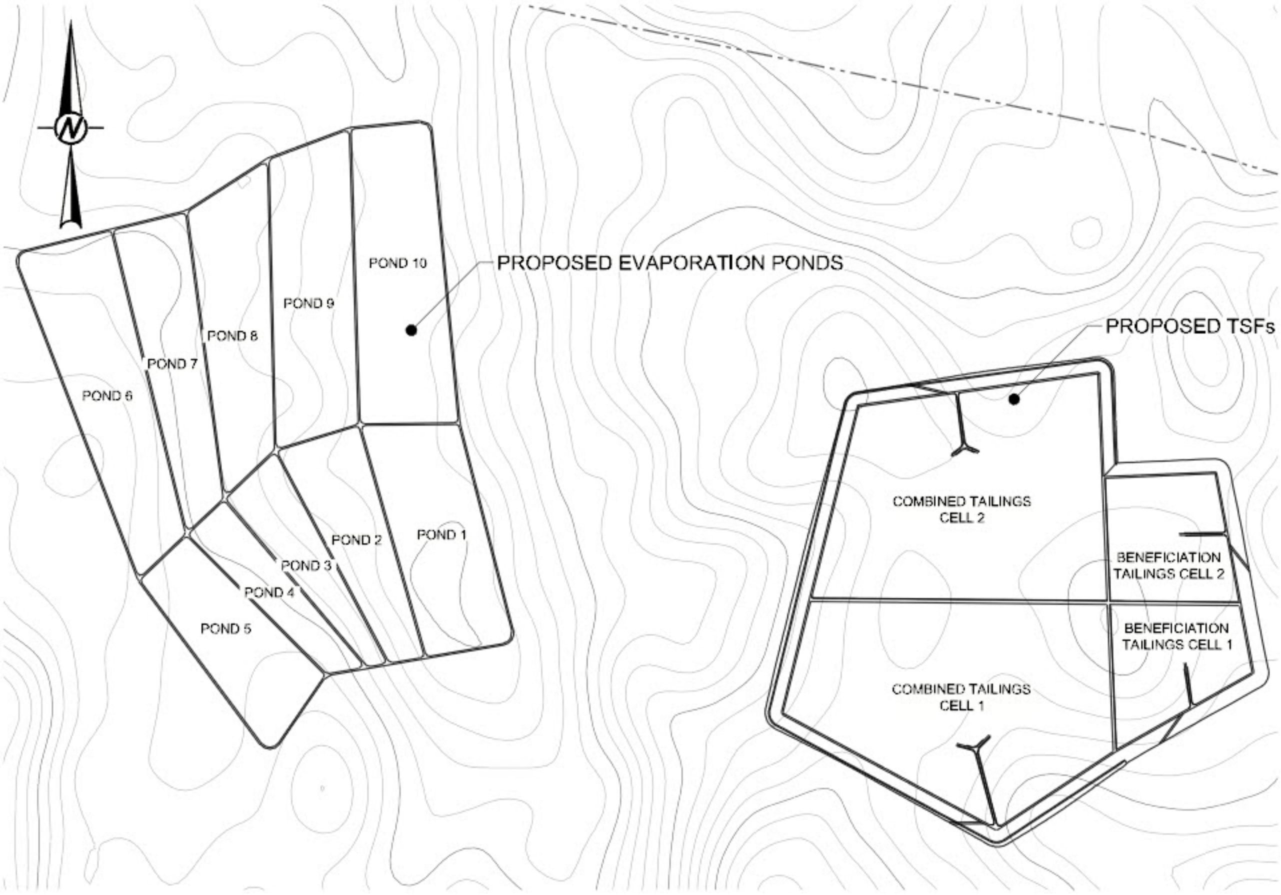

Figure 2: General configuration of TSF and evaporation ponds

It is planned for only CT Cell 1, BT Cell 1 and Evaporation Pond Cells 1 and 2 to be constructed at the outset. TSF Cells 2 will be developed after about nine months to a year after initial start-up. Natural materials will be borrowed from within the TSF and evaporation pond basins as far as practicable to reduce costs and increase facility capacities. The cells have been sized so that the rate of rise will be sufficiently low to allow for air drying and hence upstream embankment raising. Following construction of the initial pre-deposition facilities, the TSF cells will be upstream-raised using BT borrowed from the dormant cell. Additional evaporation area will be provided as required, and a total of ten cells have currently been allowed for as shown on Figure 2 and Figure in A1 in Appendix A.

3.3 Site description and current land use

There is a limited amount of readily available aerial photography for the area. The available imagery is hosted by NearMap and Google Earth, dating back to November 2006. The Kalgoorlie Esperance Railway and Coolgardie Esperance Highway are located in the south-east corner of the area indicated on Figure 1. The available aerial imagery shows that the area is undeveloped aside from development associated with these two transport corridors. The site largely comprises bushland and scrub, with occasional bedrock outcrops, which are principally located at higher points in the topography.

The elevation across the site varies between approximately 275 m AHD[3] and 320 m AHD. Topographical contours, interpolated from 10 m contour data, indicate that the terrain is generally flat with ground surface gradients between approximately 1V:500H and 1V:45H. Slightly higher ground is located toward the middle and north-east corner of the site ("Three Mile Rock"), with minor gullies draining away from these points in most directions. The area also appears to contain low vegetated dunes.

3 Australian Height Datum, which is based on the mean sea level around Australia for 1966-1968 being at elevation 0.000 m.

3.4 Interpreted site geology

The 1:100 000 Geological Series maps for Norseman (Sheet 3233) and Dundas (3232) are reproduced as Figure 3 and show the geology at the site comprises the following main geological materials and structures:

- *Granitic Bedrock* – Granitic and metamorphosed granitic rocks of the Albany-Fraser Orogeny both underlie and outcrop at the site. Outcrop is largely restricted to higher ground.
- *Colluvium* – Quartz and feldspar-rich gravel, sand and silt commonly derived from weathering of the granitic bedrock in the area but with some areas dominated by calcrete.
- *Alluvium* – Clay, silt, sand and gravel accumulated in drainage channels and floodplains.
- *Sandplain and Residual units* – residual and eolian sand with minor silt and clay with areas of ferruginous, siliceous and calcareous duricrust.
- *Dykes* – Mafic and ultramafic dykes are inferred to cross the site in various places.
- *Cundeelee Fault* – The location of the Cundeelee Fault is approximately 6.5 km south-east of the area (not shown on Figure 3). However, an un-named fault (shown on Figure 3) that may be a splay from the Cundeelee Fault likely passes beneath the site.

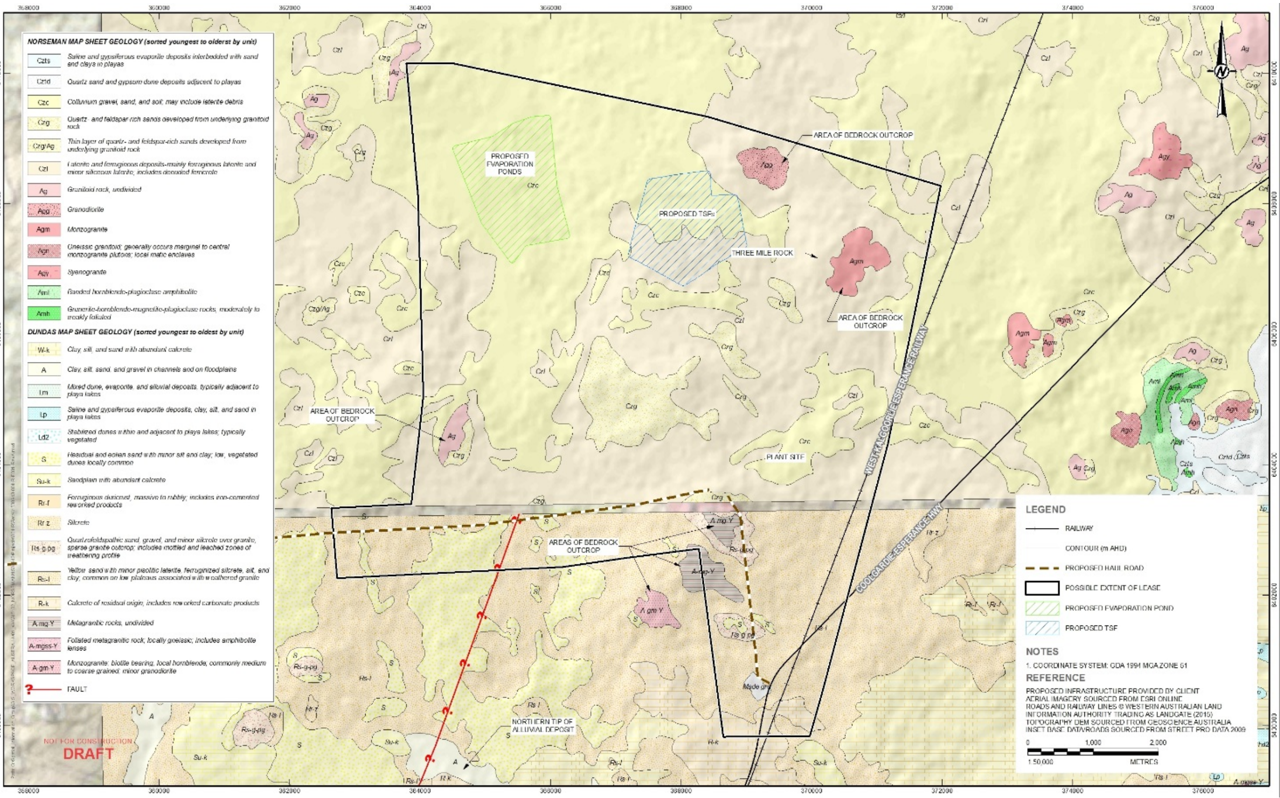

Figure 3: Interpreted geology of site

The general area contains evaporite and alluvial deposits associated with the numerous playa lakes. Furthermore, sheetwash material (silt, sand and gravel) with abundant calcrete as well as ferruginous duricrust with iron-cemented reworked products are present. Given the scale, and therefore accuracy, of the geological map it is possible these and other units will also be present at the site.

Bedrock outcrops generally appear to occur at high points in the topography. Consequently it is expected that most soils and unconsolidated sediments within ~500 m of bedrock outcrops will be relatively thin (less than 5 m). Soil thickness may be greater than 5 m in gullies and wide valleys present between topographic highs, where sheetwash and alluvial process will have led to an increase in soil thickness.

3.5 Groundwater and surface water

Norseman has a semi-arid climate and the Australia Bureau of Meteorology currently lists a mean annual rainfall of 305 mm. Given the low rainfall amount and the expected thin layer of material overlying bedrock, the majority of groundwater at the site will likely be contained within the bedrock. Some groundwater is expected to be present near the contact with the underlying bedrock and consequently close to surface in places.

Vegetation type and density may also provide an approximate indication of where groundwater may be relatively close to surface and will help target the future site geotechnical investigation. It is noted that Groundwater Resource Management Pty Ltd (GRM) has undertaken desktop studies to identify potential groundwater resources and expected pumping requirements.

The presence of surface water in the area is expected to be largely restricted to the numerous playa lakes present (e.g. Lake Dundas) several kilometres to the south and east of the site. However, given the relatively gentle topographical gradients, it is expected that some surface water may temporarily pond in topographical lows during wet periods.

3.6 Possible site preparation requirements

The following preparation requirements may be generally appropriate for the site:

- Remove all organic material, roots and other unsuitable or deleterious material from the footprint of TSF, plant site and haul road locations. These materials should be stockpiled separately and are unlikely to be suitable for re-use as structural fill.
- If soft or loose zones, or concentrations of silt and clay are encountered during site preparation they should be dug out and stockpiled for potential use in TSF embankment construction.
- Proof compaction of exposed surfaces should be completed with appropriate compaction plant to be specified following confirmation of TSF size and height. Areas not passing compaction requirements should be dug out, filled with structural fill and re-compacted. Given the potential presence of duricrust, compaction plant suited to breaking down rock may need to be considered (e.g. grid roller).
- Where fill is required to achieve required foundation levels, a borrow source for structural fill will need to be identified. This material should be placed and compacted in layers of no greater than 0.3 m loose thickness.
- If a variable blend of ferricrete or calcrete with sands is present at finish level, removal of ferricrete or calcrete cobbles and boulders should be considered below the base of future plant site footings in order to minimise the risk of differential settlement.

3.7 Excavatability and material re-use

The following items may be generally appropriate when considering excavatability and re-use of *in situ* materials:

- The potential presence of ferruginous, siliceous and calcareous duricrusts mean excavatability of materials overlying bedrock is expected to range from easy digging in silts, sands and gravels to hard digging and hard ripping in duricrust zones. Although bedrock is likely to have a weathered crust in places, it is expected that very hard ripping would be required to penetrate more than 0.5 m.

- If cut to fill operations are required to obtain desired finish levels it is likely that *in situ* materials overlying bedrock will be suitable for re-use as structural fill or as bulk fill for TSF embankments after some re-working or screening of oversize material.
- The geological maps for the area indicate that materials for re-use as low permeability zones (e.g. core or liner) in the TSF embankment, ideally with a fines content (particles smaller than 75 µm) greater than about 30% and a clay content (particles less than 2 µm) of between about 8% and 15%, are unlikely to be present in sufficient quantity on site. The geological maps show that an alluvial deposit is located approximately 3.5 km south of the site. This may represent the best opportunity of finding a high fines content borrow source that is relatively close to the site and should be examined further during field investigation.
- Gravels contained within materials on site may be suitable for re-use on plant roads after minimal reworking or crushing by compaction plant.

3.8 Climate

The climate at Medcalf area is hot and semi-arid, with temperatures ranging from 45°C in summer to 10°C in winter, and unreliable and intermittent rainfall. Average monthly climate data has been sourced from the Bureau of Meteorology (BoM) Norseman (BoM Number: 012009) and Salmon Gums (BoM Number: 012071) weather stations. The weather stations have been selected due to their relative proximity to the project location. Rainfall and temperature data have been extracted from the Norseman data and evaporation data from the Salmon Gums weather station data. The Salmon Gums data have been utilised as evaporation data are not available in the Norseman weather data. Salmon Gums is located approximately 100 km from Medcalf and its data are considered reasonable for input into this study.

Table 6: Average monthly climate data

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Monthly Rainfall (mm)	38.2	26.6	32.1	26.1	19.1	15.5	23.8	22.4	23.8	22.6	32.1	22.9	305
Highest Monthly Rainfall (mm)	93.6	136.8	149.8	71	47.6	36	55.2	48	71.8	76	92.2	79.8	454
Highest Daily Rainfall (mm)	53	50	76	39	30.4	7.8	21	23	55	43.8	42	71	76
Mean Daily Pan Evaporation (mm/d)*	7.9	6.7	5.1	3.3	1.8	1.4	1.5	2	3.1	4.5	6.1	7.2	4.2
Mean Max Temp (°C)	32.5	31.6	28.6	25.3	21	18	17.2	19.5	22.4	25.7	28.6	31	25.1
Mean Min Temp (°C)	15.8	16.1	14	10.9	7.2	4.8	4	4.3	6.4	9.5	12.2	13.9	9.9

*From Salmon Gums weather station (012071)

The region has a semi-arid climate with temperature ranging from mean daily maxima of around 35°C in mid-summer and mean daily minima around 5°C in mid-winter. Rainfall is 305 mm for the Norseman Airport weather station and is fairly evenly distributed throughout the year. Mean daily pan evaporation for Salmon Gums is 4.2 mm, varying from monthly averages between 8 and 5 mm/day in the summer months and falling to monthly lows of between 1.5 and 3 mm/day during winter months.

4.0 TAILINGS CHARACTERISATION

4.1 General

Golder received samples of gravity tailings and natural slimes, which form the majority components of the BT. These materials were combined at a ratio consistent with the mass balance proposed by Simulus to form a 'representative' sample of the BT. This has been subjected to preliminary geotechnical and geochemical testwork in order to help establish parameters for use in the PFS. Laboratory test certificates are included as Appendix B.

4.2 Geotechnical Characterisation

4.2.1 Tailings Index properties

Particle size distribution (PSD) measurements of the sample were undertaken by Microanalysis Pty Ltd using laser sizing. A particle density test was also carried out to establish a solids specific gravity for use in density and other geotechnical calculations. A summary of the results is provided in Table 7. Based on the PSD results, the BT are classified as a low plasticity Clayey SILT (CL) in accordance with the Unified Soil Classification System (USCS).

Table 7: Summary of PSD test results

Test	Parameter	Value
Particle Size Distribution	Diameter at which 80% of the material is passing (P_{80})	32 µm
	Diameter at which 50% of the material is passing (D_{50})	10 µm
	% passing 60 µm (silt + clay fraction)	90%
	% passing 2 µm (clay-sized fraction)	13%
Particle Density	Specific Gravity	3.42

4.2.2 Tailings settling behaviour

Settling tests were carried out on the tailings sample, with the aim of estimating the rate of initial water release and the associated increase in dry density over time. A suite of settling tests was undertaken on the BT sample to estimate the water release of tailings across the TSF beach. These comprised:

- Top and bottom undrained (to simulate tailings behaviour in the supernatant pond if the TSF is lined)
- Top undrained, bottom drained (to simulate tailings behaviour in the supernatant pond if the TSF is unlined)
- Top drained, bottom undrained (to simulate tailings behaviour across the beach of a lined facility)
- Top and bottom drained (to simulate tailings behaviour across the beach of an unlined facility)

The results of the testing are presented in Appendix B and a presentation of settled dry density versus time is provided in Table 8 and Figure 4.

Table 8: Settling tests – final dry density achieved (t/m^3)

Case	Dry Density (t/m^3)	Approximate Time to 90% of Final Density (Days)
Undrained	0.90	4
Top drained	0.88	6
Bottom drained	1.12	10
Top and bottom drained	1.10	10

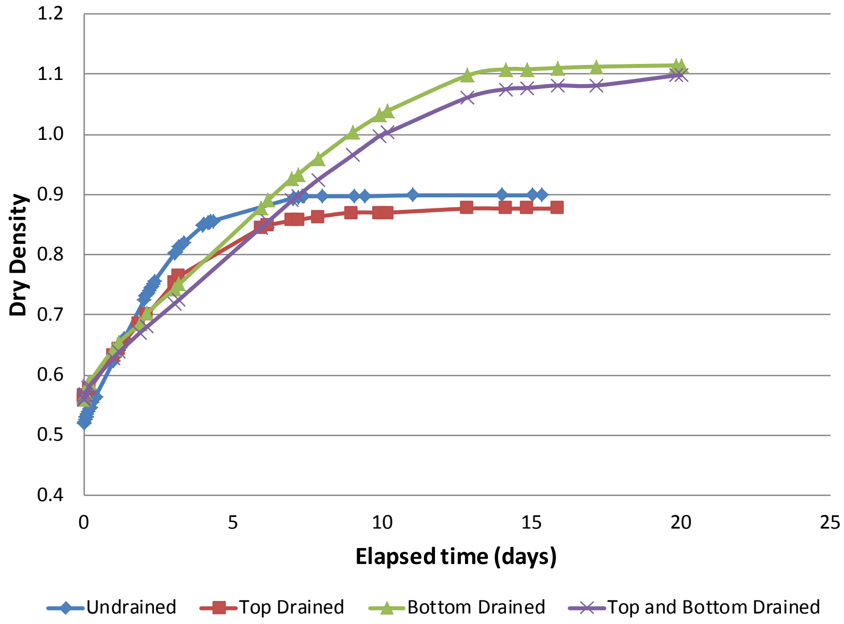

Figure 4: Settling test results – dry density versus time

Based on the test results, the time taken to achieve 90% of settled density is approximately ten days for the bottom drained cases, i.e. on an unlined TSF. The tailings on the beaches, as well as in the supernatant pond can be expected to settle to approximately 1.1 t/m^3 in an unlined TSF. However, if no drainage is provided in the base of the TSF, the undrained and top drained results indicate that the density of the tailings is unlikely to increase significantly after achieving a dry density of about 0.9 t/m^3 over four to six days.

4.2.3 Air drying

Air drying testing was carried out to assess the propensity of surficial tailings to desiccate and increase in dry density. When deposition is cycled appropriately in a TSF, this process can result in significant increases in dry density, frequently achieving dry densities similar to those achieved through self-weight consolidation loading at significant depth.

The air drying process involved two independent tests, outlined as follows:

- Shrinkage tests, wherein material is poured into a ring of known dimensions and allowed to dry. Measurement of mass and volume of the sample are taken at regular intervals. This test enables a relationship between moisture content and dry density to be established for a given material. It also provides an indication of Shrinkage Limit, which is the maximum dry density achievable through air drying. The tests are performed in a 40-50 degree Celsius oven. Time-dependent behaviour is not provided directly by this test.

- Time-dependent drying tests, wherein the material is poured into a bowl, and is first permitted to undergo the majority of undrained settling within the drying bowl. Following settling, the surficial clear water (if present) is decanted from the sample. The required time for settling to be completed is assessed by the undrained settling tests undertaken in parallel, and by visual observations of the bowl. Following settling, the drying bowl is then weighed over time to track moisture loss. The bowl is kept in locations with temperature set to the approximate daytime and evening temperatures of the relevant site. The locations consist of ovens, fridges, or climate-controlled laboratory areas, depending on the target temperatures. Typically, two tests are undertaken, to allow simulation of winter and summer conditions at the site under consideration.

The relevant climatic conditions for the Medcalf site have been estimated on the basis of typical temperatures for Norseman.

The summary of the air drying test results are summarised in Figure 5 and Figure 6.

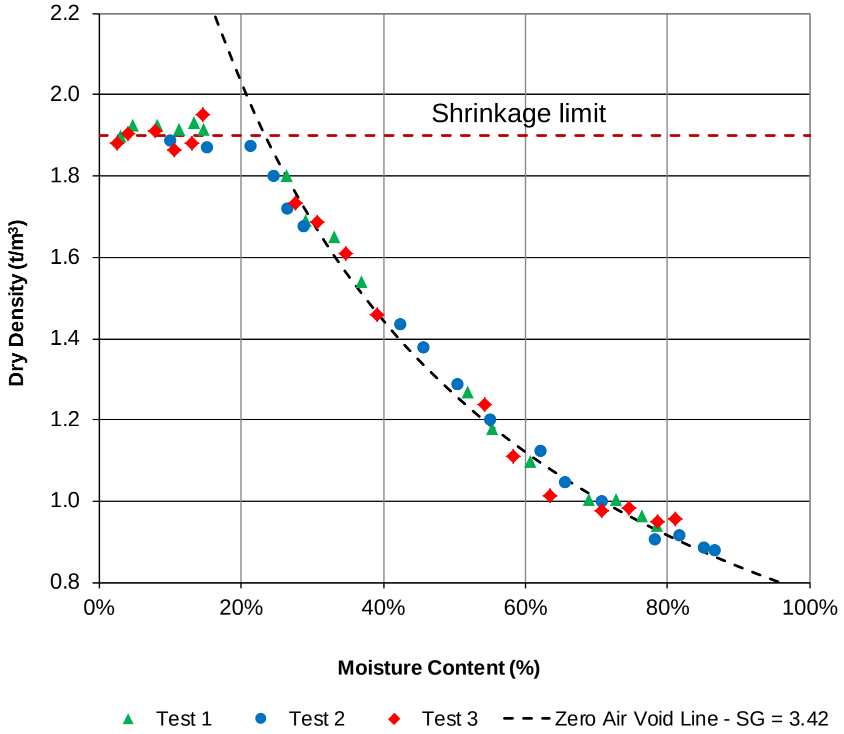

Figure 5: Shrinkage test results

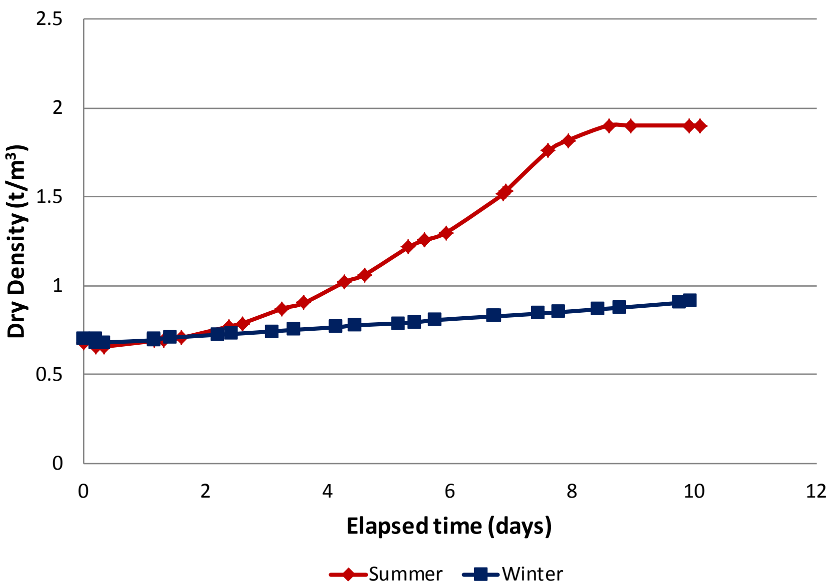

Figure 6: Air drying – dry density vs. time

The following can be interpreted from the air drying test results:

- The shrinkage limit and maximum dry density (1.9 t/m^3) may be achieved after approximately seven days under summer conditions.
- In winter conditions only a small increase in the dry density was observed, indicating that the density of the tailings will not significantly increase through evaporative drying during the winter months.

4.2.4 Consolidation

Consolidation refers to the increase in effective stress and density that occurs following dissipation of pore water pressures as the tailings are exposed to loading. This loading can be expected from the placement of additional material over the previously placed and settled tailings. Consolidation behaviour is important in assessing the expected dry densities likely to be achieved within a TSF, and the time required for such densities to be achieved. This is especially important where the drying of the tailings does not result in significant density increase, as is expected with the BT during winter (see Section 4.2.3).

The consolidation of the BT sample was measured in a slurry consolidometer, which either directly provides, or allows inferences of, the following design parameters:

- Density across a range of vertical effective stresses, typically referenced as the void ratio (e) – the ratio of the volume of voids to the volume of solids
- Permeability (k) across a range of densities

Figure 7 presents a summary of the slurry consolidometer testing results.

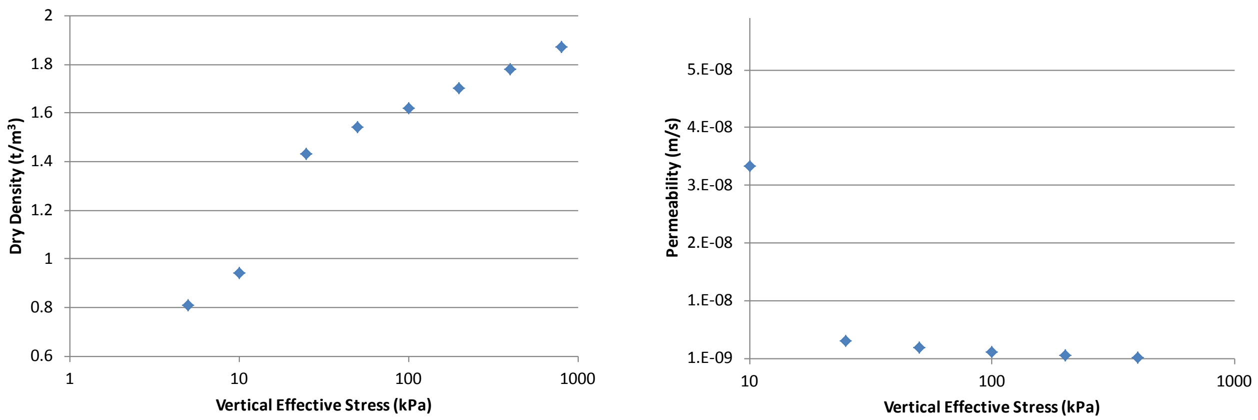

Figure 7: Summary of consolidation test results

The following can be interpreted from the results:

- A maximum consolidated dry density of approximately 1.7 t/m^3 can be expected at the bottom of the tailings stack under self-weight consolidation, assuming a height of facility of about 20 m.
- The tailings permeability can be expected to lie between 3 × 10^{-8} and 1 × 10^{-9} m/s from top to bottom within the TSF.

4.2.5 Summary

The laboratory testing undertaken indicates that the BT can be expected to achieve an initial settled density between about 0.9 and 1.1 t/m^3 on the surface of the TSF. In summer, and with appropriate water management, an air-dried dry density of 1.9 t/m^3 is conceivable, but this is not expected to be achieved in winter, or where the tailings remain submerged. Loading of the tailings could raise the dry density at the base of the TSF to around 1.7 t/m^3 under self-weight consolidation.

These considerations suggest that a dry density of 1.5 t/m^3 is a reasonable overall average value for use in design at PFS level. This corresponds to a void ratio of about 1.3, or a porosity of approximately 56%, which is higher than typically encountered in consolidated tailings, and thus represents a somewhat conservative value for the dry density.

4.3 Geochemical Characterisation

4.3.1 Analytical methods

The tailings solid sample was sent for geochemical analyses at ChemCentre in Bentley, WA. ChemCentre is a NATA accredited laboratory (Accreditation No. 8). Tailings solids were analysed by the following methods to allow an assessment of acid forming potential to be made:

- Sulfur present as SO_4
- Acid neutralising capacity (ANC) by titration
- Net acid generation test (NAG, single addition)
- NAG pH
- Cr reducible sulfur (CRS)

Method descriptions are provided in the laboratory analysis certificates contained in Appendix B.

In addition, the tailings solids were subjected to a pH and electrical conductivity (EC) tests using a 2:1 liquid to solid (L:S) paste, and the Australian standard leaching procedure (ASLP) conducted at a 20:1 L:S using a deionised water as the leaching solution. The ASLP leachate was analysed for:

- General water quality parameters: (pH, EC, total alkalinity and acidity as $CaCO_3$)
- Total anions (chloride, sulfate and nitrate)
- Total major cations (calcium, magnesium, sodium and potassium)
- Total metals (aluminium, barium, beryllium, bismuth, cadmium, cesium, chromium, cobalt, copper, gallium, iron, lead, lithium, manganese, mercury, molybdenum, nickel, silver, strontium, thorium, tin, titanium, uranium, vanadium and zinc)
- Total non-metals and metalloids (antimony, arsenic, boron, selenium, silicon and phosphorus (as total filterable reactive phosphorus)

4.3.2 Assessment Methods

Acid forming potential was assessed using the results of acid base accounting (ABA), net acid generating (NAG) CRS according to AMIRA (2002).

4.3.3 Results and discussion

4.3.3.1 Acid forming potential

A summary table of the laboratory data and calculated parameters used to assess acid forming character is provided in Table 9.

Table 9: Summary of acid base accounting results for tailings solids

Consideration	Units	Limit of Reporting	Results
$pH_{1\ solid\ :\ 2\ liquid}$		0.1	6.8
$EC_{1\ solid\ :\ 2\ liquid}$	mS/m	0.2	41
Total Sulfur (combs)	%	0.01	0.18
Sulfur present as SO_4	%	0.01	0.03
ANC	kg H_2SO_4/tonne	0.5	2.8
Chromium Reducible Sulfur	%	0.005	0.050
NAG pH		0.1	4.0
NAG to pH 7	kg H_2SO_4/tonne	0.5	1.4
Calculated Parameters			
MPA (oxidisable)	kg H_2SO_4/tonne		5.51
Net Acid Production Potential (NAPP)	kg H_2SO_4/tonne		2.71
ANC/MPA ratio			0.51

Note: N.D. = Not Determined

The $pH_{1:2}$ and electrical conductivity ($EC_{1:2}$) give an indication of the inherent acidity and salinity of the of the tailings sample when initially exposed in a waste emplacement area. The results show that the sample is near-neutral (pH 6.8) with low salinity (41 mS/m) suggesting it may be suitable for surface or uncontrolled placement as the potential effects on drainage and vegetation are expected to be minimal.

The maximum potential acidity (MPA) was estimated at 5.51 kg H_2SO_4/tonne. This is based on the total sulfur assay, and is a conservative approach since some sulfur may occur in forms other than pyrite.

The acid formed from pyrite oxidation will to some extent react with acid neutralising minerals contained within the sample. This inherent acid buffering is quantified in terms of the acid neutralising capacity (ANC). The ANC of the material was measured using an industry standard titration method. Acid buffering capacity is low (2.8 kg H_2SO_4/tonne), and therefore the tailings material does not have the ability to intrinsically buffer acid, if it is released. Low pH conditions from an inability to buffer acid released will result in leaching of metals and other key elements.

In order to assess whether the tailings solids have potential to generate ARD, the net acid producing potential (NAPP) was calculated. The NAPP is 2.71 kg H_2SO_4/tonne. As the NAPP is positive, this indicates that the tailings may be acid generating. This is confirmed by the ANC/MPA ratio being well below 1 (i.e. ANC/MPA = 0.51).

The single addition NAG test is used in association with NAPP to classify the acid generation potential of the tailings sample. The NAG pH is 4.0, and the NAG capacity is 1.4 kg H_2SO_4/tonne. As NAG pH is less than 4.5, and NAG capacity at pH 7.0 is less than 5 kg H_2SO_4/tonne, the sample of tailings tested is considered to be potentially acid forming – low potential (PAF – LC).

The total sulfur result of 0.18%, compared to a CRS value of 0.05% and total sulfate of 0.03% demonstrates that there is sulfur present in a form other than sulfide or sulfate.

4.3.3.2 Leaching potential

The chemical composition of the leachate generated in the ASLP test is provided in Table 10. As the ASLP test is conducted over a 24-hour period, the results represent those concentrations of chemical constituents likely to leach out over the short-term. The ChemCentre assay data is provided in Appendix B.

Table 10: Summary of ASLP data for tailings solids

Parameter	Units	DER Long-term Irrigation Water	DER Short-term Irrigation Water	NEPM 2013 GILs, Fresh Waters(A)	BT Sample
pH (Lab)	pH_units	6-8.5			6.5-6.8
EC @ 25°C	uS/cm				62-410
Total alkalinity (as $CaCO_3$)	mg/L				2
Acidity (as $CaCO_3$)	mg/L				2
Calcium	mg/L				1.1
Magnesium	mg/L				0.5
Sodium	mg/L				9.1
Potassium	mg/L				1.3
Chloride	mg/L	0	0		11
Nitrate (as NO_3^-)	mg/L				0.1
Reactive Phosphorus (as P)	mg/L				<0.01
Total Phosphorus (as P)	mg/L	0.05	0		<0.1
Sulfate (as SO_4)	mg/L				7
Aluminium	mg/L	5	20	0.055	0.007
Antimony	mg/L				<0.0001
Arsenic	mg/L	0.1	2		<0.001
Barium	mg/L				0.012
Beryllium	mg/L	0.1	0.5		<0.0001
Bismuth	mg/L				<0.0001
Boron	mg/L				0.13
Cadmium	mg/L	0.01	0.05	0.0002	<0.0001
Caesium	mg/L				0.0002
Chromium	mg/L	0.1	1		0.0051
Cobalt	mg/L	0.05	0.1		0.0001
Copper	mg/L	0.2	5	0.0014	0.0002
Gallium	mg/L				<0.0001
Iron	mg/L	0.2	10		<0.005
Lead	mg/L	2	5	0.0034	<0.0001
Lithium	mg/L	2.5	2.5		0.0002
Manganese	mg/L	0.2	10	1.9	0.0005
Mercury	mg/L	0.002	0.002	0.00006	<0.0001
Molybdenum	mg/L	0.01	0.05		<0.001
Nickel	mg/L	0.2	2	0.011	<0.001
Selenium	mg/L	0.02	0.05	0.005	<0.001
Silicon	mg/L				4.8
Silver	mg/L			0.00005	<0.0001
Strontium	mg/L				0.0058
Thorium	mg/L				<0.0001
Tin	mg/L				<0.0001
Titanium	mg/L				<0.0005
Uranium	mg/L	0.01	0.1		<0.0001
Vanadium	mg/L	0.1	0.5		0.0017
Zinc	mg/L	2	5	0.008	0.003
Benzene	mg/L			0.95	0.13

Note: Potential exceedances are denoted by the appropriate shading.

The local groundwater at the Medcalf Project site is considered likely to be deep and hypersaline. As there are no relevant guidelines for this receiving environment, Golder has assessed the quality of the leachate in terms of the beneficial potential re-use. The leachate appears to be fresh, and therefore the following guidelines were used for the assessment:

- DER Short-Term Irrigation Water
- DER Long-Term Irrigation Water
- NEPM 2013 GILs, Fresh Waters (A)

No exceedances were identified in terms of any of these criteria. However, it should be noted that the detection limits for mercury and silver (<0.0001 mg/L) were higher than the guideline values provided in the DER long-term irrigation water (0.00006 mg/L and 0.00005 mg/L, respectively), therefore no assessment could be made in this regard. Similarly, the detection limit for total phosphorus (0.1 mg/L) was higher than the DER short-term irrigation water guideline value (0.05 mg/L) and again no assessment could be made.

4.3.4 Summary

Acid base accounting and short-term leach testing were carried out on the sample provided. The total sulfur content in the tailings sample is considered to be low (0.18% S), and therefore the MPA was low at 5.51 kg H_2SO_4/t. The ANC was found to be 2.8 kg H_2SO_4/t, and as such the sample has a poor ability to buffer any acid should this be released. The NAPP is positive, and coupled with the low NAG pH (pH 4) and NAG capacity (1.4 kg H_2SO_4/t) the sample is considered to be PAF-LC.

The leachate generated was near-neutral (pH 6.8) with low electrical conductivity (41 mS/m). The leachate was assessed in terms of the long and short term irrigation guidelines and NEPM freshwater GILs, and no exceedances were identified. It should be noted, however, that concentrations for mercury, silver and total phosphorus were reported at the method detection limit which exceeded some of the guideline values. In the short-term the leachate is expected to be suitable for surface or uncontrolled placement as the potential effects on drainage and vegetation are likely to be minimal.

5.0 TAILINGS AND WATER MANAGEMENT CONCEPTS

5.1 Options Considered

Several options for the storage and management of tailings have been considered. These include:

- Full height versus staged construction
- Upstream, downstream and centreline wall raising methods
- Single cell versus dual cell operation
- Lined and unlined cells
- Separate versus combined tailings management

The decision tree included as Figure 8 presents a summary of the options considered.

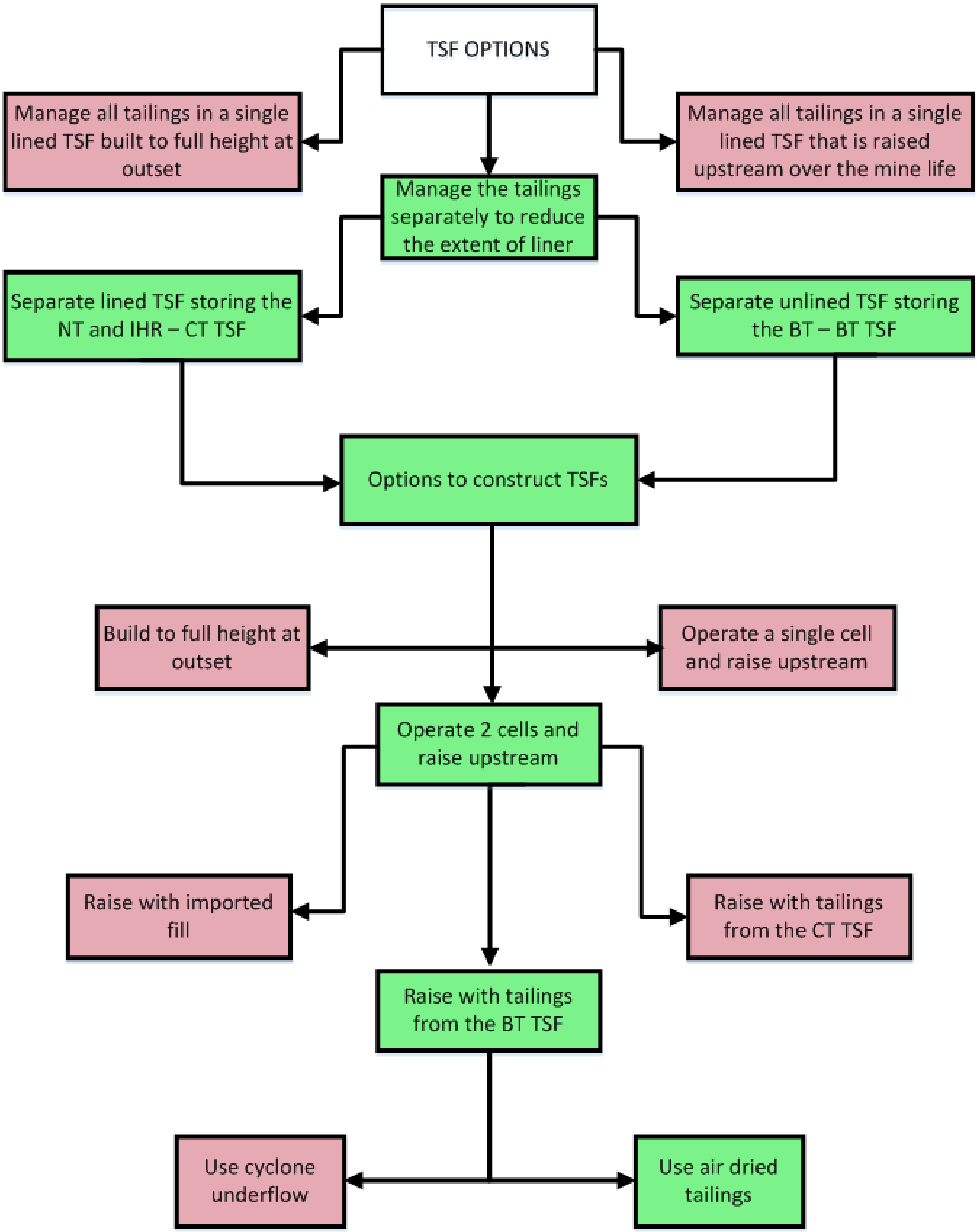

Figure 8: Decision tree showing options considered

The outcome of the options assessment (highlighted in green in Figure 8) indicated that:

- There is a preference to separate BT from CT so that lining costs can be reduced.
- The opportunity exists to construct upstream raises, minimising operational costs, but this requires dual cells to be developed to facilitate concurrent operations and wall raising. This would also allow for deferral of initial capital.
- CT are unlikely to be suitable for use in upstream raise construction, but BT are considered to be suitable.
- There will be insufficient volume of BT cyclone underflow to pursue the option for using cyclone tailings to construct the raises to the perimeter embankments.

The preferred approach is to operate dual cells for the BT and CT, with the CT cell lined and the BT cells unlined. Both the BT and CT cells would be raised upstream using BT, borrowed from the dormant BT cell.

5.2 Operating Philosophy

It is proposed that tailings slurry would be discharged into the operating cell from spigot offtakes installed every 40 m or so in the tailings distribution pipelines, to be located at the upstream crests of the perimeter embankments. Tailings would be deposited in thin discrete layers of approximately 200 mm thickness from three to five spigots at any one time. The spigots would be opened sequentially and progressively around the facility so that an even beach would develop and the decant pond maintained at a central location. In doing so, the tailings on the beach would dry through evaporation, before being covered with freshly deposited wet tailings. This sub-aerial deposition method will improve strength, consolidation of the tailings which facilitates a suitable foundation for construction of upstream raises. Conductor pipes[4] have been provided for to reduce the potential for erosion of the overliner drainage during initial deposition and to protect the liner against abrasion.

Once the operational freeboard limit (300 mm) has been reached on a particular cell, deposition would be transferred to the other cell. The tailings would then be allowed to dry in preparation for the upstream wall raise. Once the BT have dried sufficiently, borrow excavations can be developed and the tailings can be transported and placed on the perimeter embankments to form the upstream raises. This process would be continued until the final height of the TSF is reached (see Figure A4).

Supernatant water would be removed from the facility through decant towers, located in the approximate centres of the cells (see Figure A2 and A3 in Appendix A). The decant ponds should be maintained centrally around the decant towers to facilitate removal of water from the surface of the cells. The position of the ponds can be controlled by the judicious operation of the spigots around the perimeter.

The decant water would be returned to the process plant, where it may be reused, or combined with waste water from the RO plant (which is required to generate water of suitable quality for processing) and transported to the evaporation ponds.

5.3 Facility Description

5.3.1 TSF Starter Embankment

The TSF starter embankments have been assumed to be constructed of natural materials borrowed from within the basins of the TSF cells. Prior to borrowing the material, the entire footprints of the TSF cells and evaporation ponds will be cleared of vegetation and stripped to a depth of ~300 mm to obtain topsoil for stockpiling and later reuse in rehabilitation of the facilities. Following topsoil stripping, the starter embankment footprint would be excavated down to ferricrete, which is assumed to be about 0.5 to 1 m below original ground level. The borrowed material would then be moisture conditioned (in the borrow), placed and compacted to form the starter embankment.

4 Slotted PVC or HDPE pipes, larger in diameter than the outlet spigots, into which tailings are discharged and directed to the desired points of deposition, Tailings slurry discharges from the lowest slot in the conductor pipe, which becomes submerged, thus directing outflow to the next highest slot, and so on.

The CT TSF cells will be lined. Hence, the basin of these cells will need to be shaped, trimmed, moisture conditioned and compacted prior to placing a 1.5 mm high density polyethylene (HDPE) geomembrane across the full extent of the TSF. The liner will be anchored in a trench excavated into the starter embankment, 0.5 m in from the upstream crest margin. Typical cross-sections of the starter embankments are shown in Figure A5.

An overliner drainage system has been provided for, to aid consolidation of the tailings. This system consists of a series of primary and secondary collection pipes that drain to an overliner drainage sump. The configuration of the overliner drainage system is shown on Figures A2 and A3, with details shown in Figure A8.

The BT TSF basin will not be lined. However, as the erodibility/dispersivity of the material in the basin of the cells is unknown, allowance has been made for a HDPE liner on the upstream batter of the starter embankments.

Depending on the outcomes of a future field investigation and laboratory characterisation, it may be possible to eliminate the liner on the basin (and the associated overliner drainage system) and/or the liner of the upstream batters. This is discussed further as an opportunity in Section 10.0.

5.3.2 Staged TSF Development

As noted above, the TSFs will be progressively raised in an upstream direction. Each wall raise is expected to be 1.5 m in height. The staging of this wall raising will depend on the rate of rise of the tailings beach, which in turn is dependent on several factors that influence its average dry density. Average dry densities of 1.5 t/m^3 and 1.0 t/m^3 have been assumed for the BT and CT, respectively, as discussed in Section 2.4. On this basis, it is expected that a 1.5 m wall raise would be required on each CT cell approximately once every nine months. The area of the BT cells has been selected to target a similar wall raise schedule, acknowledging that a significant quantity of BT would be excavated from each cell to facilitate raises to both the CT and BT cells.

The rate of rise curves for the BT and CT cells are presented in Figure 9 and Figure 10, respectively.

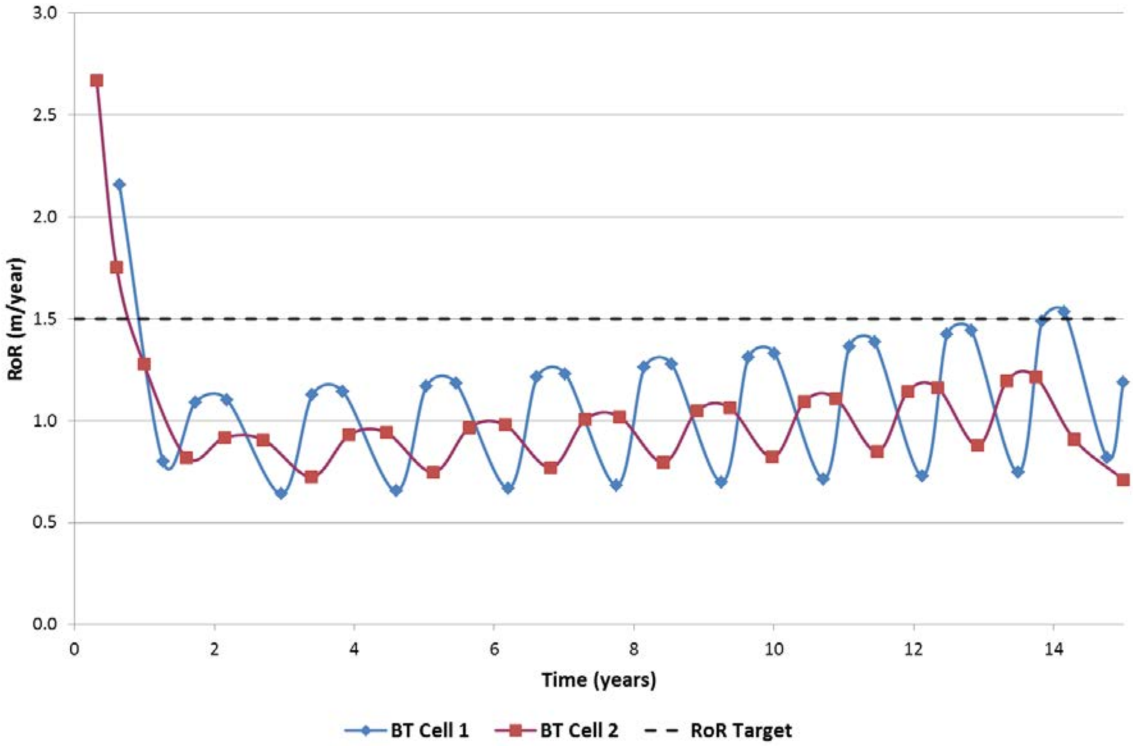

Figure 9: Estimated rate of rise for the BT cells

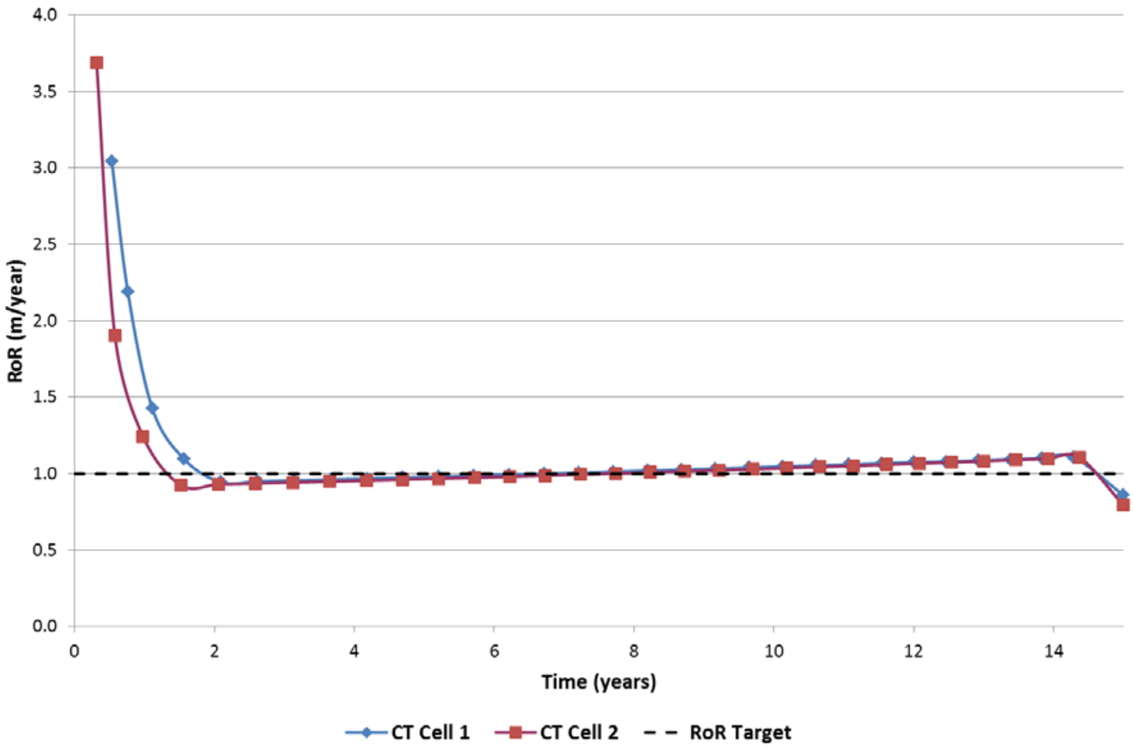

Figure 10: Estimated rate of rise for the CT cells

5.3.3 Evaporation Ponds

The evaporation ponds have been sized based on a comparison of the total inflows to the system against the evaporative potential. The inflows consist of process water and brine from the RO plant, as well as incident rainfall on the footprint of the evaporation ponds. An evaporation factor of 0.6 has been assumed, providing a potential evaporation of ~920 mm per annum. To evaporate the estimated 2.02 Mm^3 of liquor on an annual basis, an area of ~325 ha would be required (see Figure 11). Taking cognisance of the uncertainty in the evaporation factor, the potential for reusing a proportion of water in the process and allowing for some accumulation of waste water over time, a reduced footprint area of ~200 ha has been provided for.

It is anticipated the evaporation ponds will be need to be lined to meet the ECC. To minimise capital costs, it is expected that the evaporation pond cells will be developed over a number of years, with only the first cell constructed at the outset. As the capacity of each cell is reached, additional cells will be added.

The flattest ground in the vicinity of the TSF/process plant has been identified as the preferred location for the evaporation ponds. The location is shown on Figure 1 on page 5. This will minimise the earthworks quantities and allow for gravity drainage from the process plant (or TSFs). It is envisaged that the evaporation cells will be formed through a cut to fill process, where the basins of the cells are excavated to form a gently sloping or horizontal base and the surplus material is placed as perimeter embankments, prior to placement of HDPE geomembrane. The perimeter embankments would be up to 3 m in height, to provide at least 1 m freeboard and an average water depth of up to ~1 m.

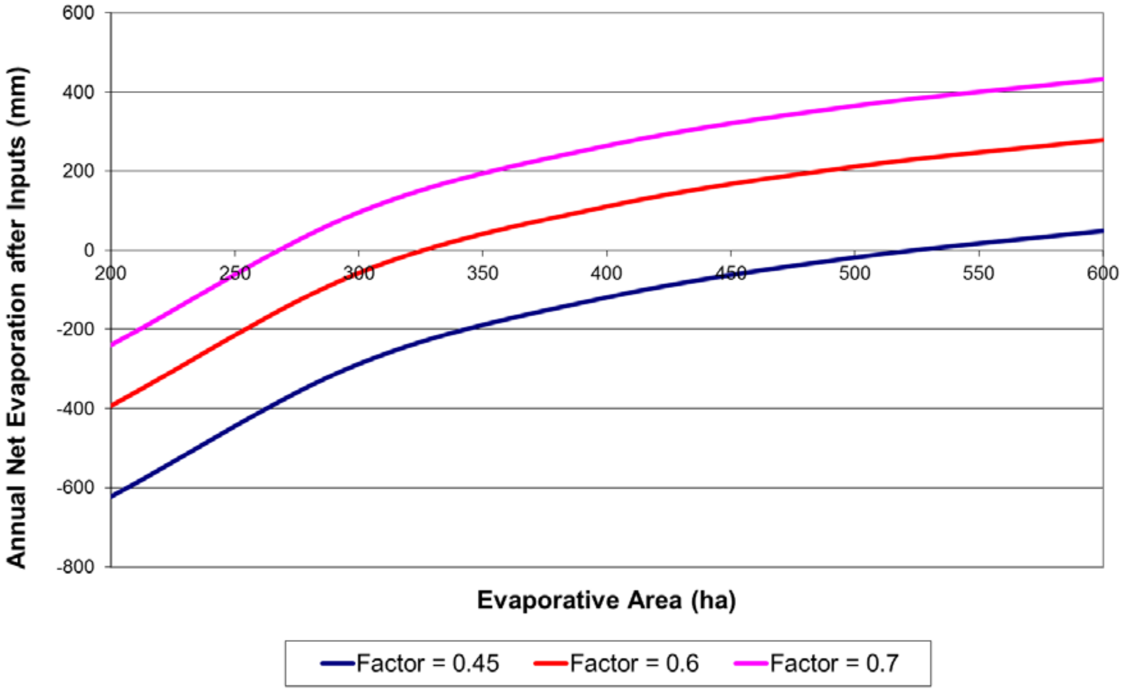

Figure 11: Estimated evaporative areas required for various evaporation factors

5.3.4 Contingency for $FeSO_4$ Crystals Storage

The Base Case assumed that the $FeSO_4$ crystals would be saleable. In the event that a suitable market cannot be identified, a storage facility for the crystals would be required. Simulus has advised that the crystals will be filtered during the process and will be generated at a very low moisture content (~2%). To manage the filtered product, a dry stack facility has been provided for.

A suitable location for the dry stack facility would be the relatively flat area located between the TSFs and the plant site. Assuming sides slopes of 1V:3H to maintain stable batters and a maximum height of 20 m (about the same as the TSFs), the area required would be in the order of 50 ha. As the geochemical characteristics of this waste stream are unknown, a liner HDPE geomembrane has been provided for, overlying a compacted base comprising locally available materials.

6.0 DESIGN CONSIDERATIONS

6.1 Stability

6.1.1 General Approach

The geotechnical stability of the TSF has been assessed using the limit equilibrium software package Slide Version 6.0, distributed by Rocscience Inc. Model sections were analysed for circular and non-circular (block failure) failure surfaces using the Morgenstern-Price method under static and post liquefaction loading. Superficial slips of depths less than 1 m were ignored in this study.

The following minimum factors of safety (FoS), which are based on the requirements set down by ANCOLD (ANCOLD, 2012), have been used to establish that the facilities will be appropriately stable:

- Static loading, FoS = 1.5
- Post Liquefaction, FoS = 1.0

These minimum values are consistent with other published values for earth dams.

6.1.2 Representative Sections

Two representative sections were selected for stability modelling for the BT and CT TSFs. The section geometries are based on an aerial survey provided by Audalia and the design described in this report. For both sections, slope stability under static loading, as well as assuming post liquefaction (earthquake) conditions have been analysed. As earthquake loading for the site is unknown, it has been assumed that the design earthquake energy would be sufficient to result in the tailings being liquefied, which is a conservative approach but consistent with ANCOLD 2012.

6.1.3 Material Parameters

The material parameters adopted for the analyses are based on the tailings characterisation (Section 4.2 on page 10) and supported by experience with similar tailings. Foundation materials have been assumed and a geotechnical investigation and laboratory testing will need to be carried out in the future to provide better estimates of the geotechnical parameters. A summary of the material parameters adopted in the analyses are shown in Table 11.

Table 11: Summary of material parameters adopted in stability analyses

Material Description	Unit Weight γ_m (kN/m^3)	Friction Angle Φ' (degrees)	Cohesion c' (kPa)	Vertical Stress Ratio (Undrained)	Vertical Stress Ratio (Post Liquefaction)
Foundation Material	20.0	32	15	-	-
Starter Embankment	21.0	33	5	-	-
Compacted BT Raise	21.0	33	5	-	-
Deposited BT	20.0	33	0	0.25	0.15
Deposited CT	21.0	30	0	0.25	0.10

6.1.4 Results of Analyses

Two-dimensional circular and non-circular (block) failures under static and post-liquefaction loading conditions have been considered. Under static loading, effective stress parameters have been assigned to the fine-grained, low permeability materials. Total stress parameters were used for post-liquefaction analyses. The results are summarised in Table 12 and a typical critical failure surface is presented in Figure 12.

Table 12: Summary of Results of Stability Analyses

Location	Loading	
	Static	Post Liquefaction
Combined TSF	1.7	1.0
Bene TSF	1.8	1.0

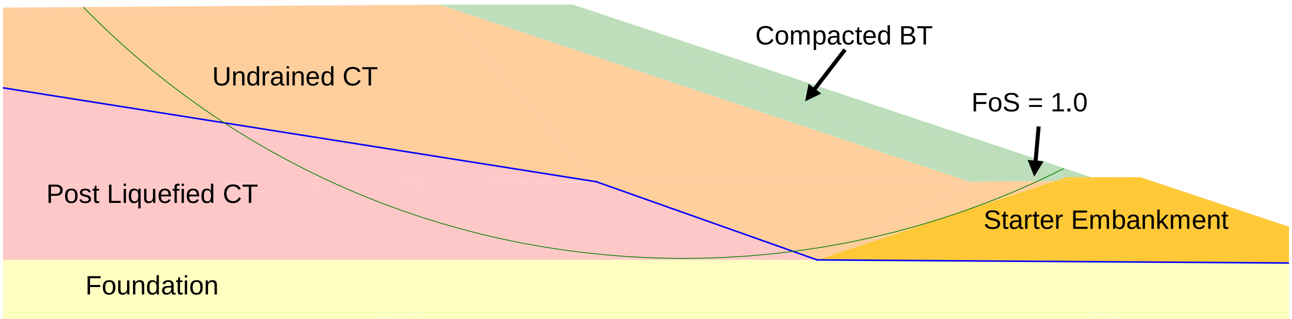

Figure 12: Typical result (post liquefaction case – CT TSF)

The results indicate that in all cases, the factor of safety against embankment failure remain at, or above, the industry recognised minimum values. It is therefore considered to be unlikely that major slope instability would occur within the TSF outer embankments, even following an earthquake with sufficient energy to induce tailings liquefaction. Nevertheless, some superficial instability (ravelling) may occur in the outer 1 m or so of the embankment during earthquake events.

The potential for saturated tailings to liquefy during an earthquake event should be investigated as part of further studies.

6.2 Consolidation

The rate of rise of the hydraulically-deposited tailings will be approximately 1 m per year and 1.5 m per year for the CT and BT cells respectively. This rate of rise is aimed at achieving air dying of the tailings away from the supernatant pond and the targeted overall average tailings dry density of 1.5 t/m^3 for the BT and 1.0 t/m^3 for the CT. In the areas of the TSF where tailings are submerged by water, the tailings will only consolidate through self-weight and thus likely reach a lower density than on the beaches.

Based on the consolidation test results (Section 4.2.4 on page 13) the BT facility is expected to undergo a total of between 3 and 4 m of consolidation settlement. Due to the low rate of rise, the majority of this consolidation settlement is expected to occur during operation of the facility and therefore only a small amount of post operational settlement is expected. This is not expected to impact on closure of the facility. The rate of consolidation of the CT is expected to be slower than the BT, and further testing will be required to establish the consolidation properties. This further testing should include:

- Slurry consolidometer testing for the combined tailings
- Settling tests for the combined tailings
- Air drying tests for the combined tailings

6.3 Seepage

It is expected that the proposed liner system will provide appropriate containment for seepage from the CT cells. It is anticipated that the starter embankment of the BT cells will be formed from materials that will protect the embankment from instability due to seepage and piping erosion. A geotechnical and hydrogeological investigation will need to be carried out as part of future studies to characterise the subsurface conditions and hydrogeology of the site. The hydraulic conductivity of the unsaturated and saturated zones should be estimated during the field investigation. This information should be included in a seepage model to estimate the likely quantities of seepage expected from the TSF. This investigation will also assist in identifying the borrow materials for construction of the starter embankments.

6.4 Water balance

6.4.1 Method

The TSFs constitute a single component of the much broader plant water management system, an assessment of which is outside the scope of this document. Simple annualised water balances for the Medcalf TSFs have been estimated, based on published meteorological data for the area, predicted tailings throughput, and estimated tailings interstitial moisture and seepage.

The water flow estimates through the tailings system are based on the following parameters:

- A tailings *in situ* dry density of 1.5 t/m^3 for BTand 1.0 t/m^3 for CT, slurry density of 40% solids by mass, and deposition rate of 670 070 tpa of BT and a total of 1 567 330 tpa of CT
- Average annual rainfall and evaporation rate data of 305.2 mm and 4.2 mm/day, respectively
- Seepage rates of 5, 10, and 15% of the total inflow water

- Interstitial water content of the tailings based on a settled dry density of 1.1 t/m^3 for the BT and 0.9 t/m^3 for the CT

The estimated slurry water inflow is based on a slurry density of 40% solids by mass, to provide information regarding the range in decant return volumes that may be achieved. Estimation of the evaporation losses are outlined in Table 13 and the parameters used in the water balance are contained in Table 14.

Table 13: Estimation of evaporation losses

Component of TSF	% of Total TSF Area	Evaporation Coefficient	
		BT	CT
Pond	10	0.7	0.7
Wet Beach	30	0.5	0.6
Drying Beach	30	0.3	0.3
Dry Beach	30	0.1	0.1

Table 14: Parameters used in water balance

Parameter	BT	CT
Specific Gravity	3.42	3.0 (average)
Slurry Water SG	1	1
Deposition Rate (tpd)	1 836	4 294
Dry density (t/m^3)	1.5	1.0 (average)
Area (ha)	24	93

6.4.2 Results

The annualised water balance results for the BT and CT cells are summarised in Table 15 and Table 16.

Table 15: CT water balance estimate

TSF Inflows (%)		Water removals from TSF (%)			
Slurry water	90	Seepage (assumed)	5	10	15
Rainfall	10	Evaporation	20	20	20
		Retained interstitial water	44	44	44
		Water return	31	26	21
Total	**100**	**Total**	**100**	**100**	**100**

Table 16: BT water balance estimate

TSF Inflows (%)		Water removals from TSF (%)			
Slurry water	93	Seepage (assumed)	5	10	15
Rainfall	7	Evaporation	11	11	11
		Retained interstitial water	36	36	36
		Water return	48	43	38
Total	**100**	**Total**	**100**	**100**	**100**

The following can be interpreted from the preliminary water balance estimates:

- Decant return water will be between 20 and 30% of total inflow for the CT TSF, equivalent to 25 to 35% of process water inflow.
- Decant return water will be between 38 and 48% of total inflow for the BT TSF, equivalent to 40 to 50% of process water inflow.

6.5 Water Management and Freeboard

6.5.1 Decant System

A pump-out decant system will be installed on each cell, comprising a reinforced concrete base and a tower constructed of 1.8 m diameter slotted reinforced concrete sections. A plan and cross-section of the proposed decant tower is shown on Figure A8.

The decant tower should be raised (coincident with the raising of the perimeter embankment) by means of stacking additional decant rings on the existing tower and the addition of drain rock placed around the new decant rings.

Ideally, the pond depth should be drawn down and maintained at an absolute minimum depth, so as to minimise the size of the decant pond. If the water being decanted is too turbid consideration should be given to whether the pump should be raised or pumping be stopped.

Water would be pumped to a purpose-built, lined, water return pond, located in the process plant area, to temporarily store water recovered from the TSF during normal operations prior to re-use in the processing circuit or transfer to the evaporation ponds.

6.5.2 Management of Incident Rainfall

Appropriate surface drainage control measures will be installed on the TSF to limit surficial erosion and overtopping of the outer embankment slopes. The incident rainfall on the crest of the perimeter embankment will be managed through grading and armouring of the crest, which will allow surface runoff to shed towards conveyance structures (slope drains and ramps) located around the perimeter of the TSF.

Incident rainfall on the top of the TSF will naturally flow to the near-central decant pond, from where it will be pumped to the process plant or to an evaporation pond.

Surface water runoff from the slopes of the perimeter embankment will be captured in a toe drain and collected in a sump at topographical low points, prior to being returned to the process plant.

6.5.3 Freeboard

Storage-area-elevation relationships for the TSF basins have been developed based on the design outlined in this report. A pre storm operating pond of 10% of the tailings depositional area has been assumed. In addition, as required by the DMP guidelines, it has been assumed that the decant facility is not operating during the rainfall events.

Three design rainfall events, the 1 in 100 annual exceedance probability (AEP) 72-hour event, the 1 in 1000 AEP 72-hour event and the 12-hour probable maximum precipitation (PMP) event, have been estimated for the freeboard assessment. The runoff resulting from the rainfall events was estimated using the Rational Method, with the runoff coefficient set to 1.0, which conservatively assumes that all of the rainfall reports as runoff and no losses occur due to infiltration or evaporation.

The results of the freeboard assessment are summarised in Table 17 and indicate that:

- All the freeboard requirements are satisfied for the starter embankment
- Additional freeboard may be required for the final embankment to store the 12-hour PMP rainfall event

Beach slopes were been assumed, and additional freeboard may be available if the beach slopes are steeper than assumed. Further studies should be carried to estimate the beach slopes of the BT and CT.

Table 17: Summary of freeboard assessment results

Rainfall Event	Estimated Freeboard (m)							
	Starter embankment				Final embankment			
	CT Cell 1	CT Cell 2	BT Cell 1	BT Cell 2	CT Cell 1	CT Cell 2	BT Cell 1	BT Cell 2
1 in 100 AEP 72-hour	1.15	1.05	1.15	1.05	0.95	0.85	0.95	0.85
1 in 1000 AEP 72-hour	1.05	1.0	1.05	1.0	0.85	0.8	0.85	0.80
12-hour PMP	0.10	0.05	0.10	0.05	Overtop	Overtop	Overtop	Overtop

6.6 Dam Break Assessment

6.6.1 Method

A Fault Mode & Effects Analysis (FMEA) has been carried out to assess the potential for failure and the likely consequences of the TSF. This approach is consistent with AS/NZS 3931:1998. The FMEA technique is normally adopted as a first stage “screening” process to assess whether there is a need to carry out more rigorous analyses. It relies upon the subjective identification and assessment of potential failure mechanisms that could result in a flow failure of the TSF.

6.6.2 Possible Failure Mechanisms

The following were identified as being potential failure mechanisms (however unlikely they may be) of the existing TSF and the proposed expansions:

1) Overtopping of a perimeter wall
2) Slope failure of an external embankment (under static conditions)
3) Slope failure of an external embankment (under seismic conditions)
4) Embankment erosion due to tailings delivery or return water pipeline breakage
5) Progressive sloughing due to seepage
6) Piping erosion failure through an external embankment
7) Foundation failure.

Table 18 summarises the failure mechanisms and potential events that could trigger the failure.

Table 18: Potential events to trigger the failure mechanisms

Case	Failure Mechanisms	Required Events to Trigger the Failure Mechanisms			Consequence
		Primary	Secondary	Tertiary	
1	Uncontrolled overtopping of a perimeter wall	Extreme rainfall event	Poor surface water management	Minimum freeboard at time of rainfall event	Overtopping and/or release of liquefied tailings
2	Slope failure of an external embankment (under static conditions)	Slope failure	Tension cracking and/or loss of freeboard and/or piping erosion	No corrective action taken and subsequent extreme rainfall	Overtopping and/or release of liquefied tailings
3	Slope failure of an external embankment (under seismic conditions)	Seismic event	Slope failure	No corrective action taken	Release of liquefied tailings
4	Erosion of an embankment due to pipeline breakage	Pipeline burst	Erosion of perimeter embankment	No corrective action taken and subsequent extreme rainfall	Overtopping/ Release of liquefied tailings
5	Progressive sloughing of embankment due to seepage	Saturation of the perimeter embankment	Seepage observed and no corrective action taken	Slope failure	Release of liquefied tailings
6	Piping erosion failure through an external embankment	Seepage through embankment	Seepage observed and no corrective action taken	Slope failure	Release of liquefied tailings
7	Foundation failure	Slope failure	Tension cracking and/or loss of freeboard	No corrective action taken and subsequent extreme rainfall	Release of liquefied tailings

6.6.3 Results

The likelihood of occurrence of each event and the potential for the event to result in a flow failure have been estimated on a scale of 1 to 5 (low = 1, high = 5). The risks of failure for each case have been computed as the product of these two assigned values as shown in Table 19.

Table 19: Assigned risk to dam break study

Case	Failure Mechanism	Likelihood of Occurrence		Potential to Result in a Flow Failure		Product
		Rating	Justification	Rating	Justification	
1	Uncontrolled overtopping of the external embankment	2	Freeboard estimates indicate overtopping would be very unlikely	3	If overtopping occurs the likelihood of a flow failure is high	6
2	Slope failure of the external embankment (under static conditions)	1	Stability analyses indicate a satisfactory level of assurance	1	Low rates of rise and internal drainage measures likely to result in unsaturated tailings	1
3	Slope failure of the external embankment (under seismic conditions)	2	Stability analyses indicate a satisfactory level of assurance, but higher likelihood than under static loading	2	Liquefaction of tailings and release after major earthquake is possible	4
4	Erosion of the embankment due to pipeline breakage	2	Pipeline failure possible but lines will be inspected on a frequent basis	1	Likelihood of extent of erosion resulting in major flow failure is negligible	2
5	Progressive sloughing of embankment	2	Progressive sloughing unlikely to result in large scale failure due to 3(H):1(V) slopes.	1	Low rates of rise and internal drainage measures likely to result in unsaturated tailings	2
6	Piping erosion failure through the external embankment	2	Internal drainage to be installed.	2	Localised erosion is unlikely to result in large scale failure.	4
7	Foundation failure	1	Stability analyses indicate a satisfactory level of assurance	1	Low rates of rise and internal drainage measures likely to result in unsaturated tailings	1

These values have been entered into the risk-rating matrix presented in Table 20.

Table 20: Summary of Risk Ratings

Likelihood of Occurrence	Potential to Result in a Flow Failure				
	Low (1)	Low to Moderate (2)	Moderate (3)	Moderate to High (4)	High (5)
Almost Certain (5)					
Likely (4)					
Moderate (3)					
Unlikely (2)	4,5	3,6	1		
Rare (1)	2,7				

Risk Level
High
Moderate
Low

From Table 19 and Table 20 it is evident that:

- There is no entry in the 'high' risk zone of the matrix.
- Only one entry is in the 'moderate' risk zone (overtopping due to extreme rainfall event).
- Most identified risks are 'low'.
- The average risk rating is 3.

The identified potential failure mechanisms have been addressed as part of the design as follows.

- Overtopping would only arise in the extremely unlikely circumstance of a rainfall event equivalent to the 12-hour PMP occurring during one of the brief periods immediately prior to embankment raise construction. This risk is considered to be extremely low but could be mitigated through provision of additional freeboard.
- Stability analyses (refer Section 6.1 on page 22) demonstrate a high level of assurance that stability of the outer perimeter embankments of the TSF will be maintained under static and post-liquefaction conditions up to the maximum height of the TSF envisaged under the current proposal.
- The use of pump-out decant systems eliminates the potential for failure of gravity decant systems. Tailings distribution pipework will be located at the internal crest margins and embankment crests will have safety bunds at the outer crest margin with a cross-fall towards the centre of the TSF to capture pipe spillages or failures.

Based on this assessment, the risk of a dam break occurring with release of tailings from the TSF is "low" and a more rigorous dam break analysis is not considered to be required.

7.0 CLOSURE CONSIDERATIONS

7.1.1 Selection of cover system

Various cover systems can be adopted to close and complete TSFs. ANCOLD (2012) states that *"closure options need to be reviewed on a case by case basis as there are likely to be specific issues to be addressed in each case"*. There are a range of cover types and the climates in which they are generally implemented, as shown Figure 13, published by The International Network on Acid Prevention (INAP 2009).

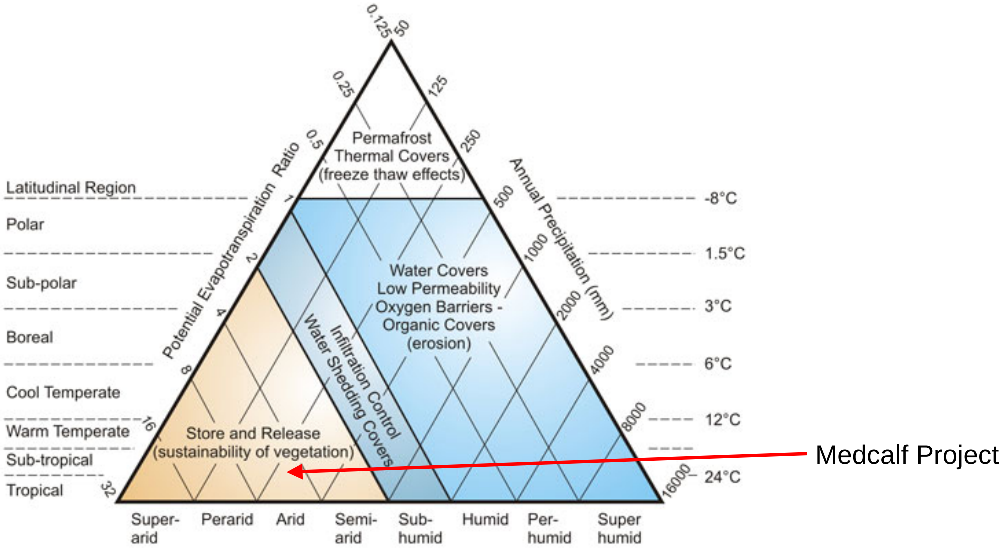

Figure 13: Covers and Climate Types, modified from Holdridge et al., 1971 by Wickland and Wilson (INAP, 2009)

At the site of the TSFs, the annual precipitation is reported to be 305 mm, with a potential evapotranspiration ratio of about five. The site is therefore located in a semi-arid to arid environment, and a store and release cover is indicated to be the most suitable.

The cover options outlined in ANCOLD (2012) are consistent with the tri-linear plot published by INAP (2009), with examples provided as listed below. It should be noted that ANCOLD (2012) takes consideration of Australia's climatic setting and permafrost covers are not possible. Only wet and dry covers are therefore considered.

- *A water or saturated soil cover might be appropriate in a wet climate to maintain the tailings saturation when required to prevent oxidation and the production of contaminants in seepage.*
- *A rainfall shedding cover may be appropriate in a wet climate to minimise infiltration and ongoing seepage with an appropriately sized spillway.*
- *A store/release cover might be appropriate in a moderate or dry climate, possibly including a sealing layer.*
- *Allowing the development of an evaporative crust may be appropriate in a dry climate, in which any infiltration into the desiccated tailings will re-evaporate, without reliance on vegetation.*

A store and release cover has therefore been selected for the Medcalf TSFs, taking cognisance of the climatic setting. We anticipate the cover design for the upper surface of the landform will incorporate the following features:

- A capillary break/drainage layer will be provided on the surface of the tailings to inhibit upward migration of salts and to direct infiltrated rainwater to pre-determined locations.
- The surface of the two TSFs will then be covered with borrowed materials, likely clayey in nature, to form the final landform.
- The stockpiled topsoil will be spread over the surface, to allow growth of native vegetation common in the area.
- The cover material will inhibit water infiltration, capturing and storing some water, which will encourage plant growth and remove water through evapo-transpiration in the drier months.

7.1.2 Closure landform

The TSFs have been designed with slope batters of 3H:1V. Placing the material at this angle allows for trafficking of the slopes at closure, facilitating placement of cover materials. Erosion control will be required on the slopes, which may be achieved through placement of durable, erosion-resistant materials from a specific borrow area (yet to be identified).

Tailings storage infrastructure such as pipelines, water storage ponds and the temporary slurry storage area will be decommissioned and rehabilitated. The ponds will be filled in and graded to tie in to the surrounding natural ground.

7.1.3 Early closure

An early termination of mining operations (e.g. if the mine were unable to be developed to its full extent) would lead to the need to close the TSFs prematurely. This may occur with little warning. In the event that it is necessary to decommission the active TSF prior to achieving the design capacity, the following steps would be implemented.

- A pre-decommissioning review of the TSFs would be carried out and a specific closure plan developed in consideration of the stage of development of the TSF.
- The exposed tailings surfaces would be covered with borrowed material.

- Topsoil will be borrowed from the stockpile and spread over the cover surface.

Identification of suitable materials for placement on the surface and slopes of the TSFs should be carried out as part of the next stage of study.

8.0 MONITORING AND AUDITING EXPECTATIONS

Regular inspections and monitoring of the TSF landforms and associated infrastructure will be used to assess the performance of the TSFs. A monitoring program will be designed to monitor key environmental and design performance indicators and will include the following:

- Periodic inspections and/or testing of:
  - The water levels and freeboard on the TSFs and the evaporation ponds.
  - A check for fauna in the TSFs, evaporation and other ponds.
  - Inspection of all sides of the TSFs, including the slope and toe for evidence of seepage. The toe drain allowed for on the crest of the starter embankment should also be inspected for evidence of seepage.
  - Inspection of the surface of the TSFs to identify areas of water ponding that may lead to infiltration.
  - Inspection of crests, benches and slopes for signs of settling or failure (e.g., crack development, minor slumps) or signs of erosion.
  - Inspection of peripheral vegetation for signs of stress.
  - Inspection following heavy rainfall events or flooding of the TSFs for signs of erosion of the slopes, crest or ramps, or the creation of low spots.
- Vibrating wire piezometers (VWPs) should be installed in the TSFs to monitor for pore pressure in the embankments. The location of the VWPs will be selected as part of future studies.
- Groundwater monitoring should be carried out in accordance with the license.
- A technical review and operational audit of the TSF should be carried out by a suitably qualified geotechnical professional after the first six months of operation and every year thereafter. The technical review will assess the performance of the TSF against the design criteria and the conditions outlined in the License to Operate and approved Mining Proposal. The audit will include a review of the tailings management procedures, operating manual and monitoring data.

9.0 COST ESTIMATES

Bills of Quantities for each of the TSFs, evaporation ponds and a facility to contain the $FeSO_4$ crystals, with unit rates developed from first principles, are included in Appendix C. The following assumptions have been made in the development of the Bill of Quantities:

- The CT cells will be lined
- The liner system will include an overliner drainage system
- Filter materials, gravel sheeting and sand will be sourced from Kalgoorlie
- Excavated topsoil will be stockpiled within a haul distance of <2 km of the TSF cells and evaporation ponds
- Construction of the initial cells will occur over a period of 12 months

- Each TSF raise will be constructed over a 2-month period
- No contingency has been included, as it has been assumed that Audalia will include an overall contingency

The estimated costs associated with the Medcalf TSFs, evaporation ponds and $FeSO_4$ crystal storage facility based on the assumptions stated above are shown in Table 21 and Table 22. Detailed costs are presented in Appendix C. This cost estimate does not include process (pumping and piping) and maintenance costs involved in the operation of the TSFs.

Table 21: Estimated Capital Costs

Item	Cost
CT Cell 1 Starter	$42.3 million
BT Cell 1 Starter	$3.0 million
Evaporation Pond 1	$6.1 million
Total Capital for Base Case	**$51.4 million**
$FeSO_4$ Crystal Pad (allowance)	$9.6 million
Total Capital for Alternative Case	$61.0 million

Table 22: Estimated Deferred Costs

Item	Cost
CT Cell 2 and Wall Raises	$106.0 million
BT Cell 2 and Wall Raises	$4.7 million
Evaporation Ponds 2-10	$47.7 million
Total Deferred	$158.4 million over ~14 years

Based on the Bill of Quantities a total capital cost of $51.4 million is estimated for the Base Case. Should a facility be required to store the $FeSO_4$ crystals, an additional $9.6 million will need to be provided for. Deferred costs in the order of $160 million over 14 years are estimated for ongoing development of the facilities.

An allowance of $10/m^2 has been allowed for closure of the TSFs and evaporation ponds, based on experience with similar facilities in regional Western Australia. Based on a footprint area of 455 ha and including a 10% allowance for additional disturbed areas (access road, seepage interception drains, etc.), this equates to a closure cost in the order of $50 million.

10.0 OPPORTUNITIES

Developing the TSF design to PFS-level without undertaking laboratory characterisation of the CT tailings and a geotechnical and hydrogeological investigation of the proposed site has necessitated making a number of assumptions. These assumptions have been conservative in order to provide Audalia with a Base Case cost estimate that is unlikely to be exceeded. However, as more information is collected and supplementary laboratory testing and field investigations are carried out, there are opportunities to reduce the anticipated capital costs by adjusting the TSF and evaporation pond design.

The following opportunities have been identified, along with the studies required to be undertaken to enable a decision to be made.

1) An allowance has been made for the installation of a HDPE liner on the upstream batter of the starter embankment for the BT TSF, as the quality of borrow materials to be used for construction of the starter embankments is currently unknown. Should a geotechnical investigation identify suitable construction materials, such as clayey materials of sufficient strength, sufficiently low permeability and no (or low) potential for dispersivity, the liner may be omitted from the design.

   This has the potential to save ~$0.5 million in capital costs and ~$0.4 million in deferred capital (second stage of TSF development).

2) An allowance has been made for installation of an HDPE liner across the basin of the CT TSF due to the unknown (but suspected adverse) geochemical characteristics of the NT and IHR waste streams. To enable a decision as to whether the liner is needed, the geochemical character of the NT and IHR will need to be identified through testwork and the results considered in light of the hydrogeological conditions beneath the site (groundwater level and quality), as well as the ECC. If it can be established that seepage from the TSF can be managed in a way that will not breach the ECC, then a liner (and the associated overliner drainage system) would not be required. In the event that only one of the NT or the IHR has a geochemical character that indicates the need for a liner, there may be value in managing these streams separately, as has been proposed for the BT.

   This has the potential to save ~$34 million in capital costs and ~$20 million in deferred capital (second stage of TSF development).

3) The materials required for the overliner drainage system will need to have a specific grading to provide satisfactory filter compatibility with the tailings. These materials are unlikely to be available locally, so it has been assumed they will be transported to site from Kalgoorlie. Should the geotechnical investigation reveal suitable materials in the vicinity of the site, and the overliner drainage system is required, a substantial cost saving could be made.

   This has the potential to save between $10 and $15 million in capital costs for the CT TSF and between $9 and $14 million in deferred capital (second stage of TSF development).

4) An allowance has also been made for installation of a HDPE liner across the basin of the evaporation ponds due to the unknown condition of the groundwater in the vicinity of the proposed site. Similar to point 2) above, if it can be established that seepage of the potentially hypersaline liquor from the ponds can be managed in a way that will not breach the ECC, then a liner would not be required. This would require a hydrogeological investigation across the evaporation pond site, in conjunction with that at the TSF site.

   This has the potential to save ~$3 million in capital costs for the evaporation ponds and ~$2 million per pond in deferred capital costs.

5) The estimated evaporative area has been based on an evaporation factor of about 0.6 (from pan evaporation) and assumes all waste water is directed to the evaporation ponds. Identification of the actual evaporation of the brine generated by the reverse osmosis plant through laboratory testing could result in a reduction in evaporative area required. In addition, if a portion of the waste water can be used for dust suppression purposes, less water would need to be managed. Validation of these assumptions could reduce the need for ongoing construction of evaporation ponds throughout the operational period.

   If the evaporation factor were to increase by 0.05 (i.e. from 0.6 to 0.65) the required area of the evaporation ponds would decrease by ~13%, resulting in a cost saving of ~$6 million.

In addition to the above, additional minor opportunities exist to refine the cost estimate by confirming ground conditions across the TSF and evaporation pond sites. The influence on the capital and operating costs is expected to be significantly less than the items noted above, and hence have not been specifically identified. However, it is recommended that a detailed geotechnical investigation be carried out in advance of the next stage of study to improve the understanding of the subsurface conditions and allow for appropriate design adjustments to be made.

11.0 FUTURE WORK

As outlined in the previous section, a number of opportunities exist to reduce capital costs for the project. It is recommended that the feasibility study for the project be staged to prioritise key activities. We recommend that the initial stage includes geochemical characterisation of the waste streams, field investigations and preliminary seepage modelling. The objectives of the initial stage would be to:

- Identify the subsurface conditions beneath the proposed footprints for the TSFs and evaporation ponds
- Identify the elevation and quality of the groundwater in the vicinity of the TSFs and evaporation ponds
- Undertake *in situ* hydraulic testing to provide parameters for seepage modelling
- Identify candidate borrow areas and materials for use in construction and for closure
- Collect samples for laboratory testing
- Identify the seepage management measures required, through development of a preliminary seepage model, taking cognisance of the geochemical characteristics of the waste streams, the outcomes of the field investigations and the ECC for the project

After completion of this work, the potential to realise the opportunities identified in Section 0 should be revisited.

The following stage of the feasibility study would include the tasks typically attributed to a study of that type, as listed below. The work undertaken as part of the feasibility study could also be used to seek approvals for the project. Allowance has been made for a separate approvals report in the tasks listed below.

- Supplementary laboratory testing of the waste streams and the RO brine (this would include both geotechnical and geochemical testing)
- Laboratory testing of the samples collected during the field investigations (above)
- Updates to the design of the TSF, taking cognisance of the supplementary laboratory testing, field investigations and preliminary seepage modelling. This task will include:
  - Confirmation of the basis of design, particularly the dry density for the waste streams and the target rate of rise
  - Confirmation of the ECC
  - Re-examination of the layouts and capacity requirements for the TSFs
  - Development of stage capacity curves
  - Development of figures that present the staged development of the TSF
  - Design analyses, including stability, water balance, freeboard, consolidation, dam break assessment, updated seepage, water management and liner/drainage design (if required)
  - A specific water balance for the evaporation ponds, taking cognisance of laboratory testing to identify the evaporative potential of the liquor

- Closure design studies, including final landform development, cover design and erosion modelling for the side slopes

- Updated cost estimate, with quantities estimated from three-dimensional design models based on ground survey for the proposed sites
- Updated figures and drawings presenting the design
- Preparation of a report suitable for use as a supporting document for the approvals process
- Preparation of a summary report suitable for inclusion in the overall feasibility study.

The extent of work required for the feasibility study is strongly dependent on the outcomes of the proposed initial stage of work. For budgeting purposes, it is estimated that the geochemical characterisation of the waste streams, field investigations (geotechnical and the hydrogeological component associated with the TSFs and evaporation ponds) and preliminary seepage modelling will incur costs in the order of $150 000 to $250 000, including allowance for engagement of a suitable drill rig. This work would likely require about four to six months to complete.

The remaining tasks for the feasibility study, as listed above, would likely incur costs in the order of $200 000 to $350 000 and require an additional four to six months to complete. It is recommended that a budget of $600 000, and a schedule of at least 12 months, be allowed for the TSF and evaporation pond feasibility-level design.

12.0 IMPORTANT INFORMATION

Your attention is drawn to the document titled – "Important Information Relating to this Report", which is included in Appendix D of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations Golder has under the contract between it and its client.

GOLDER ASSOCIATES PTY LTD

Dr Peter Chapman
Principal Tailings Engineer

David Williams
Principal

DAW&PJC/PJC&DAW/hsl

A.B.N. 64 006 107 857

\\golder.gds\gap\perth\jobs-mining\jobs415\design\1538943 - audalia tailings pfs medcalf project\deliverables\1538943-004-r-rev0 medcalf pfs tsf design.docx

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Groenewald, B, Doyle, C, and Jones, S (2008). *Dundas,WA; Sheet 3232*. Geological Survey of Western Australia, 1:100 000 Geological Series.

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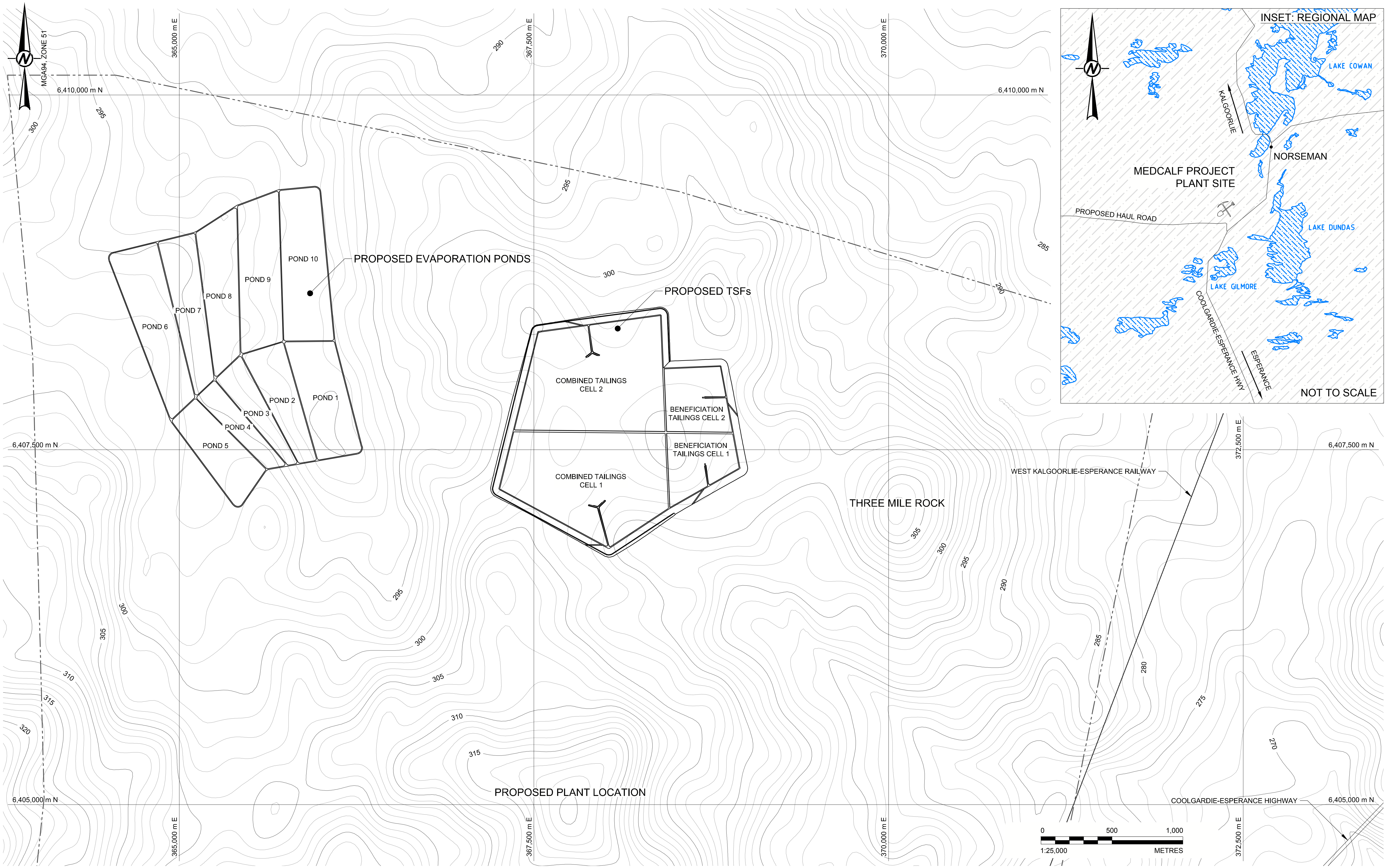
APPENDIX A

Figures



LEGEND

PROPOSED EXTENT OF LEASE

252 — TOPOGRAPHICAL CONTOUR AND ELEVATION (mAHD)

NOTE(S)

1. ALL LEVELS ARE IN METRES TO AUSTRALIAN HEIGHT DATUM (AHD).
2. SURVEY DATA FROM THE SHUTTLE RADAR TOPOGRAPHY MISSION (SRTM) AT APPROXIMATELY 10 m ACCURACY. CONTOURS INTERPOLATED TO 1 m FOR PRESENTATION.

CLIENT
AUDALIA RESOURCES LIMITED

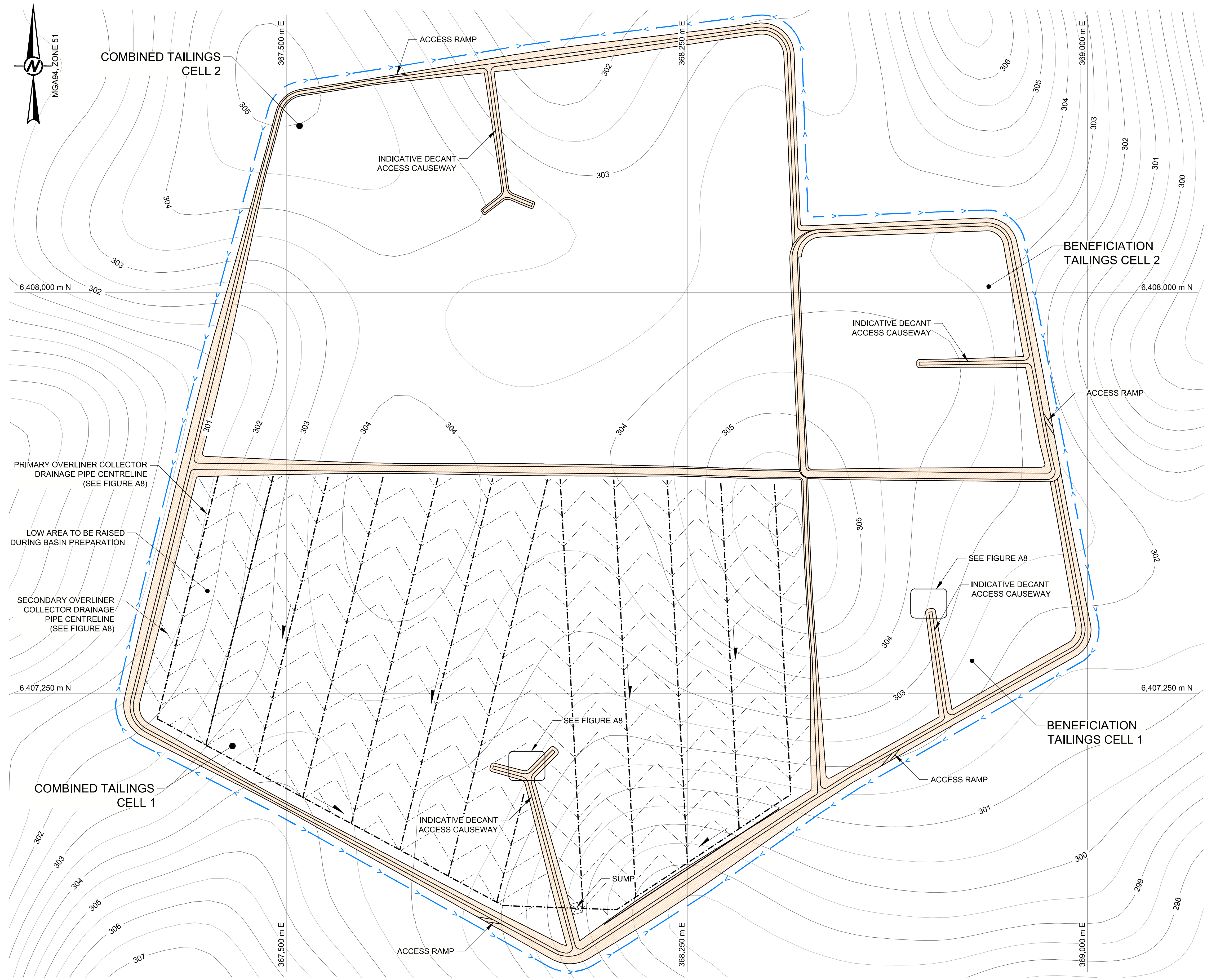
CONSULTANT
Golder Associates

YYYY-MM-DD	2016-01-13
DESIGNED	B. CUMMINS
PREPARED	C. JUZI
REVIEWED	P. CHAPMAN
APPROVED	

PROJECT
MEDCALF PROJECT PREFEASABILITY STUDY

TITLE
LOCALITY PLAN AND GENERAL ARRANGEMENT

PROJECT NO.	DOCUMENT No.	REV.	FIGURE
1538943	004-R	0	FA1



LEGEND

- STARTER EMBANKMENT FILL
- 252 — TOPOGRAPHICAL CONTOUR AND ELEVATION (mAHD)
- PRIMARY OVERLINER DRAINAGE PIPE CENTRELINE
- SECONDARY OVERLINER DRAINAGE PIPE CENTRELINE
- FLOW DIRECTION
- DIVERSION DRAIN

NOTE(S)

1. ALL LEVELS ARE IN METRES TO AUSTRALIAN HEIGHT DATUM (AHD).
2. SURVEY DATA FROM THE SHUTTLE RADAR TOPOGRAPHY MISSION (SRTM) AT APPROXIMATELY 10 m ACCURACY. CONTOURS INTERPOLATED TO 0.5 m FOR PRESENTATION.

CLIENT
AUDALIA RESOURCES LIMITED

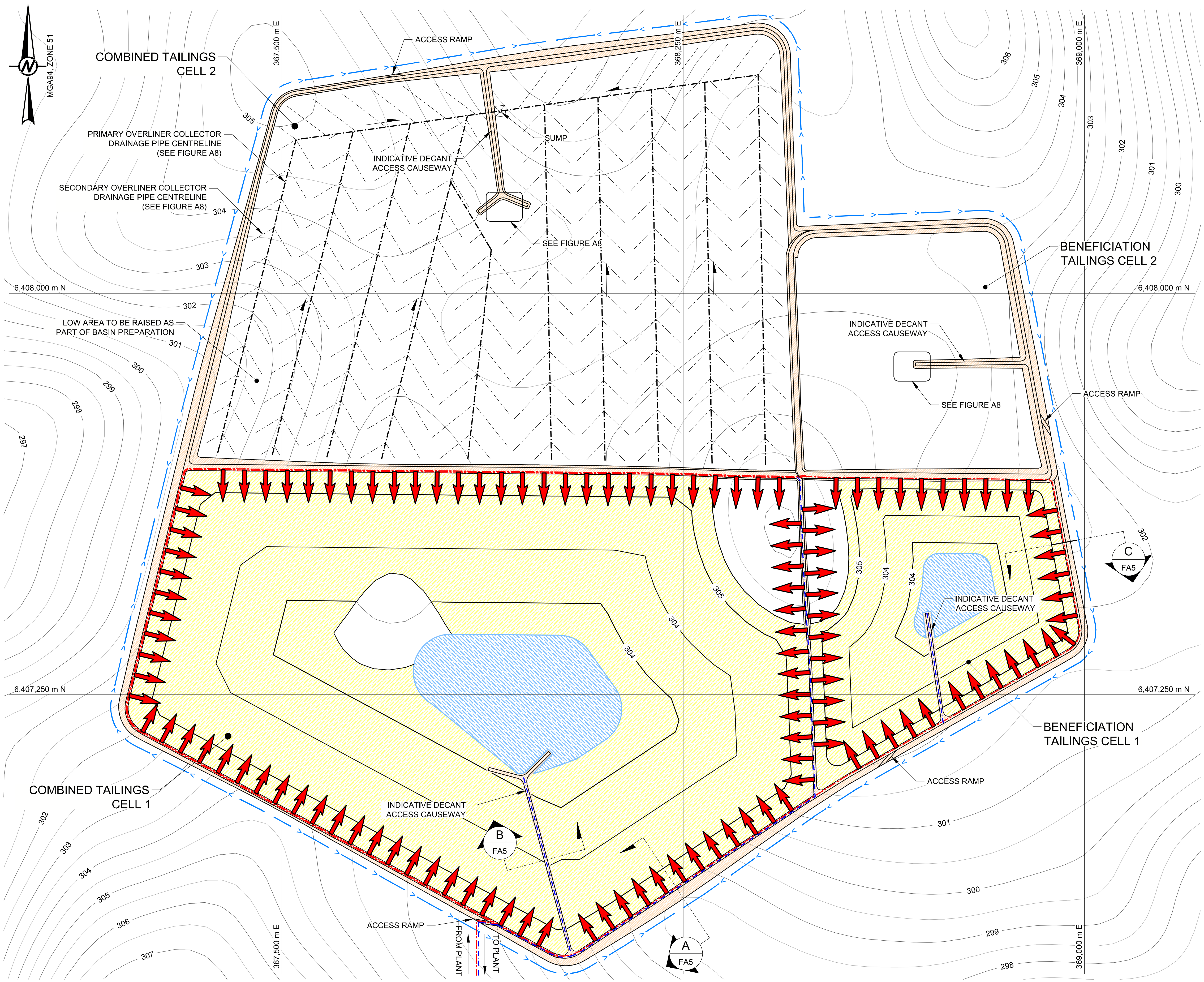
PROJECT
MEDCALF PROJECT PREFEASABILITY STUDY

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-01-13
DESIGNED	B. CUMMINS
PREPARED	C. JUZI
REVIEWED	P. CHAPMAN
APPROVED	

TITLE
TSF CELL 1 STARTER EMBANKMENT AND DRAINAGE SYSTEM CONFIGURATION

PROJECT NO.	DOCUMENT No.	REV.	FIGURE
1538943	004-R	0	FA2



LEGEND

- STARTER EMBANKMENT FILL
- TAILINGS
- SUPERNATANT POND
- 252 TOPOGRAPHICAL CONTOUR AND ELEVATION (mAHD)
- PRIMARY OVERLINER DRAINAGE PIPE CENTRELINE
- SECONDARY OVERLINER DRAINAGE PIPE CENTRELINE
- FLOW DIRECTION
- DIVERSION DRAIN
- TAILINGS DISCHARGE LOCATION
- INDICATIVE TAILINGS DELIVERY PIPELINE
- RETURN WATER PIPELINE

NOTE(S)

1. ALL LEVELS ARE IN METRES TO AUSTRALIAN HEIGHT DATUM (AHD).
2. SURVEY DATA FROM THE SHUTTLE RADAR TOPOGRAPHY MISSION (SRTM) AT APPROXIMATELY 10 m ACCURACY. CONTOURS INTERPOLATED TO 0.5 m FOR PRESENTATION.

0 125 250
1:7,500 METRES

CLIENT
AUDALIA RESOURCES LIMITED

PROJECT
MEDCALF PROJECT PREFEASABILITY STUDY

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-01-13
DESIGNED	B. CUMMINS
PREPARED	C. JUZI
REVIEWED	P. CHAPMAN
APPROVED	

TITLE
TSF CELL 2 STARTER EMBANKMENT AND DRAINAGE SYSTEM CONFIGURATION

PROJECT NO.	DOCUMENT No.	REV.	FIGURE
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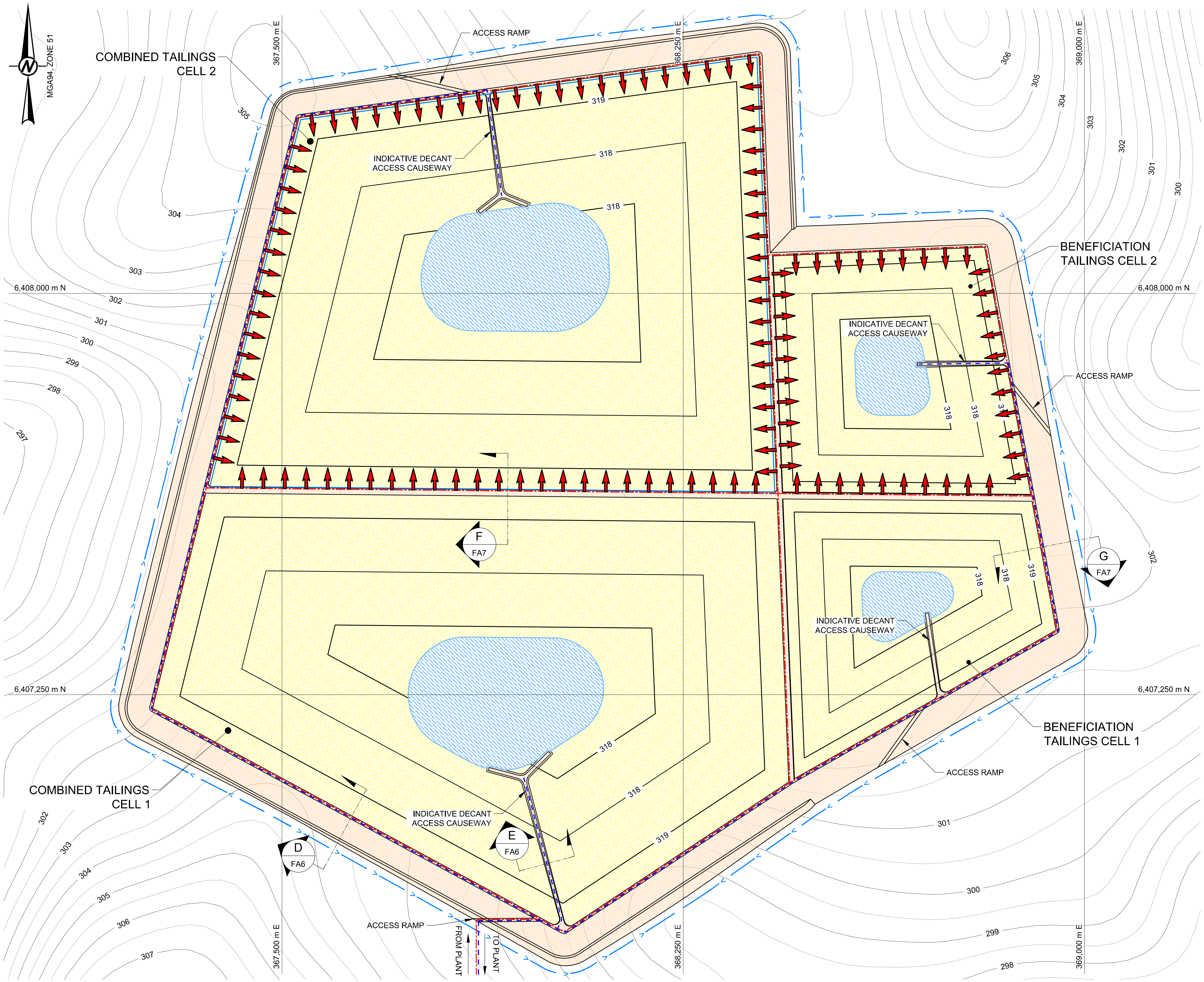


LEGEND

- STARTER EMBANKMENT FILL
- TAILINGS
- SUPERNATANT POND
- 252 TOPOGRAPHICAL CONTOUR AND ELEVATION (mAHD)
- DIVERSION CHANNEL
- INDICATIVE TAILINGS DISCHARGE LOCATION
- TAILINGS DELIVERY PIPELINE
- RETURN WATER PIPELINE

NOTE(S)

1. ALL LEVELS ARE IN METRES TO AUSTRALIAN HEIGHT DATUM (AHD).
2. SURVEY DATA FROM THE SHUTTLE RADAR TOPOGRAPHY MISSION (SRTM) AT APPROXIMATELY 10 m ACCURACY. CONTOURS INTERPOLATED TO 0.5 m FOR PRESENTATION.

0 125 250

1:7,500 METRES

CLIENT
AUDALIA RESOURCES LIMITED

PROJECT
MEDCALF PROJECT PREFEASABILITY STUDY

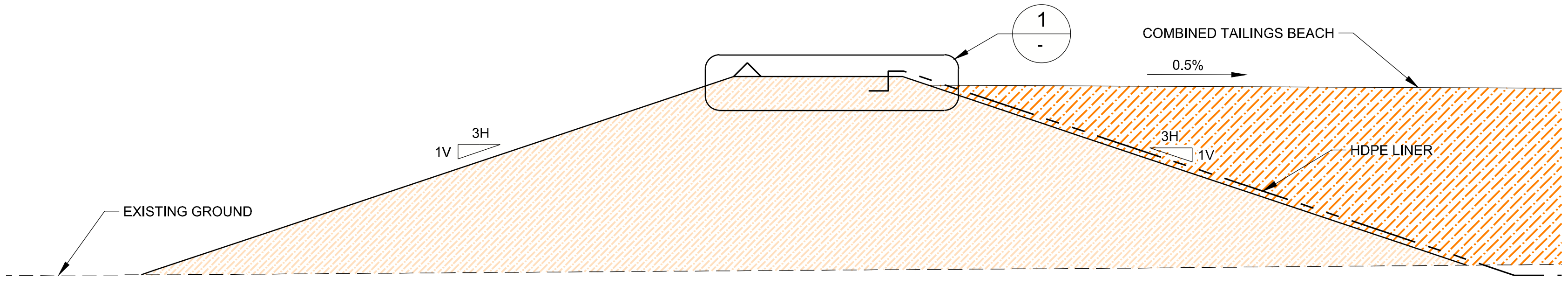
CONSULTANT

Golder Associates

YYYY-MM-DD	2016-01-13
DESIGNED	B. CUMMINS
PREPARED	C. JUZI
REVIEWED	P. CHAPMAN
APPROVED	

TITLE
TSF FINAL HEIGHT PLAN

PROJECT NO.	DOCUMENT No.	REV.	FIGURE
1538943	004-R	0	FA4



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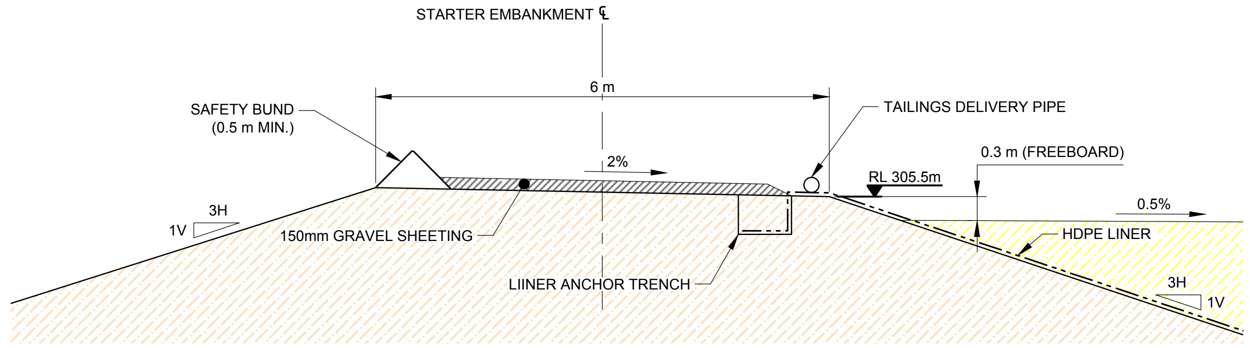

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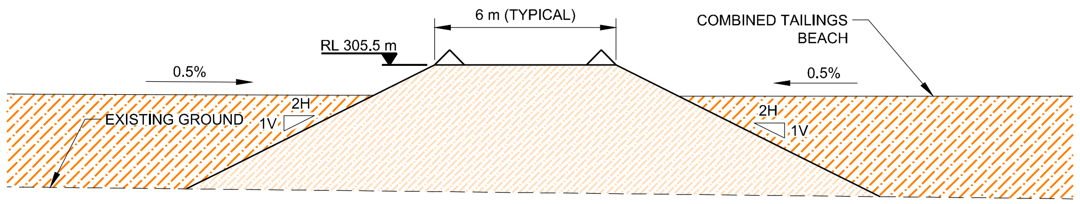

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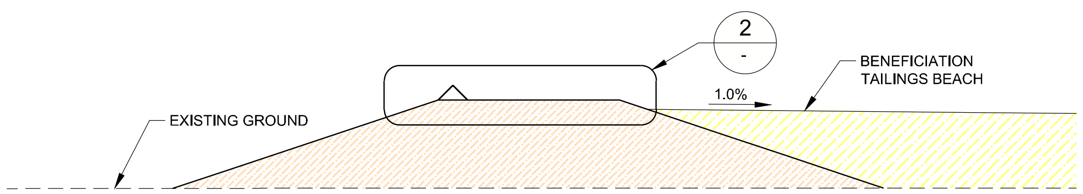

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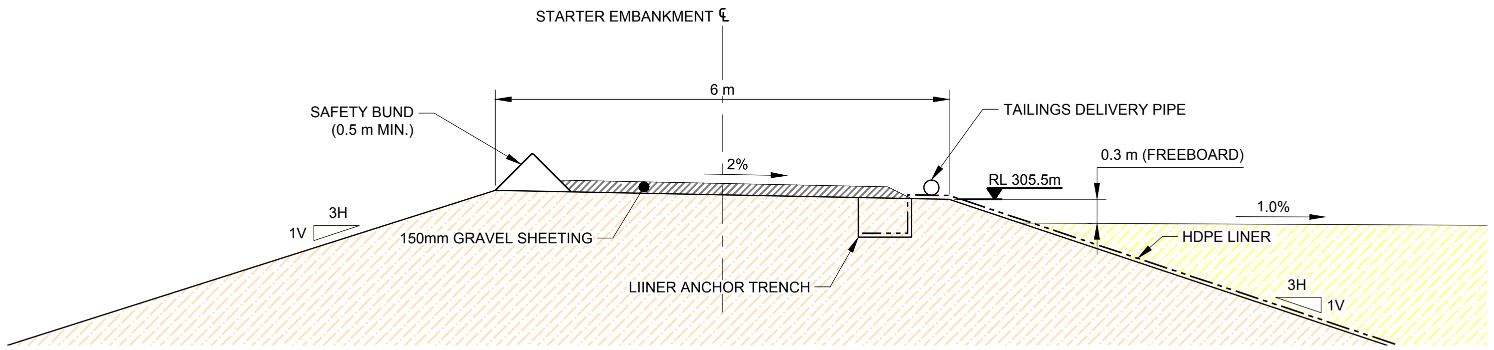


SCALE 1:100 2 - TYPICAL CREST DETAIL

LEGEND

- COMBINED TAILINGS
- BENEFICIATION TAILINGS
- STARTER EMBANKMENT FILL

0 2.5 5
1:100 METRES

0 5 10
1:250 METRES

CLIENT AUDALIA RESOURCES LIMITED	PROJECT MEDCALF PROJECT PREFEASABILITY STUDY
CONSULTANT Golder Associates	TITLE **TSF CELL 1 SECTIONS AND DETAILS**

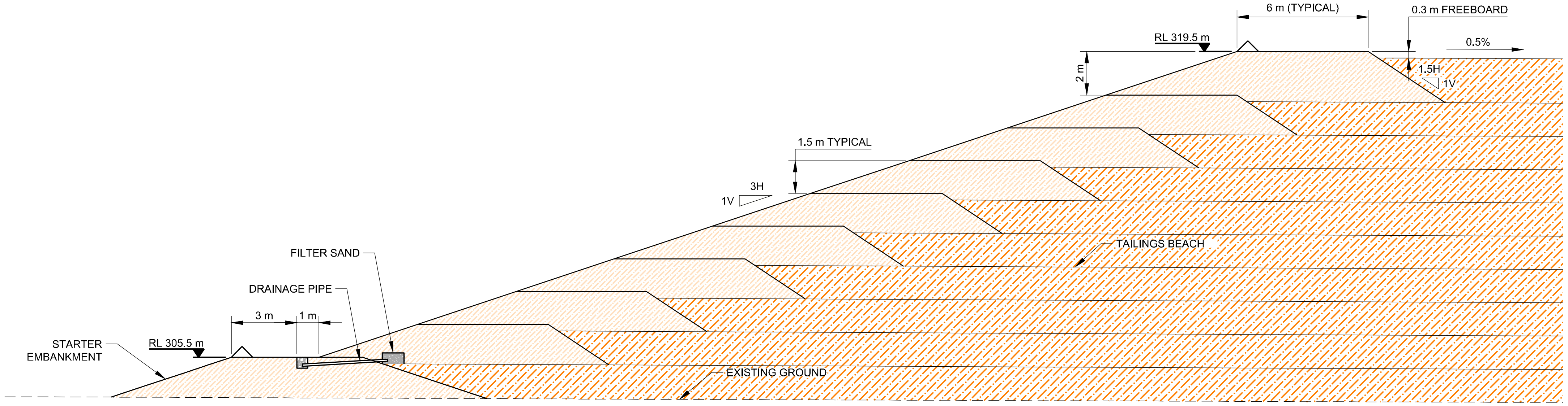
YYYY-MM-DD	2016-01-13
DESIGNED	B. CUMMINS
PREPARED	C. JUZI
REVIEWED	P. CHAPMAN
APPROVED	

PROJECT NO.	DOCUMENT No.	REV.	FIGURE
1538943	004-R	0	FA5

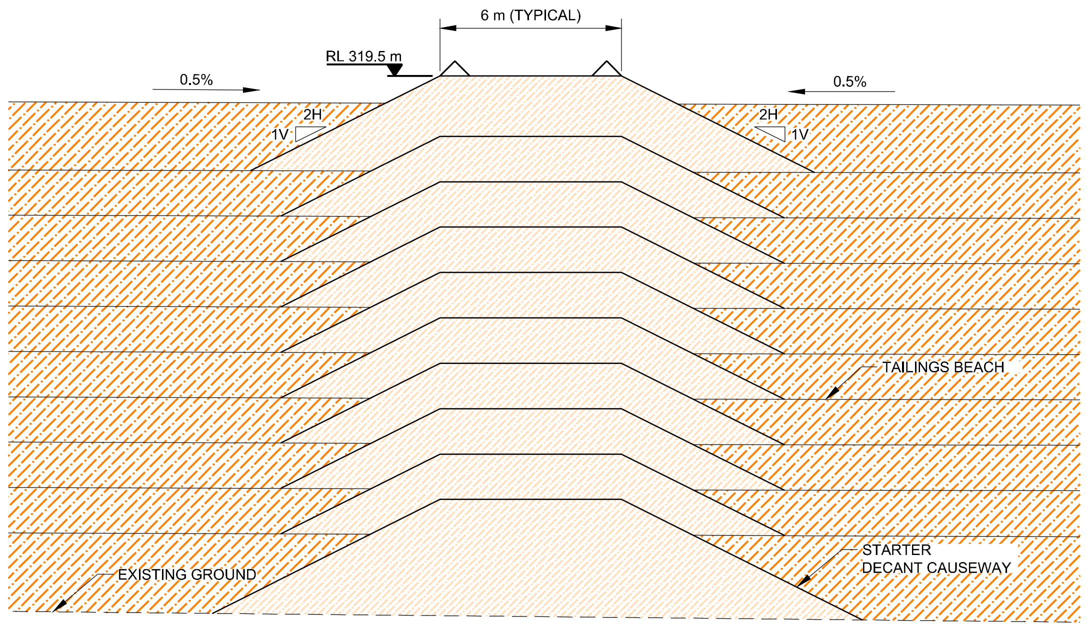
LEGEND

COMBINED TAILINGS

EMBANKMENT FILL



SCALE 1:250 D FA4 COMBINED TAILINGS CELL 1 FINAL HEIGHT SECTION



SCALE 1:250 E FA4 COMBINED TAILINGS CELL 1 DECANT CAUSEWAY SECTION

0 5 10

1:250 METRES

CLIENT AUDALIA RESOURCES LIMITED			PROJECT MEDCALF PROJECT PREFEASABILITY STUDY
CONSULTANT	YYYY-MM-DD	2016-01-13	TITLE TSF FINAL HEIGHT SECTIONS
Golder Associates	DESIGNED	B. CUMMINS	
	PREPARED	C. JUZI	
	REVIEWED	P. CHAPMAN	PROJECT NO. 1538943 · DOCUMENT No. 004-R · REV. 0 · FIGURE FA6
	APPROVED		

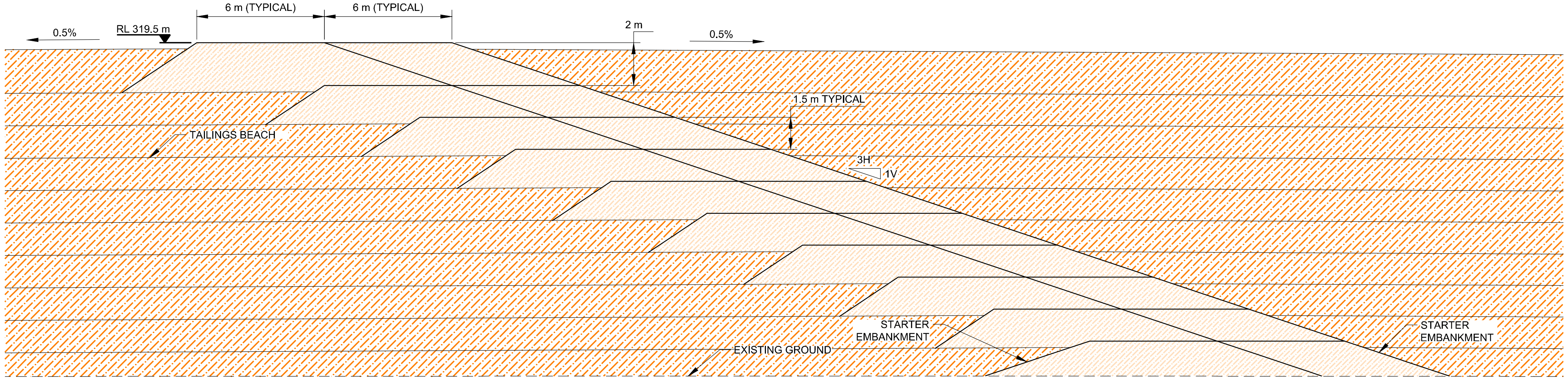
Path: \\golder.gds\gap\Perth\Geomatics\Audalia_Resources_Limited\Medcalf\99_PROJECTS\1538943-Audalia_Tailings_PFS_Medcalf_Project\02_PRODUCTION\FIGURES\004-R\ | File Name: 1538943-004-R-F006 & F007.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

25 mm

LEGEND

- COMBINED TAILINGS
- BENEFICIATION TAILINGS
- EMBANKMENT FILL



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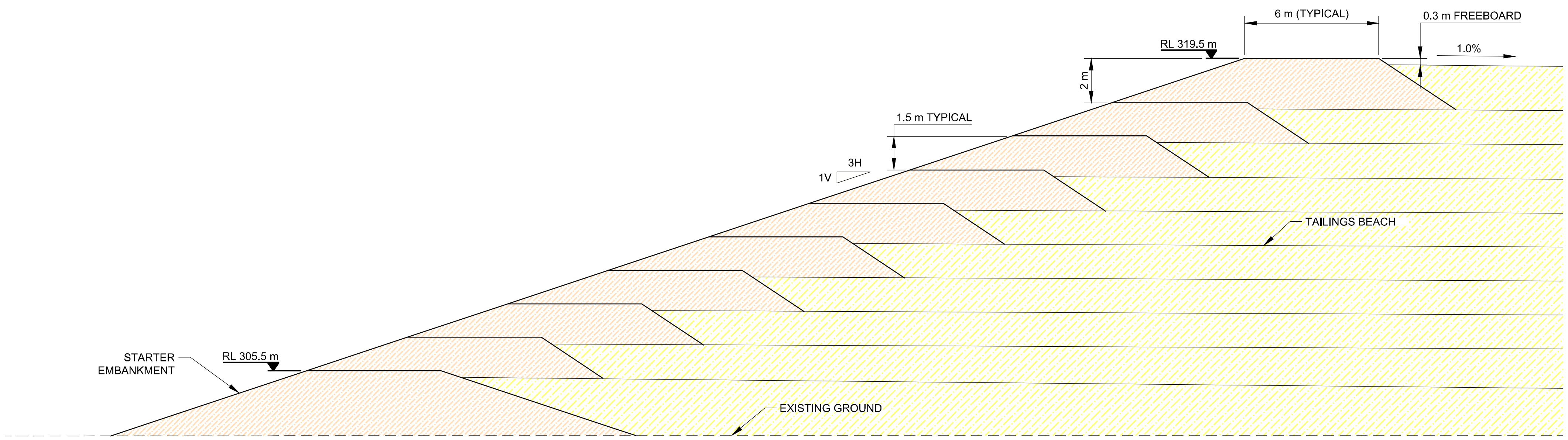

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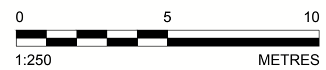
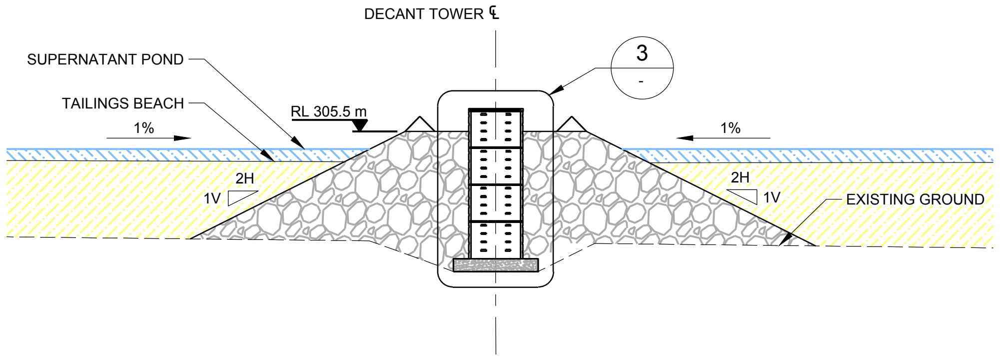
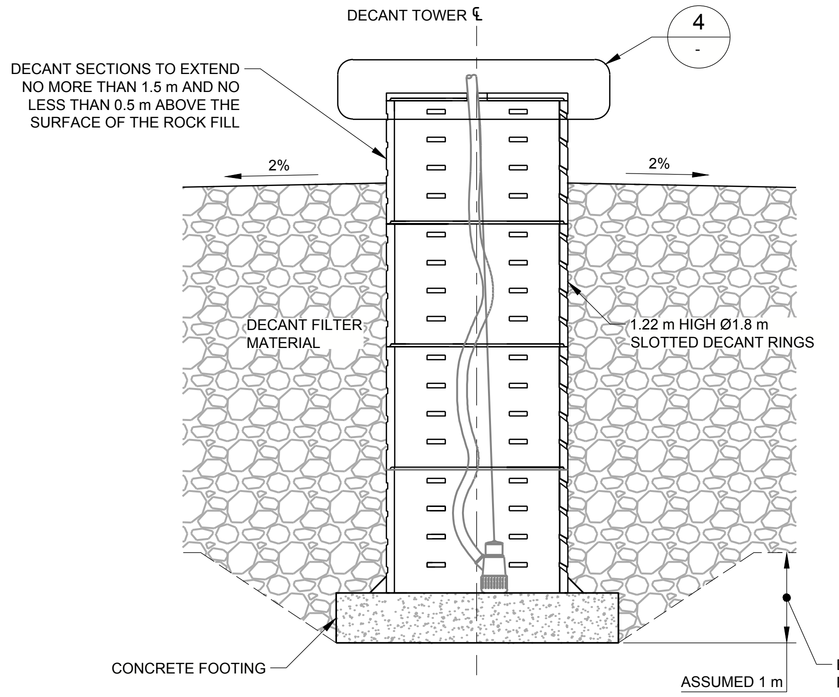


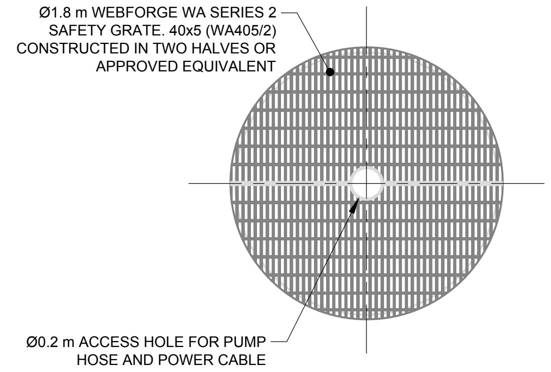
CLIENT AUDALIA RESOURCES LIMITED		PROJECT MEDCALF PROJECT PREFEASABILITY STUDY	
CONSULTANT Golder Associates	YYYY-MM-DD: 2016-01-13 DESIGNED: B. CUMMINS PREPARED: C. JUZI REVIEWED: P. CHAPMAN APPROVED:	TITLE **TSF FINAL HEIGHT SECTIONS**	
PROJECT NO. 1538943	DOCUMENT No. 004-R	REV. 0	FIGURE FA7



TYPICAL DECANT TOWER SECTION
SCALE 1:250



SCALE 1:75 3 DECANT TOWER



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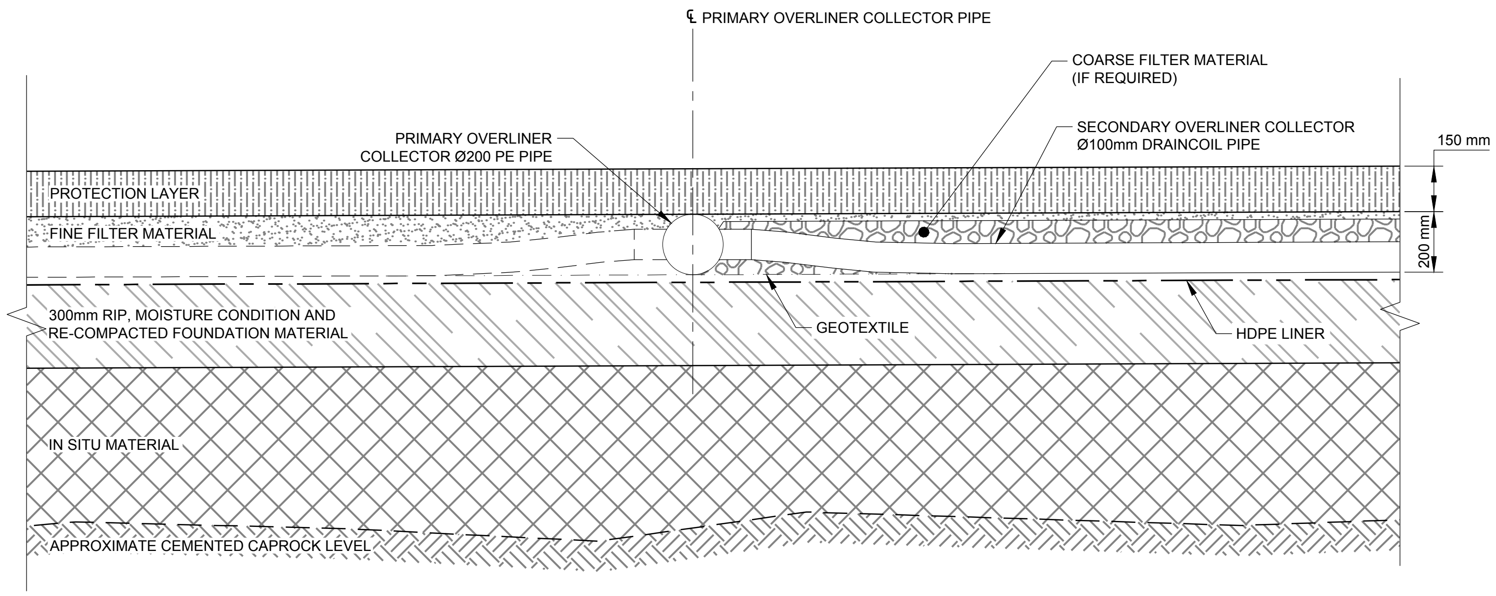
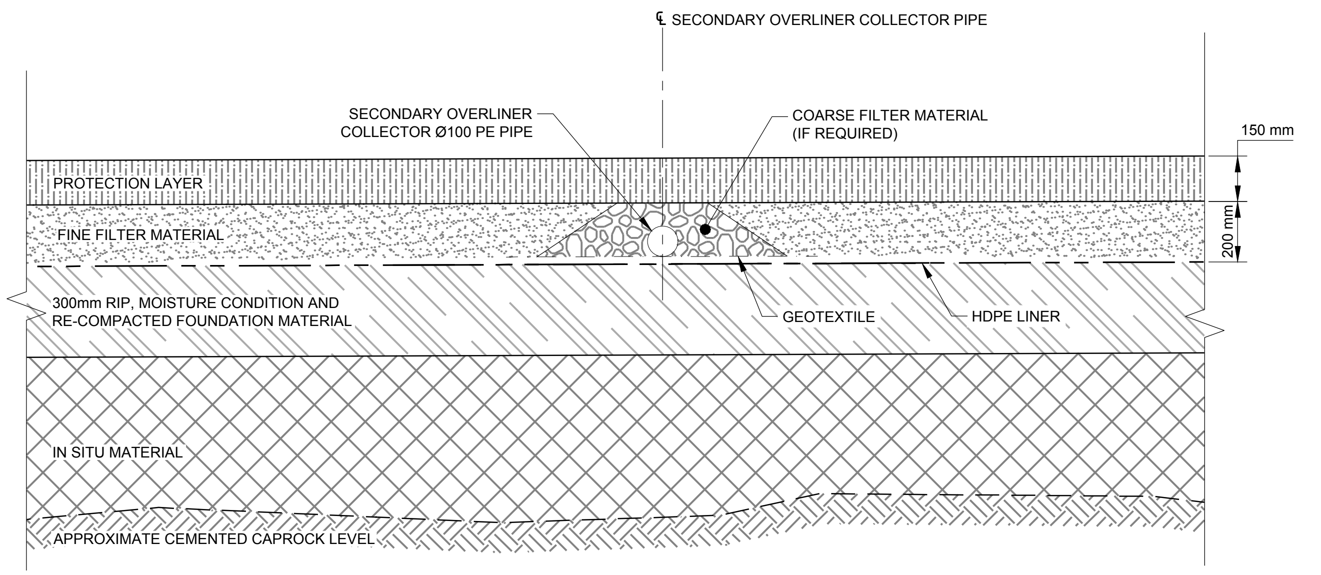


TYPICAL PRIMARY PIPE COLLECTOR DETAIL
SCALE 1:25



TYPICAL SECONDARY PIPE COLLECTOR DETAIL
SCALE 1:25

CLIENT
AUDALIA RESOURCES LIMITED

PROJECT
MEDCALF PROJECT PREFEASABILITY STUDY

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-01-13
DESIGNED	B. CUMMINS
PREPARED	C. JUZI
REVIEWED	P. CHAPMAN
APPROVED	

TITLE
DECANT AND DRAINAGE SECTIONS AND DETAILS

PROJECT NO.	DOCUMENT No.	REV.	FIGURE
1538943	004-R	0	FA8

APPENDIX B

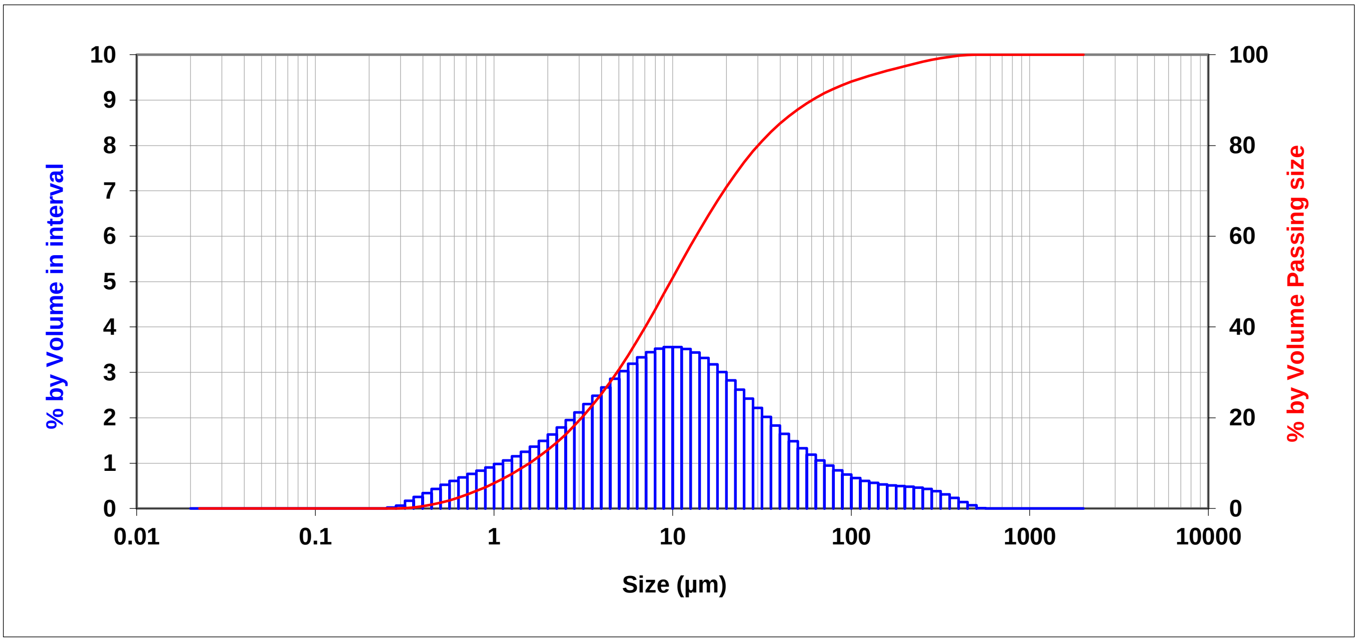
Laboratory Test Certificates

Suite 6
642 Albany Hwy
Victoria Park
WA 6100

Client:	Golder and Associates
Client ID:	1538943/151344
Job No :	15_1239
Lab ID No :	15_1239_01

Analysis:	Laser diffraction size distribution following ISO13320-1:1999		
Dispersant:	Water	**RI/ABS:**	2.74 / 0.1
Additives:	10 millilitres sodium hexametaphosphate	**Analysis Model:**	General purpose
Sonication:	5 min sonication	**Result units:**	Volume

Concentration:	0.0094 % vol	**Vol. Weighted Mean D[4,3]:**	26.82 µm	**d(0.1):**	1.577	µm
Obscuration:	18.64 %	**Surface Weighted Mean D[3,2]:**	4.012 µm	**d(0.5):**	9.756	µm
Weighted Residual:	0.559 %	**Specific Surface Area:**	1.5 m^2/cc	**P80:**	30.126	µm
				d(0.9):	60.397	µm



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.020	0.00	0.142	0.00	1.002	5.63	7.096	40.31	50.238	87.94	355.656	99.54
0.022	0.00	0.159	0.00	1.125	6.62	7.962	43.75	56.368	89.27	399.052	99.78
0.025	0.00	0.178	0.00	1.262	7.68	8.934	47.28	63.246	90.46	447.744	99.92
0.028	0.00	0.200	0.00	1.416	8.83	10.024	50.84	70.963	91.53	502.377	99.99
0.032	0.00	0.224	0.00	1.589	10.08	11.247	54.40	79.621	92.47	563.677	100.00
0.036	0.00	0.252	0.00	1.783	11.45	12.619	57.92	89.337	93.32	632.456	100.00
0.040	0.00	0.283	0.02	2.000	12.94	14.159	61.36	100.237	94.07	709.627	100.00
0.045	0.00	0.317	0.09	2.244	14.57	15.887	64.68	112.468	94.74	796.214	100.00
0.050	0.00	0.356	0.26	2.518	16.36	17.825	67.86	126.191	95.35	893.367	100.00
0.056	0.00	0.399	0.52	2.825	18.31	20.000	70.87	141.589	95.92	1002.374	100.00
0.063	0.00	0.448	0.86	3.170	20.43	22.440	73.69	158.866	96.45	1124.683	100.00
0.071	0.00	0.502	1.30	3.557	22.73	25.179	76.31	178.250	96.96	1261.915	100.00
0.080	0.00	0.564	1.82	3.991	25.22	28.251	78.74	200.000	97.46	1415.892	100.00
0.089	0.00	0.632	2.43	4.477	27.89	31.698	80.96	224.404	97.95	1588.656	100.00
0.100	0.00	0.710	3.12	5.024	30.75	35.566	82.98	251.785	98.42	1782.502	100.00
0.112	0.00	0.796	3.88	5.637	33.78	39.905	84.81	282.508	98.85	2000.000	100.00
0.126	0.00	0.893	4.72	6.325	36.97	44.774	86.45	316.979	99.23		

Analyst: Emily Barker, B.Sc.(Nanotechnology)
Reported: Emily Barker, B.Sc.(Nanotechnology)
Approved: Michael Simeoni, B.Sc.(Chemistry), M.Sc. (Science Administration), Ph.D.

Particle Size Distribution & Plasticity Index Test Report

Perth Laboratory
84 Guthrie Street Osborne Park
Perth WA 6017
P: +61 8 9441 0700 F: +61 8 9441 0701
www.golder.com
perthlab@golder.com.au

Client: Audalia Resources Limited
111 Hay Street West Perth
Project: Medcalf Project | **Date:** 3/12/15
Location: Lake Johnson Western Australia | **Project No.:** 1538943

Lab Reference Number: 151344 | **Sample Identification:** Gravity Tailings

Laboratory Specimen Description: Silty SAND
AS 1726 - Soil Classification:

Particle Size Distribution AS 1289.3.6.1

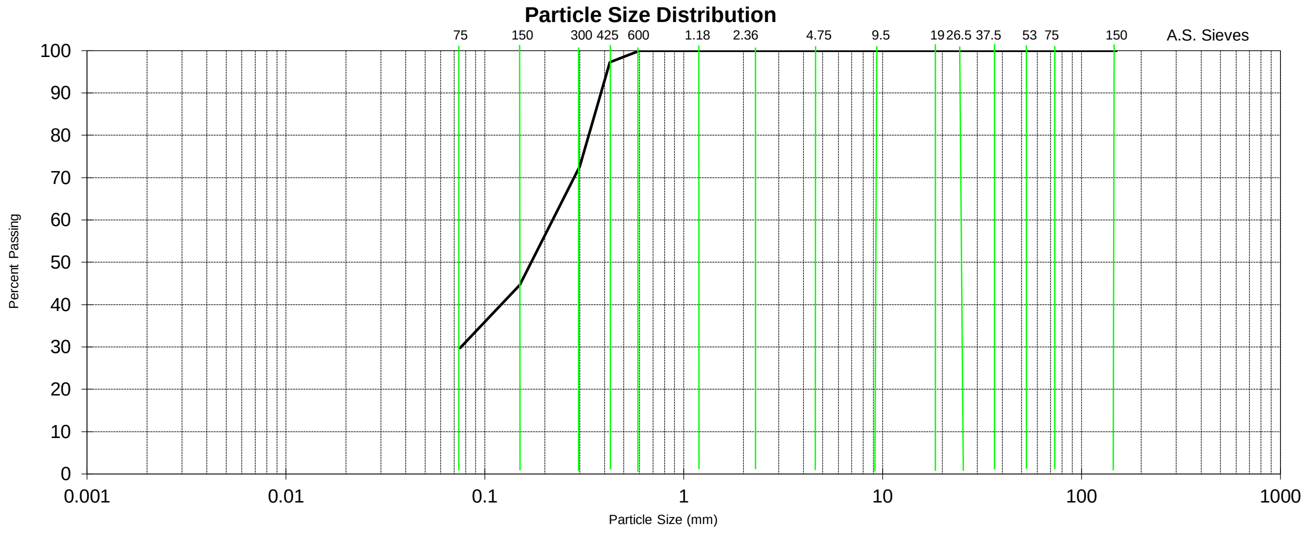
Sieve Size		% Passing	Specification
150.0	mm	100	
75.0	mm	100	
53.0	mm	100	
37.5	mm	100	
26.5	mm	100	
19.0	mm	100	
9.5	mm	100	
4.75	mm	100	
2.36	mm	100	
1.18	mm	100	
0.600	mm	100	
0.425	mm	97	
0.300	mm	73	
0.150	mm	45	
0.075	mm	30	

Plasticity Index and Moisture Content

Test		Method	Result	Specification
Liquid Limit	%	AS 1289.3.1.2	ND	
Plastic Limit	%	AS 1289.3.2.1	ND	
Plasticity Index	%	AS 1289.3.3.1	ND	
Linear Shrinkage	%	AS 1289.3.4.1	ND	
Moisture Content	%	AS 1289.2.1.1	ND	

Sample History: Air Dried
Preparation Method: Dry Sieved
Cracking/Crumbling/Curling of linear shrinkage:
Linear shrinkage mould length (mm):
ND = not determined NO = not obtainable NP = non plastic

Notes:



Tested as received **PLF1-003 RL0 27/11/12**

Certificate Reference: **1538943_151344_TR-150112_Class_Rev0**

NATA Accreditation No: 1961 Perth
Accredited for compliance with ISO/IEC 17025
THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL

Hamish Campbell – Senior Laboratory Technician

Particle Size Distribution & Plasticity Index Test Report

Perth Laboratory
84 Guthrie Street Osborne Park
Perth WA 6017
P: +61 8 9441 0700 F: +61 8 9441 0701
www.golder.com
perthlab@golder.com.au

Client:	Audalia Resources Limited 111 Hay Street West Perth		
Project:	Medcalf Project	**Date:**	3/12/15
Location:	Lake Johnson Western Australia	**Project No.:**	1538943
Lab Reference Number:	151344	**Sample Identification:**	Natural Slimes

Laboratory Specimen Description: SILT
AS 1726 - Soil Classification:

Particle Size Distribution AS 1289.3.6.1

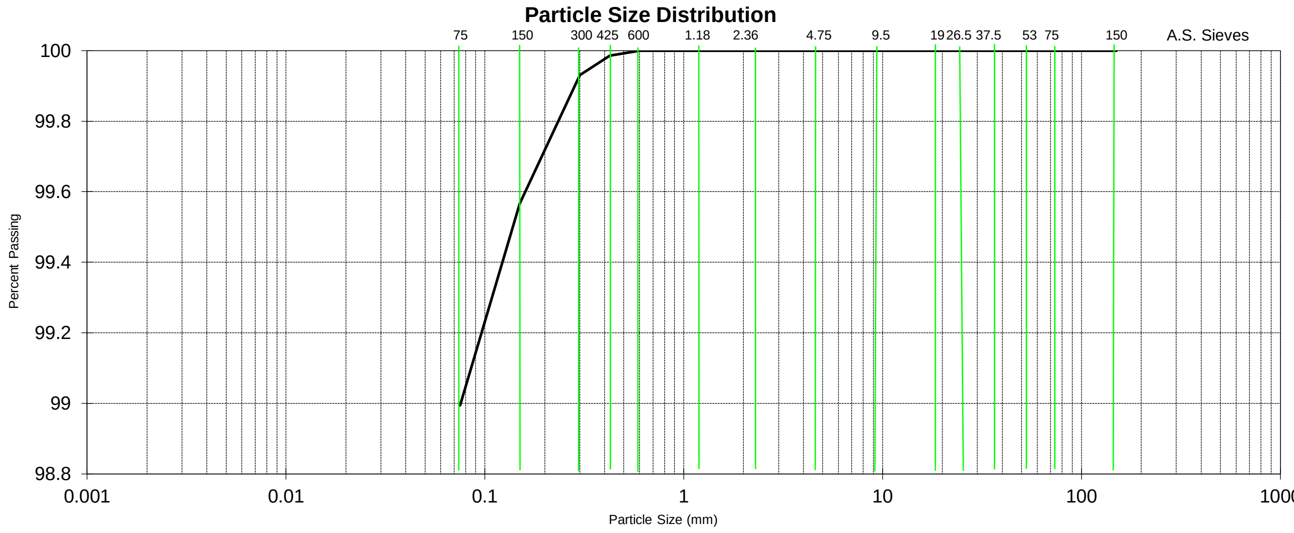
Sieve Size		% Passing	Specification
150.0	mm	100	
75.0	mm	100	
53.0	mm	100	
37.5	mm	100	
26.5	mm	100	
19.0	mm	100	
9.5	mm	100	
4.75	mm	100	
2.36	mm	100	
1.18	mm	100	
0.600	mm	100	
0.425	mm	100	
0.300	mm	100	
0.150	mm	100	
0.075	mm	99	

Plasticity Index and Moisture Content

Test		Method	Result	Specification
Liquid Limit	%	AS 1289.3.1.2	ND	
Plastic Limit	%	AS 1289.3.2.1	ND	
Plasticity Index	%	AS 1289.3.3.1	ND	
Linear Shrinkage	%	AS 1289.3.4.1	ND	
Moisture Content	%	AS 1289.2.1.1	ND	

Sample History: Air Dried
Preparation Method: Dry Sieved
Cracking/Crumbling/Curling of linear shrinkage:
Linear shrinkage mould length (mm):
ND = not determined NO = not obtainable NP = non plastic

Notes:



Tested as received — **PLF1-003 RL0 27/11/12**

Certificate Reference: **1538943_151344_TR-150112_Class_Rev0**

NATA Accreditation No: 1961 Perth

Accredited for compliance with ISO/IEC 17025

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Hamish Campbell – Senior Laboratory Technician

Particle Size Distribution & Plasticity Index Test Report

Perth Laboratory
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perthlab@golder.com.au

Client:	Audalia Resources Limited 111 Hay Street West Perth		
Project:	Medcalf Project	**Date:**	3/12/15
Location:	Lake Johnson Western Australia	**Project No.:**	1538943

Lab Reference Number: 151344 **Sample Identification:** Combined Tailings
Natural Slimes / Gravity Tailings

Laboratory Specimen Description: Sandy SILT
AS 1726 - Soil Classification:

Particle Size Distribution AS 1289.3.6.1

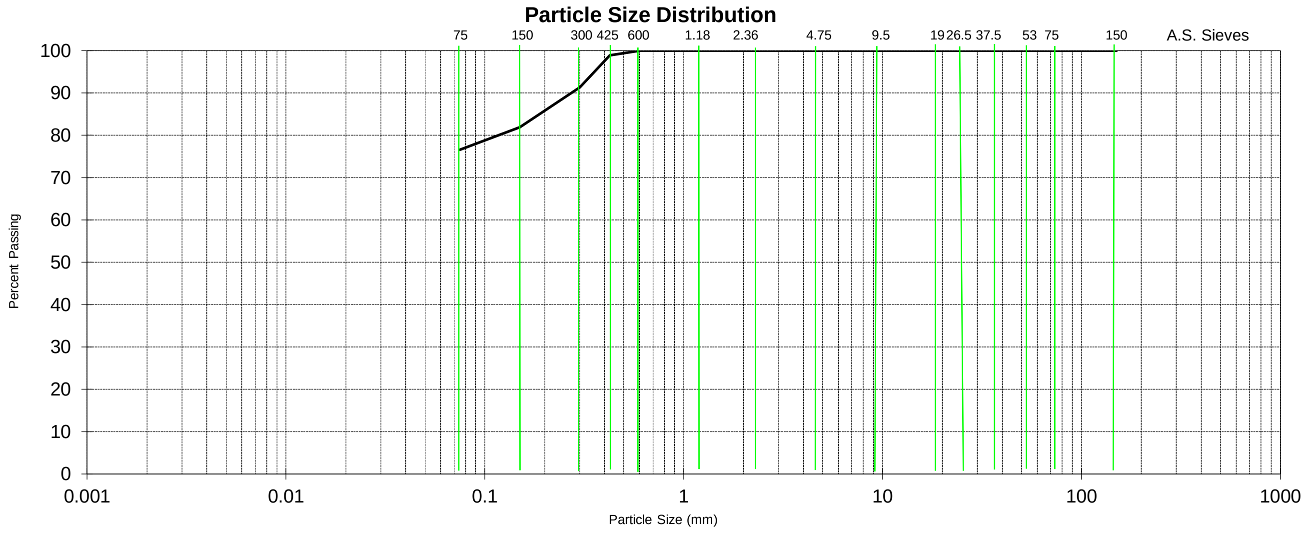
Sieve Size	% Passing	Specification
150.0 mm	100	
75.0 mm	100	
53.0 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
9.5 mm	100	
4.75 mm	100	
2.36 mm	100	
1.18 mm	100	
0.600 mm	100	
0.425 mm	99	
0.300 mm	91	
0.150 mm	82	
0.075 mm	77	

Plasticity Index and Moisture Content

Test		Method	Result	Specification
Liquid Limit	%	AS 1289.3.1.2	ND	
Plastic Limit	%	AS 1289.3.2.1	ND	
Plasticity Index	%	AS 1289.3.3.1	ND	
Linear Shrinkage	%	AS 1289.3.4.1	ND	
Moisture Content	%	AS 1289.2.1.1	ND	

Sample History: Air Dried
Preparation Method: Dry Sieved
Cracking/Crumbling/Curling of linear shrinkage:
Linear shrinkage mould length (mm):
ND = not determined NO = not obtainable NP = non plastic

Notes:



Tested as received **PLF1-003 RL0 27/11/12**

Certificate Reference: **1538943_151344_TR-150112_Class_Rev0**

NATA Accreditation No: 1961 Perth
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Slurry Consolidometer Test Report

Client: Audalia Resources Limited
111 Hay Street West Perth

Date: 3/12/2015

Project: Medcalf Project

Project No.: 1538943

Sample Identification: Combined Sample - Natural Slimes / Gravity Tailings (2:1 ratio)

Test procedure: In-house
Specimen Type: Slurry
Test Conditions: Top drainage of specimen while undergoing compression
Sample Diameter (mm): 71

Specimen Properties:

Solids
Type: Tailings
Particle Density (t/m^3): 3.42 (measured)

Fluid
Type: DI Water
Preparation solids concentration: 51%
Suspended solids concentration (g/l): Not determined

Preparation description: Sample combined in a 2:1 ratio of natural slimes to gravity tailings. Reslurried using demineralised water to a non-segregating solids concentration consistency.

Test conditions:

Vertical Effective Pressure σv' (kPa)	Void Ratio e (-)	Dry Density ρd (t/m^3)	Permeability k (m/s)	Confining Modulus M (kPa)	Coefficient of Volume Compressibility m_v (m^2/MN)	Coefficient of Consolidation Cv (m^2/yr)
-	-	-	-	-	-	-
10	2.65	0.94	3.4E-08	38	28.5	-
25	1.39	1.43	4.0E-09	43	27.9	0.8
50	1.23	1.54	2.9E-09	372	2.8	3.8
100	1.11	1.62	2.1E-09	963	1.1	6.9
200	1.01	1.70	1.6E-09	2101	0.5	13.0
400	0.92	1.78	1.0E-09	4271	0.2	18.0
800	0.83	1.87	7.2E-10	8580	0.1	21.8
200	0.83	1.87	-	-	-	-
50	0.84	1.86	-	-	-	-
10	0.86	1.84	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

Notes: Permeability measured by constant head testing. Coefficient of consolidation calculated from base pore pressure dissipation.

Riccardo Fanni - Tailings Engineer

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Slurry Consolidometer Test Report

Client: Audalia Resources Limited
111 Hay Street West Perth

Date: 3/12/2015

Project: Medcalf Project

Project No.: 1538943

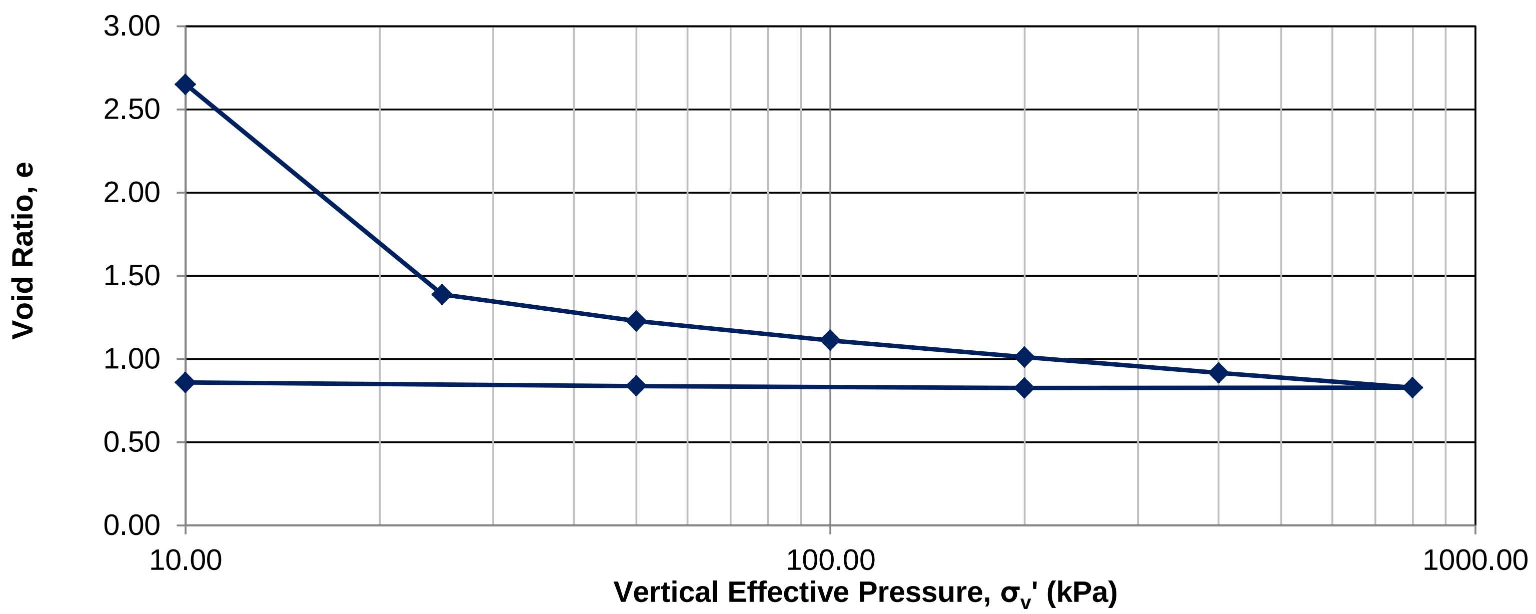
Sample Identification: Combined Sample - Natural Slimes / Gravity Tailings (2:1 ratio)

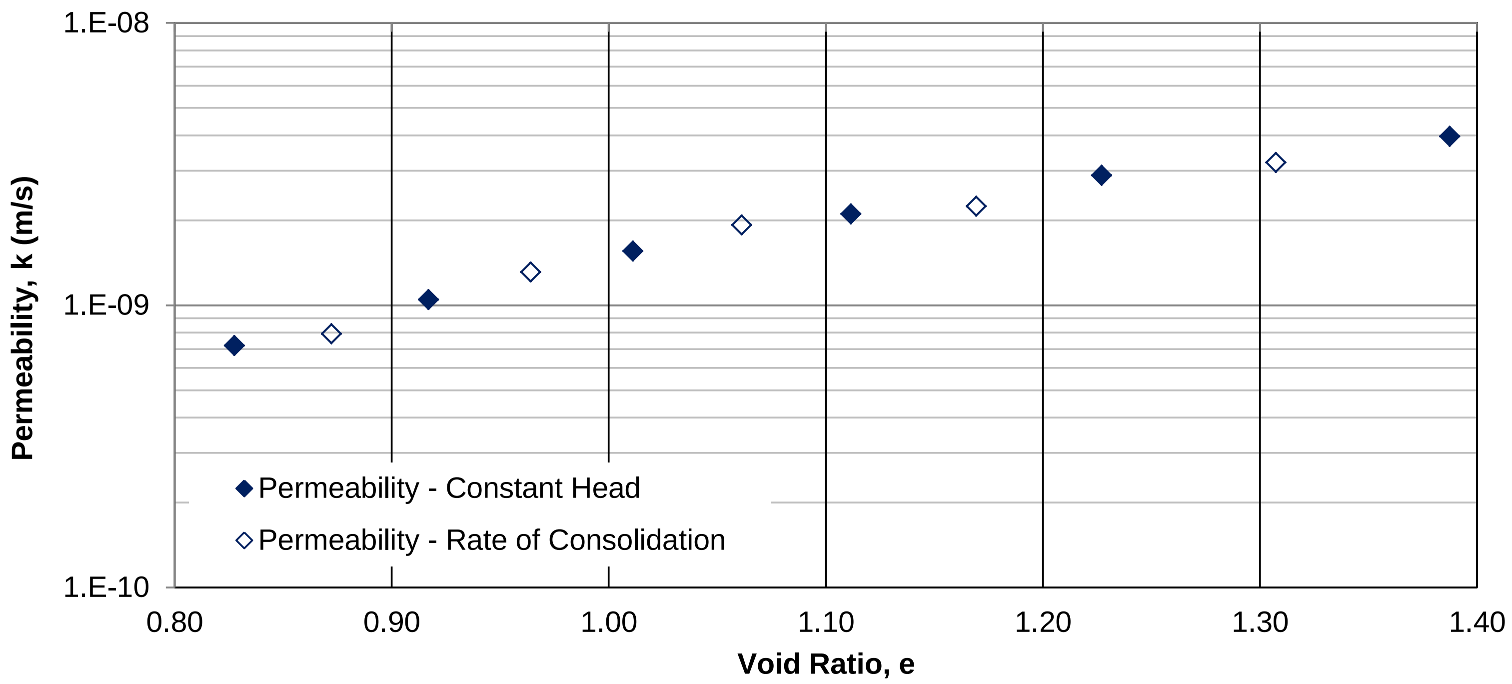
Test procedure: In-house
Specimen Type: Sandy SILT
Test Conditions: Top drainage of specimen while undergoing compression
Sample Diameter (mm): 71

Specimen Properties:

Solids
Type: Tailings
Particle Density (t/m^3): 3.42 (measured)

Fluid
Type: DI Water
Preparation solids concentration: 51%
Suspended solids concentration (g/l): Not determined





Notes: Permeability measured by constant head testing. Coefficient of consolidation calculated from base pore pressure dissipation.

Riccardo Fanni - Tailings Engineer

Settling Tests Summary Report

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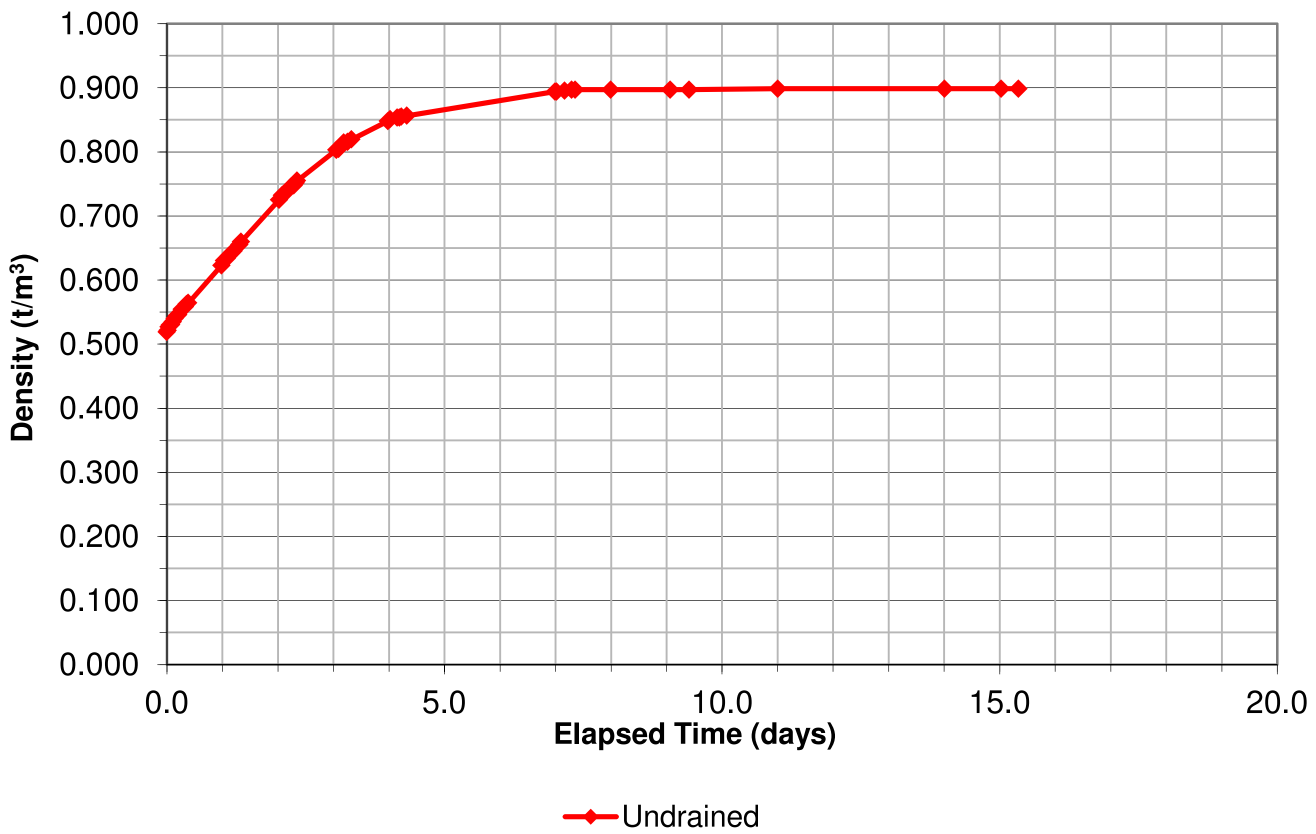
Client:	Audalia Resources Limited		
	111 Hay street West Perth		
Project:	Medcalf Project	**Date:**	4/11/15
Location:	Lake Johnson Western Australia	**Project No.:**	1538943
Lab Reference No.:	151344	**Sample Identification:**	Combined Sample Natural Slimes / Gravity Tailings

Laboratory Specimen Description:	Sandy Silt
Test Procedure	In-house Method
Tested Percent Solids (%)	38
Date Test Started	19/10/15



Notes: Sample Combined in a; 2:1 ratio of natural slimes to gravity tailings

Tested as received **PLF7-007 RL0 28/02/13**

Certificate Reference: 1538943_151344_TR-150112_Settling_Rev1

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Hamish Campbell - Senior Laboratory Technician

Shrinkage Test

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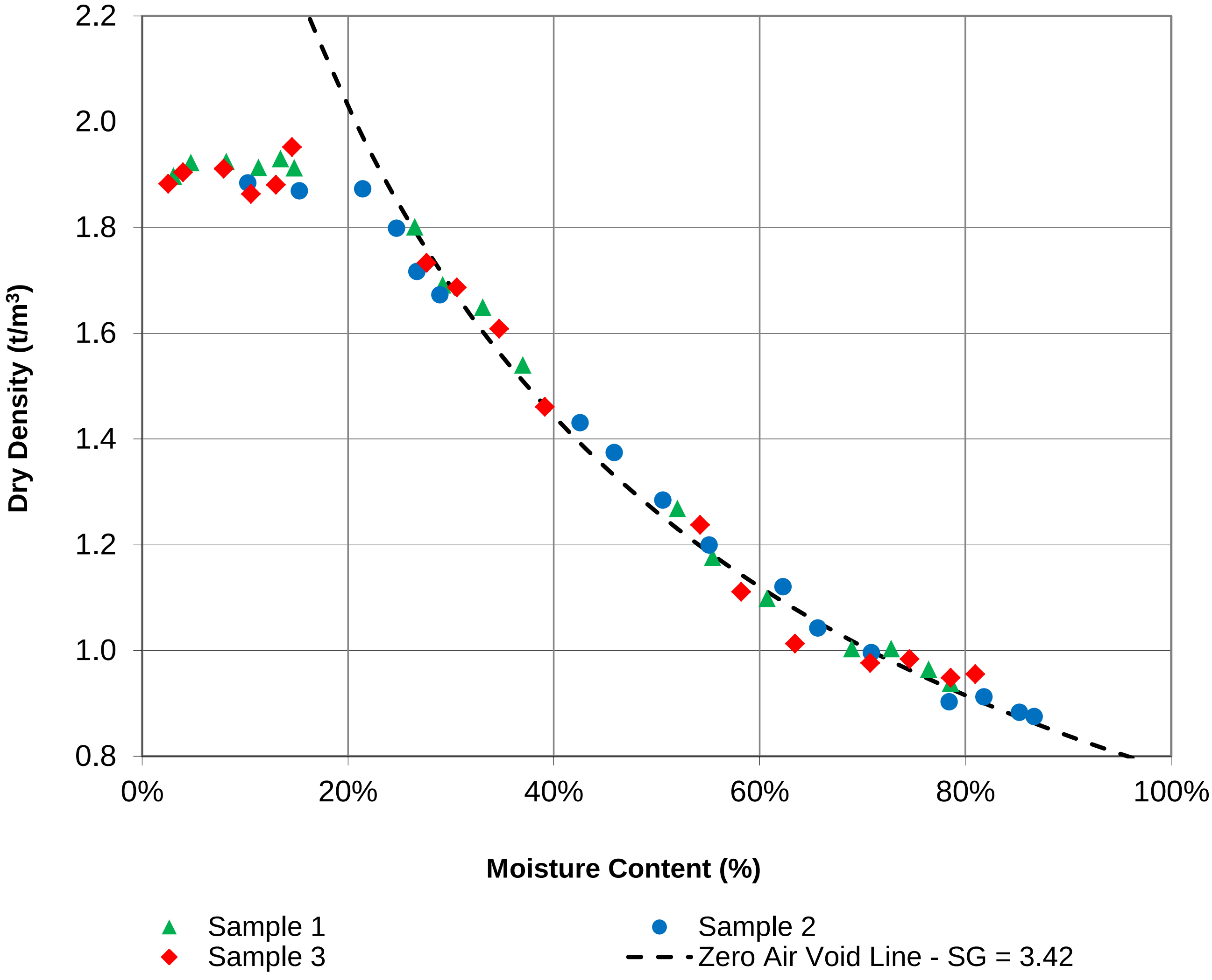
Client:	Audalia Resources Limited 111 Hay Street West Perth		
Project:	Medcalf Project	**Date:**	2/12/15
Location:	Lake Johnson Western Australia	**Project No.:**	1538943

Test procedure: In House Method

Sample Identification: Combined sample - Natural Slimes / Gravity Tailings

Preparation description: Sample combined in a 2:1 ratio of natural slimes to gravity tailings. Reslurried to 50% solids concentration using demineralised water to a non-segregating consistency.



Tabulated - Air Drying (Summer Cycle) Test Report

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Client:	Audalia Resources Limited 111 Hay Street West Perth		
Project:	Medcalf Project	**Date:**	3/12/15
Location:	Lake Johnson Western Australia	**Project No.:**	1538943

Lab Reference Number:	151344	**Sample Identification:**	Combined Sample Natural Slimes / Gravity Tailings

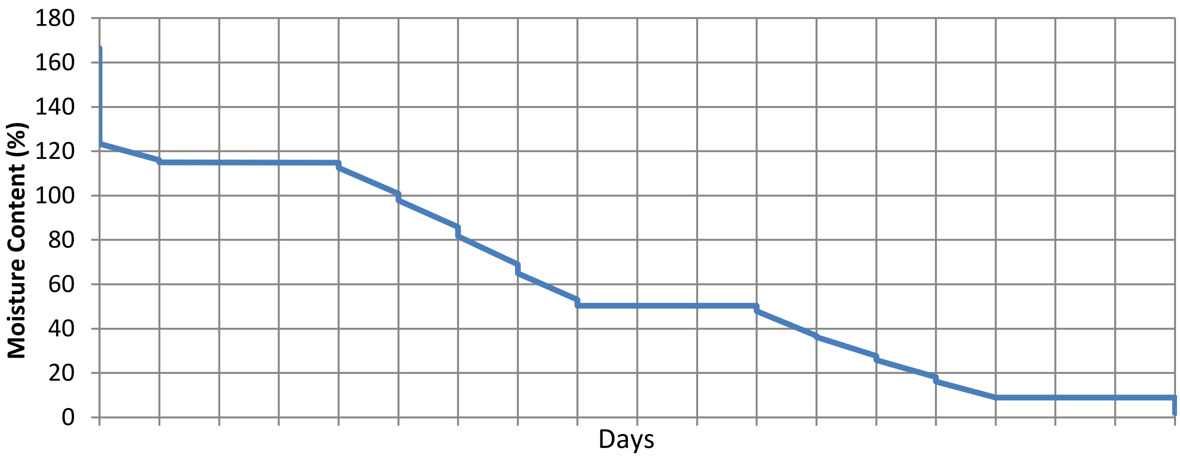
Laboratory Specimen Description: Sandy SILT

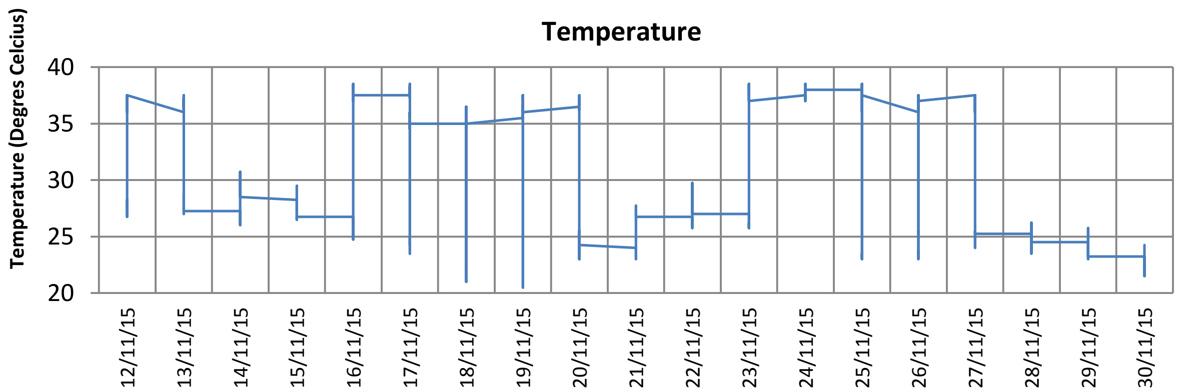
Test procedure: Internal

Required Summer Cycle: **37 During the night in a oven and on bench in laboratory during the day.**

Test Performed with material at 40% Percent Solids

Date Tested: 12/11/2015





Notes:

Tested as received **PLF7-005 RL0 21/01/13**

Certificate Reference:	**1538943_151344_TR-0_Summer Cycle_Rev0**

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Tabulated - Air Drying (Summer Cycle) Test Report

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Client:	Audalia Resources Limited 111 Hay Street West Perth		
Project:	Medcalf Project	**Date:**	3/12/15
Location:	Lake Johnson Western Australia	**Project No.:**	1538943

Lab Reference Number:	151344	**Sample Identification:**	Combined Sample Natural Slimes / Gravity Tailings

Laboratory Specimen Description: Sandy SILT

Test procedure: Internal

Initial Container & Wet Sample	g	2012.8
Initial Container & Wet Sample After Decant	g	1814.2
Final Container & Dry Sample	g	1245.3
Container	g	731.7
Final Dry Sample Mass	g	480.8

Required Summer Cycle: **37 During the night in a oven and on bench in laboratory during the day.**

Date Tested: 12/11/2015

Date:	Time hr:min	Elapsed Time (days)	Sample & Container (g)	Wet Mass (g)	Moisture content (%)
12/11/15	8:34	0.000	1781.4	1049.7	118.3
12/11/15	13:15	0.195	1777.1	1045.4	117.4
12/11/15	13:17	0.197	1809.9	1078.2	124.3
12/11/15	16:26	0.328	1805.3	1073.6	123.3
13/11/15	12:22	1.158	1770.4	1038.7	116.0
13/11/15	16:11	1.317	1765.1	1033.4	114.9
16/11/15	9:18	4.031	1764.4	1032.7	114.8
16/11/15	15:51	4.303	1753.8	1022.1	112.6
17/11/15	10:40	5.088	1697.2	965.5	100.8
17/11/15	16:00	5.310	1682.7	951.0	97.8
18/11/15	7:47	5.967	1625.0	893.3	85.8
18/11/15	16:17	6.322	1604.8	873.1	81.6
19/11/15	8:10	6.983	1543.7	812.0	68.9
19/11/15	16:10	7.317	1524.8	793.1	65.0
20/11/15	9:21	8.033	1467.4	735.7	53.0
20/11/15	15:48	8.301	1454.7	723.0	50.4

Notes:

Tested as received **PLF7-005 RL0 21/01/13**

Certificate Reference: **1538943_151344_TR-0_Summer Cycle_Rev0**

Hamish Campbell - Senior Laboratory Technician

Tabulated - Air Drying (Summer Cycle) Test Report

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Client: Audalia Resources Limited
111 Hay Street West Perth

Project: Medcalf Project | **Date:** 3/12/15

Location: Lake Johnson Western Australia | **Project No.:** 1538943

Lab Reference Number: 151344 | **Sample Identification:** Combined Sample
Natural Slimes / Gravity Tailings

Laboratory Specimen Description: Sandy SILT

Test procedure: Internal

Required Summer Cycle: **37 During the night in a oven and on bench in laboratory during the day.**

Date Tested: 12/11/2015

Date:	Time hr:min	Elapsed Time (days)	Sample & Container (g)	Wet Mass (g)	Moisture content (%)
23/11/15	7:56	10.974	1454.2	722.5	50.3
23/11/15	16:10	11.317	1442.6	710.9	47.9
24/11/15	14:48	12.260	1389.4	657.7	36.8
24/11/15	15:30	12.289	1386.6	654.9	36.2
25/11/15	8:20	12.990	1345.6	613.9	27.7
25/11/15	16:19	13.323	1336.5	604.8	25.8
26/11/15	8:03	13.978	1299.7	568.0	18.1
26/11/15	16:39	14.337	1290.3	558.6	16.2
27/11/15	15:49	15.302	1255.6	523.9	9.0
30/11/15	7:41	17.963	1255.5	523.8	8.9
30/11/15	12:12	18.151	1254.5	522.8	8.7
30/11/15	12:13	18.152	1221.6	489.9	1.9

Notes:

Tested as received PLF7-005 RL0 21/01/13

Certificate Reference: **1538943_151344_TR-0_Summer Cycle_Rev0**

Hamish Campbell - Senior Laboratory Technician

Tabulated - Air Drying (Winter Cycle) Test Report

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Client:	Audalia Resources Limited 111 Hay Street West Perth		
Project:	Medcalf Project	**Date:**	3/12/15
Location:	Lake Johnson Western Australia	**Project No.:**	1538943

Lab Reference Number:	151344	**Sample Identification:**	Combined Sample Natural Slimes / Gravity Tailings

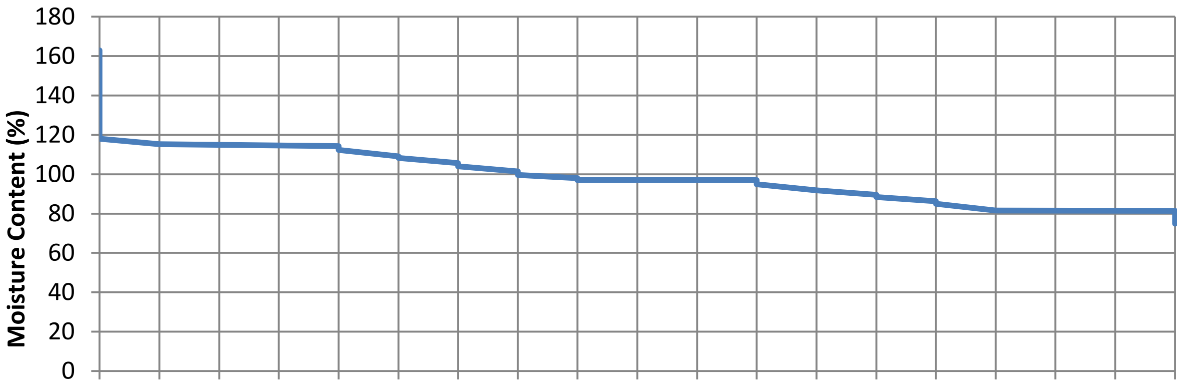
Laboratory Specimen Description: Sandy SILT

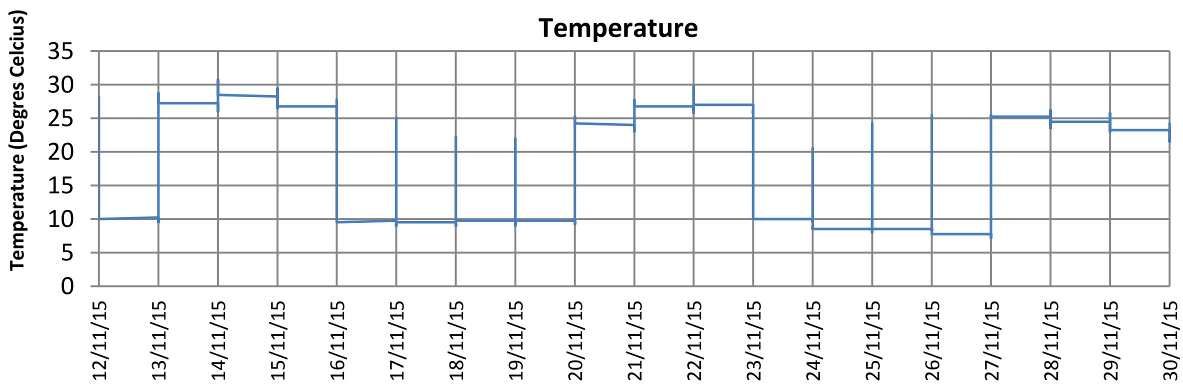
Test procedure: Internal

Required Winter Cycle: **10 During the night in a fridge and on bench in laboratory during the day.**

Test Performed with material at 40% Percent Solids

Date Tested: 12/11/2015





Notes:

Tested as received **PLF7-006 RL0 21/01/13**

Certificate Reference: **1538943_151344_TR-150112_Winter Cycle_Rev0**

Hamish Campbell - Senior Laboratory Technician

Tabulated - Air Drying (Winter Cycle) Test Report

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Client:	Audalia Resources Limited		
	111 Hay Street West Perth		
Project:	Medcalf Project	**Date:**	3/12/15
Location:	Lake Johnson Western Australia	**Project No.:**	1538943

Lab Reference Number:	151344	**Sample Identification:**	Combined Sample Natural Slimes / Gravity Tailings

Laboratory Specimen Description: Sandy SILT

Test procedure: Internal

Initial Container & Wet Sample	g	2255.3
Initial Container & Wet Sample After Decant	g	2000.2
Final Container & Dry Sample	g	1334.0
Container	g	714.7
Final Dry Sample Mass	g	586.0

Required Summer Cycle: **10 During the night in a fridge and on bench in laboratory during the day.**

Date Tested: 12/11/2015

Date:	Time hr:min	Elapsed Time (days)	Sample & Container (g)	Wet Mass (g)	Moisture content (%)
12/11/15	8:40	0.000	1966.9	1252.2	113.7
12/11/15	13:21	0.195	1963.1	1248.4	113.0
12/11/15	13:23	0.197	1996.4	1281.7	118.7
12/11/15	16:24	0.322	1992.1	1277.4	118.0
13/11/15	12:20	1.153	1976.3	1261.6	115.3
16/11/15	9:19	4.027	1970.9	1256.2	114.4
16/11/15	15:52	4.300	1959.4	1244.7	112.4
17/11/15	10:41	5.084	1939.5	1224.8	109.0
17/11/15	15:57	5.303	1935.1	1220.4	108.3
18/11/15	7:43	5.960	1919.4	1204.7	105.6
18/11/15	16:18	6.318	1909.9	1195.2	104.0
19/11/15	8:55	7.010	1895.2	1180.5	101.5
19/11/15	16:09	7.312	1884.9	1170.2	99.7
20/11/15	9:19	8.027	1874.6	1159.9	97.9
20/11/15	15:47	8.297	1869.5	1154.8	97.1
23/11/15	7:57	10.970	1869.1	1154.4	97.0

Notes:

Tested as received **PLF7-006 RL0 21/01/13**

Certificate Reference: **1538943_151344_TR-150112_Winter Cycle_Rev0**

Hamish Campbell - Senior Laboratory Technician

Tabulated - Air Drying (Winter Cycle) Test Report

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Client: Audalia Resources Limited
111 Hay Street West Perth

Project: Medcalf Project | **Date:** 3/12/15

Location: Lake Johnson Western Australia | **Project No.:** 1538943

Lab Reference Number: 151344 | **Sample Identification:** Combined Sample, Natural Slimes / Gravity Tailings

Laboratory Specimen Description: Sandy SILT

Test procedure: Internal

Required Summer Cycle: **10 During the night in a fridge and on bench in laboratory during the day.**

Date Tested: 12/11/2015

Date:	Time hr:min	Elapsed Time (days)	Sample & Container (g)	Wet Mass (g)	Moisture content (%)
23/11/15	16:11	11.313	1857.1	1142.4	94.9
24/11/15	14:49	12.256	1838.7	1124.0	91.8
24/11/15	15:28	12.283	1838.8	1124.1	91.8
25/11/15	8:22	12.988	1825.7	1111.0	89.6
25/11/15	16:19	13.319	1819.1	1104.4	88.5
26/11/15	8:04	13.975	1806.0	1091.3	86.2
26/11/15	16:38	14.332	1798.9	1084.2	85.0
27/11/15	15:50	15.299	1778.7	1064.0	81.6
30/11/15	7:39	17.958	1778.0	1063.3	81.5
30/11/15	11:58	18.138	1773.0	1058.3	80.6
30/11/15	12:01	18.140	1739.7	1025.0	74.9

Notes:

Tested as received | **PLF7-006 RL0 21/01/13**

Certificate Reference: **1538943_151344_TR-150112_Winter Cycle_Rev0**

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Hamish Campbell - Senior Laboratory Technician

APPENDIX C

Bill of Quantities

PROJECT: **MEDCALF TSF DESIGN**
COMBINED TAILINGS STORAGE FACILITY

PROJECT No.: 1538943
DATE: 12-Jan-16
REVISION 0

ITEM	DESCRIPTION	UNIT	MEASURED QUANTITY	RATES	TOTAL (AUD$)
	CAPITAL COSTS				
0.0	**Preliminaries and General**				
0.1	Establishment	sum	1	$ 220,000.00	$ 220,000.00
0.2	Disestablishment	sum	1	$ 40,000.00	$ 40,000.00
0.3	Insurance, bonds & finance	sum	1	$ 1,400,000.00	$ 1,400,000.00
0.4	Preliminaries and general ongoing inc. contractor supervision	months	10	$ 420,000.00	$ 4,200,000.00
			PRELIMINARIES AND GENERAL		$ 5,860,000.00
1.0	**Perimeter embankment bulk compacted earthworks**				
1.1	Clear and grub	m^2	934,000	$ 0.20	$ 186,800.00
1.2	Excavate topsoil (300 mm) and stockpile (within 2 km)	m^3	280,200	$ 4.70	$ 1,316,940.00
1.3	Excavate material for starter embankment construction (sourced from within footprint)	m^3	190,372	$ 5.80	$ 1,104,157.60
1.4	Excavate to ferricrete across alignment, blend, moisture condition, replace and compact material to prepare foundation	m^3	43,113	$ 0.90	$ 38,801.70
1.5	Blend, load, haul, place, moisture condition in borrow and compact fill material to form starter embankment Cell 1	m^3	190,372	$ 5.50	$ 1,047,046.00
			COMPACTED EARTHWORKS		**$ 3,693,745.30**
2.0	**Liner Works**				
2.1	Shape, trim and proof roll TSF basin	m^2	934,000	$ 0.50	$ 467,000.00
2.2	Shape and trim TSF embankment face	m^2	66,276	$ 0.65	$ 43,079.40
2.3	Excavate anchor trench	linear m	1,105	$ 4.70	$ 5,191.62
2.4	Supply and install 1.5 mm HDPE liner to TSF basin for cell 1	m^2	867,724	$ 11.00	$ 9,544,964.00
2.5	Supply and install 1.5 mm HDPE liner to TSF embankment for cell 1	m^2	66,276	$ 11.00	$ 729,036.00
2.6	Fill and recompact anchor trench	linear m	1,105	$ 12.50	$ 13,807.50
2.7	Supply and install herringbone drain pipe to cell 1 (2/3 75 mm coredrain or equivalent and 1/3 100 mm for main collector pipe)	linear m	20,074	$ 30.00	$ 602,233.83
2.8	Supply,haul,place, moisture condition and compact sand blanket under drain to TSF Basin cell 1 (200 mm thick) (200 km ex Kalgoorlie)	m^3	173,545	$ 59.00	$ 10,239,135.33
2.9	Supply,haul,place, moisture condition and compact protection layer to sand blanket (150 mm thick) (200 km ex Kalgoorlie)	m^3	130,159	$ 80.00	$ 10,412,680.00
2.10	Overliner drainage sump (inc. footing, the towers, solid pipes, etc.)	item	1	$ 59,500.00	$ 59,500.00
2.11	Install PVC conductor pipes placed on HDPE lined surface	linear m	414	$ 29.00	$ 12,012.53
			LINER WORKS		**$ 32,116,627.68**
3.0	**Access road, sheeting and safety windrow**				
3.1	Supply, haul, place, moisture condition and compact Material to form safety windrows for perimeter embankment crests	m^3	331	$ 20.30	$ 6,727.01
3.2	Supply, haul, place, moisture condition and compact Material to form safety windrows for decant access embankment crests	m^3	129	$ 24.70	$ 3,194.45
3.3	Install access roads around perimeter toe	m	4,500	$ 51.00	$ 229,500.00
3.4	Supply,haul, and place gravel sheeting to perimeter embankment crest (150 mm thick, 3 m wide)	m^3	2,025	$ 7.00	$ 14,175.00
			SAFETY WINDROW		**$ 253,596.47**
4.0	**Surface water management**				
4.2	Excavate and trim perimeter drains (by grader)	m	3,682	$ 0.40	$ 1,472.80
			SURFACE WATER MANAGEMENT		**$ 1,472.80**
5.0	**Decant Tower**				
5.1	Install geotextile on lined upstream face of perimeter embankment	m^2	315	$ 12.50	$ 3,937.50
5.2	Excavate, blend, load, haul, place, moisture condition and compact fill material to form decant access causeway	m^3	25,000	$ 11.30	$ 282,500.00
5.3	Supply filter matieral for decant area (10 to 100 mm cobbles) for filter zone	m^3	1,000	$ 87.00	$ 87,000.00
5.4	Decant tower footing inc. liner protection	m^3	15	$ 760.00	$ 11,400.00
5.5	Decant tower and grate	m	6	$ 2,850.00	$ 17,100.00
			DECANT TOWER		**$ 401,937.50**
				TOTAL CAPITAL	**$ 42,327,379.75**
	DEFERRED CAPITAL COSTS				
6.0	**Cell 2 Embankment and Decant Raises (Including preliminaries and general)**				
6.1	Clear and grub	m^2	819,834	$ 0.20	$ 163,966.80
6.2	Excavate topsoil (300 mm) and stockpile	m^3	245,950	$ 4.70	$ 1,155,965.94
6.3	Excavate material for starter embankment construction	m^3	94,869	$ 5.80	$ 550,240.20
6.4	Excavate keyway, blend, moisture condition, replace and compact material to form keyway	m^3	27,781	$ 25.00	$ 694,525.00
6.5	Starter Embankment: Blend, load, haul, place, moisture condition and compact borrowed fill to form starter embankment	m^3	94,869	$ 5.50	$ 521,779.50
6.6	Place material for decant access causeway and install decant tower in Cell 2	item	1	$ 402,000.00	$ 402,000.00
6.7	Year 2: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	34,706	$ 13.00	$ 451,175.24
6.8	Year 3: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	34,433	$ 13.00	$ 447,634.39
6.9	Year 4: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	34,188	$ 13.00	$ 444,449.27
6.10	Year 5: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	33,951	$ 13.00	$ 441,361.96
6.11	Year 6: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	33,720	$ 13.00	$ 438,364.77
6.12	Year 7: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	33,496	$ 13.00	$ 435,452.13
6.13	Year 8: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	33,278	$ 13.00	$ 432,619.57
6.14	Year 9: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	33,066	$ 13.00	$ 429,863.66
6.15	Year 10: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	32,859	$ 13.00	$ 427,171.59
6.16	Year 11: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	32,658	$ 13.00	$ 424,554.99
6.17	Year 12: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	32,463	$ 13.00	$ 422,016.36
6.18	Year 13: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	32,507	$ 13.00	$ 422,595.98
6.19	Year 14: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	32,325	$ 13.00	$ 420,219.19
6.20	Year 15: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	37,545	$ 13.00	$ 488,080.80
			TOTAL CELL 2 RAISES		**$ 9,614,037.34**
7	**Liner Cell 2**				
7.1	Excavate anchor trench	m^3	**1069**	$ 4.70	$ 5,025.24
7.2	Supply and install HDPE liner to TSF basin for cell 1	m^2	**755848**	$ 11.00	$ 8,314,328.00
7.3	Supply and install HDPE liner to TSF embankment for cell 1	m^2	**64152**	$ 11.00	$ 705,672.00
7.4	Fill and recompact anchor trench	m^2	**1069**	$ 12.50	$ 13,365.00
7.5	Supply and install herringbone drain pipe to cell 1	m	**17486**	$ 30.00	$ 524,587.58
7.6	Supply,haul,place, moisture condition and compact sand blanket under drain (200 mm thick) to TSF Basin cell 1 (200 km ex Kalgoorlie)	m^3	**151169**	$ 59.00	$ 8,918,990.67
7.7	Supply,haul,place, moisture condition and compact protection layer to sand blanket (150 mm thick) (200 km ex Kalgoorlie)	m^3	**113377**	$ 80.00	$ 1,398,900.22
			TOTAL LINER CELL 2		$ 19,880,868.71
8.0	**Cell 1 Embankment and Decant Raises (including preliminaries and general)**				
8.1	Year 2: Remove sheeting, excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	43,899	$ 1,430.00	$ 62,775,326.88
8.2	Year 3: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	37,344	$ 13.00	$ 485,465.97
8.3	Year 4: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	37,058	$ 13.00	$ 481,754.67
8.4	Year 5: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	36,781	$ 13.00	$ 478,153.50
8.5	Year 6: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	36,510	$ 13.00	$ 474,624.36
8.6	Year 7: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	36,244	$ 13.00	$ 471,166.79
8.7	Year 8: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	35,983	$ 13.00	$ 467,778.04
8.8	Year 9: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	35,728	$ 13.00	$ 464,458.84
8.9	Year 10: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	35,477	$ 13.00	$ 461,198.12
8.10	Year 11: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	35,466	$ 13.00	$ 461,057.99
8.11	Year 12: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	35,225	$ 13.00	$ 457,931.33
8.12	Year 13: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	34,990	$ 13.00	$ 454,873.11
8.13	Year 14: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	34,760	$ 13.00	$ 451,884.28
8.14	Year 15: Excavate from BT TSF, blend, load, haul, place, moisture condition and tailings to form raise	m^3	37,201	$ 13.00	$ 483,611.85
			TOTAL CELL 1 RAISES		**$ 68,385,673.86**
9.0	**Elevated Toe Drain Cells 1 and 2**				
9.1	Excavate tailings from toe drain trench	m^3	**2160**	$ 1.80	$ 3,888.00
9.2	Supply and install slotted pipe	m	**7200**	$ 30.00	$ 216,000.00
9.3	Supply and place filter material in trench	m^3	**2160**	$ 86.00	$ 185,760.00
			TOTAL ELEVATED TOE DRAIN		**$ 405,648.00**
				TOTAL DEFERRED	**$ 98,286,227.91**

PROJECT: **MEDCALF TSF DESIGN**
BENE TAILINGS STORAGE FACILITY

PROJECT No.: 1538943
DATE: 12-Jan-16
REVISION 0

ITEM	DESCRIPTION	UNIT	MEASURED QUANTITY	RATES	TOTAL (AUD$)
	CAPITAL COSTS				
0.0	**Preliminaries and General**				
0.1	Establishment	sum	1	$ 90,000.00	$ 90,000.00
0.2	Disestablishment	sum	1	$ 25,000.00	$ 25,000.00
0.3	Insurance, bonds & finance	sum	1	$ 105,000.00	$ 105,000.00
0.4	Preliminaries and general ongoing	months	2	$ 420,000.00	$ 840,000.00
			PRELIMINARIES AND GENERAL		$ 1,060,000.00
1.0	**Perimeter embankment bulk compacted earthworks**				
1.1	Clear and grub	m^2	234,906	$ 0.20	$ 46,981.20
1.2	Excavate topsoil (300 mm) and stockpile (within 2 km)	m^3	70,472	$ 4.70	$ 331,217.46
1.3	Excavate material for starter embankment construction (sourced from within footprint)	m^3	57,801	$ 5.80	$ 335,245.80
1.4	Excavate to ferricrete across alignment, blend, moisture condition, replace and compact material to prepare foundation	m^3	45,528	$ 0.90	$ 40,975.20
1.5	Blend, load, haul, place, moisture condition in borrow and compact fill material to form starter embankment Cell 1	m^3	57,801	$ 5.50	$ 317,905.50
			COMPACTED EARTHWORKS		**$ 1,072,325.16**
2.0	**Liner Works**				
2.1	Shape and trim TSF embankment face	m^2	42,734	$ 1.00	$ 42,734.00
2.2	Excavate anchor trench at upstream crest margin and 5 m from upstream toe	m^3	1,115	$ 9.50	$ 10,590.60
2.3	Supply and install HDPE liner to TSF embankment for cell 1	m^2	42,734	$ 11.00	$ 470,074.00
2.4	Fill and recompact anchor trench	m^2	1,115	$ 12.50	$ 13,935.00
2.5	Install PVC conductor pipes placed on HDPE lined surface	linear m	209	$ 31.00	$ 6,479.78
			LINER WORKS		**$ 543,813.38**
3.0	**Access road, sheeting and safety windrow**				
3.1	Supply, haul, place, moisture condition and compact Material to form safety windrows for perimeter embankment crests	m^3	331	$ 20.50	$ 6,793.29
3.2	Supply, haul, place, moisture condition and compact Material to form safety windrows for decant access embankment crests	m^3	55	$ 25.00	$ 1,383.75
3.3	Install access roads around perimeter toe	m	1,867	$ 51.00	$ 95,222.10
3.4	Supply,haul, and place gravel sheeting to embankment crest (150 mm thick, 3 m wide)	m^3	932	$ 7.00	$ 6,527.12
			SAFETY WINDROW		**$ 109,926.26**
4.0	**Surface water management**				
4.2	Excavate and trim perimeter drains (by grader)	m	1,867	$ 0.40	$ 746.84
			SURFACE WATER MANAGEMENT		**$ 746.84**
5.0	**Decant Tower**				
5.1	Install geotextile on lined upstream face of TSF Embankment	m^2	315	$ 12.50	$ 3,937.50
5.2	Excavate, blend, load, haul, place, moisture condition and compact fill material to form decant access causeway	m^3	7,565	$ 11.30	$ 85,484.50
5.3	Supply decant rock for decant area (10 to 100 mm cobbles) for filter zone	m^3	1,000	$ 87.00	$ 87,000.00
5.4	Decant tower footing	m^3	15	$ 760.00	$ 11,400.00
5.5	Decant tower and grate	m	6	$ 2,850.00	$ 17,100.00
			DECANT TOWER		**$ 200,984.50**
				TOTAL CAPITAL	**$ 2,987,796.13**
	DEFERRED CAPITAL COSTS				
6.0	**Cell 2 Embankment and Decant Raises (Including preliminaries and general)**				
6.1	Clear and grub	m^2	203,886	$ 0.20	$ 40,777.20
6.2	Excavate topsoil (300 mm) and stockpile	m^3	61,166	$ 4.40	$ 269,129.52
6.3	Excavate material for starter embankment construction	m^3	53,601	$ 5.50	$ 294,805.50
6.4	Excavate to ferricrete, blend, moisture condition, replace and compact material to prepare foundation	m^3	63,790	$ 0.90	$ 57,411.00
6.5	Starter Embankment: Blend, load, haul, place, moisture condition and compact borrowed fill to form starter embankment	m^3	53,601	$ 5.50	$ 294,805.50
6.6	Place material for decant access causeway and install decant tower in Cell 2	item	1	$ 201,000.00	$ 201,000.00
6.7	Year 2: remove sheeting,excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	13,369	$ 8.70	$ 116,313.80
6.8	Year 3: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	14,509	$ 7.50	$ 108,815.34
6.9	Year 4: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	14,575	$ 7.50	$ 109,311.37
6.10	Year 5: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	14,465	$ 7.50	$ 108,490.80
6.11	Year 6: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	14,548	$ 7.50	$ 109,107.11
6.12	Year 7: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	11,366	$ 7.50	$ 85,243.42
6.13	Year 8: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	14,742	$ 7.50	$ 110,564.46
6.14	Year 9: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	14,854	$ 7.50	$ 111,403.96
6.15	Year 10: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	11,404	$ 7.50	$ 85,530.70
6.16	Year 11: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	15,104	$ 7.50	$ 113,280.09
6.17	Year 12: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	15,245	$ 7.50	$ 114,335.89
6.18	Year 13: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	11,473	$ 7.50	$ 86,047.32
6.19	Year 14: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	15,561	$ 7.50	$ 116,705.60
6.20	Year 15: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	15,739	$ 7.50	$ 118,044.60
			TOTAL CELL 2 RAISES		**$ 2,651,123.19**
7	**Liner Cell 2**				
7.1	Excavate anchor trench	m^3	1,025	$ 4.70	$ 4,819.38
7.2	Supply and install HDPE liner to TSF embankment for cell 1	m^2	30,762	$ 11.00	$ 338,382.00
7.3	Fill and recompact anchor trench	m^2	1,025	$ 12.50	$ 12,817.50
			TOTAL LINER CELL 2		$ 356,018.88
8.0	**Cell 1 Embankment and Decant Raises (including preliminaries and general)**				
8.1	Year 2: Remove sheeting, excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	19,366	$ 8.70	$ 168,483.54
8.2	Year 3: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	11,174	$ 7.50	$ 83,802.34
8.3	Year 4: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	19,446	$ 7.50	$ 145,842.27
8.4	Year 5: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	10,952	$ 7.50	$ 82,136.52
8.5	Year 6: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	19,369	$ 7.50	$ 145,270.95
8.6	Year 7: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	19,463	$ 7.50	$ 145,972.11
8.7	Year 8: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	10,749	$ 7.50	$ 80,615.06
8.8	Year 9: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	19,682	$ 7.50	$ 147,614.38
8.9	Year 10: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	19,805	$ 7.50	$ 148,540.80
8.10	Year 11: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	10,560	$ 7.50	$ 79,197.17
8.11	Year 12: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	20,085	$ 7.50	$ 150,638.63
8.12	Year 13: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	20,533	$ 7.50	$ 153,996.42
8.13	Year 14: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	20,712	$ 7.50	$ 155,338.36
8.14	Year 15: Excavate from adjacent borrow, blend, load, haul, place, moisture condition and tailings to form raise	m^3	30,521	$ 7.50	$ 228,911.16
			TOTAL CELL 1 RAISES		**$ 1,687,448.57**
				TOTAL DEFERRED	**$ 4,694,590.64**

PROJECT: **MEDCALF TSF DESIGN**
EVAPORATION PONDS

PROJECT No.: 1538943
DATE: 12-Jan-16
REVISION 0

ITEM	DESCRIPTION	UNIT	MEASURED QUANTITY	RATES	TOTAL (AUD$)
	CAPITAL COSTS				
0.0	**Preliminaries and General for initial pond**				
0.1	Establishment	sum	1	$ 105,000.00	$ 105,000.00
0.2	Disestablishment	sum	1	$ 3,000.00	$ 3,000.00
0.3	Insurance, bonds & finance	sum	1	$ 65,000.00	$ 65,000.00
0.4	Preliminaries and general ongoing inc. contractor supervision	months	2	$ 375,000.00	$ 750,000.00
			PRELIMINARIES AND GENERAL		$ 923,000.00
1.0	**Perimeter embankment bulk compacted earthworks**				
1.1	Clear and grub	m^2	276,662	$ 0.20	$ 55,332.40
1.2	Excavate topsoil (300 mm) and stockpile (within 2 km)	m^3	82,999	$ 5.10	$ 423,292.86
1.3	Excavate material for embankment construction (sourced from within footprint)	m^3	105,840	$ 7.50	$ 793,800.00
1.4	Excavate to ferricrete across alignment, blend, moisture condition, replace and compact material to prepare foundation	m^3	28,224	$ 0.90	$ 25,401.60
1.5	Blend, load, haul, place, moisture condition in borrow and compact fill material to form Pond 1 Embankment	m^3	82,999	$ 5.50	$ 456,492.30
			COMPACTED EARTHWORKS		**$ 1,754,319.16**
2.0	**Liner Works**				
2.1	Shape, trim and proof roll Evap pond basin	m^2	276,662	$ 0.50	$ 138,331.00
2.2	Shape and trim embankment face	m^2	21,168	$ 2.00	$ 42,336.00
2.3	Excavate anchor trench	linear m	2,352	$ 4.70	$ 11,054.40
2.4	Supply and install 1.5 mm HDPE liner	m^2	276,662	$ 11.00	$ 3,043,282.00
2.5	Fill and recompact anchor trench	linear m	2,352	$ 12.50	$ 29,400.00
			LINER WORKS		**$ 3,264,403.40**
3.0	**Access road, sheeting and safety windrow**				
3.1	Supply, haul, place, moisture condition and compact Material to form safety windrows for perimeter embankment crests	m^3	423	$ 20.50	$ 8,678.88
3.3	Install access roads around perimeter toe	m	2,352	$ 51.00	$ 119,952.00
3.4	Supply,haul, and place gravel sheeting to perimeter embankment crest (150 mm thick, 3 m wide)	m^3	1,058	$ 7.00	$ 7,408.80
			SAFETY WINDROW		**$ 136,039.68**
4.0	**Surface water management**				
4.2	Excavate and trim perimeter drains (by grader)	m	2,352	$ 0.40	$ 940.80
			SURFACE WATER MANAGEMENT		**$ 940.80**
				TOTAL CAPITAL	**$ 6,078,703.04**
	DEFERRED CAPITAL COSTS				
DC0	**Preliminaries and General for subsequent 9 ponds**				
DC0.1	Establishment	sum	9	$ 105,000.00	$ 945,000.00
DC0.2	Disestablishment	sum	9	$ 3,000.00	$ 27,000.00
DC0.3	Insurance, bonds & finance	sum	9	$ 65,000.00	$ 585,000.00
DC0.4	Preliminaries and general ongoing inc. contractor supervision	months	18	$ 375,000.00	$ 6,750,000.00
			PRELIMINARIES AND GENERAL		$ 8,307,000.00
5.0	**Pond 2 (excluding preliminaries and general)**				
5.1	Clear and grub	m^2	186,728	$ 0.20	$ 37,345.60
5.2	Excavate topsoil (300 mm) and stockpile	m^3	56,018	$ 5.10	$ 285,693.84
5.3	Excavate material for embankment construction	m^3	59,580	$ 7.50	$ 446,850.00
5.4	Excavate to ferricrete, blend, moisture condition, replace and compact material to prepare foundation	m^3	15,888	$ 0.90	$ 14,299.20
5.5	Embankment: blend, load, haul, place, moisture condition and compact borrowed fill to form embankment	m^3	94,869	$ 5.50	$ 521,779.50
			TOTAL POND 2		**$ 1,305,968.14**
6.0	**Liner Pond 2**				
6.1	Excavate anchor trench	m^3	2,196	$ 0.50	$ 1,098.00
6.2	Shape, trim and proof roll Evap pond basin	m^2	186,728	$ 2.00	$ 373,456.00
6.3	Shape and trim embankment face	m^2	11,916	$ 4.70	$ 56,005.20
6.4	Supply and install HDPE liner	m^2	186,728	$ 11.00	$ 2,054,008.00
6.5	Fill and recompact anchor trench	m^2	2,196	$ 12.50	$ 27,450.00
			TOTAL LINER POND 2		$ 2,512,017.20
7.0	**Pond 3 (excluding preliminaries and general)**				
7.1	Clear and grub	m^2	127,202	$ 0.20	$ 25,440.40
7.2	Excavate topsoil (300 mm) and stockpile	m^3	38,161	$ 5.10	$ 194,619.06
7.3	Excavate material for embankment construction	m^3	50,805	$ 7.50	$ 381,037.50
7.4	Excavate to ferricrete, blend, moisture condition, replace and compact material to prepare foundation	m^3	13,548	$ 0.90	$ 12,193.20
7.5	Embankment: blend, load, haul, place, moisture condition and compact borrowed fill to form embankment	m^3	50,805	$ 5.50	$ 279,427.50
			TOTAL POND 3		**$ 892,717.66**
8.0	**Liner Pond 3**				
8.1	Excavate anchor trench	m^3	2,000	$ 0.50	$ 1,000.00
8.2	Shape, trim and proof roll Evap pond basin	m^2	127,202	$ 2.00	$ 254,404.00
8.3	Shape and trim embankment face	m^2	10,161	$ 4.70	$ 47,756.70
8.4	Supply and install HDPE liner	m^2	127,202	$ 11.00	$ 1,399,222.00
8.5	Fill and recompact anchor trench	m^2	2,000	$ 12.50	$ 25,000.00
			TOTAL LINER POND 3		$ 1,727,382.70
9.0	**Pond 4 (excluding preliminaries and general)**				
9.1	Clear and grub	m^2	112,094	$ 0.20	$ 22,418.80
9.2	Excavate topsoil (300 mm) and stockpile	m^3	33,628	$ 5.10	$ 171,503.82
9.3	Excavate material for embankment construction	m^3	47,745	$ 7.50	$ 358,087.50
9.4	Excavate to ferricrete, blend, moisture condition, replace and compact material to prepare foundation	m^3	12,732	$ 0.90	$ 11,458.80
9.5	Embankment: blend, load, haul, place, moisture condition and compact borrowed fill to form embankment	m^3	47,745	$ 5.50	$ 262,597.50
			TOTAL POND 4		**$ 826,066.42**
10.0	**Liner Pond 4**				
10.1	Excavate anchor trench	m^3	1,848	$ 0.50	$ 924.00
10.2	Shape, trim and proof roll Evap pond basin	m^2	112,094	$ 2.00	$ 224,188.00
10.3	Shape and trim embankment face	m^2	9,549	$ 4.70	$ 44,880.30
10.4	Supply and install HDPE liner	m^2	112,094	$ 11.00	$ 1,233,034.00
10.5	Fill and recompact anchor trench	m^2	1,848	$ 12.50	$ 23,100.00
			TOTAL LINER POND 4		$ 1,526,126.30
11.0	**Pond 5 (excluding preliminaries and general)**				
11.1	Clear and grub	m^2	211,278	$ 0.20	$ 42,255.60
11.2	Excavate topsoil (300 mm) and stockpile	m^3	63,383	$ 5.10	$ 323,255.34
11.3	Excavate material for embankment construction	m^3	60,705	$ 7.50	$ 455,287.50
11.4	Excavate to ferricrete, blend, moisture condition, replace and compact material to prepare foundation	m^3	16,188	$ 0.90	$ 14,569.20
11.5	Embankment: blend, load, haul, place, moisture condition and compact borrowed fill to form embankment	m^3	60,705	$ 5.50	$ 333,877.50
			TOTAL POND 5		**$ 1,169,245.14**
12.0	**Liner Pond 5**				
12.1	Excavate anchor trench	m^3	2,065	$ 0.50	$ 1,032.50
12.2	Shape, trim and proof roll Evap pond basin	m^2	211,278	$ 2.00	$ 422,556.00
12.3	Shape and trim embankment face	m^2	12,141	$ 4.70	$ 57,062.70
12.4	Supply and install HDPE liner	m^2	211,278	$ 11.00	$ 2,324,058.00
12.5	Fill and recompact anchor trench	m^2	2,065	$ 12.50	$ 25,812.50
			TOTAL LINER POND 5		$ 2,830,521.70

13.0	**Pond 6 (excluding preliminaries and general)**				
13.1	Clear and grub	m^2	335,121	$ 0.20	$ 67,024.20
13.2	Excavate topsoil (300 mm) and stockpile	m^3	100,536	$ 5.10	$ 512,735.13
13.3	Excavate material for embankment construction	m^3	122,805	$ 7.50	$ 921,037.50
13.4	Excavate to ferricrete, blend, moisture condition, replace and compact material to prepare foundation	m^3	32,748	$ 0.90	$ 29,473.20
13.5	Embankment: blend, load, haul, place, moisture condition and compact borrowed fill to form embankment	m^3	122,805	$ 5.50	$ 675,427.50
			TOTAL POND 6		**$ 2,205,697.53**
14.0	**Liner Pond 6**				
14.1	Excavate anchor trench	m^3	2,966	$ 0.50	$ 1,483.00
14.2	Shape, trim and proof roll Evap pond basin	m^2	335,121	$ 2.00	$ 670,242.00
14.3	Shape and trim embankment face	m^2	24,561	$ 4.70	$ 115,436.70
14.4	Supply and install HDPE liner to TSF basin for cell 1	m^2	335,121	$ 11.00	$ 3,686,331.00
14.5	Fill and recompact anchor trench	m^2	2,966	$ 12.50	$ 37,075.00
			TOTAL LINER POND 6		$ 4,510,567.70
15.0	**Pond 7 (excluding preliminaries and general)**				
15.1	Clear and grub	m^2	226,429	$ 0.20	$ 45,285.80
15.2	Excavate topsoil (300 mm) and stockpile	m^3	67,929	$ 5.10	$ 346,436.37
15.3	Excavate material for embankment construction	m^3	59,400	$ 7.50	$ 445,500.00
15.4	Excavate to ferricrete, blend, moisture condition, replace and compact material to prepare foundation	m^3	15,840	$ 0.90	$ 14,256.00
15.5	Embankment: blend, load, haul, place, moisture condition and compact borrowed fill to form embankment	m^3	59,400	$ 5.50	$ 326,700.00
			TOTAL POND 7		**$ 1,178,178.17**
16.0	**Liner Pond 7**				
16.1	Excavate anchor trench	m^3	2,636	$ 0.50	$ 1,318.00
16.2	Shape, trim and proof roll Evap pond basin	m^2	226,429	$ 2.00	$ 452,858.00
16.3	Shape and trim embankment face	m^2	11,880	$ 4.70	$ 55,836.00
16.4	Supply and install HDPE liner to TSF basin for cell 1	m^2	226,429	$ 11.00	$ 2,490,719.00
16.5	Fill and recompact anchor trench	m^2	2,636	$ 12.50	$ 32,950.00
			TOTAL LINER POND 7		$ 3,033,681.00
17.0	**Pond 8 (excluding preliminaries and general)**				
17.1	Clear and grub	m^2	225,470	$ 0.20	$ 45,094.00
17.2	Excavate topsoil (300 mm) and stockpile	m^3	63,000	$ 5.10	$ 321,300.00
17.3	Excavate material for embankment construction	m^3	63,000	$ 7.50	$ 472,500.00
17.4	Excavate to ferricrete, blend, moisture condition, replace and compact material to prepare foundation	m^3	16,800	$ 0.90	$ 15,120.00
17.5	Embankment: blend, load, haul, place, moisture condition and compact borrowed fill to form embankment	m^3	63,000	$ 5.50	$ 346,500.00
			TOTAL POND 8		**$ 1,200,514.00**
18.0	**Liner Pond 8**				
18.1	Excavate anchor trench	m^3	2,697	$ 0.50	$ 1,348.50
18.2	Shape, trim and proof roll Evap pond basin	m^2	225,470	$ 2.00	$ 450,940.00
18.3	Shape and trim embankment face	m^2	12,600	$ 4.70	$ 59,220.00
18.4	Supply and install HDPE liner to TSF basin for cell 1	m^2	225,470	$ 11.00	$ 2,480,170.00
18.5	Fill and recompact anchor trench	m^2	2,697	$ 12.50	$ 33,712.50
			TOTAL LINER POND 8		$ 3,025,391.00
19.0	**Pond 9 (excluding preliminaries and general)**				
19.1	Clear and grub	m^2	310,145	$ 0.20	$ 62,029.00
19.2	Excavate topsoil (300 mm) and stockpile	m^3	93,044	$ 5.10	$ 474,521.85
19.3	Excavate material for embankment construction	m^3	62,145	$ 7.50	$ 466,087.50
19.4	Excavate to ferricrete, blend, moisture condition, replace and compact material to prepare foundation	m^3	16,572	$ 0.90	$ 14,914.80
19.5	Embankment: blend, load, haul, place, moisture condition and compact borrowed fill to form embankment	m^3	62,145	$ 5.50	$ 341,797.50
			TOTAL POND 9		**$ 1,359,350.65**
20.0	**Liner Pond 9**				
20.1	Excavate anchor trench	m^3	2,747	$ 0.50	$ 1,373.50
20.2	Shape, trim and proof roll Evap pond basin	m^2	310,145	$ 2.00	$ 620,290.00
20.3	Shape and trim embankment face	m^2	12,429	$ 4.70	$ 58,416.30
20.4	Supply and install HDPE liner to TSF basin for cell 1	m^2	310,145	$ 11.00	$ 3,411,595.00
20.5	Fill and recompact anchor trench	m^2	2,747	$ 12.50	$ 34,337.50
			TOTAL LINER POND 9		$ 4,126,012.30
21.0	**Pond 10 (excluding preliminaries and general)**				
21.1	Clear and grub	m^2	342,365	$ 0.20	$ 68,473.00
21.2	Excavate topsoil (300 mm) and stockpile	m^3	102,710	$ 5.10	$ 523,818.45
21.3	Excavate material for embankment construction	m^3	61,605	$ 7.50	$ 462,037.50
21.4	Excavate to ferricrete, blend, moisture condition, replace and compact material to prepare foundation	m^3	16,428	$ 0.90	$ 14,785.20
21.5	Embankment: blend, load, haul, place, moisture condition and compact borrowed fill to form embankment	m^3	61,605	$ 5.50	$ 338,827.50
			TOTAL POND 10		**$ 1,407,941.65**
22.0	**Liner Pond 10**				
22.1	Excavate anchor trench	m^3	2,796	$ 0.50	$ 1,398.00
22.2	Shape, trim and proof roll Evap pond basin	m^2	342,365	$ 2.00	$ 684,730.00
22.3	Shape and trim embankment face	m^2	12,321	$ 4.70	$ 57,908.70
22.4	Supply and install HDPE liner to TSF basin for cell 1	m^2	342,365	$ 11.00	$ 3,766,015.00
22.5	Fill and recompact anchor trench	m^2	2,796	$ 12.50	$ 34,950.00
			TOTAL LINER POND 10		$ 4,545,001.70
				TOTAL DEFERRED	**$ 47,689,380.96**
					$ 6,199,619.52

PROJECT: **MEDCALF TSF DESIGN**
$FeSO_4$ Crystal Pad

PROJECT No.: 1538943
DATE: 12-Jan-16
REVISION 0

ITEM	DESCRIPTION	UNIT	MEASURED QUANTITY	RATES	TOTAL (AUD$)
	CAPITAL COSTS				
0.0	**Preliminaries and General**				
0.1	Establishment	sum	1	$ 105,000.00	$ 105,000.00
0.2	Disestablishment	sum	1	$ 3,000.00	$ 3,000.00
0.3	Insurance, bonds & finance	sum	1	$ 65,000.00	$ 65,000.00
0.4	Preliminaries and general ongoing inc. contractor supervision	months	2	$ 375,000.00	$ 750,000.00
		PRELIMINARIES AND GENERAL			$ 923,000.00
1.0	**Perimeter embankment bulk compacted earthworks**				
1.1	Clear and grub	m^2	500,000	$ 0.20	$ 100,000.00
1.2	Excavate topsoil (300 mm) and stockpile (within 2 km)	m^3	150,000	$ 5.10	$ 765,000.00
1.3	Cut to fill pad construction	m^3	250,000	$ 7.50	$ 1,875,000.00
		COMPACTED EARTHWORKS			**$ 2,740,000.00**
2.0	**Liner Works**				
2.1	Shape, trim and proof roll Pad foundation	m^2	500,000	$ 0.50	$ 250,000.00
2.2	Excavate anchor trench	linear m	2,256	$ 4.70	$ 10,602.28
2.3	Supply and install 1.5 mm HDPE liner	m^2	500,000	$ 11.00	$ 5,500,000.00
2.4	Fill and recompact anchor trench	linear m	2,352	$ 12.50	$ 29,400.00
		LINER WORKS			**$ 5,790,002.28**
3.0	**Access road, sheeting and safety windrow**				
3.3	Install access roads around perimeter toe	m	2,352	$ 51.00	$ 119,952.00
3.4	Supply,haul, and place gravel sheeting to perimeter embankment crest (150 mm thick, 3 m wide)	m^3	1,058	$ 7.00	$ 7,408.80
		SAFETY WINDROW			**$ 127,360.80**
4.0	**Surface water management**				
4.2	Excavate and trim perimeter drains (by grader)	m	2,352	$ 0.40	$ 940.80
		SURFACE WATER MANAGEMENT			**$ 940.80**
				TOTAL CAPITAL	**$ 9,581,303.88**

APPENDIX D

Important Information

IMPORTANT INFORMATION RELATING TO THIS REPORT

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

This Report is provided for use solely by Golder's Client and persons acting on the Client's behalf, such as its professional advisers. Golder is responsible only to its Client for this Report. Golder has no responsibility to any other person who relies or makes decisions based upon this Report or who makes any other use of this Report. Golder accepts no responsibility for any loss or damage suffered by any person other than its Client as a result of any reliance upon any part of this Report, decisions made based upon this Report or any other use of it.

This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification.

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