# Gladstone Pit TSF (WAI-985-000-LC-0010)

## Design Report

Oceana Gold (New Zealand) Limited

17 February 2025

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**The Power of Commitment**

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# 1. Introduction

## 1.1 Background

Oceana Gold (New Zealand) Limited (OGNZL) owns and operates the Waihi Gold Mine in Waihi, New Zealand. The current life of mine plan (LoMP) has production ending by the end of 2032. OGNZL has identified the Waihi North Project (WNP) as an opportunity to extend the life of mine. Broadly speaking, the WNP includes:

– A new underground mine (Wharekirauponga Underground Mine - WUG) located approximately 11 km northwest of the current Processing Plant.
– Mining of a new open pit near the existing Processing Plant, Gladstone Open Pit (GOP).
– A new tailings storage facility designated TSF3.
– New rock stack designated the Northern Rock Stack (NRS).

The GOP will be converted to an in-pit tailings storage facility (TSF) upon completion of mining. This report outlines the design of the GOP TSF for the purpose of supporting the resource consent application for the WNP.

Note, all coordinates and elevations used throughout this report are relative to the mine datum.

## 1.2 Purpose of this report

The purpose of this report is to describe the design elements of the GOP TSF to support the resource consent application for the WNP under the Fast-Track Approvals process.

## 1.3 Scope of works

The design report includes the following:

– Introduction
– Background information
– Project conditions
– Summary of options considered
– Basis of design
– Design concepts and drawings
– Design risks
– Construction requirements
– Operation requirements
– Closure and rehabilitation

## 1.4 Limitations

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## 1.5 Acronyms

The following is a list of acronyms used throughout the report.

| Acronym | Definition |
|---|---|
| **AEP** | Annual Exceedance Probability |
| **ANCOLD** | Australian National Committee on Large Dams |
| **CU** | Consolidated Undrained |
| **EGL** | Engineering Geology Limited |
| **EMP** | Emergency Management Plan |
| **FoS** | Factor of Safety |
| **GISTM** | Global Industry Standard on Tailings Management |
| **GOP** | Gladstone Open Pit |
| **ICOLD** | International Committee on Large Dams |
| **LoMP** | Life of Mine Plan |
| **MOP** | Martha Open Pit |
| **MUG** | Martha Underground Mine |
| **NAF** | Non-Acid Forming |
| **NRS** | Northern Rock Stack |
| **NZSOLD** | New Zealand Society on Large Dams |
| **OBE** | Operating Basis Earthquake |
| **OGNZL** | Oceana Gold New Zealand Limited |
| **OMS** | Operations, Maintenance and Surveillance |
| **PAF** | Potentially-Acid Forming |

| Acronym | Definition |
| --- | --- |
| **PGA** | Peak Ground Acceleration |
| **PQP** | Project Quality Plan |
| **PMP** | Probable Maximum Precipitation |
| **RQD** | Rock Quality Designation |
| **ROM** | Run of Mine |
| **SEE** | Safety Evaluation Earthquake |
| **TSF** | Tailings Storage Facility |
| **UCS** | Uniaxial Compressive Strength |
| **WNP** | Waihi North Project |
| **WUG** | Wharekirauponga Underground Mine |

# 2. Project setting

## 2.1 Project location

The proposed GOP will be situated over Gladstone Hill and Winner Hill. The processing plant is located immediately to the east of the pit and the Martha Pit conveyor is directly to the north. Current land use comprises rolling farmland and pastures, with a small pine plantation to the south-west. The Ohinemuri River is located approximately 300 m south-west of the GOP.

## 2.2 Site geology

### 2.2.1 Geological setting

A review of geological information presented by OGNZL (2021), EGL (2021) and PSM (2022) has been completed and summarised herein.

Regionally, the Waihi basin is defined as a series of localised north to north-east trending horst and graben structures. The basin is a result of a historic fault-controlled caldera structure (PSM 2022). The Waihi Fault is the largest of the bounding faults in the area and marks the northern border of the Waihi Basin and associated caldera. Other faults include the Martha Fault, Reptile Fault, Amaranth Fault, No 9 Fault and the Favona Fault. As shown in Figure 1, the GOP straddles the steeply dipping Western Fault and No 9 Fault.

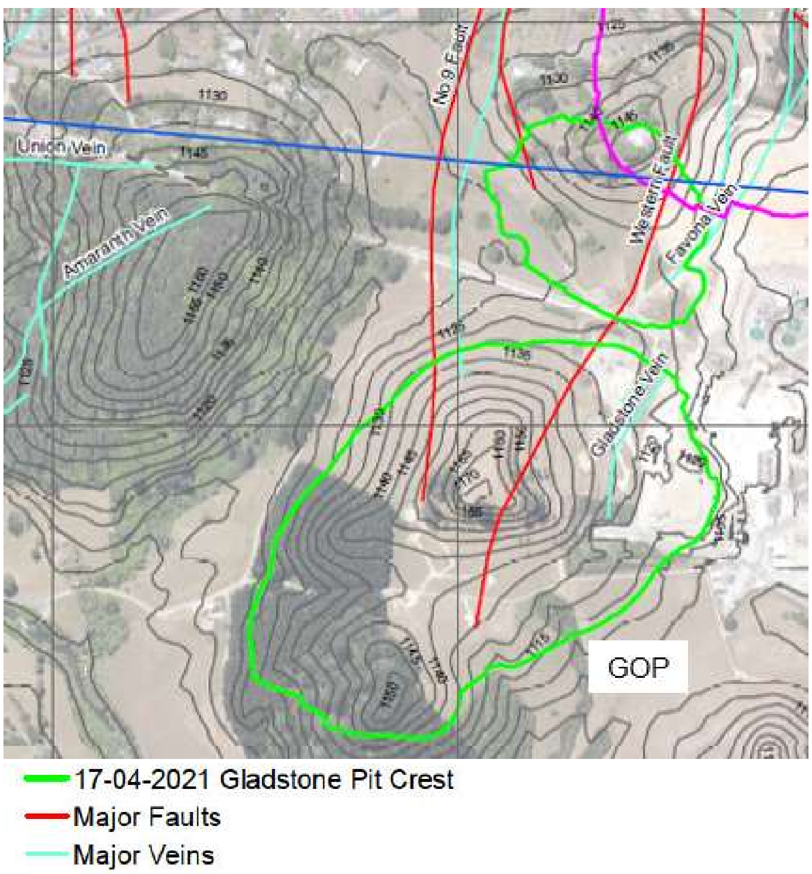


*Figure 1 Major faults and veins near the GOP (PSM 2021)*

The geological setting in the Waihi area, and particularly the rock units to be encountered during pit development, can be described following three main groups:

- **Andesite Host Rock** primarily consists of fine to medium porphyritic andesite flows with varying degrees of clay alteration and silicification. Also included within this category are volcanic ash and tephra deposits stratified within the main body of the andesite host rock. This host rock is prevalent throughout the wider area. The andesite rock is of medium rock strength (typically R2 to R3), although the strength is variable ranging from R1 to R4. Fractured and brecciated zones are common throughout the unit, with defects commonly clay infilled. The presence of clay tends to decrease with depth which results in increased Rock Quality Designation (RQD).
- **Quartz Andesite** which is the dominant host lithology for the Martha Vein system and in the Union Hill epithermal vein system. Generally described as a quartz-feldspar phyric andesite lava.
- **Hydrothermal Vent Breccia** is found at shallow levels (above RL 1000 m) in funnel shaped vents comprising of clay to quartz altered breccias. The unit is blueish grey, brown and light grey/white. It is generally gravelly, clayey and silty with angular to subrounded clasts up to 70 mm. The strength of the unit varies between a stiff soil and very low rock strength (R1) with variable RQD.

Young volcanics, ignimbrite, dacite, volcanic ash, and alluvial sediments overlie the andesite (the basement rock).

The geology and mineralogy of the GOP is expected to be generally consistent with that encountered in the existing Martha, Favona, Trio, and Correnso mines. However, the geology in the vicinity of GOP is notable for the weathered breccia and deposition of young volcanics (dacite), particularly on the eastern and southern sides of Gladstone Hill. Figure 2 shows the geological makeup of the final pit walls.

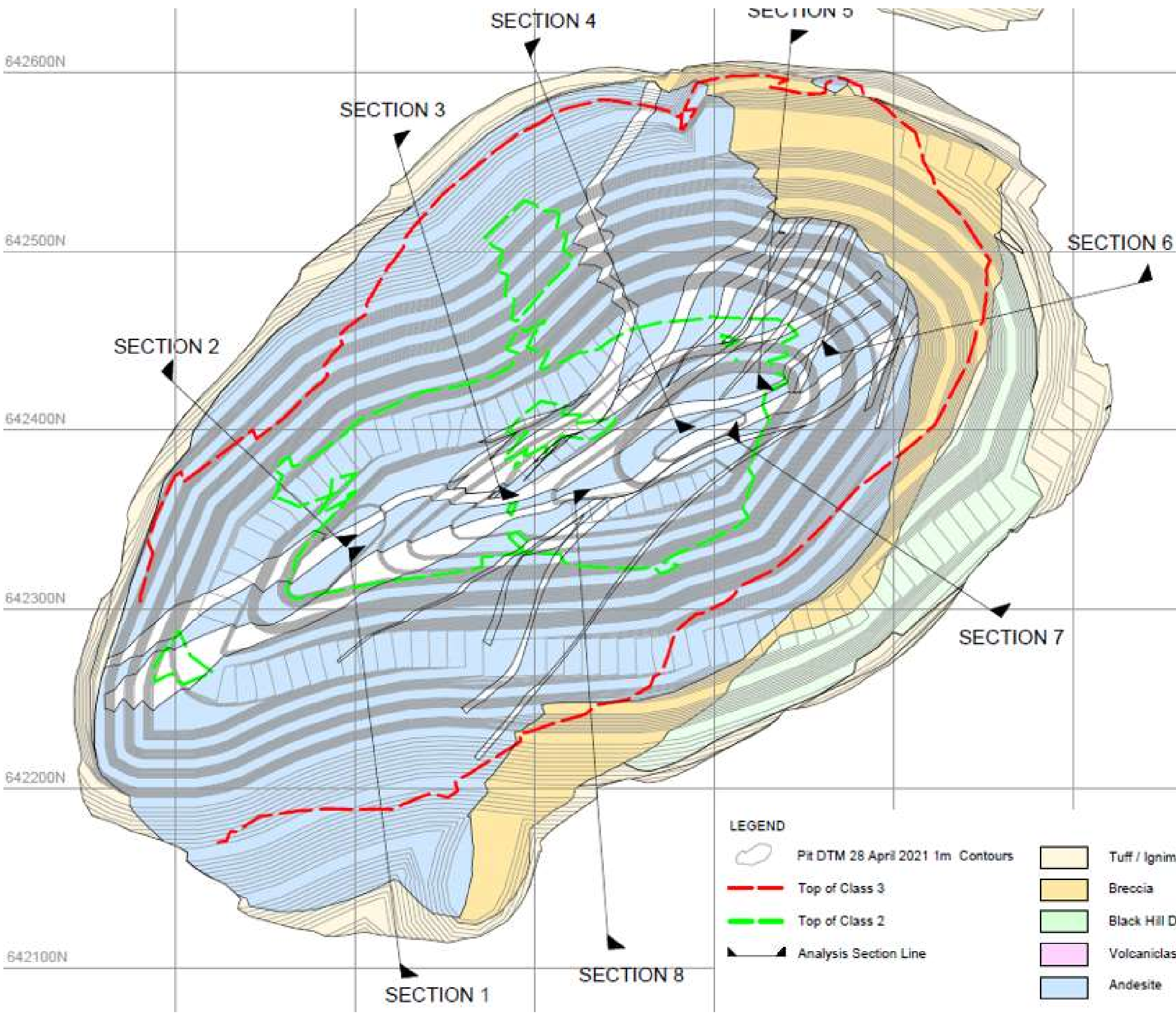


*Figure 2 Geological setting of the GOP (PSM 2022)*

## 2.2.2 Landslides near Gladstone pit.

Two landslide features have been observed by OGNZL staff adjacent to the GOP (Figure 3). These features were investigated by Engineering Geology Ltd (EGL) and documented in a memorandum (EGL 2021). The observations from the investigation are summarised as follows:

- A large active landslide, with a well-defined geometry, is evident on the western side of Gladstone Hill. The slide is approximately 60 m high and the movement is inferred to be translational. EGL noted that the failure is assumed to be occurring either within the surficial volcanic ash units or rhyolite tuff. The failure is attributed to low shear strength of these materials, natural slope of the ground (initial static shear stress) and the transient generation of pore water pressure after intense rainfall.
- A second landslide is observed on the north eastern side of Gladstone Hill. The landslide is 35 m high with translational movement observed. The mechanism of failure is similar to the western landslide. Surface evidence indicated the landslide is not active.

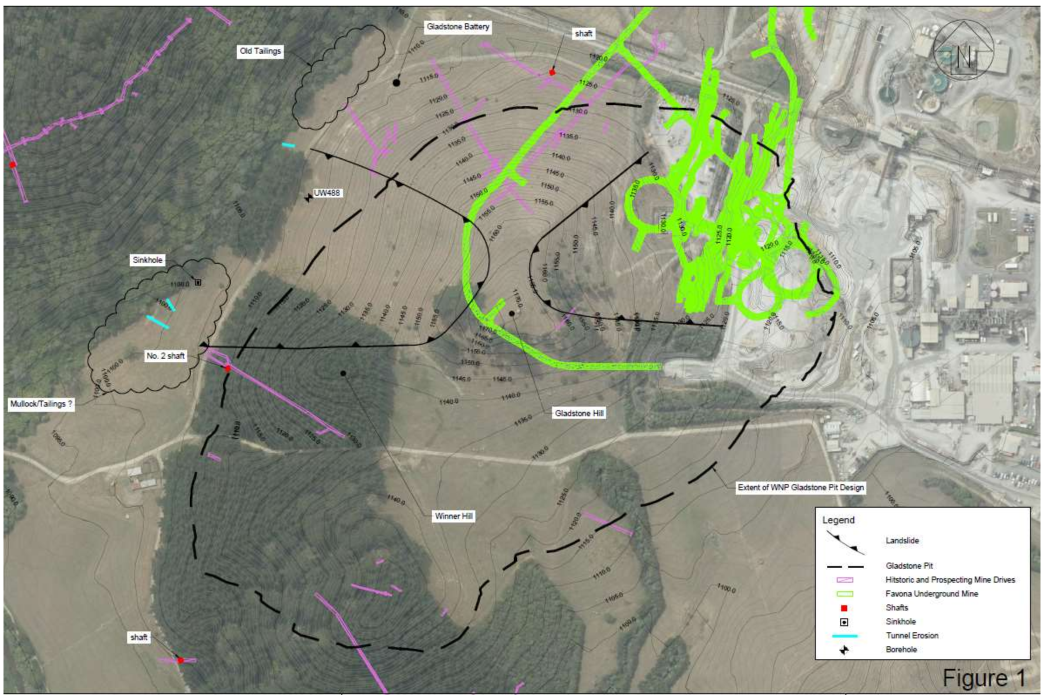


*Figure 3* ***Landslides and other surficial features at the GOP (EGL 2021)***

The implications of EGL's findings, regarding the GOP mining and TSF operations, are as follows:

- Mining of the GOP will reduce the height of the slope of the western side of Gladstone Hill. This would result in a decrease in the failure mobilising forces, and thus, an improvement in the stability of the landslide. The entire north eastern landslide is removed by the mining of GOP.
- The operation of GOP as a TSF may rewet the toe of the existing landslide, with the potential to cause further instability. This risk is considered negligible given the use of a liner and underdrainage in the GOP TSF design.
- The presence of the landslide should not affect the proposed GOP TSF. However, design work at the detailed design phase should consider the presence of the weak ground that is the cause of the landslides. This weak ground is inferred to be at a relatively shallow depth and is likely to only affect the upper reaches of the GOP.
- Figure 3 also shows historical workings that intercept the pit and potentially daylight outside of the pit footprint. These historical workings will need to be identified and remediated (through plugging) prior to filling of the GOP TSF to minimise the risk of release.

## 2.3 Geotechnical properties

The following presents a summary of tailings and pit wall geotechnical properties.

The tailings properties presented are based on tailings from Martha Pit and Martha Underground (MUG). However, tailings deposited into the GOP TSF will primarily be from the processing of ore from the WUG. The WUG tailings are expected to be similar to the MUG tailings, with a slurry density of 45% solids and a $P_{80}$ of 53 microns.

### 2.3.1 Tailings

#### 2.3.1.1 Index properties

The Waihi operations tailings are fine-grained silts of generally low plasticity. Occasional lenses of coarser sands are noted in the historical cone penetration test (CPTu) data. The tailings typically show fines content (less than 75 microns) in the range between 41% and 96%, with clay contents between 13% and 20%. Plasticity index varies from 0 to 22%. The range of gradation of Waihi tailings are shown in Figure 4.

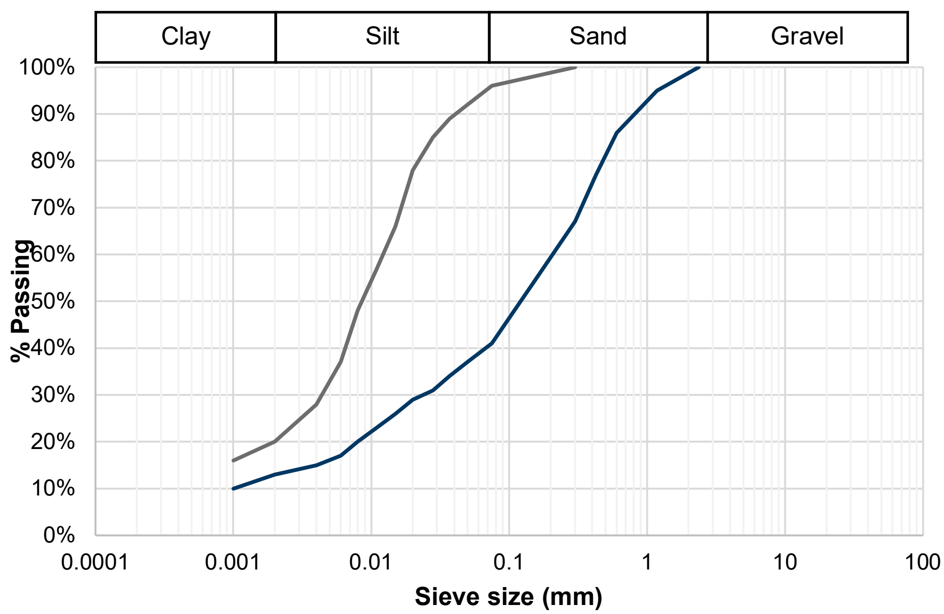


*Figure 4 Particle size distribution range for Waihi tailings*

#### 2.3.1.2 Hydraulic properties

Oedometer tests were conducted by OGNZL on tailings from TSF2 in 1992. Based on these oedometer tests, the coefficient of hydraulic conductivity was estimated for the material at vertical effective confining stresses in the range of 1 kPa to 1000 kPa (Figure 5). It is observed that permeability reaches a value as low as 1 x $10^{-10}$ m/s at the maximum confining stress.

In addition to the oedometer testing, in 2010 two constant head permeability tests were conducted (flexible wall permeameter). Similar tests were conducted in 2017. The results show that coefficient of permeability of the Waihi tailings varies from 1 x $10^{-9}$ m/s to 1 x $10^{-11}$ m/s, at equivalent vertical effective stress from 112 kPa to 900 kPa, respectively.

There is unlikely to be a material change to the tailings from the 1992 and 2010 testing, however, additional testing is recommended at the detailed design phase to confirm the tailings properties.

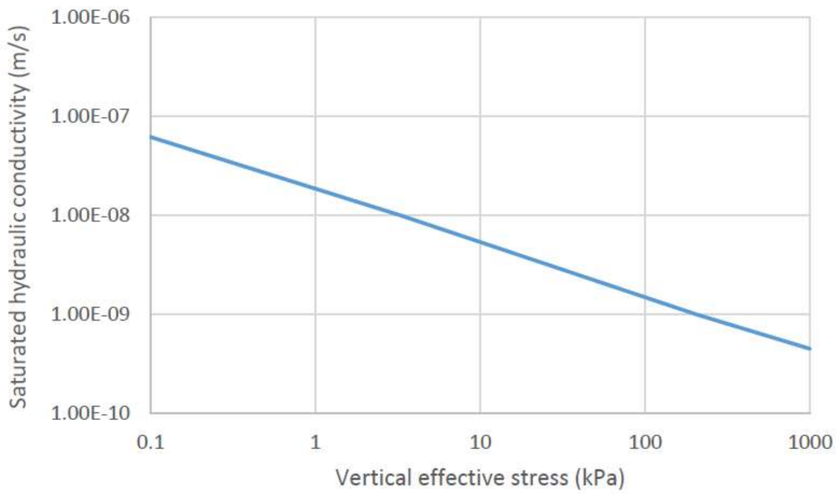


*Figure 5 Saturated conductivity versus effective stresses*

#### 2.3.1.3 Production rate

Planned tailings production rates for the Waihi Operations are shown in Table 1 (as provided by OGNZL in August 2024). Only a portion of the total tailings produced will be deposited in GOP TSF with the remainder being deposited in TSF1a, TSF2 and TSF3 (refer Table 3).

*Table 1 Tailings production rate for Waihi Operation*

| Year | Tailings (tonnes per annum) |
|---|---|
| Year 1 | 415,770 |
| Year 2 | 415,770 |
| Year 3 | 438,897 |
| Year 4 | 509,590 |
| Year 5 | 504,570 |
| Year 6 | 542,172 |
| Year 7 | 542,225 |
| Year 8 | 742,394 |
| Year 9 | 921,815 |
| Year 10 | 949,544 |
| Year 11 | 1,370,039 |
| Year 12 | 1,695,884 |
| Year 13 | 1,128,897 |
| Year 14 | 814,558 |
| Year 15 | 808,956 |
| Year 16 | 797,515 |
| Year 17 | 494,884 |
| Year 18 | 102,942 |

### 2.3.2 Gladstone pit slope design parameters

PSM (2022) conducted analysis of geological logs, core photographs and laboratory testing results to develop properties for the most relevant geotechnical units for slope design at GOP. Seven geotechnical units were identified by PSM:

– Ignimbrite
– Dacite (in north east only)
– Volcaniclastic (in north east only)
– Andesite – Classes 1 to 4, with Class 1 the highest and Class 4 the lowest rock quality.

Representative specimens were sourced from each geotechnical unit and further laboratory tests were conducted, including multistage consolidated undrained (CU) triaxial tests and uniaxial compressive strength (UCS) tests. The CU triaxial tests and UCS were conducted in rock with typical strength as equal or less than R1 and R2, respectively[1]. In addition, where core specimens showed strength values exceeding R2, point load index tests were conducted.

Table 2 presents the recommended geotechnical parameters for the GOP by PSM (2022). These parameters have also been adopted for the GOP TSF design.

***Table 2 Geotechnical parameters for the GOP recommended by PSM (2022)***

| Material | Unit Weight ($kN/m^3$) | Strength parameters | | UCS (kPa) | GSI | Mi | D |
|---|---|---|---|---|---|---|---|
| | | Friction Angle (°) | Cohesion (kPa) | | | | |
| Ignimbrite | 18 | 25 | 40 | - | - | - | - |
| Dacite | 18 | - | - | 8,000 | 40 | 25 | 0 |
| Volcaniclastic | 19 | 15 | 40 | - | - | - | - |
| Andesite Class 4 | 22.5 | 24 | 65 | - | - | - | - |
| Andesite Class 2 | 22.5 | - | - | 25,000 | 40 | 25 | 0 |
| Andesite Class 3 | 22.5 | - | - | 12,000 | 29 | 25 | 0 |

**Note:** there is no Andesite Class 1 intersected by the pit design.

## 2.4 Hydrogeology and groundwater

### 2.4.1 Background

Site investigations have previously been carried out by GHD (2019). The site investigations focused on assessing the hydrogeology of new mine elements, including GOP, and considered the installation of several nested monitoring wells. This provided information for assessment of groundwater levels, hydraulic conductivities and groundwater interactions. The main outcomes of the previous investigations are summarised in the following sub-sections. Gladstone monitoring bores and locations are shown in Figure 6.

### 2.4.2 Shallow groundwater system

The shallow groundwater system in the Waihi area comprises groundwater flow through shallow soils, reworked young volcanics and weathered rock. The weathering of the historic surface andesite and breccia, prior to deposition of the younger volcanics, provides the hydraulic separation for shallow and deep groundwater systems. Ongoing weathering, erosion and fracturing of andesite where it outcrops on Gladstone Hill has provided a material with notably greater water storage than deeper, less weathered andesite. The weathered material, which

[1] Refers to quality grade according to Brown (1981). R1 corresponds to very weak rock (typical UCS= 1-5 MPa) and R2 corresponds to weak rock (typical UCS = 5-25 MPa).

is more prevalent towards the east and south-east of Gladstone Hill, also provides a medium through which rainwater can infiltrate.

The difference in water storage properties and desaturation of deeper andesite limits the volume of recharge which can percolate deeper. This promotes flow of infiltrating water radially away from Gladstone Hill into the younger volcanics of the shallow groundwater system.

Hydraulic conductivity testing of the dacite indicates very low permeabilities, which result in high groundwater levels, consequently supporting the streams and wetland in this area. In contrast, the higher permeability measured for the rhyolitic tuff and sandy ignimbrite on the north and west extent provide greater drainage, generally lower groundwater levels and promote more rapid flow of groundwater.

### 2.4.3 Deep groundwater system

Groundwater present within the deeper andesite rock underlying the shallow groundwater system predominantly flows through secondary porosity features, with the vein system providing sub-vertical conduits for groundwater movement. Away from fault zones and vein systems, the deep rock mass has very low permeability.

Piezometer monitoring has demonstrated the presence of downward vertical hydraulic gradients as the shallow groundwater recharges the deep groundwater system. These downwards vertical hydraulic gradients increase with depth.

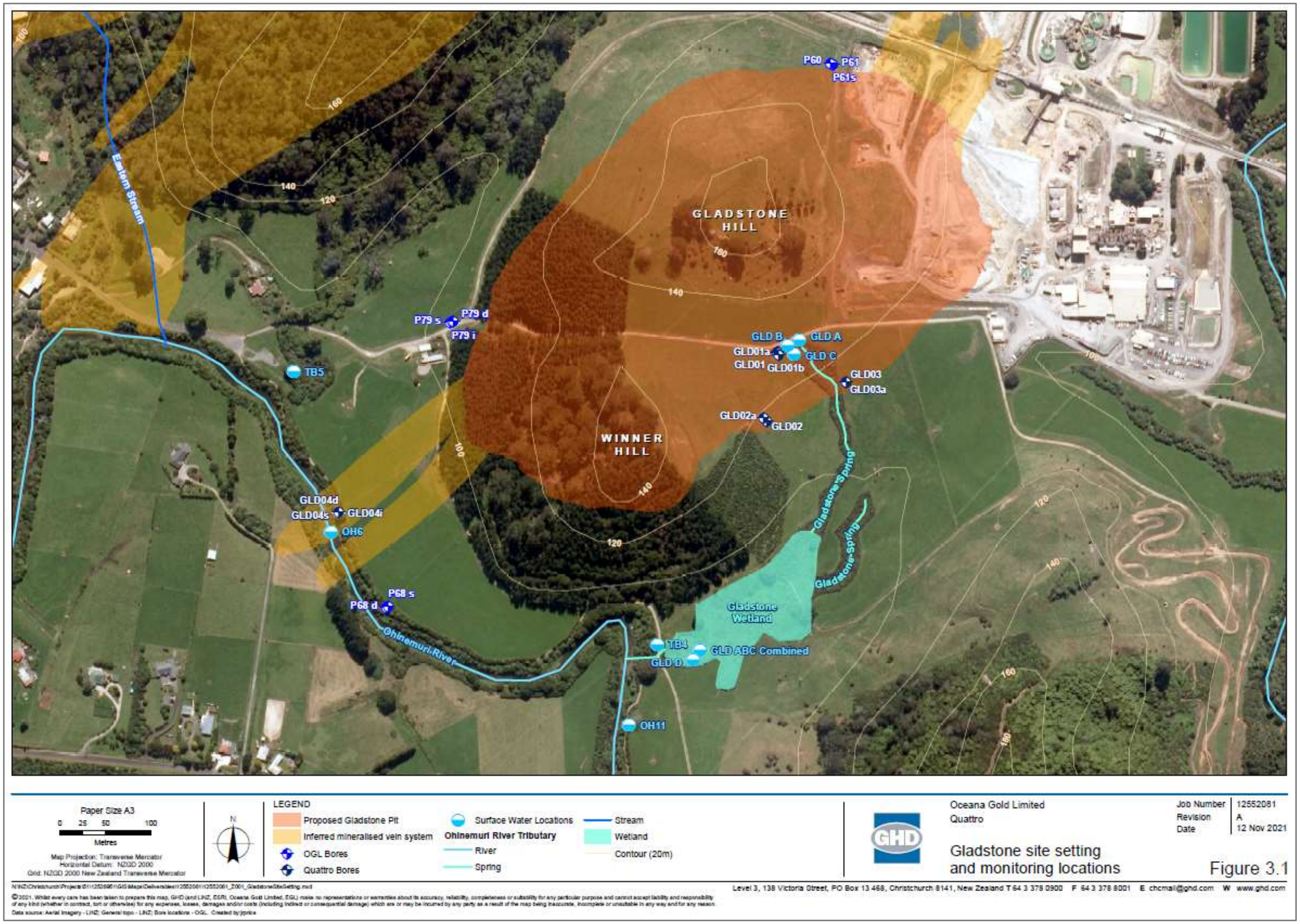


*Figure 6* *Gladstone site setting and monitoring locations*

## 2.4.4 Gladstone Hill wetland

A wetland is located to the south of Gladstone Hill as shown in Figure 7. Historic images (Figure 7) presented by GWS (2021) suggest the wetland is not natural and has developed because of human disturbance in the area. GWS (2021) discussed the implications of the mining of GOP on the flows to the wetlands. Monitoring of flows indicate that the contributions of Gladstone Hill to the wetland catchment is small and an approximate 3% reduction in flow to the wetlands is expected during mining. Flows will be restored to the wetlands post-mining through a water shedding cover and closure spillway channel.

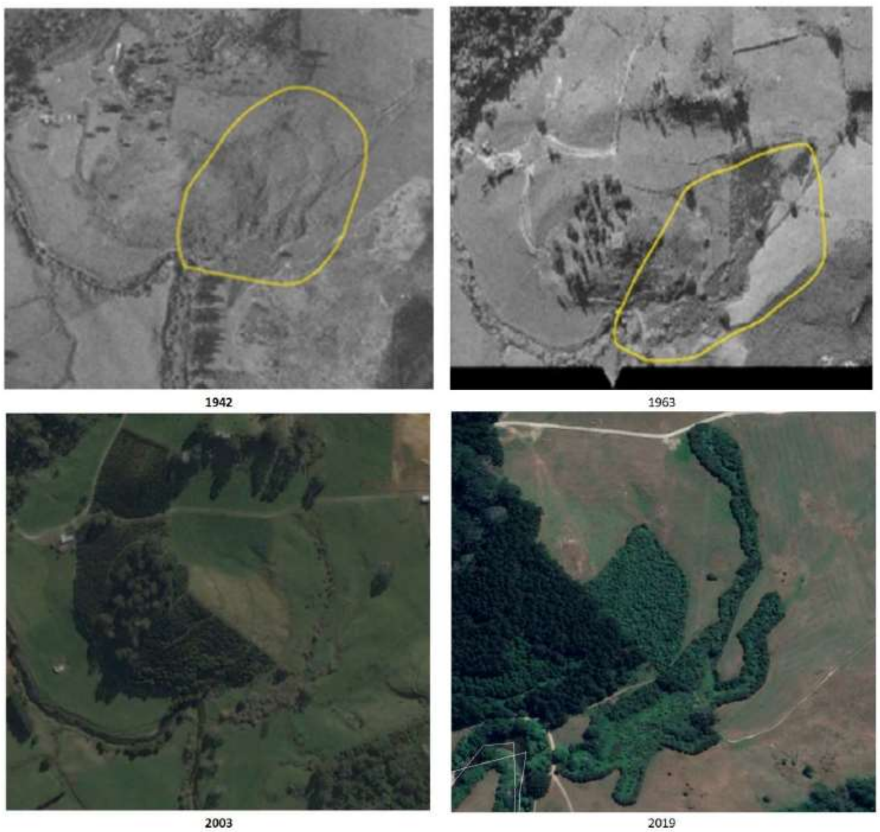


*Figure 7 Development of the Gladstone Hill wetland with time*

# 2.5 Geochemistry

## 2.5.1 Background

A geochemical assessment of the ore, tailings, and overburden for the Waihi North Project is described in AECOM (2025). Multi-element analysis, static testing, kinetic testing and column testing were used to characterise ore and overburden samples from selected boreholes distributed across the mining areas. The principal findings are summarised in this report and their impact on closure design (construction, schedule, environmental protection actions, etc.) discussed.

## 2.5.2 Overburden

As described in Section 2.2.1, the mineralised overburden types at Waihi are mainly Andesite, Quartz Andesite and Hydrothermal Breccia. Overlying the Andesite, a series of non-acid forming (NAF) overburden are generally encountered, i.e., Ignimbrite, Dacite, Volcanic Ash and Alluvial Sediments.

Figure 8 was provided by OGNZL and shows the different overburden types from GOP, categorised by geochemical composition. The NAF/PAF criteria are as per the OGNZL rock classification procedure for managing mine waste and the High (Mercury) Hg is based on >3.5mg/kg Hg

Overall, GOP will produce 18.7 Mt of overburden, of which approximately 11.9 Mt is PAF. Aside from acid forming potential, the GOP waste rock also has elevated levels of mercury (Hg). NAF-High Hg, HPAF-Low Hg and HPAF-High Hg are all treated as per PAF.

Overburden used in construction of the GOP TSF will primarily come from the NRS or MOP4 cutback and will be predominantly PAF. The overburden will be neutralised with limestone, as required, at a rate to be confirmed prior to construction. AECOM (2025) suggests the following requirements with respect to geochemical treatment:

– No additional limestone amendment required for Martha and WUG PAF material likely to be exposed for less than 20 weeks.
– Limestone amendment rate of 0.6% for Martha and WUG PAF material where a lag period of 250 days is required.
– Overburden placed within the zone of oxidation for the final proposed landform (typically within the final 2 m of placed material) should comprise NAF material only.

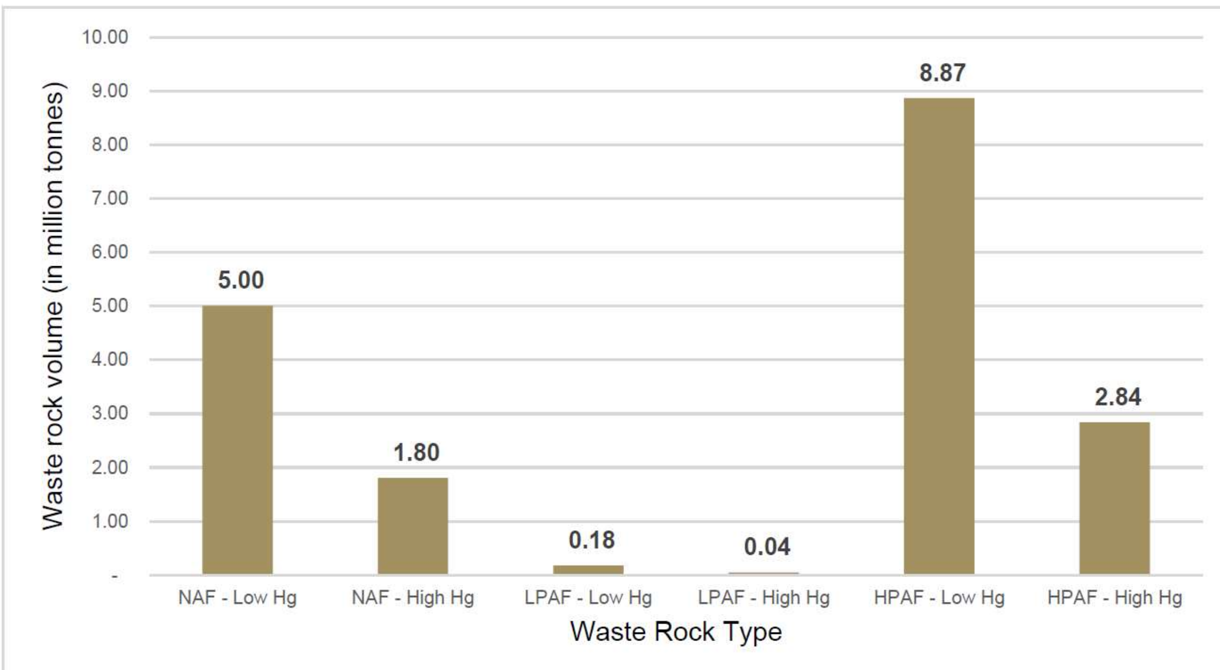


*Figure 8 Geochemical properties of the GOP waste rock*

## 2.5.3 Pit walls

AECOM (2025) indicates that approximately 73% of the GOP walls are PAF with a total volume of 13,605 $m^3$ available for oxidation, assuming an oxidation depth of 0.1 m.

## 2.5.4 Tailings

The geochemistry of the GOP TSF tailings (likely from the processing of WUG ore) are expected to have similar geochemical properties to the tailings stored in TSF1A and TSF2. Modelled pore water chemistry for the GOP TSF is presented in AECOM (2025). The pH of the porewater post closure is estimated to be 5.6, indicating slightly acidic conditions.

# 3. Basis of design

## 3.1 Pit overview

Figure 9 shows an overview of the GOP.

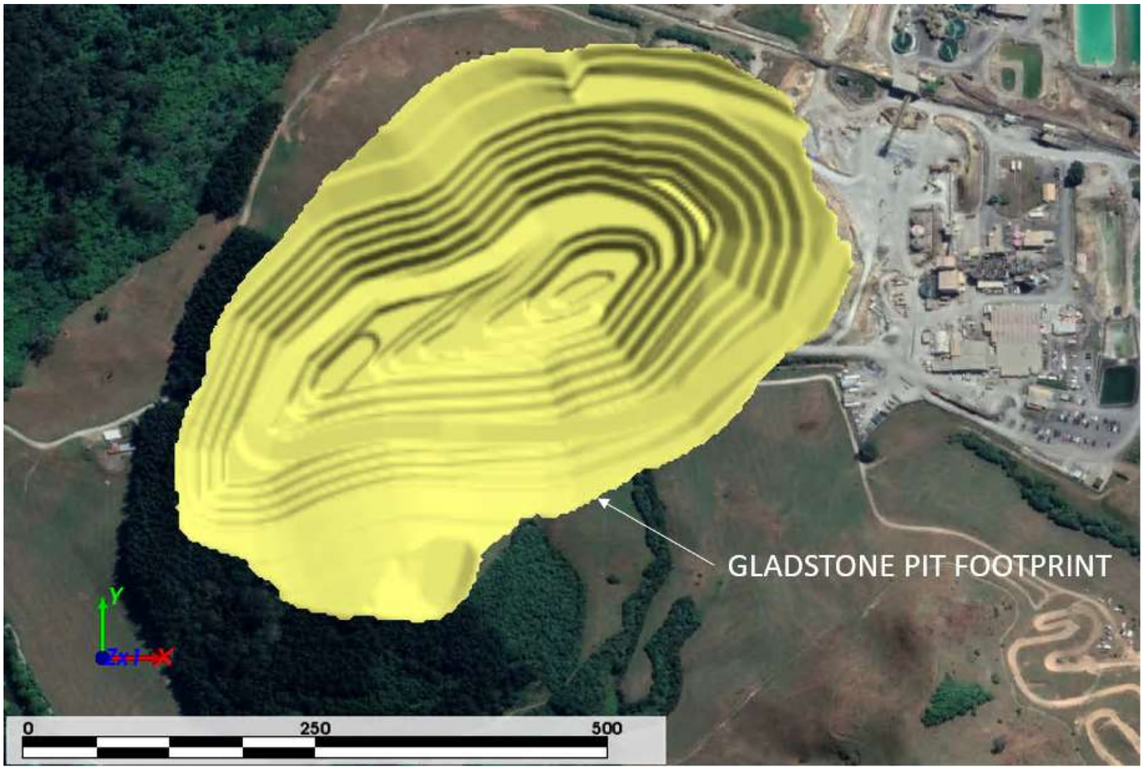


*Figure 9 GOP footprint*

## 3.2 Summary of design basis

The following summarises the basis of design for the GOP TSF.

*Table 3 Summary of basis of design*

| Criteria description | Criteria requirements | Basis |
|---|---|---|
| **General** | | |
| Final tailings level | RL 1103 m | GHD proposed |
| Final tailings storage | 2.1 Mt (based on density of 1.1 t/m$^3$) | GHD calculated |
| Staged construction | Stage 1 tailings to RL 1080 m and Stage 2 tailings to RL 1103 m. | GHD proposed |
| Construction Timing | Stage 1: construction completed in Year 13<br>Stage 2: construction completed in Year 15 | OGNZL provided Mine Plan (August 2024). |
| Potential impact classification (NZSOLD) | Low (refer Section 3.3) | GHD proposed |
| **Tailings Production and Geotechnical Properties** | | |
| Deposition Timeline | Stage 1: Year 13-14 | OGNZL provided Mine Plan (August 2024). |

| Criteria description | Criteria requirements | Basis |
|---|---|---|
| | Stage 2: Year 15+ | |
| Target storage capacity | 2.08 Mt | OGNZL provided Mine Plan (August 2024). |
| Tailings settled dry density | 1.1 t/$m^3$ | OGNZL provided Mine Plan (August 2024). |
| Tailings filling rate (rate of rise) | Varies up to almost 20 m/year during Stage 1. Uncertainty associated with filling rate for Stage 2. GHD consolidation modelling has assumed an average fill rate of 7.8 m/year. | GHD proposed |
| Specific gravity | 2.75 | OGNZL provided |
| Solids content of slurry by mass | 45% | OGNZL provided |
| Tailings classification | Low plasticity silt; P80 = 53 microns (WUG ore) | As discussed with OGNZL |
| Tailings hydraulic conductivity | Refer Figure 10 | Calibration modelling completed by EGL (2019). |
| Beach slope | Nil (assume flat surface) | GHD proposed. |
| Compressibility | Refer Figure 11 | Calibration modelling completed by EGL (2019). |
| **Pit Geometry** | | |
| Minimum pit crest elevation | RL 1107 m (south-west corner) | OGNZL provided pit (March 2021) |
| Pit area | 18 Ha | GHD measured |
| Bench angle / bench height / berm width | **Above RL1110**: 22°/10 m/5 m<br>**RL1110 to RL1080:** 55°/10 m/5 m<br>**Below RL1080:** 60°/15 m/5 m | OGNZL provided pit (March 2021) |
| **Earthworks** | | |
| Design | Pit backfilled with ROM rock to provide a surface for lining with a geosynthetic liner. | GHD proposed |
| Total backfill volume (up to RL 1105 m) | Backfill: 2.5 $Mm^3$<br>Liner sub-grade: 0.13 $Mm^3$ | GHD proposed |
| Material type | **Backfill:** ROM rock (PAF or NAF), 250 mm maximum particle size.<br>**Liner sub-grade:** Sub-20 mm crushed and screened rock produced from select high quality rock (with high permeability) from the mining operations or Martha Phase 4 pit cutback. | As discussed with OGNZL |
| Material source | Generally, from the northern rock stack (NRS) with liner sub-grade from select high quality rock from the mining operations. | As discussed with OGNZL |
| Geochemical treatment | PAF backfill to be lime treated at the same rate as recommended by AECOM (2025):<br>- No limestone amendment required for Martha and WUG PAF material likely to be exposed for a period less than 20 weeks.<br>- 0.6% limestone amendment rate for Martha and WUG rock for 250 day lag period. | As discussed with OGNZL |
| Backfill slope | 1.5H:1V (33.7°) | GHD proposed |
| Bench width | 10 m | GHD proposed |
| Construction fleet | Mine fleet (Komatsu 785 or equivalent) where possible otherwise 40t/65t articulated dump trucks | As discussed with OGNZL |

| Criteria description | Criteria requirements | Basis |
|---|---|---|
| **Stability** | | |
| Static long-term | FoS greater than 1.5 | ANCOLD (2019) |
| Static short-term | FoS greater than 1.3 | ANCOLD (2019) |
| OBE | 1 in 150 AEP PGA = 0.1g, Mw = 6.3<br>No damage to liner, only minor pit wall or external slope deformation. | As provided by EGL<br>(NZSOLD) |
| SEE | 1 in 10,000 AEP PGA = 0.39g, Mw = 6.9<br>Some deformations of pit wall and external slopes permitted, but no damage to liner and no release of contents permitted. | As provided by EGL<br>(NZSOLD) |
| **Water Management** | | |
| Liner | Entire facility fully lined with geosynthetic liner up to RL 1105 m.<br><br>Total liner area: 119,000 $m^2$ | As discussed with OGNZL |
| Under liner drainage | Yes. Consisting of an underdrainage blanket (liner subgrade) and a sump with borehole pump return to decant pond.<br>Provide two sumps for redundancy. | GHD proposed |
| Decant | Floating pontoon pump with pipeline either (1) run down face of the pit; or (2) run down access road built into backfill surface. | GHD proposed |
| Decant operation | Decant water pumped to the process plant for re-use or to water treatment plant prior to discharge.<br>Storm event removal: 30 days to remove 1:100 AEP 24-hour storm.<br>Minimum operating depth: 2.5 m | GHD proposed |
| Annual average rainfall | 2116 mm | As provided by EGL |
| Probable maximum precipitation (PMP) | 1223 mm (72 hour) | As calculated by EGL |
| Design storage allowance | Operational live pond (100,000 $m^3$) plus PMP event. | As discussed with OGNZL<br>(Same expectation as existing TSFs) |
| Freeboard | Operating pond plus PMP plus 1 m | Consistent with other TSFs on site. |
| Surface water diversion drains | 1 in 10 AEP | GHD proposed |
| **Closure** | | |
| Closure concept | Water shedding cover consisting of NAF cap over the tailings is preferred. Some PAF (from NRS) may be used initially to compensate for settlement prior to capping with NAF.<br>OGNZL have indicated 10 to 15 year closure period would be acceptable in order to achieve this. | As discussed with OGNZL |
| Water management post-closure | Spillway (broad-crested weir) cut through natural ground at the southern side of the TSF to restore pre-mining flows to natural wetlands.<br>Design to PMP for closure. | (ANCOLD 2019) |

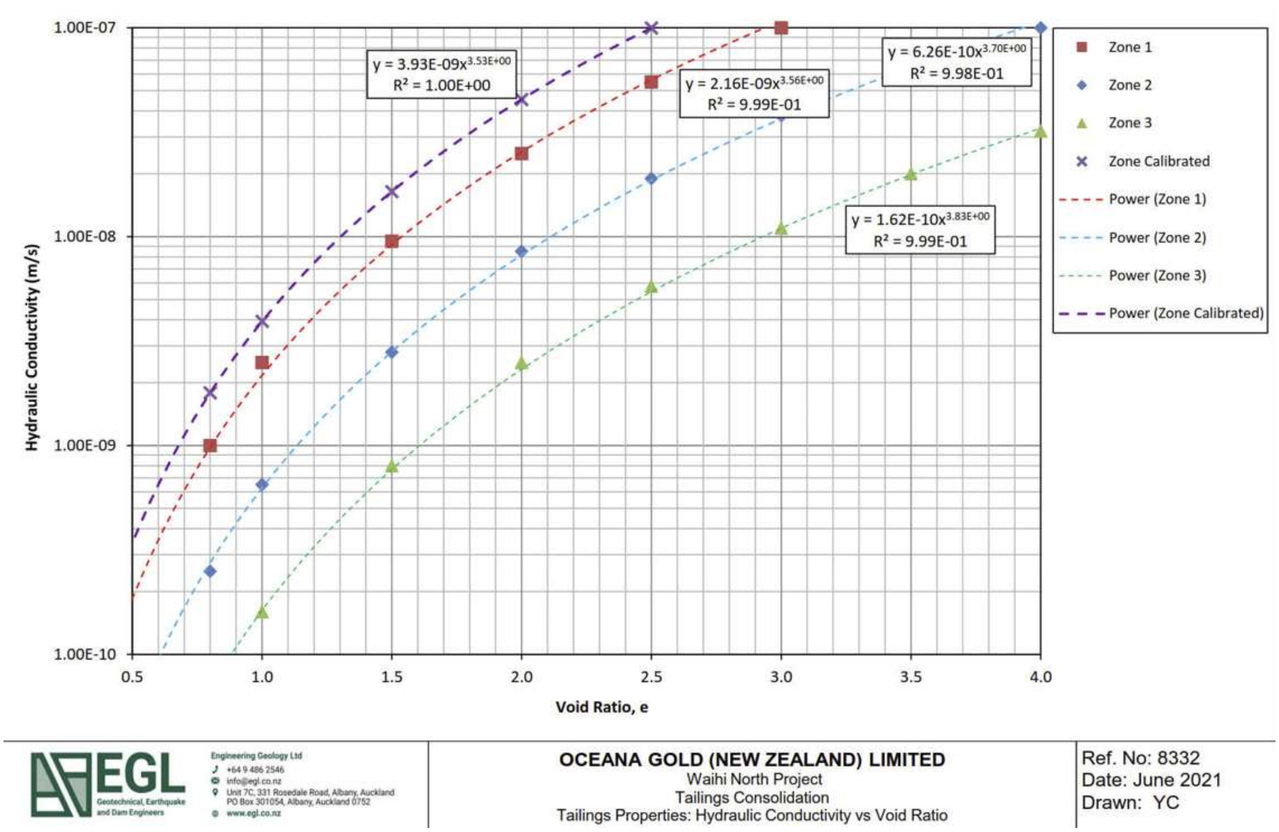


***Figure 10*** ***Hydraulic conductivity versus void ratio for Waihi tailings (provided by EGL)***

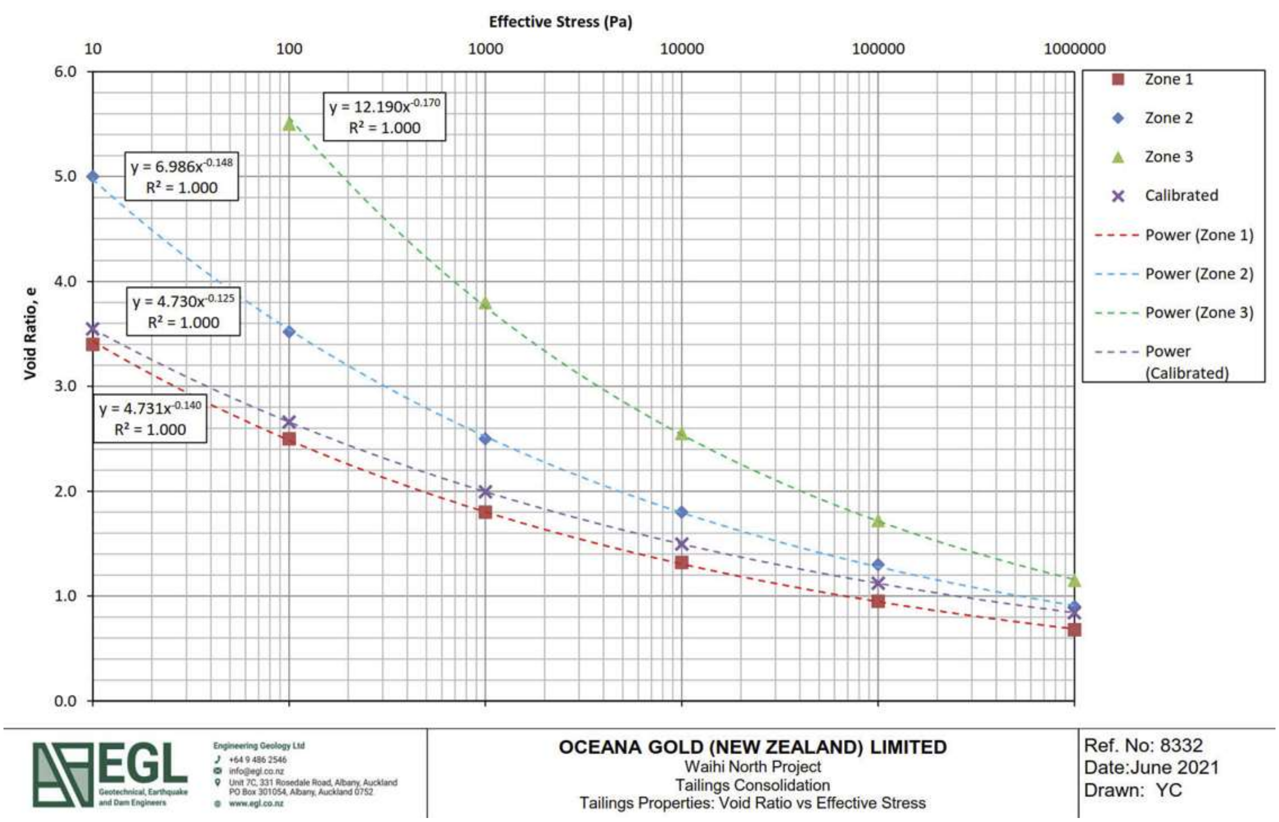


***Figure 11*** ***Void ratio versus effective stress for Waihi tailings (provided by EGL)***

## 3.3 Potential impact classification

Given that the GOP TSF is an in-pit tailings storage, no credible breach mechanisms are expected to result in a dam breach scenario. This is further discussed in Section 5.5.3. Therefore, the PIC is deemed to be non-applicable, and the relevant design and operation protocol shall be based on the lowest PIC (or consequence category) according to each relevant standard (i.e., NZSOLD *Dam Safety Guidelines* and ANCOLD *Guidelines on Tailings Dams*).

## 3.4 Geometric constraints

The final design will consider the following geometric constraints in and around the GOP:

- Existing underground portal
- Potential new underground portal
- Nearby underground mining, both historic and future workings
- Processing plant and associated infrastructure
- Martha pit conveyor
- Wetlands
- Active landslides and other surficial features.

## 3.5 Design standards

The design standards and technical references adopted for this project will be as follows:

- New Zealand Society on Large Dams (NZSOLD) *Dam Safety Guidelines* (2015)
- Australian National Committee on Large Dams (ANCOLD) *Guidelines on Tailings Dams* (2019) and related ANCOLD guidelines.
- Relevant ICOLD Guidelines.
- Global Industry Standard on Tailings Management (GISTM)

## 3.6 Identified risks

The following risks were identified during an initial risk workshop and the design has addressed these:

- In-rush risk to connected underground mine through current and historic workings (portals, historic drill holes etc). To eliminate the in-rush risk, GOP TSF will not receive tailings until all potentially connected underground mining is completed. Alternatively, a risk based-approach may be considered whereby identified controls may be implemented to reduce the in-rush risk to an acceptable level.
- Historical adits that pass through the pit shell and daylight outside of the pit footprint or connect to underground workings, potentially providing a path for release. Those historical workings that provide a potential path for release will need to be mapped and remediated (e.g., backfilled, plugged) prior to filling of GOP TSF.
- Closure within an acceptable timeframe. OGNZL have indicated the preference for a water shedding cover. The anticipated high rate of rise of tailings in the GOP TSF will potentially (a) make trafficability of the final tailings surface challenging, and (b) create significant post deposition settlement. This risk has been considered through consolidation modelling presented in Section 5.4.
- Failure of the underdrainage system leading to instability and failure of the liner and backfill surface. This risk has been addressed through stability modelling in Section 5.3 and through providing added redundancy to the underdrainage system.
- Failure of the backfill or subgrade leading to failure of the liner and delay to commissioning or high costs for re-work. This risk has been addressed through stability modelling in Section 5.3.
- Tailings and/or water release due to landslide/rockfall into the storage causing a wave of tailings/water to overtop the pit crest, resulting in damage to the environment, property and potential loss of life. This risk is addressed in Section 5.5.1.

– Failure of the pit crest on the south-west side of GOP TSF where the pit wall acts as an embankment containing tailings/water, resulting in damage to the environment, property and potential loss of life. Failure of the pit wall may be as a result of overtopping or instability. This risk is addressed in Section 5.3.

# 4. Development of GOP TSF

## 4.1 General

This section provides a summary of the GOP tailings storage facility design, including the geometrical arrangements, material zoning and proposed construction methodology.

The design drawing set is provided in Appendix A. This includes general arrangements, typical sections and details.

## 4.2 Facility geometry

This section provides explanation for the geometric arrangement of the pit backfill and lining. A summary of the facility geometry is provided in Table 4, including justification for the selected values where required.

*Table 4 GOP TSF geometric arrangement*

| Parameter | Value | Justification |
|---|---|---|
| Backfill bench width | 10 m | Minimum width for safe working during liner installation and hauling/spreading backfill. |
| Backfill bench height | 10 m | Maximum height for limiting strain and elongation of liner. To be confirmed during detailed design. |
| Backfill batter slope | 1.5H:1V (33.7°) | Upper limit slope for installation of a geomembrane liner. Upper limit selected to reduce backfill quantity and increase tailings capacity. |
| Maximum tailings level (RL) | 1103 m | Allows for storage of the operating pond plus the PMP up to the top of liner. |
| Maximum backfill / liner level (RL) | 1105 m | As designed by GHD. |
| Minimum pit crest (RL) | 1107 m | As designed by OGNZL. Allows for potential wave run-up (refer Section 5.5.1) |
| Tailings storage floor (RL) | 1060 m | Geometric constraint to still allow a reasonable area in the floor once backfill is placed. |
| Maximum depth of tailings (m) | 43 m | Based on pit geometry and maximum tailings level |

## 4.3 Materials and zoning

Figure 12 shows a typical section through the GOP TSF and Figure 13 shows an isometric view of the facility. The GOP TSF has been designed as a fully lined facility. The TSF features a backfill component to facilitate lining of the pit. The backfill consists predominantly of run of mine (ROM) waste rock with a 2 m wide external facing of processed, sub-20 mm material to provide a cushioning layer to support the liner and act as a drainage layer beneath the liner.

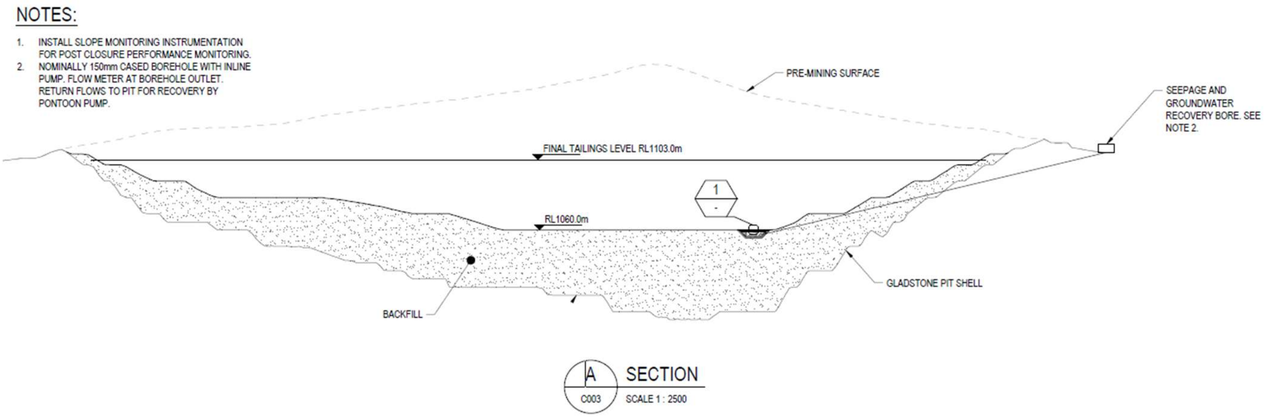


***Figure 12 Typical section of GOP TSF showing the backfill surface***

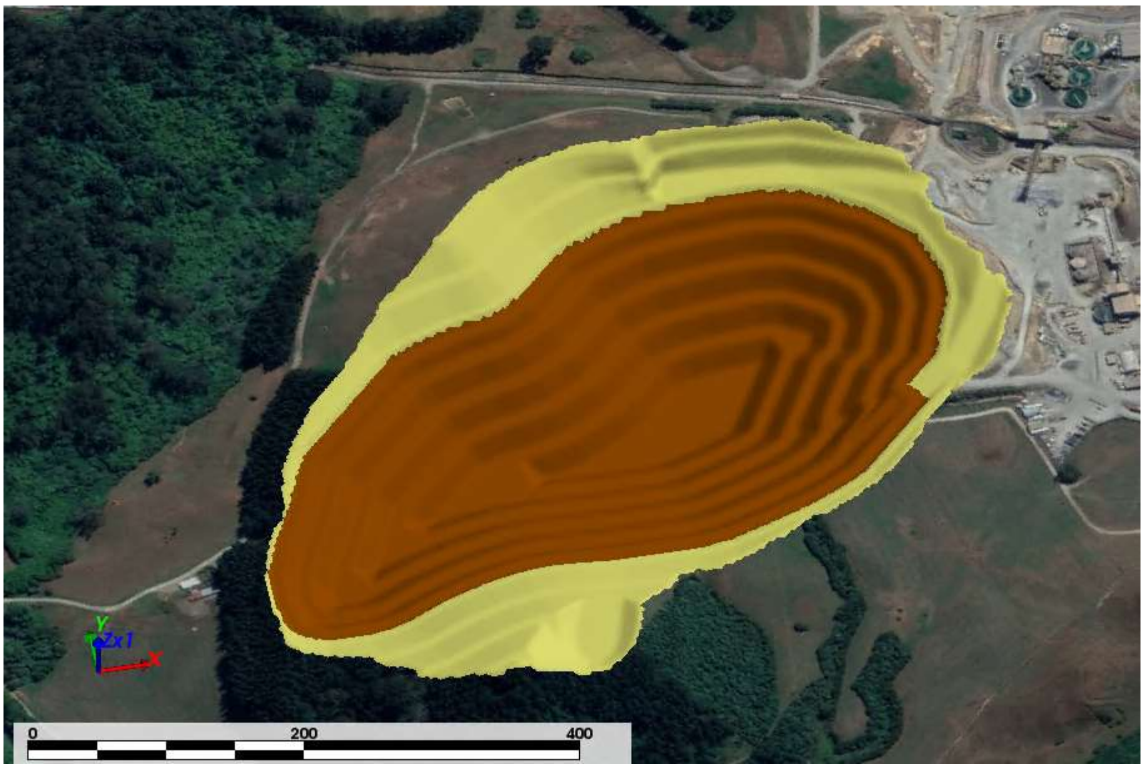


***Figure 13 Isometric view of GOP TSF backfill surface (yellow = pit shell; brown = backfill surface)***

The backfill is assumed to come from the NRS, TSF3 quarries or MOP4 cutback. Material in the NRS and from MOP4 cutback has typically run through the jaw crusher and has a maximum particle size of 250 mm. However, the particle size and quality of rock is expected to be highly variable depending upon where the material was mined. Where possible, priority should be given to selecting fresher rock (higher strength) for the rockfill above RL 1060 m. Weathered rockfill/earthfill should be placed in the base of the pit, where strength is generally less critical.

The backfill may consist of either potentially acid forming (PAF) or non-acid forming (NAF) rock. However, a large proportion of the backfill is expected to be PAF given the scarcity of NAF on site. All PAF will be lime treated and is assumed to be treated at a similar rate recommended in AECOM (2025). This treatment rate is 0.2% to 0.4% for Martha Pit overburden, assuming a target lag time of 210 days before being covered.

The sub-20 mm liner subgrade will consist of select rock from the mining operations, crushed and screened using a mobile crushing plant. The subgrade will also act as a drainage layer beneath the liner, to (a) capture leakage

1. Limiting the amount of time that the subgrade is exposed by incrementally lining the face as the backfill is placed (i.e., backfill to first bench, line, backfill to second bench, line, etc.).
2. Diverting run-off using bunds, drains, sumps and pumps.
3. Developing repair methods (if required) which do not require significant bulk earthworks to cutback erosion gullies or rilling such as repair with small equipment / long reach excavator for subgrade replacement with sub- 20 mm or alternate materials such as cement stabilised fill or shotcrete.

A geosynthetic liner is recommended for lining the GOP TSF. The type of geosynthetic liner shall be confirmed during detailed design and the decision shall be based on the following criteria:

– Impact resistance and puncture strength given the potentially rough and uneven sub-grade.
– Demonstrated experience being installed at steeper slopes (i.e., steeper than 2H:1V).
– Longevity of the liner.
– Speed of installation.

The liner will be anchored in a trench at each bench to limit the strain on the liner, given the relatively high pit face.

Table 5 summarises the material quantities for the GOP TSF.

*Table 5 GOP TSF bulk quantities*

| Material | Description | Material quantity | Material source |
|---|---|---|---|
| Backfill | Bulk earth and rockfill (PAF or NAF); maximum 250 mm particle size. | 2,490,000 $m^3$ | NRS and/or MOP4 cutback |
| Liner subgrade | Sub-20 mm crushed and screened rock produced from select high quality rock (with high permeability) from the mining operations or Martha Phase 4 pit cutback. | 131,000 $m^3$ | Manufactured material from select ROM rock |
| Liner | Geosynthetic liner (e.g., bituminous geomembrane, HDPE or PVC) | 119,000 $m^2$ | Liner supplier |

## 4.4 Construction aspects

Backfill and liner subgrade is proposed to be placed in horizontal layers of maximum 1 m thickness. Material will be loaded near the processing plant or at the NRS and hauled to the base of the pit using haul trucks. The haul trucks will dump the material where a dozer will spread into 1 m lifts. Placement of the external facing (sub-20 mm sub-grade) will be placed steeper than design to enable compaction to the edge of the lift. An excavator will be used to trim the batters to the design slope of 1.5H:1V. Compaction using rollers will be required for the external facing, liner subgrade. However, the continued passing of loaded haul trucks may provide acceptable compaction for the backfill. This will need to be confirmed by completing a trial lift prior to construction, otherwise rollers will also be required to compact the backfill.

The liner will be installed incrementally as each 10 m bench of backfill is constructed. The minimum crest width of the backfill platform will be 10 m wide (at the final bench) but will generally be much wider. This will provide plenty of width for traffic and for safe construction of the liner. The general liner installation procedure is illustrated in Figure 14.

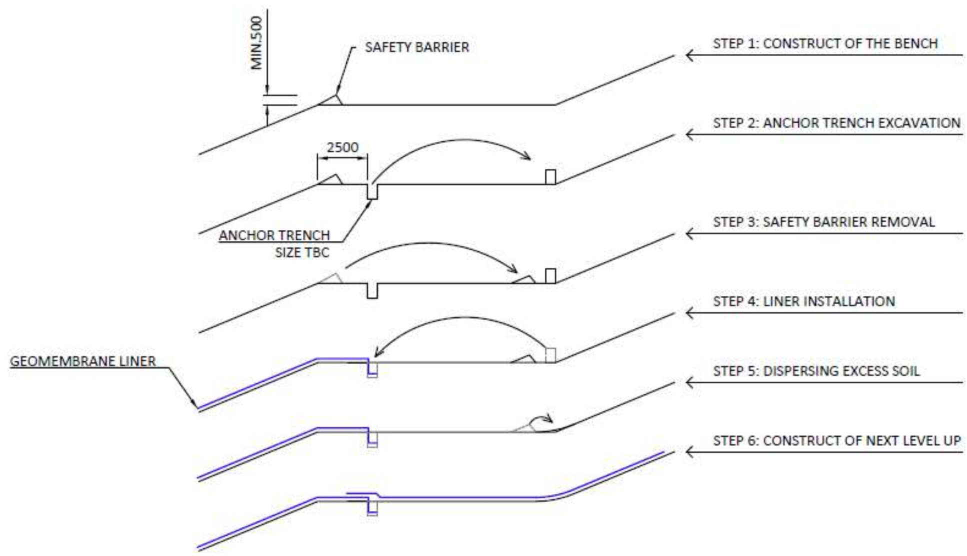


***Figure 14*** ***Liner installation sequence***

Figure 15 shows the backfill elevation vs volume curve for the pit. RL 1060 m represents the elevation of the GOP TSF floor. This shows that approximately 40% of the total backfill is required to be placed in the base of the pit before any lining occurs. Subsequent 10 m lifts progressively get smaller, ranging from 450,000 m$^3$ to 250,000 m$^3$ of backfill material up to the final elevation (RL 1105 m).

Similarly, Figure 16 shows the liner area vs elevation curve. This shows that the liner area for a 10 m lift ranges from approximately 16,000 to 35,000 m$^2$, with the final 10 m lift having the largest liner area.

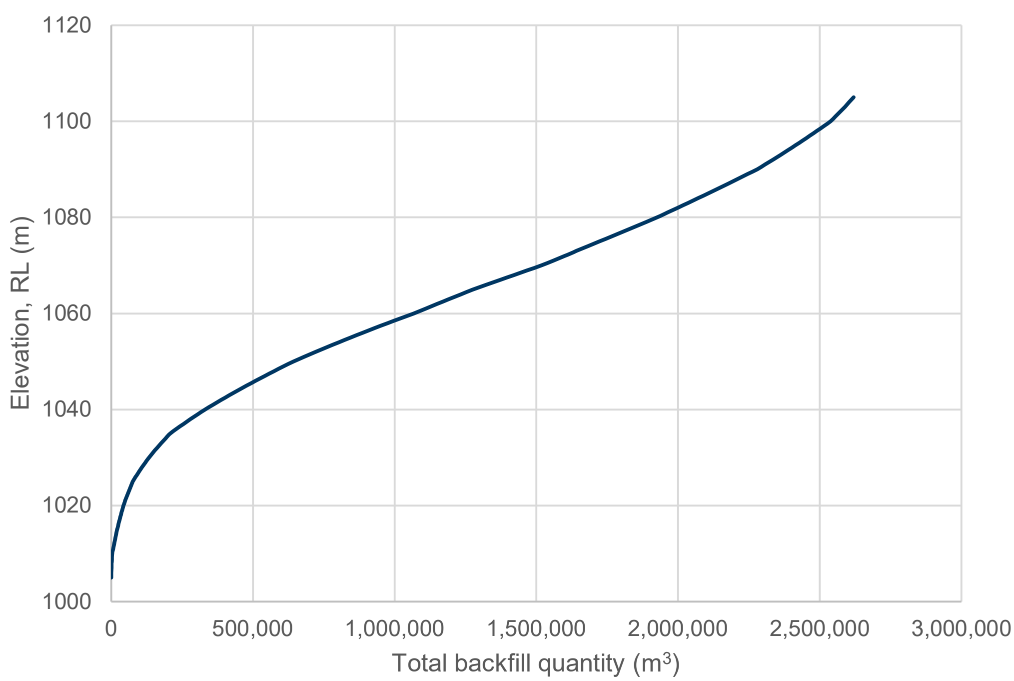


***Figure 15*** ***Total backfill quantity versus elevation for the GOP TSF***

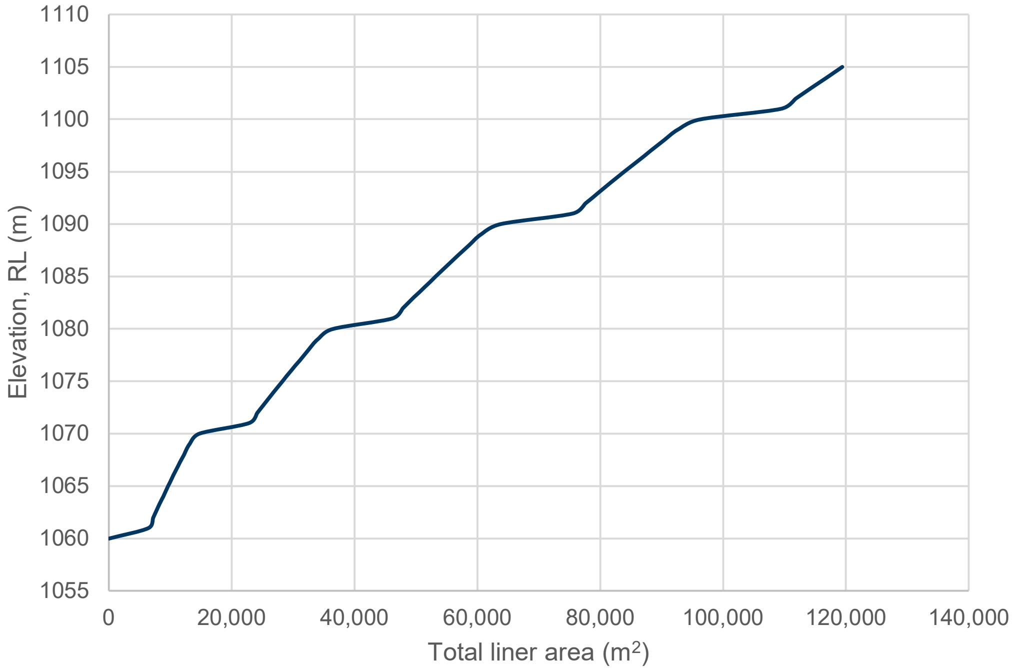


*Figure 16* *Total liner area versus elevation for the GOP TSF*

## 4.5 Storage capacity

Figure 17 shows the tailings storage vs elevation curve for the GOP TSF. The total storage is 2.1 Mt up to RL 1103 m, assuming a density of 1.1 t/ $m^3$ (settled density proposed by OGNZL). The final tailings level of RL 1103 m is approximately 4 m below the crest of the pit (at the lowest point on the western side). This accounts for design flood storage and freeboard requirements.

Given the relatively small capacity of the GOP TSF and the high degree of uncertainty in the construction schedule, the GOP TSF should be considered a supplementary storage to the other TSFs on site. Relying solely on the GOP TSF would present a significant risk to the continuity of operations. Directing a smaller fraction of the total tailings stream to GOP TSF assists in limiting the rate of rise and improving consolidation of the tailings. Reducing the rate of rise will improve with closure of the GOP TSF by improving trafficability of the final tailings surface and limiting excessive post-deposition settlement.

The filling of GOP TSF is proposed to occur in two stages with Stage 1 being to RL 1080 m and Stage 2 to RL 1103 m. The advantages of staging filling (and construction) are:

– Deferral of capital expenditure.
– Increased scheduling flexibility
– Enables filling of GOP TSF to commence earlier

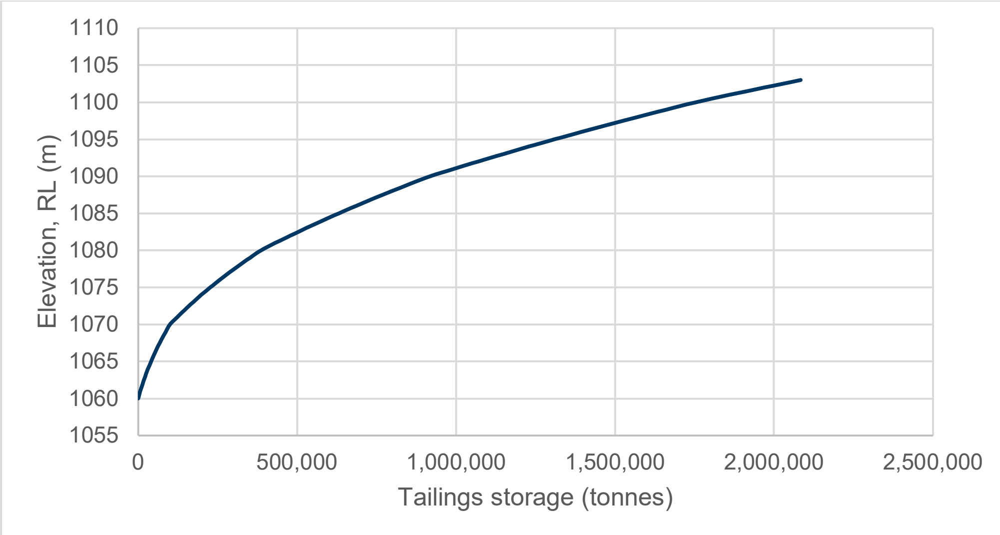


*Figure 17 GOP TSF storage curve*

## 4.6 Construction schedule

Figure 18 outlines a high-level schedule for the GOP TSF. The schedule is based on the following assumptions:

- Backfill placement is completed at an average rate of 4,080 $m^3$/day assuming one construction front (reduced from 5,000 $m^3$/day active backfill placement to account for weather delays.
- Liner install is completed at an average rate of 340 $m^2$/day (reduced from 400 $m^2$/day active liner placement rate to account for weather delays).
- Day shift only for backfill and liner.
- Backfill and liner placement cannot happen simultaneously due to access restrictions and safety.
- GOP TSF will be filled in two stages: Stage 1 to RL 1080 m and Stage 2 to RL 1103 m.
- GOP TSF acts as a supplementary storage to the primary TSFs on site, with tailing deposition per the schedule shown in the basis of design (Table 3).
- Filling of GOP TSF does not commence until completion of underground workings in the vicinity of GOP.

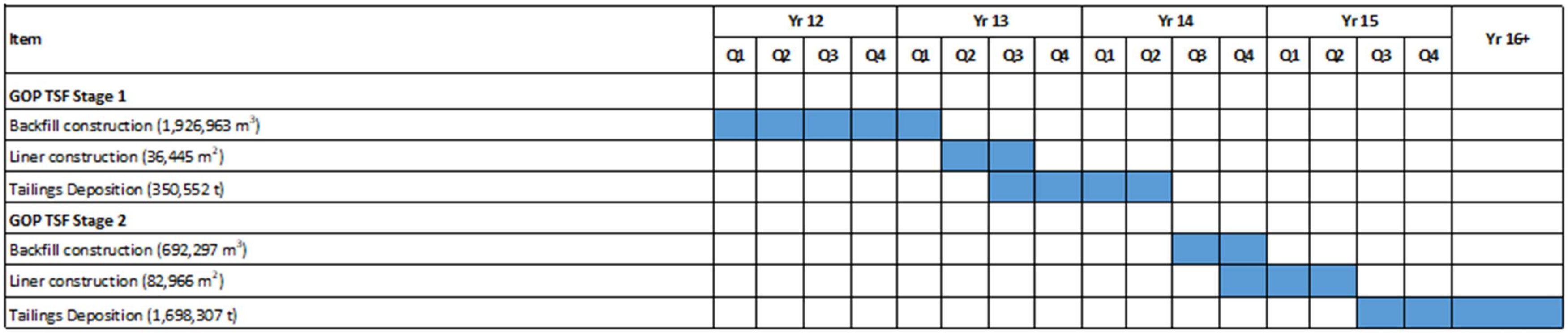


*Figure 18 Proposed constructions schedule*

# 4.7 Tailings management strategy

## 4.7.1 Overview

Tailings will be deposited via three deposition pipelines down the side of the pit. The rate of rise of the tailings will be approximately 8 m per year, assuming only a fraction of the Waihi tailings stream is directed at the GOP TSF (typically ranges between 20% and 50% of total tailings stream). Depositing a smaller fraction of the tailings is recommended to limit the rate of rise and improve consolidation and reduce post closure settlement. Given the relatively high rate of rise (e.g. compared to the site's other TSFs), tailings deposition will be primarily sub-aqueous, meaning the settled tailings density is expected to be low and the post-filling settlements high. As the tailings settle, additional tailings can be deposited to "top up" the tailings level and reduce the final cover thickness.

Regular density reconciliations through completion of bathymetric surveys will be important to confirm the design assumptions for rate of rise, as this will control the settled density and post-deposition settlement.

## 4.7.2 Tailings pipeline

The tailings deposition pipeline will consist of three slotted HDPE spigots running down the side of the lined pit wall, one each in the north, east and west. Each spigot will be anchored at the top of the pit and supported at the base of the pit using a concrete cradle. The concrete cradle will be installed prior to lining. The purpose of the concrete cradle is to allow some movement and thermal expansion of the spigot pipe. A collar will be installed on the end of the pipeline as a 'stopper' to prevent the spigot floating free from the concrete cradle as the pit fills with tailings and supernatant water. The slotted pipe allows tailings to progressively flow from higher slots as the tailings level comes up and buries the spigot.

Installation of the tailings pipeline will be in two stages due to limited access to the base of the pit to install the spigot into the concrete cradle. The pit will first be backfilled and lined to RL 1080 m. The spigots will then be carefully lowered down the lined face using a crane and guided into place by personnel who have rappelled to the base. The top of the spigots will be anchored at RL 1080 m, with the tailings pipeline running up the pit haul road to the process plant. The tailings will then be deposited up to RL 1080 m. Stage 2 will then line the pit to RL 1107 m before installing the spigots in a similar way to the first stage and then depositing tailings up to RL 1103 m.

Alternatively, to avoid the need to rappel down the liner and to improve access to the base of the pit, a light vehicle access ramp may be built into the backfill surface, as sketched in Figure 19. This will allow access by a light vehicle or a small crane to the floor of the pit to assist with installing the tailings pipeline. Alternatively, the tailings pipeline could be installed along the access road rather than down the face of the pit.

The inclusion of a light vehicle access ramp will also improve access for any erosion repair to the backfill surface that may be required.

*Figure 19 Proposed light vehicle access road down the backfill face*

## 4.8 Water management strategy

### 4.8.1 Decant

The decant will consist of a floating pontoon pump, with a pipeline either run down the face of the pit or along the access road (refer Section 4.7.2). If the pipeline is run down the face, the pipeline will be anchored at the pit crest using a similar anchor system as the tailings spigots. The decant water will be pumped to the Processing Plant for re-use or to the Water Treatment Plant prior to discharge to the environment.

The typical "live" operating pond was assumed to be 100,000 $m^3$ in the water balance and freeboard calculation. The GOP TSF should not be used to store excess water beyond the typical operating pond as this will reduce the flood storage capacity, increasing the risk of overtopping. After a significant rain event, the decant pond level should be reduced to the typical operating volume within 30 days.

Sizing of the decant pumping system should be completed at the detailed design phase.

### 4.8.2 Over liner drainage

GHD considered an over liner to improve consolidation of the tailings by allowing downward and radial drainage. However, an over liner has been excluded from the design for the following reasons:

– Experience shows that the tailings adjacent to tailings underdrainage systems can become orders of magnitude lower in permeability (relative to the remaining tailings), effectively "blinding off" the drain making the underdrainage system ineffective.
– Extracting the water from the underdrainage system would have proved challenging and would have required a bore through the liner to pump the water to the surface introducing additional risk due to liner penetrations.

### 4.8.3 Under liner drainage

The under-liner drainage will rely on the higher permeability of the liner sub-grade, relative to the permeability of the pit walls. The under-liner drainage will (a) capture any leakage through the liner, and (b) reduce the uplift pressure on the underside of the liner from potential groundwater inflow while the TSF is empty.

Intercepted seepage/groundwater will percolate down through the backfill to the base of the pit. A sump will be installed beneath the liner to (a) maintain zero pressure on the liner, and (b) maintain saturation of the rockfill beneath the liner (which may be PAF). The drainage sump will consist of a zone of no-fines, coarse rockfill. The no-fines coarse rockfill will be overlayed by a layer of selectively well-graded rockfill and sand to prevent fines ingress to the sump to reduce risk of sump/pump blockage.

Water will be retrieved from the sump via an inclined borehole with an inline pump. A redundancy borehole will be installed adjacent to the primary borehole given the importance of the underdrainage system. Groundwater pumped to the surface will be returned to the GOP decant pond for recovery by the decant pump.

## 4.9 Closure plan

The closure plan concept is illustrated in Drawing 12537997-C006 and C007 (Appendix A). The current plan for closure is to cap the tailings with a water shedding cover once a majority of the post-deposition settlement has been completed and the storage has been "topped up" with further tailings or PAF waste rock to minimise cover thickness. The capping layer will consist of low permeability NAF weathered rockfill, with a minimum thickness of 1.0 m.

The final capped surface will be graded towards two outlets, one on the southern side of the GOP TSF near the wetlands, and one on the western side where the pit crest is lowest (Figure 20). The outlets will consist of trapezoidal channels cut into natural ground. The south-eastern spillway channel is important to restore pre-mining flows to the down gradient wetlands. Each closure spillway channel has conservatively been designed to pass peak rainfall during the PMP event. The design flow was estimated using the Rational Method, with time of concentration calculated using the Kinematic Wave Equation (assuming sheet flow across the catchment). Table 6 summarises the spillway design criteria.

Where the spillway is cut in weathered rock that may be susceptible to erosion, rip-rap ($D_{50}$ = 300 mm) should be used to line and protect the spillway channel.

The pit highwalls above the final tailings closure surface will be mined to an overall slope of 2.5H:1V for improved stability and visual aspects of the post-mining landform.

*Table 6 Spillway channel design criteria*

| Design criteria | Design value |
|---|---|
| Design rainfall event | PMP |
| Design rainfall intensity (mm/hr) | 215 (based on 15-minute storm) |
| Peak outflow ($m^3/s$) | 10.8 |
| Catchment area (Ha) | 18 |
| Run-off coefficient | Conservatively, assume 100% run-off |
| Channel grade (%) | 3 |
| Base width (m) | 10 |
| Side slopes (XH:1V) | 2 |

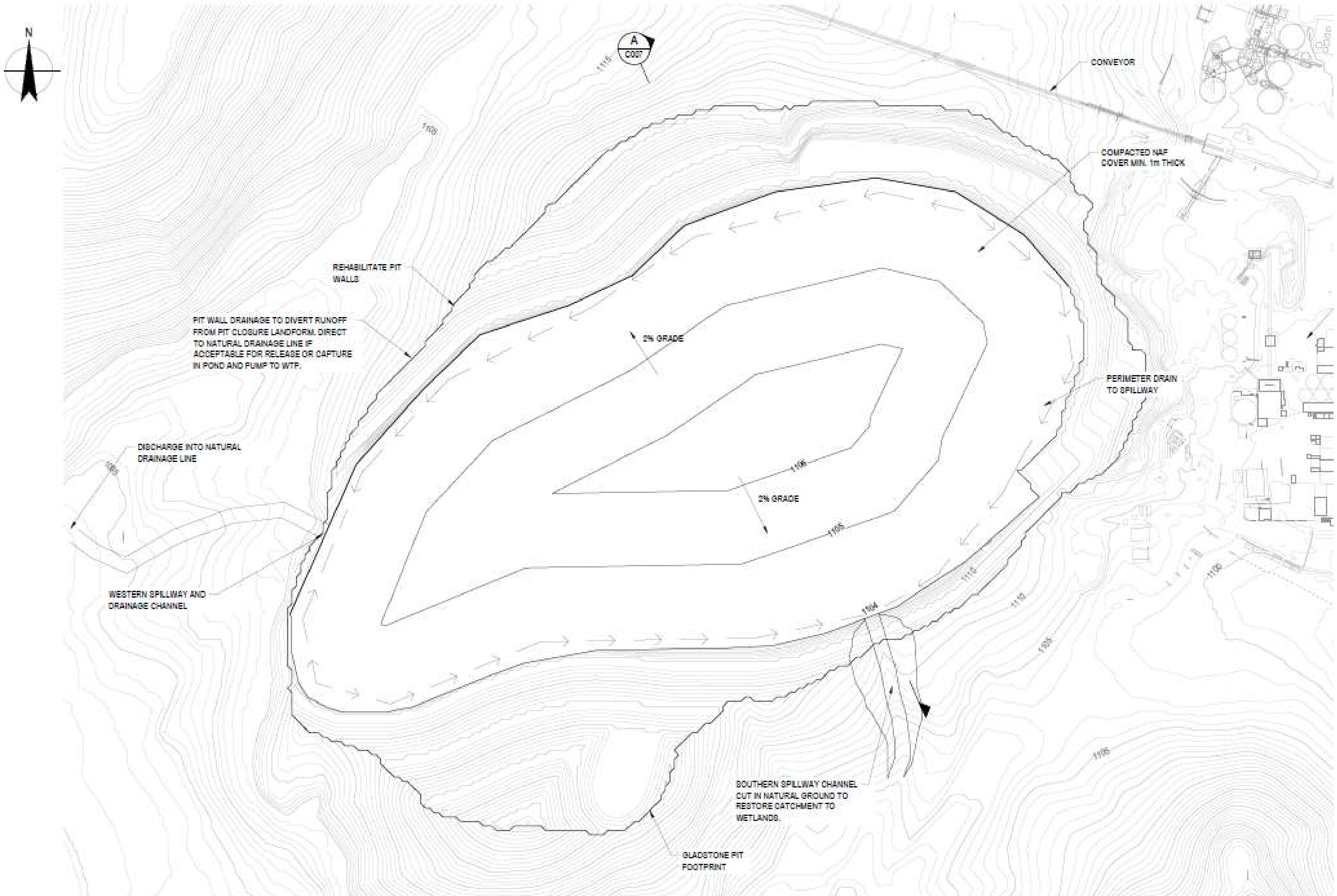


*Figure 20 Proposed closure plan*

# 5. Design analysis

## 5.1 Groundwater

### 5.1.1 Overview

A groundwater assessment was undertaken by GHD (2025a) to assess the impact of GOP TSF on the surrounding environment. Assessment of potential effects on groundwater and surface water has focused on the influence on the following:

– Shallow and deep groundwater levels and baseflow to surface water during excavation and dewatering of the GOP, including:
  - The Gladstone wetland and the intermittent Ohinemuri tributary at TB4, south of the pit.
  - The intermittent Ohinemuri tributary at TB5, northwest of the pit.
  - The Ohinemuri River.

– Water quality, shallow and deep groundwater levels and changes to surface water baseflow during the following phases of the TSF:
  - Operational TSF
  - Long-term TSF
  - TSF closure

Potential impacts on groundwater and surface water associated with the proposed GOP TSF were assessed using conceptual interpretation, supported by the use of 2D numerical groundwater models and simplistic analytical models. The results of the groundwater study are provided in GHD (2025a). The following provides a brief summary of the key outcomes.

### 5.1.2 Summary

During development of the GOP TSF the deep groundwater system is anticipated to continue to under-drain the shallow groundwater system due to ongoing dewatering in the surrounding underground mining. Estimated groundwater drawdown and groundwater levels in this scenario are similar to during mining, as the tailings pond and recharge to the tailings is not expected to influence the adjacent shallow groundwater system. Instead, tailings pore water not recovered at surface as decant is expected to percolate downwards, ultimately discharging to the deep groundwater where it will contribute to flow being captured by underground mine dewatering.

Following capping of the GOP TSF and cessation of underground mine dewatering, represented by the long-term GOP TSF scenario in GHD (2025a), rewatering of the deep groundwater system will result in elevated groundwater levels within the deep groundwater system. As a result of this, downwards vertical hydraulic gradients currently recorded between the shallow and deep system are expected to reduce or reverse. This reduces the estimated zone of influence of the groundwater drawdown, and groundwater levels are estimated in a number of locations to be greater than current conditions, including in the vicinity of the Ohinemuri tributary to the north (TB5 – refer Figure 6 for monitoring locations) and the Ohinemuri River (OH3). Groundwater levels in the vicinity of the Gladstone Wetland (TB4) are modelled to increase by approximately 3 m in comparison to current conditions.

The modelling assessment indicates that the greatest influence on groundwater levels within the receiving environment is the elevation of the GOP TSF drainage system and rewatering of the deep groundwater system (long-term GOP TSF and GOP TSF closure scenario). The proposed Martha Pit Lake level (1,104 mRL) is expected to impose a water level control on the connected mine workings.

Hydraulic containment of the tailings and waste rock backfill is anticipated to be achieved by the GOP TSF drainage system, with the drain modelled to capture both tailings pore water generated from infiltrating rainwater (approximately 58 $m^3$/day) and deep groundwater (approximately 1,194 $m^3$/day), upwelling from the deep groundwater system.

On complete closure of the GOP TSF, when the GOP TSF drainage system is no longer operated (GOP TSF closure scenario in GHD (2025a)), groundwater discharge from the GOP TSF (approximately 50 $m^3$/day) is estimated to be predominantly towards the Ohinemuri River (OH6). This dominant flow path results from the presence of the relatively permeable young volcanics on the western pit face at an elevation that allows contact with the saturated waste rock. Water being discharged from the GOP TSF is modelled to be primarily groundwater upwelling through the waste rock, and rainwater infiltrating the cover and migrating above the tailings towards the pit rim. Only a relatively small proportion of water is expected to be influenced by tailings (approximately 10%), due to the low permeability of consolidated tailings relative to emplaced waste rock.

## 5.2 Surface water

### 5.2.1 Water balance

The GHD Water Balance Model (WBM) (outlined in GHD 2025b) incorporates both GOP sump water (during development) and tailings pond water (during filling). The model assumes that both sump and decant water is pumped to the nearby water treatment plant (WTP) for processing before discharge into the Ohinemuri River. The WBM estimates that sufficient capacity within the WTP and discharge (subject to various upgrades and consent variations) together with adaptive management procedures such as prioritisation of decant pumping will allow the GOP TSF to operate within the assumed normal operating water levels with allowance for the appropriate freeboard and contingency storage volume.

### 5.2.2 Surface water diversion drains

During construction, management of surface water run-off will be important to minimise damage (erosion) of the liner sub-grade and interference with installation of the liner. A perimeter drain will be constructed on the bench above the construction front to intercept run-off and divert away from the work front and safely convey down the pit wall to the base of the pit to a sump for recovery.

The perimeter drainage network will be designed during the detailed design phase.

## 5.3 Stability

### 5.3.1 Analysis overview

Stability analyses were completed for the following aspects of the GOP TSF:

1. Stability assessment of the constructed backfill surface including:
    a. An infinite slope assessment of the thin, outer-facing liner sub-grade material.
    b. A global stability assessment of the backfill using the two-dimensional, limit-equilibrium based software package Rocscience Slide.
2. Stability assessment of the portion of pit crest on the western side that may act as an embankment due to the natural topography falling away (Figure 21). The assessment of the pit rim was completed using the two-dimensional, limit-equilibrium based software package Rocscience Slide.

The stability analyses were based on generally assumed parameters for rockfill and natural ground, with some guidance on the pit wall geotechnical parameters provided by the values recommended by PSM (2022). Correlations from literature were used to develop parameters for the backfill material.

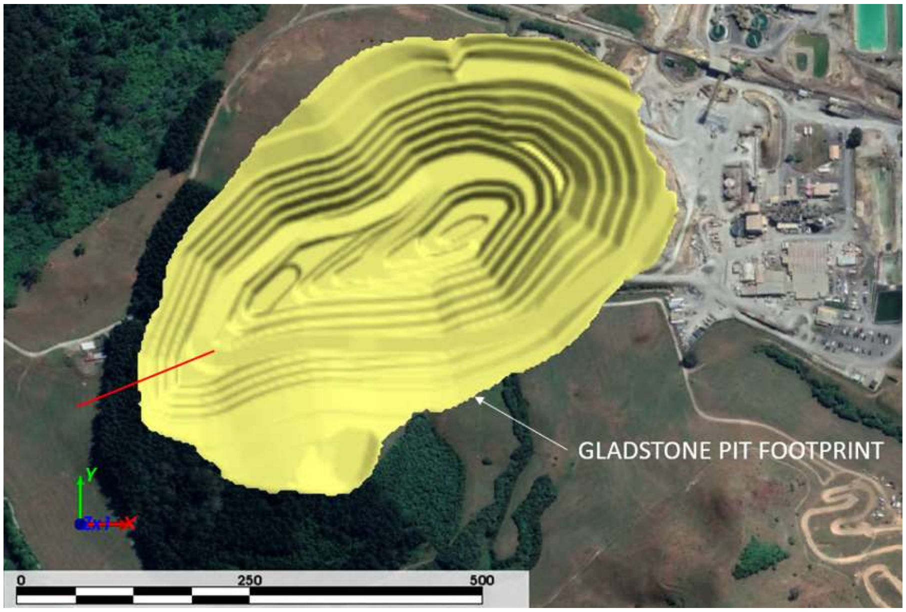


*Figure 21 Pit crest stability section (shown in red)*

### 5.3.2 Material parameters

The material parameters adopted for the analysis are summarised in Table 7. The material parameters adopted for the rockfill have been derived from published correlations by Leps (1970). The following assumptions were made in deriving the materials:

– Coefficient of uniformity (Cu) is greater than 4.
– Target relative density of greater than 60% is achieved.
– Given the friction angle of rockfill generally decreases with increasing normal stress, a maximum normal stress of approximately 700 kPa (assuming 40 m maximum depth of rockfill) was used when deriving the friction angle. This is considered a conservative assumption, particularly for the liner sub-grade, which will be under low stress during the critical case (i.e., with no tailings).
– Average rockfill assumed for the backfill as defined by Leps (1970). This assumes that overburden is selectively placed as backfill on the side slopes and highly weathered material with low strength is rejected or used in the base of the pit.

Parameters for the parent rock were based on strengths derived by PSM (2022) for Andesite Class 3 (refer Section 2.3.2). Conservative parameters were adopted for the shallow surface materials when assessing the stability of the pit rim.

*Table 7 Parameters adopted for the stability analysis*

| Material | Unit weight (kN/m$^3$) | Friction angle, $\phi$ (°) | Cohesion, c (kPa) |
|---|---|---|---|
| Parent rock (pit walls) | 22.5 | 50 | 140 |
| Ignimbrite | 22.5 | 25 | 40 |
| Backfill | 20 | 42 | 0 |
| Liner sub-grade | 20 | 42 | 0 |

### 5.3.3 Summary of results

#### 5.3.3.1 Backfill

The infinite slope assessment was completed to confirm the stability of the thin, outer-facing liner sub-grade material. For an infinite slope, the factor of safety (FoS) is equal to:

$$FoS = \tan(\emptyset) / \tan(\beta)$$

where $\phi$ is the friction angle and $\beta$ is the slope of the surface. This calculation assumes the liner sub-grade material remains freely draining. Given the inter-bench slope of the backfill is 1.5H:1V (approximately 33.5°), the FoS was calculated to be 1.4. This is considered acceptable as the slope is temporary and the FoS will improve as the GOP TSF is filled with tailings.

The global stability assessment critical slip surface is shown in Figure 22. The calculated minimum FoS of 1.8 is considered acceptable.

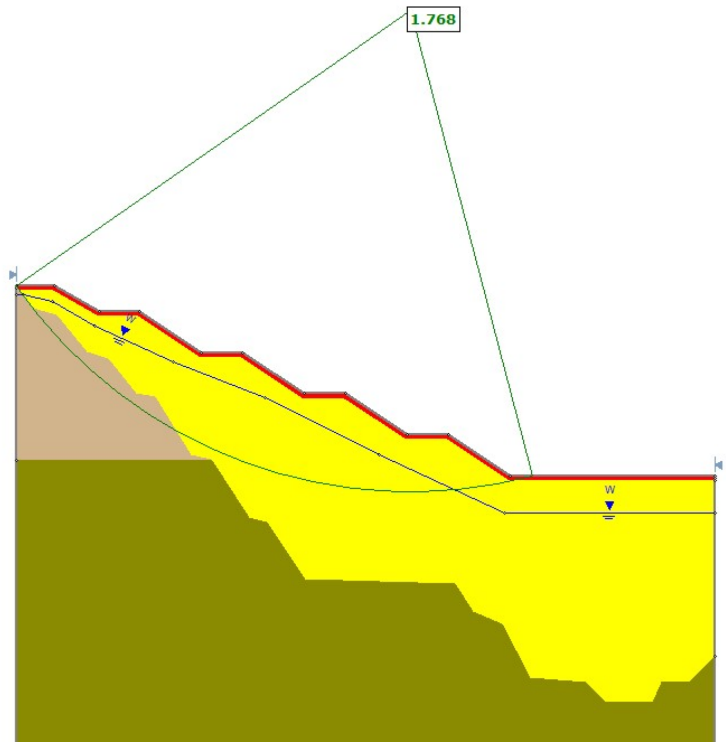


*Figure 22 Global stability results for backfill surface*

#### 5.3.3.2 Pit crest

The stability of the pit crest was analysed to assess whether there was credible failure mode that justified completing a dam breach assessment. The assessment focused on the western side of the pit where the natural topography meant that the pit rim may have been considered an embankment. The pit rim was conservatively assumed to have lower strength material and had properties more representative of an extremely/completely weathered rock.

Results in Figure 23 show a calculated factor of safety equal to 4.7, for the critical slip surface that impacts the crest of the backfill. While there is no guidance on assessing the credibility of failure modes compared to calculated factors of safety, the following observations are made:

– The calculated factor of safety is high, and the identified slip surface appears improbable.
– The portion of pit crest analysed has a relatively flat slope and the height is low compared to most traditional embankments.

Therefore, instability of the western crest leading to release of containment was not considered a credible failure mode.

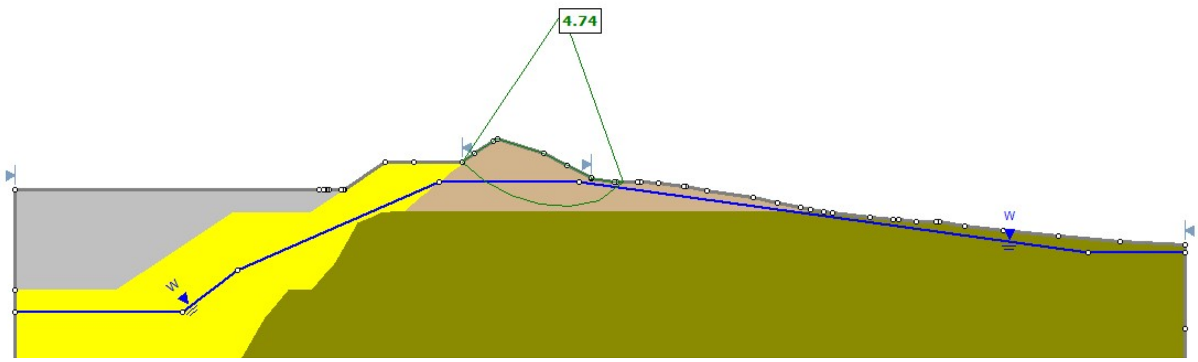


*Figure 23* *Stability of western pit rim*

# 5.4 Tailings consolidation and settlement

## 5.4.1 Analysis overview

Consolidation modelling was completed to provide an estimate of post deposition settlement and void ratio profile of the deposited tailings. The magnitude of post deposition settlement and final void ratio profile will have implications on the closure of the GOP TSF, including:

– Unsafe/impossible to traffic the soft tailings surface for construction of a water-shedding cover resulting in delay in closing the TSF.
– Excessive quantities of capping material required to account for large settlement while still maintaining the designed closure profile.

The consolidation modelling approach proposed by Li et al. (2012) was adopted to model the consolidation behaviour of the tailings deposited in GOP TSF. This modelling approach was developed specifically for tailings deposition with high rate of rise, where large settlements are anticipated under the self-weight of the tailings.

For the analysis, the following key assumptions were made:

– The pit will be lined. Therefore, it is reasonably assumed that only one-way drainage to the top surface will occur and tailings will consolidate under a one-dimensional condition.
– The scope of work does not include additional tailings laboratory testing of the WUG tailings, the consolidation properties were assumed based on the test data provided by OGNZL.
– The additional water on top of the subaqueous tailings would have negligible effect on the consolidation of the tailings during post deposition periods.
– There is uncertainty associated with the rate of deposition into GOP TSF. For the range deposition rates considered, the rate of rise is expected to be high. For the purpose of the modelling, an average rate of rise of 7.8 m/year was adopted.

An update of the consolidation modelling will be completed at the detailed design phase to confirm results based on updated laboratory testing (slurry consolidation and permeability tests) of the WUG tailings.

## 5.4.2 Summary of results

The initial consolidation analysis was carried out to estimate the degree of consolidation as the pit is filled with tailings up to RL 1103.0 m. The average degree of consolidation was estimated to be approximately 84% after five and a half years of operation (assumed end of deposition).

The consolidation analysis for post-deposition periods was carried out to estimate how long it would take for final consolidation settlement to occur. The estimated post-deposition settlement with time is shown in Figure 24. Based on the consolidation analysis, the GOP TSF would take approximately 40 years to achieve the final consolidation of the tailings from the time of final deposition. The estimated final settlement is approximately 2.8

m. However, approximately 75% of post-deposition settlement occurs in the first 10 years after deposition is ceased.

Figure 25 shows the estimated dry density profile after the tailings are fully consolidated. The estimated dry density ranges from approximately 1.02 tonne/m$^3$ to 1.40 tonne/m$^3$.

Based on the current modelling, closure capping works would be anticipated to begin approximately seven to ten years post-deposition. The capping of the TSF is expected to take 12-24 months.

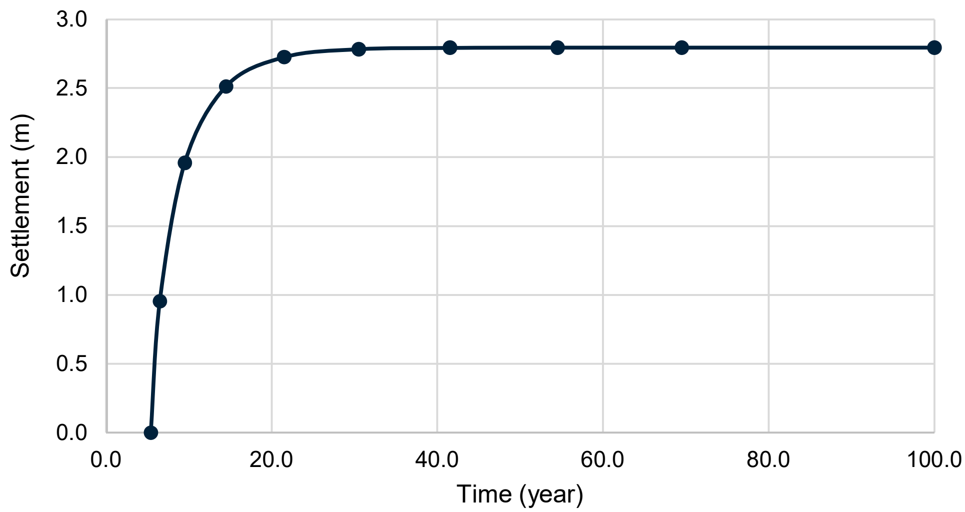


*Figure 24* ***Post deposition settlement versus time***

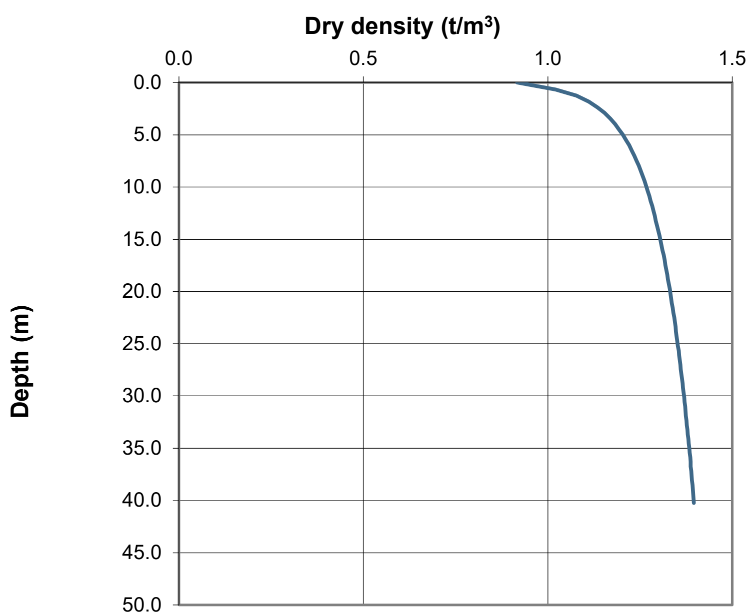


*Figure 25* ***Final dry density profile***

### 5.4.3 Sensitivity analysis

Sensitivity analysis was completed to demonstrate the effect of filling rate on the post deposition settlement and the results are shown in Figure 26. These results can help to guide the operation of GOP TSF such that the facility can be operated with a view towards closure.

In the sensitivity analysis, filling rate ranged from 2.5 years to 10 years. The post deposition settlement was estimated to be 1.9 m for a 10-year filling time and 4.4 m for 2.5-year filling time.

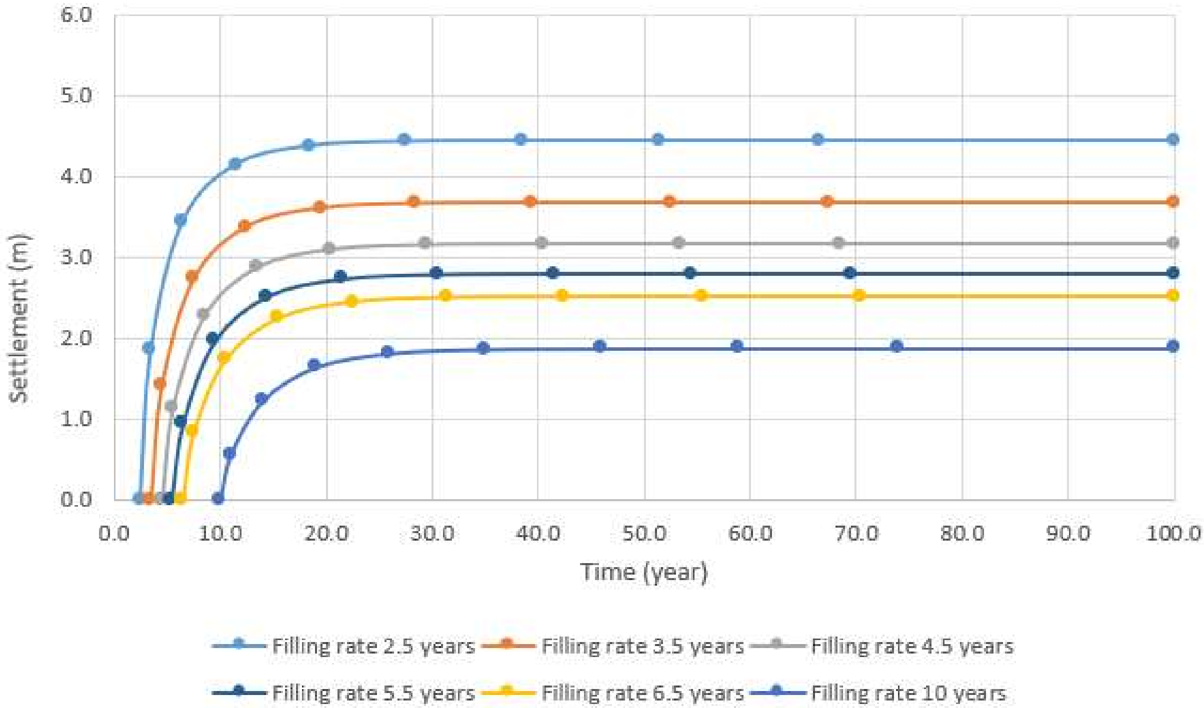


*Figure 26* ***Sensitivity analysis showing post deposition settlement versus time for different filling rates***

# 5.5 Freeboard

## 5.5.1 Wave run-up

### Overview

An empirical based assessment of a sub-aerial landslide / rockfall has been completed to assess the possible wave run-up heights if a failure of the pit wall was to occur. The assessment was based on published literature on impulse waves (Heller et al. 2009) and does not include stability analyses or an assessment on the probability of failure of pit walls.

PSM (2022) demonstrated that the likelihood of a planar and wedge scale at the inter-bench scale is low. Similarly, the risk of global failure is also low. This risk has been further reduced by the shallow slope angles of the as-mined surface above the final tailings level. The assumed failure mass is illustrated in Figure 27. The assumed bulk volume of the failure mass was 10,000 $m^3$.

Three failure scenarios were considered. These are illustrated in Figure 28 and summarised as follows:

1. A failure at location A and wave run-up at location X.
2. A failure at location B and wave run-up at location X.
3. A failure at location B and wave run-up at location Y.

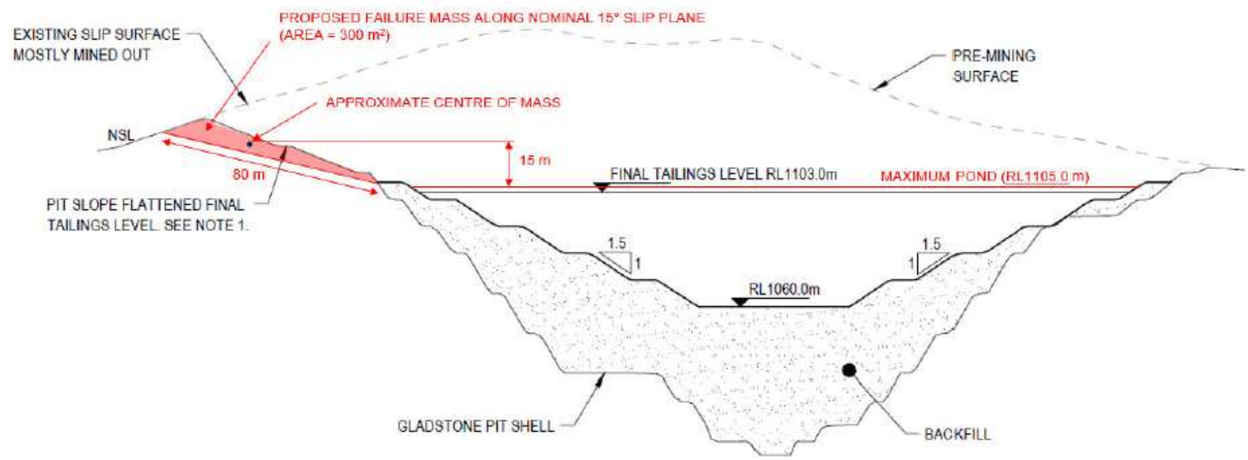


*Figure 27 Estimated failure surface for wave run-up calculations*

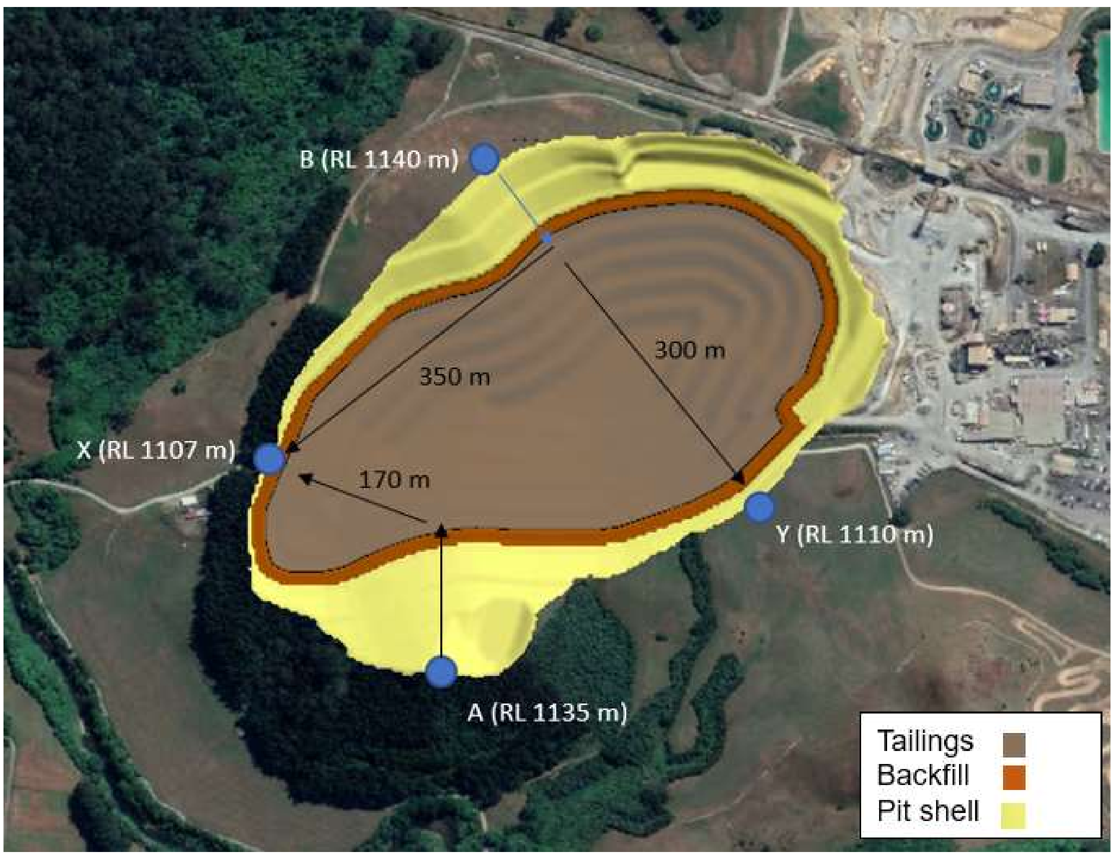


*Figure 28 Failure scenarios considered*

## Summary of results

The calculated wave run-ups for each scenario are shown in Table 8. These results demonstrated that the available freeboard above the maximum operating pond is considered reasonable to reduce the risk of a rockfall causing an overtopping wave. Note this scenario is only relevant as the tailings approach the final level (prior to this the freeboard is much larger than any potential wave run-up).

*Table 8 Wave run-up estimates*

| Scenario | Wave run-up height (m) | Freeboard above maximum decant pond level (m) | Overtop (y/n?) |
|---|---|---|---|
| 1 | 1.8 | 2 | No |
| 2 | 1.0 | 2 | No |
| 3 | 4.6 | 5 | No |

### 5.5.2 Minimum freeboard

The maximum tailings elevation is RL 1103.0 m and the minimum pit crest is RL 1107.0 m, meaning the minimum freeboard is 4 m. This freeboard accounts for the following:

– Maximum operating pond from water balance: 100,000 $m^3$
– Probable maximum precipitation (PMP): 220,000 $m^3$
– 1 m of additional freeboard for wave run-up

Note the storage is designed to be lined up to RL 1105 m, meaning wave run-up and peak extreme flood storage may be unlined. This is acceptable given the temporary nature of such an event.

### 5.5.3 Dam breach assessment

Unlike a traditional embankment TSF, the GOP TSF is an in-pit storage facility with tailings stored below ground without relying on an external embankment. Therefore, no dam breach assessment was completed for the GOP TSF and is further justified based on the following:

– There is no credible failure mode of the pit crest on the western side of the GOP TSF based on the stability analysis results in Section 5.3.3.2.
– The high walls will be mined relatively flat above the final tailings level. Consequently, the likelihood of a landslide/rockslide failure of the pit wall is significantly reduced.
– The minimum freeboard is met as described in Section 5.5.2 which accounts for the PMP, as well as wave-run up from a potential landslide-generated wave. This freeboard significantly reduces the likelihood of overtopping and tailings release.

# 6. Construction

GHD understands that OGNZL intend to complete the work through an independent Contractor supervised by OGNZL. The Contractor would complete the works in accordance with the design drawings and technical specification prepared by the Designer. The liner works are highly technical and should be completed by a lining contractor with relevant experience in projects of similar size. On site construction should be by overseen by an experienced representative of the Contractor and Designer.

The Contractor should prepare a Project Quality Plan (PQP). The PQP would set out specifically the requirements and obligations of the Contractor to ensure the GOP TSF is constructed in accordance with the design and technical specification. As a minimum, the PQP shall include:

– A project organisation chart, including nominated project personnel showing their positions, lines of communication and details of the responsibilities of the positions.
– Details of the qualifications and experience of nominated project personnel.
– A lot plan and the methods by which lots (i.e., construction areas) will be identified.
– Inspection and test plans for the various phases during construction and commissioning.
– Method statement for the key components of work.
– Application of the Contractor’s Quality System to the project.

As-constructed records from the GOP TSF construction will be the responsibility of OGNZL. The as-constructed records shall include:

– An as-built survey
– Final earthworks quantities, including breakdown by rockfill type (e.g., NAF/PAF)
– Photographic records
– A set of as-constructed drawings
– All conformance and non-conformance reports
– All test results, analyses, reports, measurements and observations
– All inspection and test plans and associated checklists

The Designer should be closely involved in the construction. The Designer should have ongoing interaction with the Contractor’s representative to ensure the design intent is achieved and that any potential deviations from the design or changes in site conditions are communicated to and acted upon by the Designer. The construction program should include milestone hold points by the Designer, with the milestone schedule to be determined during detailed design.

# 7. TSF operation and ongoing maintenance and surveillance

## 7.1 General

The following sub-section describe the operational requirements for GOP TSF in general accordance with NZSOLD *Dam Safety Guidelines* and ANCOLD *Guidelines on Tailings Dams*. Given that there are no credible breach mechanisms the operation protocol has been based on the lowest PIC (or consequence category) according to each relevant guideline.

## 7.2 Operation and maintenance requirements

An Operation, Maintenance and Surveillance (OMS) Manual should be prepared for GOP TSF (either a new OMS Manual or incorporating into the existing TSF OMS Manual) prior to commissioning. The OMS Manual should cover the following specific to GOP TSF:

- Organisational roles and responsibilities
- Design intent
- Expected behaviour of the tailings
- Tailings management plan and strategy
- Trigger action response plan
- Daily operations and inspections
- Water management procedures
- Operational requirements for mechanical and electrical works, including pumps
- Surveillance regime
- Maintenance and reporting requirements
- Operator training requirements

The OMS Manual should be updated at a minimum of every two years.

## 7.3 Surveillance requirements

The minimum surveillance frequencies for a Low PIC dam (per NZSOLD) are recommended for the GOP TSF. These are summarised in Table 9.

While formal routine inspections are noted to occur on a monthly basis, given the dynamic nature of a TSF and rapid rise rate in GOP TSF, ad-hoc visual inspections by trained operators are an essential part of the TSF surveillance regime. These impromptu inspections may not be formally documented but are anticipated to occur much more frequently than monthly during operation (e.g., daily to weekly).

*Table 9 Recommended surveillance frequencies for GOP TSF*

| Inspection type | Frequency |
|---|---|
| Routine | Monthly |
| Intermediate | On first filling then two yearly |
| Comprehensive | - |
| Special (e.g., earthquake) | As required |

## 7.4 Emergency response and preparedness

The emergency response plan for GOP TSF shall be incorporated into the OMS manual. The Waihi Operation Emergency Management Plan (EMP), which covers the entire site, shall be updated to reflect the emergency requirements for GOP TSF.

# 8. Safety in design

Safety in design is a strategy aimed at preventing injuries by considering hazards as early as possible in the planning and design process, enhancing safety through choices in the design process. A safety in design approach considers the safety of those who construct, operate, maintain, clean, repair and demolish an asset (includes building, structure, plant or equipment). Parties involved in the planning and design stage of a project are in a position to reduce the risks that arise during the life cycle of the asset and have a legal requirement to do so.

At each design stage "designers" can make a significant contribution by identifying and eliminating hazards, and reducing likely risks from hazards where elimination is not possible. Often the most cost-effective and practical approach is to avoid introducing a hazard to the workplace in the first place, by eliminating hazards at the design stage.

The definition of "designer" not only affects the actual designer but also those who are connected with the design (e.g. during construction), including parties where the end product is to be used, or could reasonably be expected to be used, as, or at a workplace (e.g. during end use, inspection, operation, cleaning, maintenance and demolition). Furthermore, the "designer" must ensure, so far as is reasonably practicable, that the plant, substance or structure is designed to minimise risks to the health and safety of workers where the design is for the purposes of a workplace.

It is therefore reasonable to consider the wider practical definition of "designer" to include:

– Design professionals
– Head contractors, project managers, clients, end-users and workers
– Quantity surveyors, insurers, quality assurance staff, work safety professionals and ergonomics practitioners
– Suppliers including manufacturers, importers, those who hire plant, constructors, installers and trades and maintenance people

GHD has been engaged by OGNZL to provide design services described in this report. As such GHD has undertaken a component of the designer's role in this project. In this role, GHD has identified and mitigated a number of potential risks within the limitations of our scope, in consultation with other members of the design team.

As part of the safety in design process, a risk assessment workshop was completed for the project on the 20$^{th}$ January 2021. Participants for the workshop included:

– OGC: Guy Butcher, Tully Davies, David Townsend, Ian Schuh, Marc Reid
– GHD: Rob Longey, Wes Herweynen, Tim Mulliner, Anthony Kirk, Phil Bennett (Geotest)
– EGL: Trevor Matuschka

The workshop was completed as part of the liner study and considered several approaches for lining the pit. The outcomes of the risk assessment fed into the selection of the lining approach for the PFS design.

# 9. Conclusions and recommendations

This report summarises the design of the GOP TSF, an in-pit tailings storage facility at Waihi Gold Mine. The following conclusions and recommendations are made based on this design:

– The proposed GOP TSF design has been completed in accordance with NZSOLD *Dam Safety Guidelines* and ANCOLD (2019) *Guidelines on Tailings Dams.*
– The design has included a geomembrane liner and underdrainage system to limit groundwater discharge to the surrounding environment.
– The underdrainage is important to maintain liner stability and minimise potential bulging of the liner prior to tailings being deposited.
– No tailings deposition is recommended until the completion of any underground workings connected to GOP due to the potential in-rush risk.
– Backfill of the pit to provide a flatter, engineered surface for lining is recommended. The backfill shall consist of ROM overburden with a processed (crushed and screened) select rock used as a liner sub-grade.
– PAF rockfill is proposed to be used for a majority of the backfill material and is recommended to be lime dosed in accordance with the rates recommended by AECOM (2025).
– The tailings rate of rise should be slowed where possible to minimise post-closure settlement and the GOP TSF should be used as a supplementary storage for a fraction of the total tailings stream, with the remaining tailings going to the other TSFs on site.
– Tailings density reconciliation through bathymetric surveys should be completed on a regular basis to confirm design assumptions related to settled dry density, rate of rise and post-deposition settlement.
– Consider inclusion of a light vehicle road in the backfill surface to provide access for remediating potential erosion damage and providing safe access for tailings pipeline installation. The access road could also be used to run the tailings and/or water return pipelines to the base of the pit.
– An OMS manual should be prepared for the GOP TSF. The emergency response plan for GOP TSF shall be incorporated into the OMS manual. The Waihi Operation Emergency Management Plan (EMP), which covers the entire site, should be updated to reflect the emergency requirements for GOP TSF.

# 10. References


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# Appendices

# Appendix A

## GOP TSF Drawings

# OCEANA GOLD NEW ZEALAND LTD
# GLADSTONE PIT TSF
# PRE-FEASIBILITY STUDY
# 12537997

N


SITE LOCATION

LOCALITY PLAN

NOT TO SCALE

DRAWING LIST

| DRG No. | DRAWING TITLE |
|---|---|
| 1237997-C001 | LOCALITY PLAN AND DRAWING LIST |
| 1237997-C002 | SITE PLAN |
| 1237997-C003 | FINAL STAGE - PLAN |
| 1237997-C004 | SECTIONS AND DETAILS |
| 1237997-C005 | TAILINGS SPIGOT DETAILS |
| 1237997-C006 | CLOSURE PLAN |
| 1237997-C007 | CLOSURE - SECTION AND DETAILS |

**PRELIMINARY**

| No | Revision | Drawn | Job Manager | Project Director | Date |
|---|---|---|---|---|---|
| B | ISSUED FOR CONSENTING | VJ | WH | RL | 17.06.22 |
| A | ISSUED FOR CLIENT COMMENT | VJ | WH | RL | 16.04.21 |

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Project **GLADSTONE PIT TSF PRE-FEASIBILITY STUDY**
Title **LOCALITY PLAN AND DRAWING LIST**

Original Size **A3** **Drawing No: 12537997-C001** **Rev: B**

Plot Date: 17 June 2022 - 2:02 PM Plotted By: Wesley Herweynen Cad File No: G:\51\12537997\CADD\Drawings\12537997-C001.dwg


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0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE

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Title **SITE PLAN**

Original Size A3 | Drawing No: **12537997-C002** | Rev: **B**

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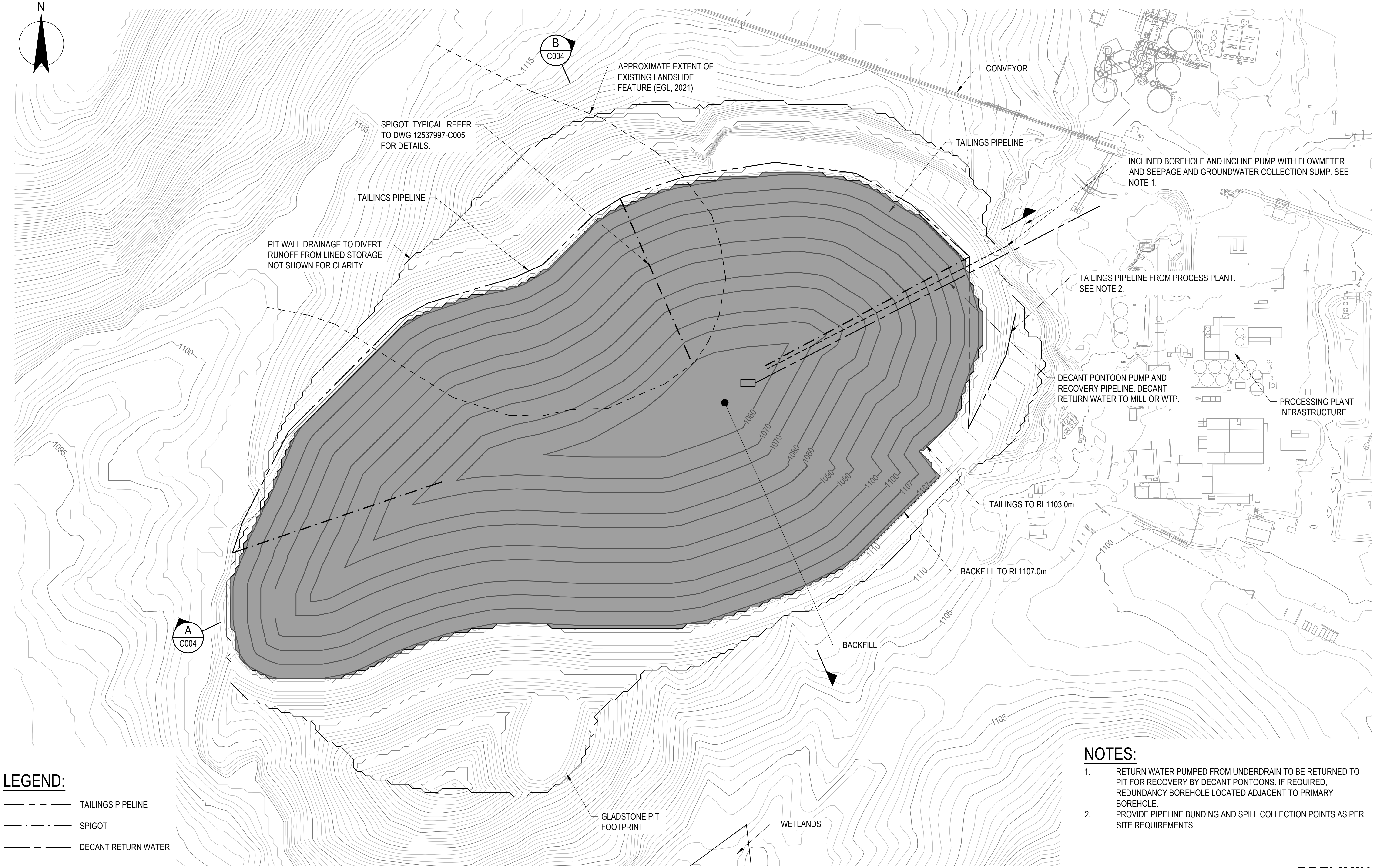


## LEGEND:

- TAILINGS PIPELINE
- SPIGOT
- DECANT RETURN WATER

## NOTES:

1. RETURN WATER PUMPED FROM UNDERDRAIN TO BE RETURNED TO PIT FOR RECOVERY BY DECANT PONTOONS. IF REQUIRED, REDUNDANCY BOREHOLE LOCATED ADJACENT TO PRIMARY BOREHOLE.
2. PROVIDE PIPELINE BUNDING AND SPILL COLLECTION POINTS AS PER SITE REQUIREMENTS.

**PRELIMINARY**

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|---|---|---|---|---|---|
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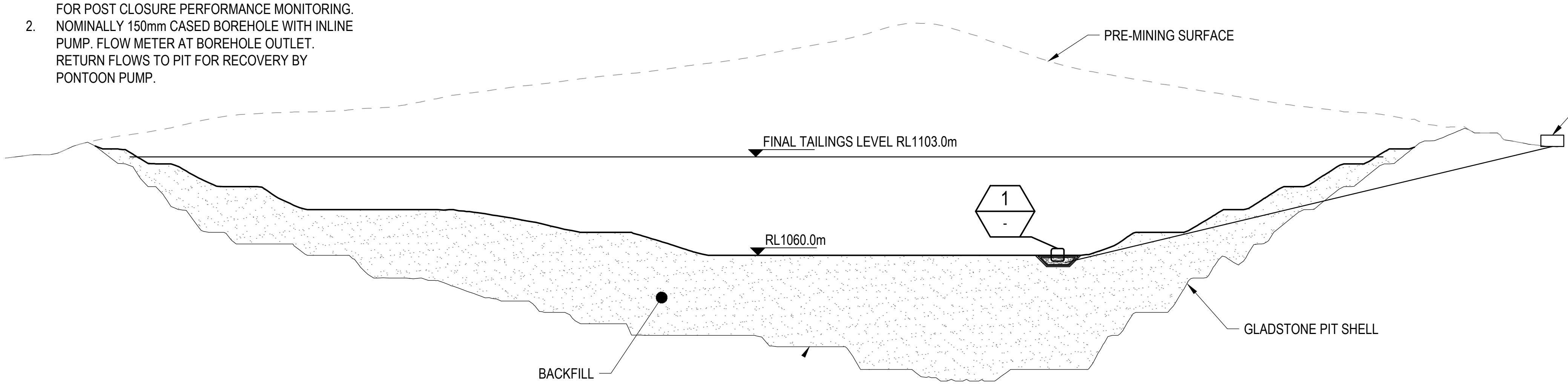
Client **OCEANA GOLD NEW ZEALAND LTD**
Project **GLADSTONE PIT TSF PRE-FEASIBILITY STUDY**
Title **FINAL STAGE PLAN**
**FINAL STAGE BACKFILL PLAN**

Original Size A3 | Drawing No: **12537997-C003** | Rev: **B**

Plot Date: 17 June 2022 - 2:03 PM Plotted By: Wesley Herweynen Cad File No: G:\51\12537997\CADD\Drawings\12537997-C003.dwg

# NOTES:

1. INSTALL SLOPE MONITORING INSTRUMENTATION FOR POST CLOSURE PERFORMANCE MONITORING.
2. NOMINALLY 150mm CASED BOREHOLE WITH INLINE PUMP. FLOW METER AT BOREHOLE OUTLET. RETURN FLOWS TO PIT FOR RECOVERY BY PONTOON PUMP.

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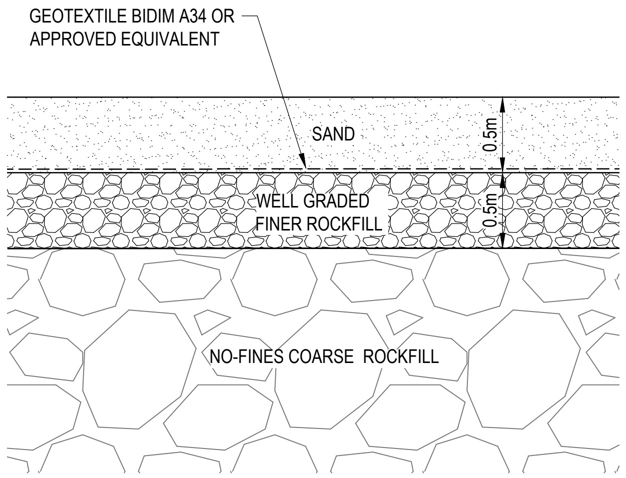


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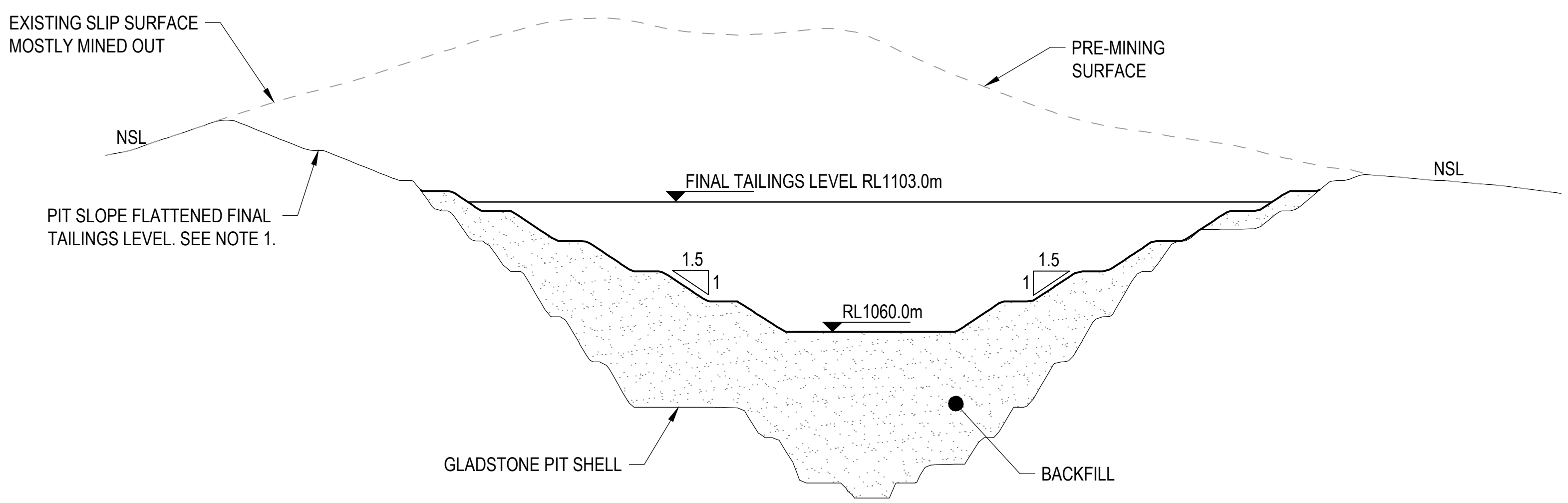


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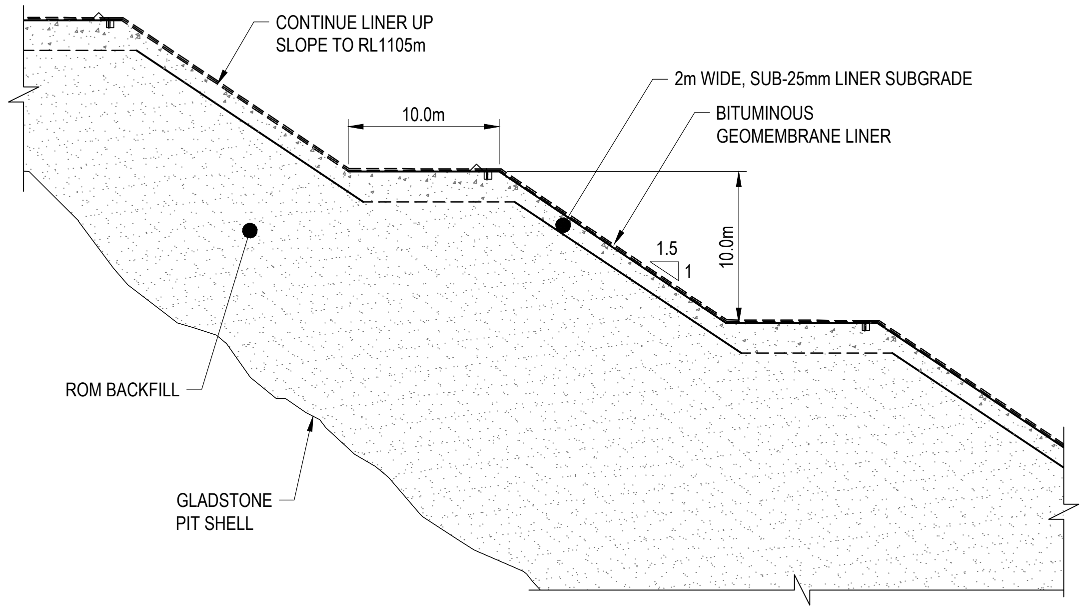


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**DO NOT SCALE**



Drawn V. JENKINS | Designer W. HERWEYNEN
Drafting Check | Design Check
Approved (Project Director)
Date
Scale AS SHOWN
This Drawing must not be used for Construction unless signed as Approved

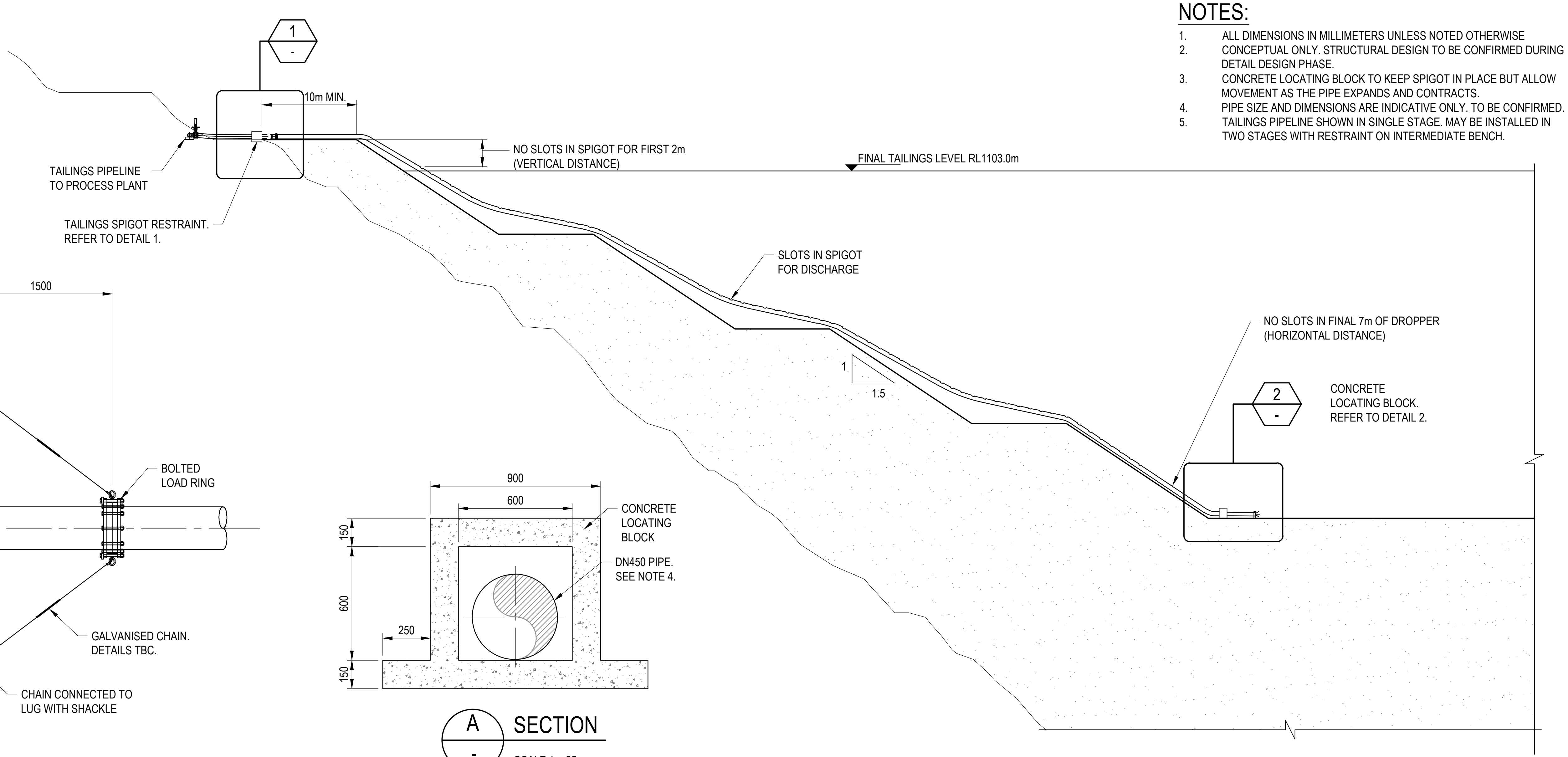
Client **OCEANA GOLD NEW ZEALAND LTD**
Project **GLADSTONE PIT TSF PRE-FEASIBILITY STUDY**
Title **SECTIONS AND DETAILS**

Original Size A3 Drawing No: **12537997-C004** Rev: **B**


Plot Date: 17 June 2022 - 2:26 PM Plotted By: Wesley Herweynen Cad File No: G:\51\12537997\CADD\Drawings\12537997-C004-C005 - UPDATED.dwg

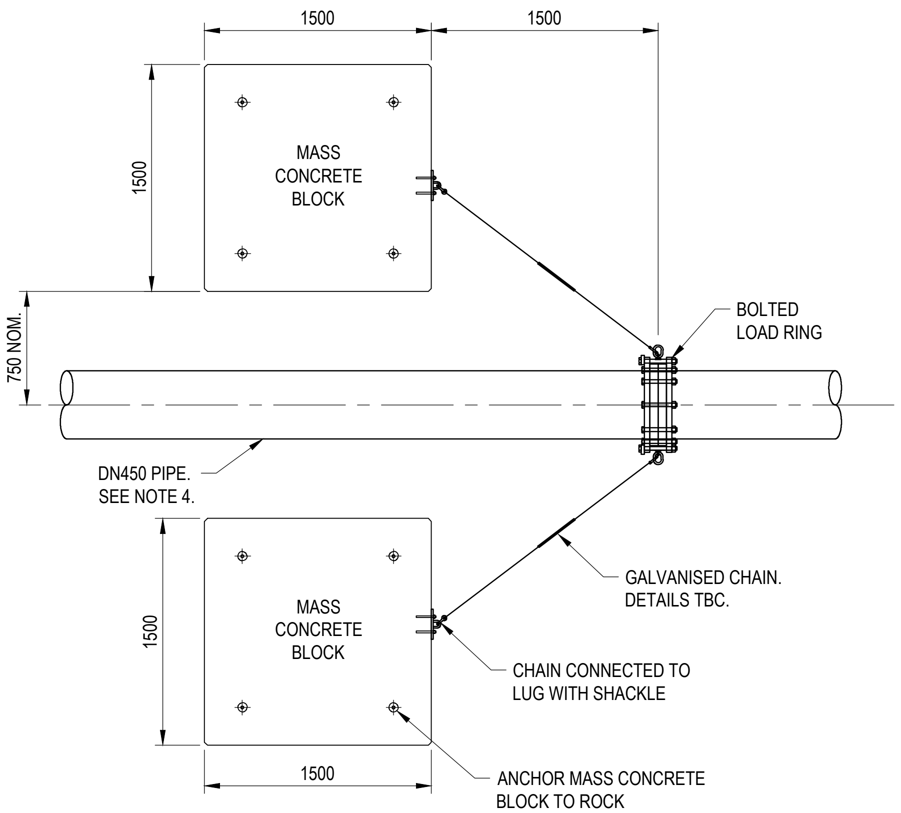
## NOTES:

1. ALL DIMENSIONS IN MILLIMETERS UNLESS NOTED OTHERWISE
2. CONCEPTUAL ONLY. STRUCTURAL DESIGN TO BE CONFIRMED DURING DETAIL DESIGN PHASE.
3. CONCRETE LOCATING BLOCK TO KEEP SPIGOT IN PLACE BUT ALLOW MOVEMENT AS THE PIPE EXPANDS AND CONTRACTS.
4. PIPE SIZE AND DIMENSIONS ARE INDICATIVE ONLY. TO BE CONFIRMED.
5. TAILINGS PIPELINE SHOWN IN SINGLE STAGE. MAY BE INSTALLED IN TWO STAGES WITH RESTRAINT ON INTERMEDIATE BENCH.




TYPICAL SPIGOT DETAIL

NOT TO SCALE



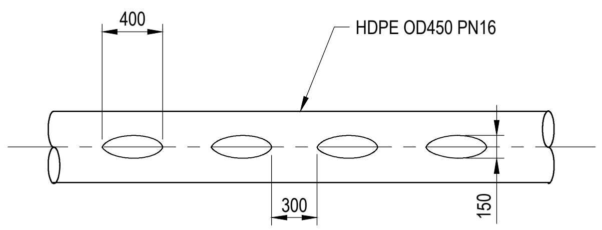

1 - DETAIL - PLAN

SCALE 1 : 50

900
600
CONCRETE LOCATING BLOCK
150
DN450 PIPE. SEE NOTE 4.
600
250
150

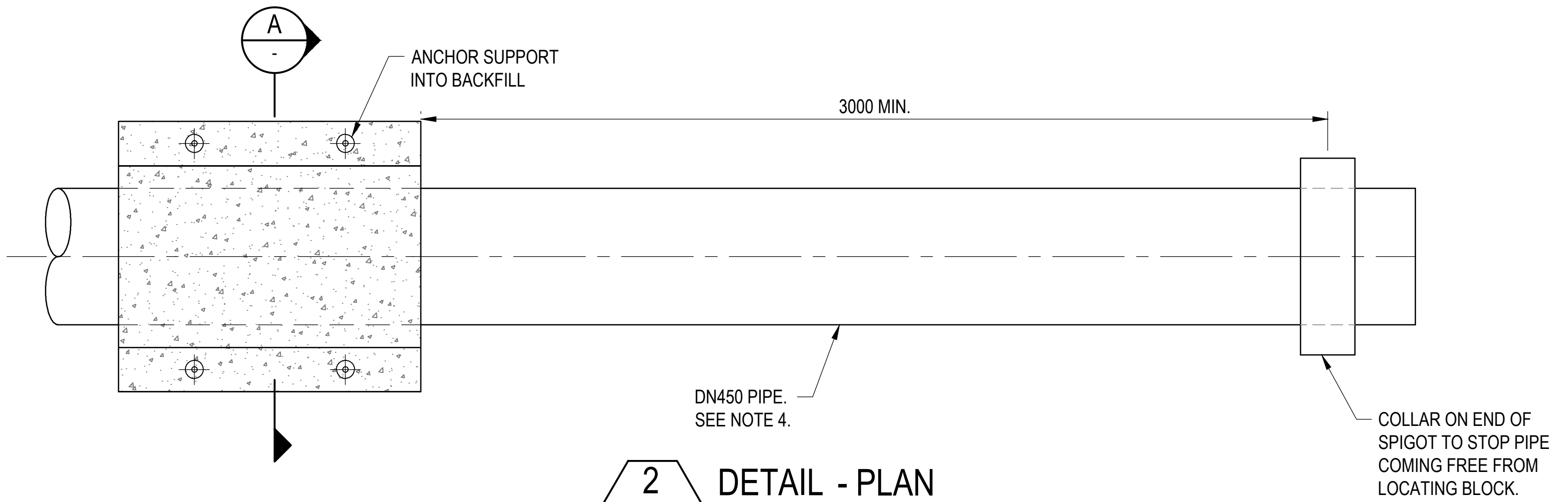
A - SECTION

SCALE 1 : 25




SLOT DETAIL

NOT TO SCALE




2 - DETAIL - PLAN

SCALE 1 : 25

**PRELIMINARY**

| No | Revision | Drawn | Job Manager | Project Director | Date |
|---|---|---|---|---|---|
| B | ISSUED FOR CONSENTING | VJ | WH | RL | 17.06.22 |
| A | ISSUED FOR CLIENT COMMENT | VJ | WH | RL | 16.04.21 |

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 500 1000 1500mm SCALE 1:50 AT ORIGINAL SIZE

0 5 10 15m SCALE 1:500 AT ORIGINAL SIZE

0 250 500 750mm SCALE 1:25 AT ORIGINAL SIZE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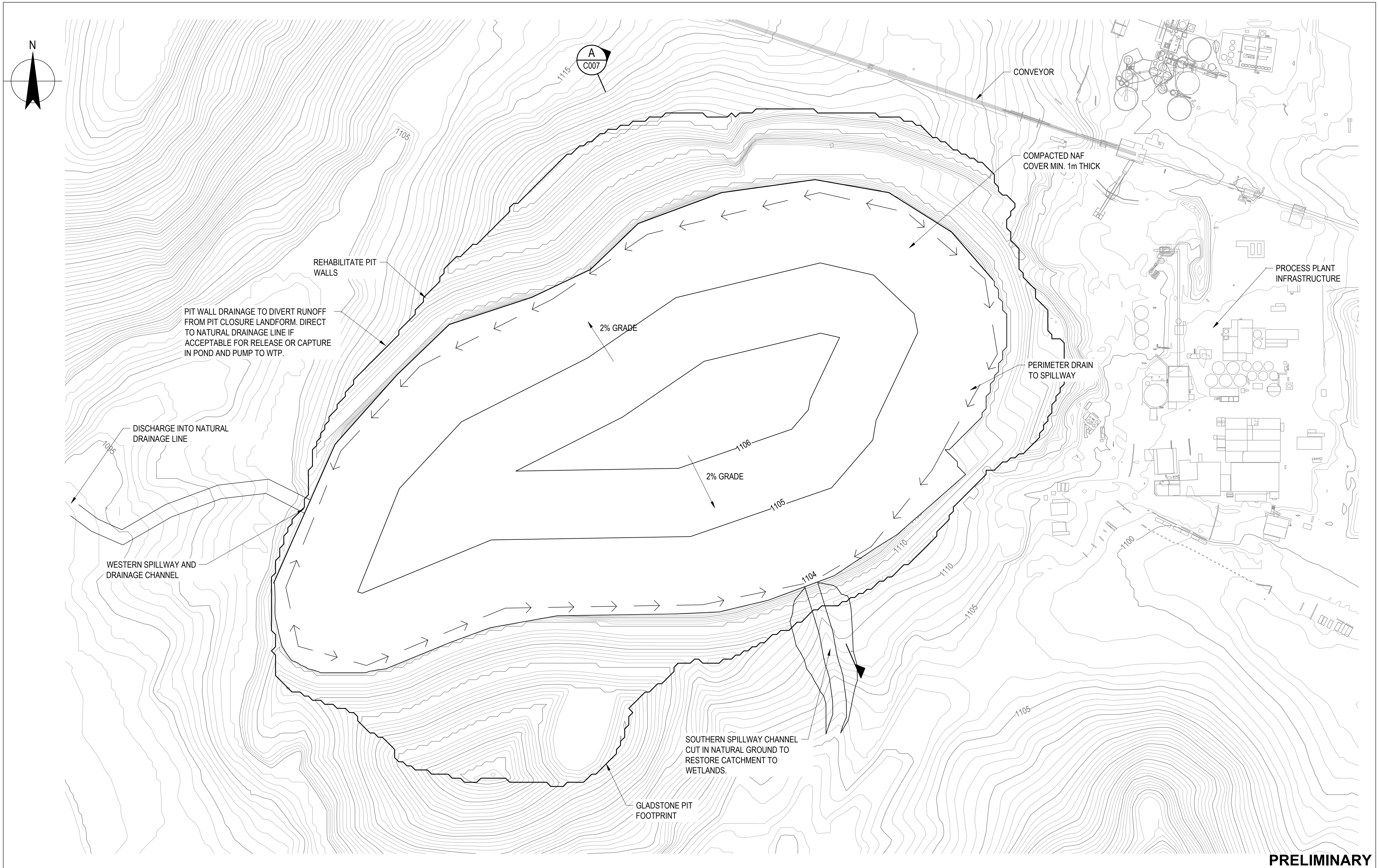
Client **OCEANA GOLD NEW ZEALAND LTD**
Project **GLADSTONE PIT TSF PRE-FEASIBILITY STUDY**
Title **TAILINGS SPIGOT DETAILS**

Original Size A3 | Drawing No: **12537997-C005** | Rev: **B**

Plot Date: 17 June 2022 - 2:08 PM Plotted By: Wesley Herweynen Cad File No: G:\51\12537997\CADD\Drawings\12537997-C004-C005 - UPDATED.dwg




**PRELIMINARY**

| No | Revision | Drawn | Job Manager | Project Director | Date |
|---|---|---|---|---|---|
| B | ISSUED FOR CONSENTING | VJ | WH | RL | 17.06.22 |
| A | ISSUED FOR CLIENT COMMENT | VJ | WH | RL | 16.04.21 |

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0 25 50 75m
SCALE 1:2500 AT ORIGINAL SIZE

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|---|---|---|---|
| Drawn | V. JENKINS | Designer | W. HERWEYNEN |
| Drafting Check | | Design Check | |
| Approved (Project Director) | | | |
| Date | | | |
| Scale | 1:2500 | This Drawing must not be used for Construction unless signed as Approved | |

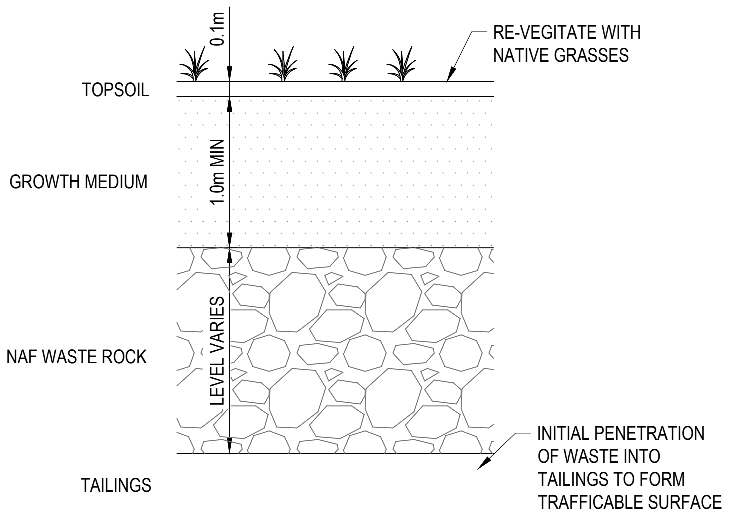
Client **OCEANA GOLD NEW ZEALAND LTD**
Project **GLADSTONE PIT TSF PRE-FEASIBILITY STUDY**
Title **CLOSURE PLAN**

Original Size **A3** Drawing No: **12537997-C006** Rev: **B**

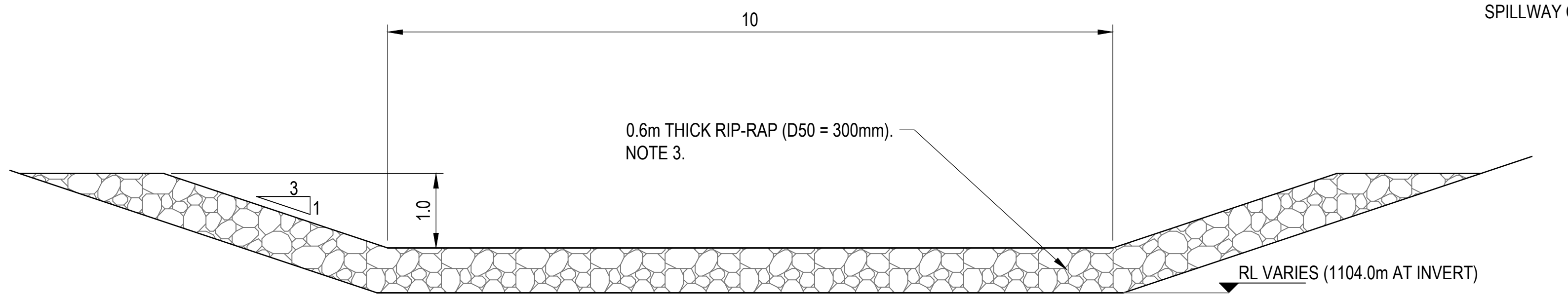
Plot Date: 17 June 2022 - 3:02 PM Plotted By: Wesley Herweynen Cad File No: G:\51\12537997\CADD\Drawings\12537997-C006.dwg

# NOTES:

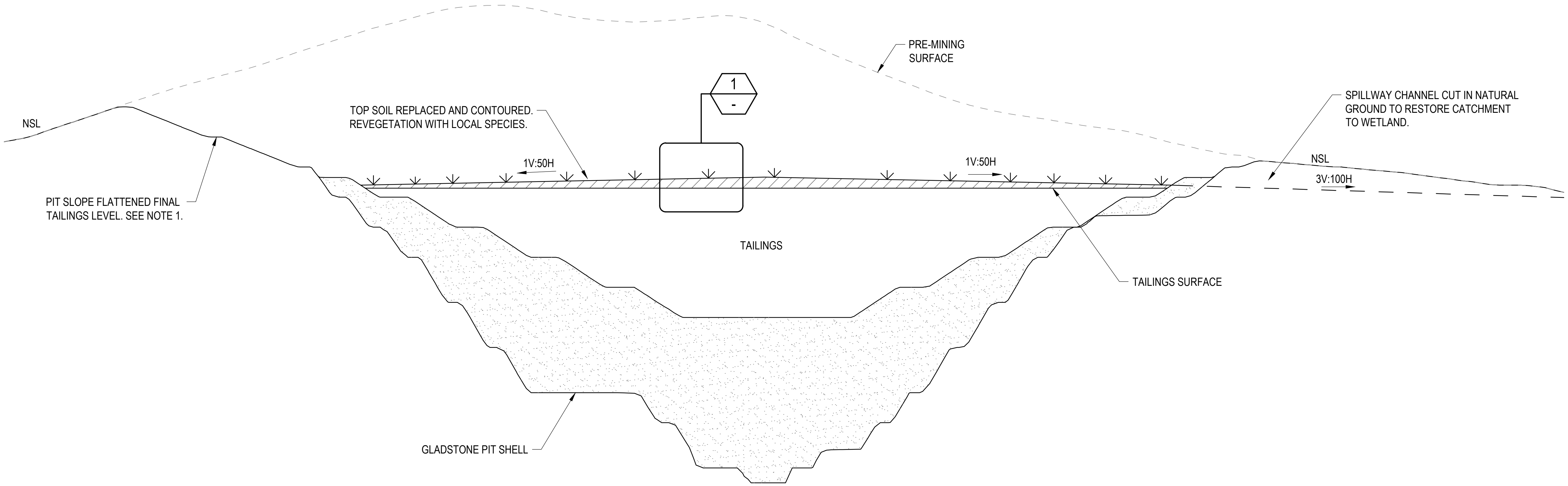
1. INSTALL SLOPE MONITORING INSTRUMENTATION FOR POST CLOSURE PERFORMANCE MONITORING.
2. CAP AND RE-VEGETATE PIT WALLS, AS REQUIRED.
3. PLACE RIP-RAP FOR EROSION PROTECTION WHERE SPILLWAY CUT THROUGH HIGHLY WEATHERED ROCK.




1 - DETAIL
SCALE 1 : 50




CLOSURE SPILLWAY CHANNEL TYPICAL SECTION
SCALE 1:100




A C006 SECTION
SCALE 1 : 1500

**PRELIMINARY**

| No | Revision | Drawn | Job Manager | Project Director | Date |
|---|---|---|---|---|---|
| B | ISSUED FOR CONSENTING | VJ | WH | RL | 17.06.22 |
| A | ISSUED FOR CLIENT COMMENT | VJ | WH | RL | 16.04.21 |

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0 0.5 1.0 1.5m
SCALE 1:50 AT ORIGINAL SIZE

0 1 2 3m
SCALE 1:100 AT ORIGINAL SIZE

0 15 30 45m
SCALE 1:1500 AT ORIGINAL SIZE


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| Drawn | V. JENKINS | Designer | W. HERWEYNEN |
| Drafting Check | | Design Check | |
| Approved (Project Director) | | | |
| Date | | | |
| Scale | AS SHOWN | This Drawing must not be used for Construction unless signed as Approved | |

Client **OCEANA GOLD NEW ZEALAND LTD**
Project **GLADSTONE PIT TSF PRE-FEASIBILITY STUDY**
Title **CLOSURE - SECTION AND DETAILS**

Original Size **A3** **Drawing No: 12537997-C007** **Rev: B**

Plot Date: 17 June 2022 - 3:07 PM Plotted By: Wesley Herweynen Cad File No: G:\51\12537997\CADD\Drawings\12537997-C007.dwg

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The Power of Commitment