SOUTHERNSKIES ENVIRONMENTAL

EROSION AND SEDIMENT CONTROL ASSESSMENT REPORT

Waihi North Project

Prepared for OceanaGold New Zealand Limited

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Limitations
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CONTENTS

1. INTRODUCTION

This Erosion and Sediment Control Assessment Report (**ESCAR**) provides:

- the overarching erosion and sediment control (**ESC**) principles and procedures for the earthwork activities associated with the OceanaGold New Zealand Ltd (OGNZL) Waihi North Project (**the Project**);
- an assessment of the effectiveness of those ESC principles and procedures in minimising potential sediment discharges to an acceptable level; and
- concepts that inform the development of the Site-Specific Erosion and Sediment Control Plans (**SSESCPs**).

It is to be read in conjunction with the following appended documents:

- Chemical Treatment Management Plan (**CTMP**);
- Erosion and Sediment Control Monitoring Plan; and
- SSESCPs.

The ESCAR and supporting documents address the management of non-acid forming (**NAF**) soils that are to be exposed and placed during the Project development (for example site establishment works and NAF stockpiling). Runoff from all potential acid forming (**PAF**) material will be directed to the existing Water Treatment Plant**.** That runoff is acknowledged in this ESCAR but is not assessed.

Prior to earthworks commencing in each area, the corresponding SSESCP will be finalised and provided to Waikato Regional Council (WRC) for certification as required by the conditions of consent. This approach is standard practice and allows for flexibility, fine tuning and ownership of the ESC measures and methodologies by the project manager.

2. PROJECT DESCRIPTION

2.1. Overview

The Project represents the further development of the mineral resources in the Waihi Epithermal District. It comprises the following components (see Figures 1 to 5 below):

- Wharekirauponga underground (**WUG**) mine:
  - Surface infrastructure to support WUG located on farmland (owned by OGNZL) at Willows Road.
  - Underground access to dual tunnels extending to the Wharekirauponga orebody and a connecting tunnel from the dual tunnels to the existing Processing Plant at Waihi.
  - Exploratory drilling and vent shafts located at points along the tunnels to the ore body.
- Gladstone Open Pit (**GOP**):
  - A new open pit to the west of the Processing Plant, with associated infrastructure. This will require the relocation of the Martha Underground (**MUG**) portal, with the new portal opening also providing access to Wharekirauponga underground mine portal (**WUG portal**).
- Tailings Storage Facility 3 (**TSF3**):
  - A new tailing storage facility impoundment located to the east of the existing TSF1A, constructed to crest height of 155m RL.
- Northern Rock Stack (**NRS**):
- A new rock storage facility to be established north of existing TSF2. Processing Plant Upgrade:

  - An upgrade of the Processing Plant to increase its capacity from 1.25 million tonnes per annum to 2.25 million tonnes per annum.
- Water Treatment Plant Upgrade:
  - An upgrade of the existing Water Treatment Plant (**WTP**) to double its current treatment capacity.
- Reconsenting of the existing treated water discharge consents.

The specific details of each component of the Project are described in the Assessment of Environmental Effects (**AEE**), prepared by Mitchell Daysh, and the SSESCPs provided in Appendix C.

2.2. Wharekirauponga Underground Mine – Willows Road

Surface works associated with the Wharekirauponga underground mine, and Willows Road site will comprise:

- A new Portal.
- Willows Waste Rock Stack.
- Surface Magazine Storage Area.
- Topsoil Stockpiling.
- Surface Facilities Area.
- Access roads.
- Exploratory drilling and vent shafts.
- Willows Farm Helipad
- Services Trench - Utility corridor from the Willows Road site to the existing Processing Plant at Baxter Road.
  - The activities associated with the Service Trench has been submitted as a separate resource consent application.

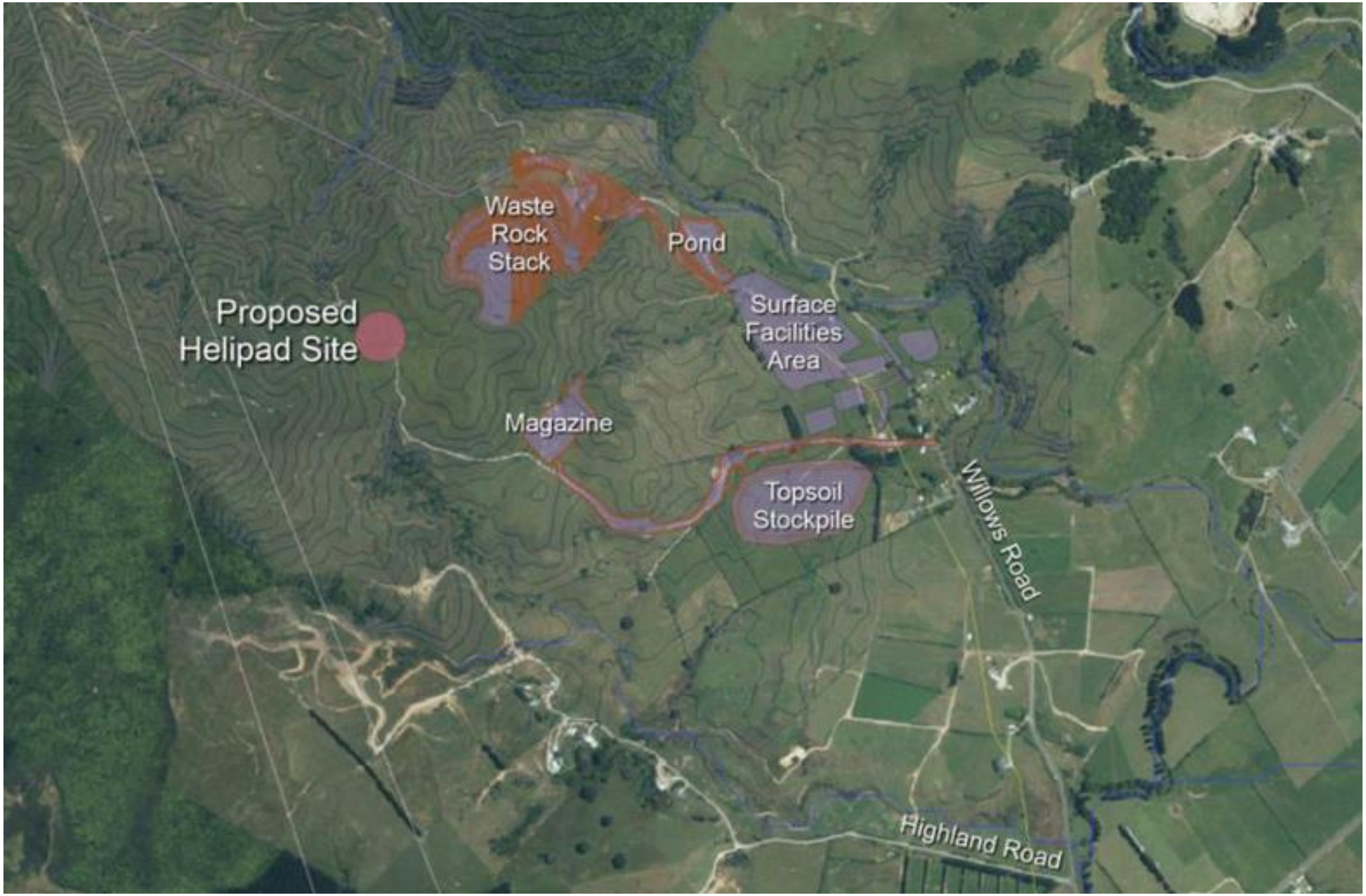

Figure 1: Willows Road Surface Facilities Area General Arrangements (Source: OGNZL).

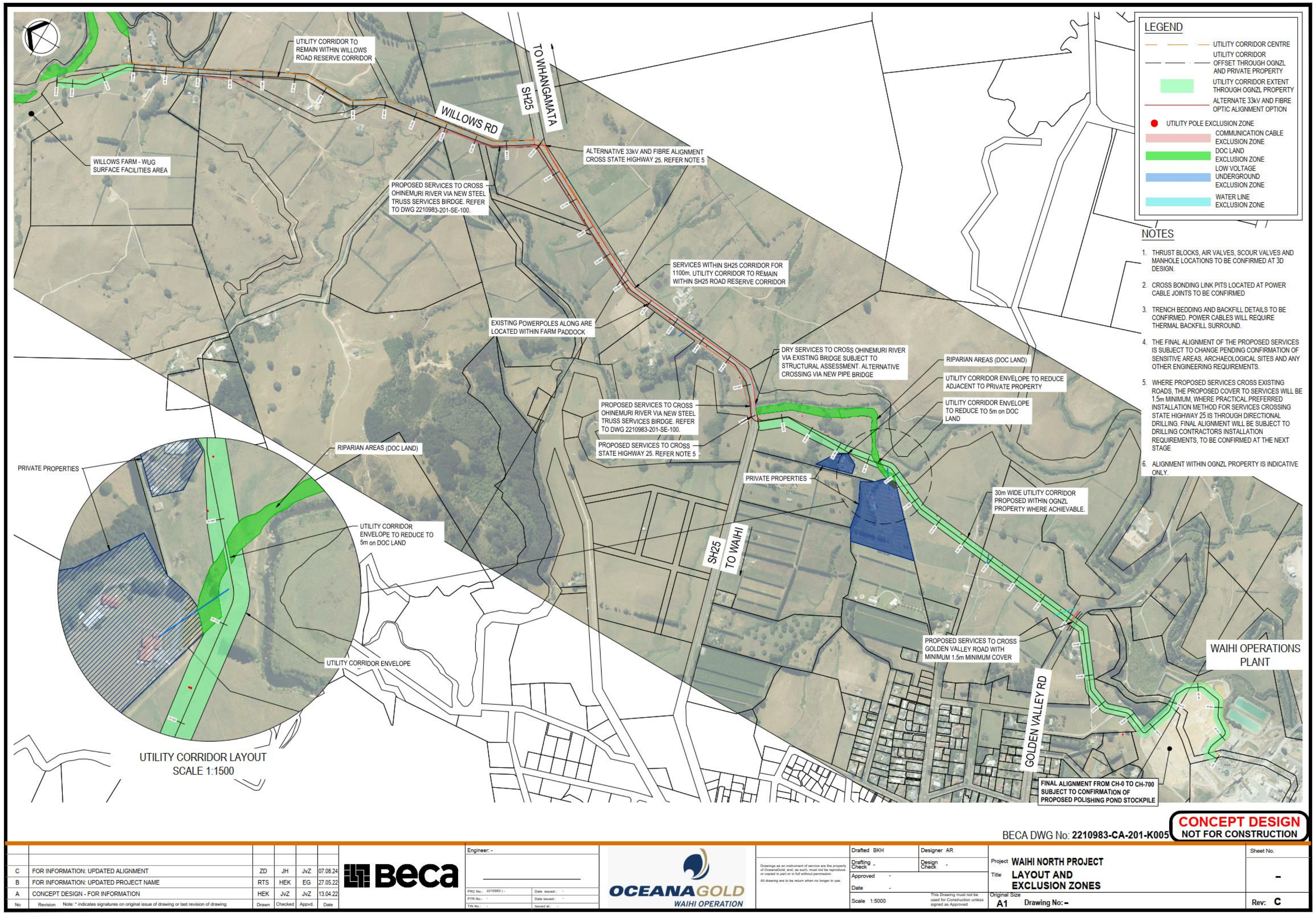

Figure 2: Services Trench layout and exclusion zones (Source: BECA).

2.3. Gladstone Open Pit

GOP is a new open pit to the west of the Processing Plant. The earthworks operations to establish the pit will include:

- Establishment of erosion and sediment control measures (clean water control, sediment retention devices and dirty (site) water control);
- Initial vegetation clearance and topsoil stripping;
- Establishment of the Southern Stockpile for the storage of topsoil and initial overburden (NAF material) adjacent to the pit footprint; and
- Establishment of laydown and working yard areas.

Once the pit excavation becomes inverted all site water will report to the pit and be managed via pumping to the existing WTP.

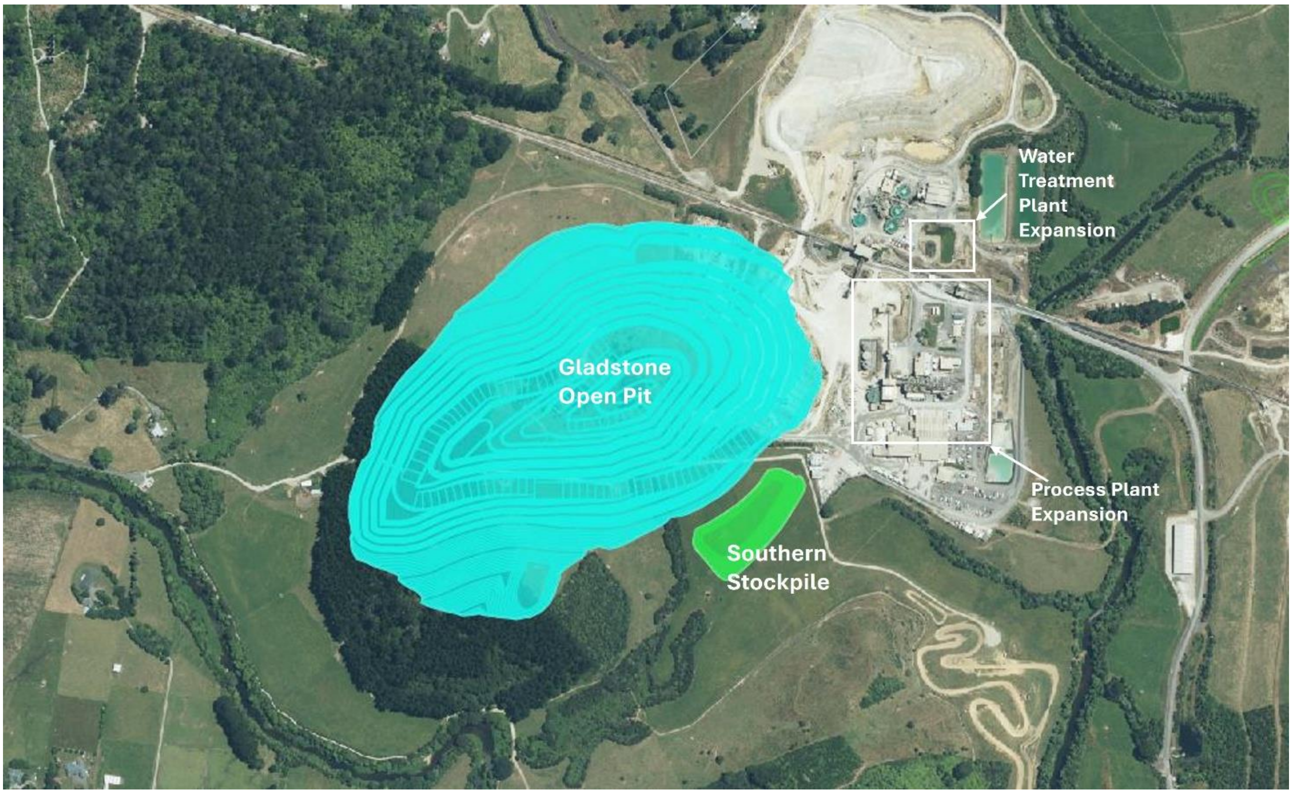

Figure 3: Gladstone Pit (Source: OGNZL).

2.4. Northern Rock Stack

The NRS is a new rock storage facility to be established to the north of TSF2, involving the following earthwork and stream work operations:

- Initial vegetation clearance and topsoil stripping;
- Establishment of the upper catchment cleanwater diversion channel;
- Establishment of erosion and sediment control measures (cleanwater control, sediment retention devices and dirty (site) water control);
- Establishment of stockpile areas for the topsoil and initial overburden (non-acid forming material) adjacent to the Northern Rock Stack footprint;
- Ground improvements and water collection drains;

- Construction of a new workshop and yard;
- Construction of a water collection pond; and
- Construction of the structural perimeter bunds.

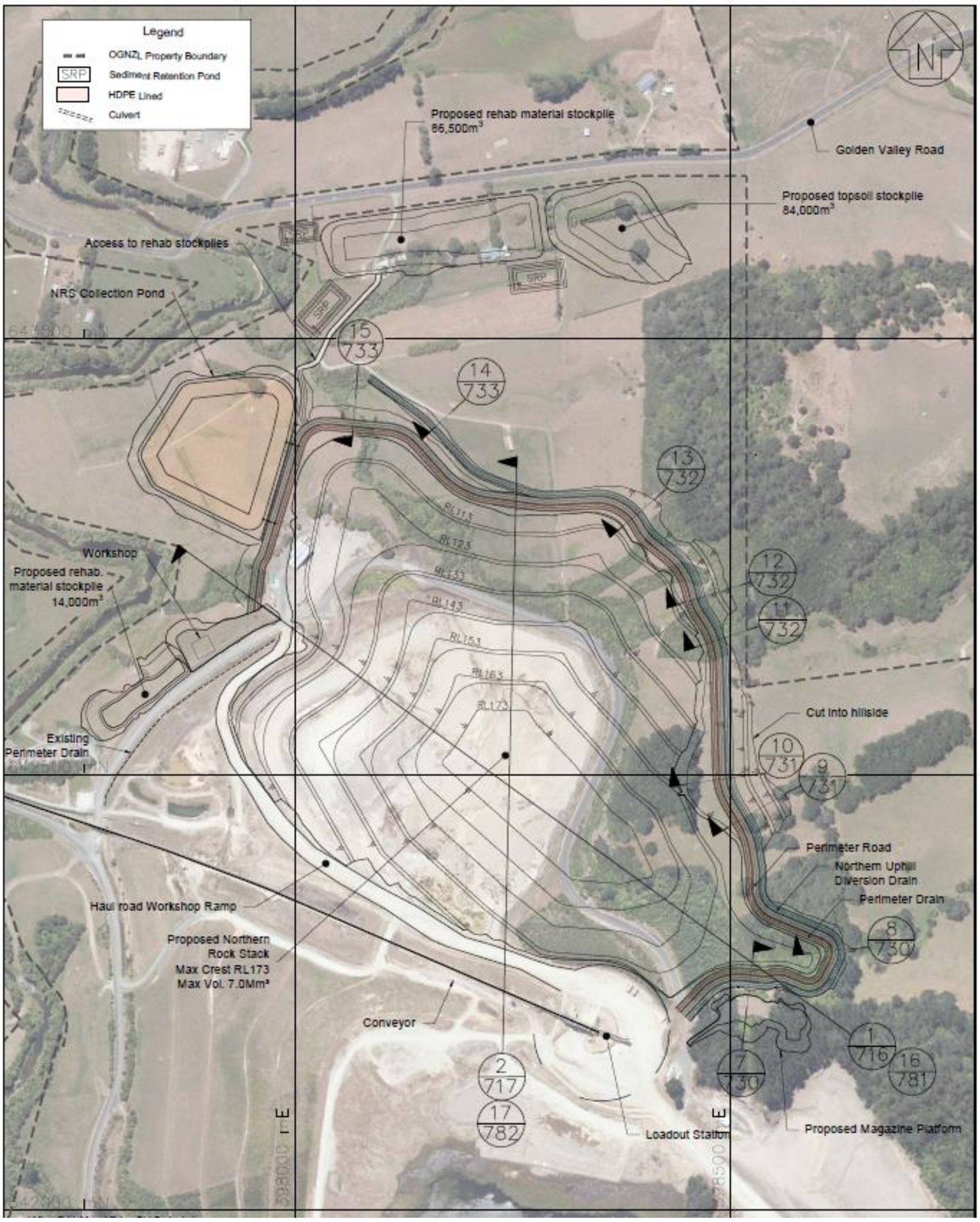

Figure 4: Northern Rock Stack (Source: Engineering Geology Limited).

2.5. Tailings Storage Facility 3

It is expected that the construction of TSF3 will precede mining of the GOP and Martha open pit. Waste rock to construct the TSF3 embankment will be initially sourced from material borrowed from within the TSF3 footprint and on the eastern side of the NRS.

TSF3 is proposed to be constructed immediately east of the established TSF1A.

The construction of this facility will initially utilise NAF, which will drain to traditional sediment control measures, and then PAF that will drain to the new Collection Pond (once constructed). The Collection Pond will drain to the existing WTP.

The establishment of TSF3 involves the following earthwork and streamwork operations:

- Progressive establishment of a permanent upper catchment clean water diversion channel, with associated fills and stockpiles;
- Establishment of erosion and sediment control measures, including temporary clean water diversions, sediment retention ponds and other devices;
- Establishment of stockpile areas for the topsoil and initial overburden (non-acid forming material) adjacent to the TSF3 footprint;
- Ground improvements including excavation of paleo-gully deposits;
- Formation of the permanent containment bund, access road, and permanent stormwater collection pond; and
- Stream realignments of unnamed tributaries of the Ruahorehore Stream.

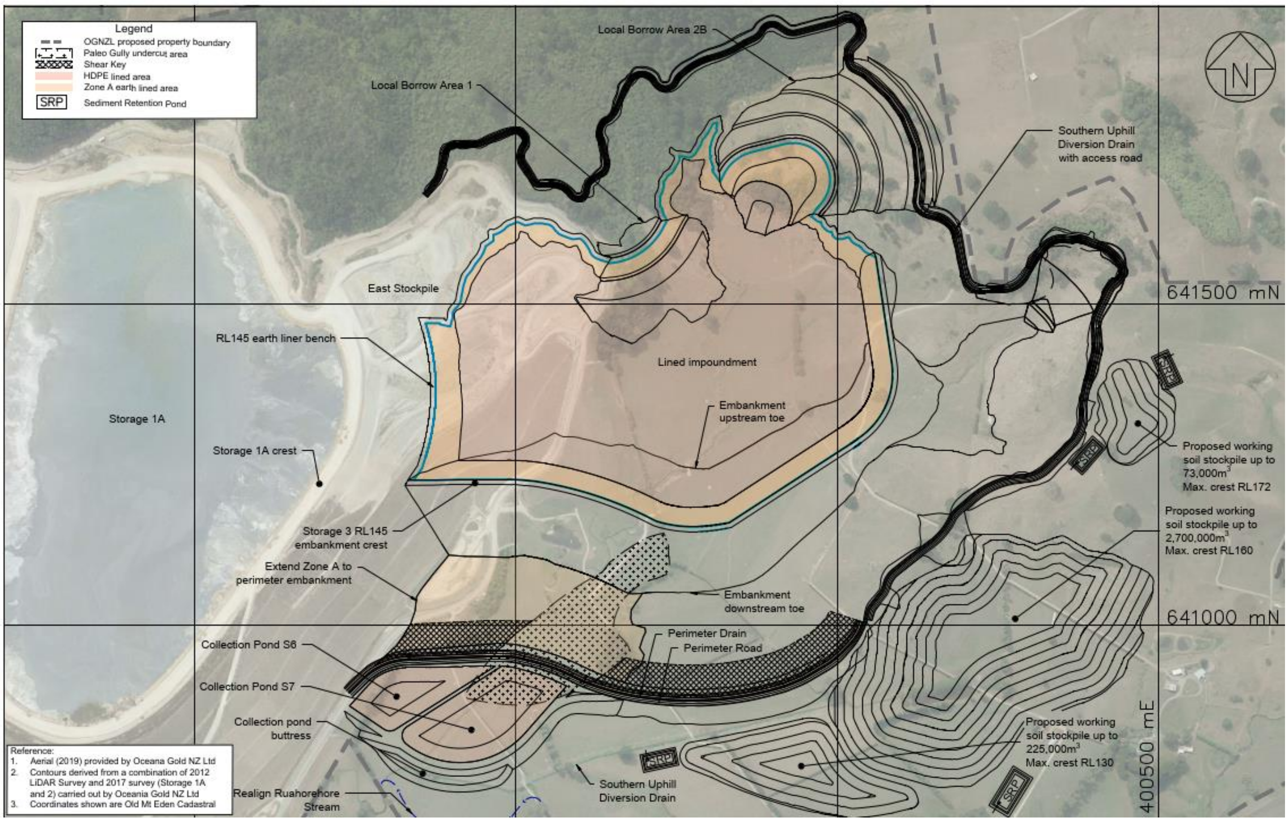

Figure 5: TSF3 design and layout (Source: Engineering Geology Limited).

2.6. Earthworks Summary

Table 1 summarises the total earthworks areas anticipated for the Project. However, runoff from all PAF material will be directed to the permanent collection ponds and treated via the existing WTP. That runoff is not addressed in this report, but the SSESCPs do identify the staging of works and the extent of works that will be treated via sediment retention devices and the extent and timing of diversion of runoff to the WTP.

Additional earthworks will be required for the WUG, but this is considered mining operations and runoff will be directed to the collection ponds and WTP for treatment.

Minor excavations are required within the Coromandel Forest Park to assist with establishing drill sites and associated with the construction of vent raises. Ecological suitability and geotechnical assessments will be undertaken to confirm suitability of these sites. Geotechnical investigations at each shaft site will require the clearance of approximately 12m by 12m of vegetation. Following the clearance, a temporary 10m by 10m drilling pad will be constructed.

Appropriate ESC measures will be incorporated, which given the minor nature of the works will generally include silt fence or silt socks.

Table 1: Anticipated earthworks areas.

Site	Area (ha)
Willows Road Site (Surface Facilities Area, Willows Rock Stace, Wharekirauponga Underground Mine)	18.2
Willows Road to Baxter Road Services Trench (4,849 m long, average maximum trench width 2.5m)	4.36
Gladstone Pit	18.7
Northern Rock Stack	24
Tailings Storage Facility 3	95

3. RECEIVING ENVIRONMENTS

3.1. Summary of Environments

OGNZL's Waihi operation is located within the Waihou-Piako catchment. Discharges from the WNP will enter the Mataura Stream, Ohinemuri River or Ruahorehore Stream before joining the Waihou River and eventually flowing to sea at the Firth of Thames.

The earthworks sites are within the Ohinemuri River and Ruahorehore Stream catchments, as summarised in Table 2. The freshwater ecological characteristics of the receiving environments are described in the Ecological Assessment prepared by Boffa Miskell[1].

Table 2: Sediment retention device receiving environments.

Site	Receiving Environment	Comments
Willows Road Site	Unnamed tributary and Mataura Stream (Ohinemuri tributary).	Runoff will be treated by ESC measures that will discharge overland and via drainage channels to an unnamed tributary, approximately 1km channel length upstream of the river.
Services Trench	Ohinemuri River.	The trench alignment will cross various overland flow paths and drains that fall towards the river. It will also require services crossing of the river at Willows Road and State Highway 25.
Gladstone Pit	Two unnamed tributaries Ohinemuri River.	Runoff will be treated by ESC measures that will discharge overland to two tributaries that discharge to the river approximately 400m from the site. The southern tributary contains the wetland.

[1] *Freshwater Ecological Effects Assessment*; 1 June 2022, prepared by Boffa Miskell

Northern Rock Stack	TB1 Stream and Ohinemuri River.	TB1 Stream to be diverted into new constructed channel and middle and lower reaches and tributaries to be reclaimed. ESC controls will treat runoff during construction. Other ESC ponds will discharge across land to the Ohinemuri River.
Tailings Storage Facility 3	Unnamed tributaries and Ruahorehore Stream.	Farm drains and some modified tributaries to be reclaimed. Runoff treated by ESC measures will discharge to tributaries and Ruahorehore Stream.

4. STATUTORY CONSIDERATIONS

A high-level summary of the statutory considerations applicable to the proposed erosion and sediment control provisions of the WNP relevant to the Fast-track Approvals Act is set out below, with further coverage of this provided in the Assessment of Environmental Effects prepared by Mitchell Daysh Limited.

4.1. Resource Management Act

The Resource Management Act 1991 (**RMA**) regulates the activities associated with the Project. Section 9 of the RMA governs land disturbance as a land use activity and Section 15 governs discharges of contaminants (including sediment) to land and water. The RMA is given effect to by National Environmental Standards, National Policy Statements and Regional and District Plans.

Section 105 of the RMA requires applications for discharge permits to have regard to the nature of the discharge and sensitivity of the receiving environment to adverse effects, the reasons for the proposed discharge method selected and any potential alternative methods. The proposed ESC methodology takes account of the relevant matters listed in s105 of the RMA.

Where practicable, OGNZL has sought to ensure that construction phase discharges discharge to land in the first instance to minimise the potential for sediment and/or contaminant to enter water. Where construction effects occur within a waterbody, best practice erosion and sediment control principles and procedures (as described in sections 5 and 6) will ensure that any downstream effects are temporary and minor.

Consistent with the outcomes required by Section 107 of the RMA, the adoption of the proposed ESC methodology is anticipated to avoid, after reasonable mixing, all or any of the following effects in the receiving waters:

- the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
- any conspicuous change in the colour or visual clarity;
- any emission of objectionable odour;
- the rendering of fresh water unsuitable for consumption by farm animals; or
- any significant adverse effects on aquatic life.

The erosion and sediment control principles and procedures described in sections 5 and 6 will ensure that the construction phase of the project will not give rise to any of the above effects.

4.2. Overview of National and Regional Policy Directives

4.2.1. National Policy Statement for Freshwater Management 2020

The National Policy Statement for Freshwater Management 2020 (**NPSFM**) contains an objective and various policies relating to the management water quality and quantity.

The policies of the NPSFM most relevant to the potential effects of sediment discharges during the construction phase of the Project are:

- Policy 1: Freshwater is managed in a way that gives effect to Te Mana o te Wai.
- Policy 2: Tangata whenua are actively involved in freshwater management (including decision-making processes), and Māori freshwater values are identified and provided for.
- Policy 3: Freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments.
- Policy 5: Freshwater is managed through a National Objectives Framework to ensure that the health and well-being of degraded water bodies and freshwater ecosystems is improved, and the health and well-being of all other water bodies and freshwater ecosystems is maintained and (if communities choose) improved.
- Policy 7: The loss of river extent and values is avoided to the extent practicable.
- Policy 9: The habitats of indigenous freshwater species are protected.
- Policy 12: The national target (as set out in Appendix 3 of the NPSFM) for water quality improvement is achieved.
- Policy 13: The condition of water bodies and freshwater ecosystems is systematically monitored over time, and action is taken where freshwater is degraded, and to reverse deteriorating trends.
- Policy 15: Communities are enabled to provide for their social, economic, and cultural well-being in a way that is consistent with this National Policy Statement.

4.2.2. Waikato Regional Policy Statement

The Waikato Regional Policy Statement (**WRPS**) became operative on 20 May 2016. The WRPS provides overarching objectives and policies addressing resource management issues of the Waikato region, and to achieve integrated management of the natural and physical resources of the Region.

The key themes within WRPS that are of most relevance to construction phase of the project include:

- Ensuring the mauri and identified values of waterbodies are maintained or enhanced[2], including by reducing sediment, contaminants and sedimentation of freshwater bodies;
- Managing effects on riparian areas and wetlands[3],
- Maintaining and enhancing amenity values;[4]

[2] Objective 3.14 and associated polices, Waikato Regional Policy Statement.
[3] Objective 3.16 and associated polices, Waikato Regional Policy Statement.
[4] Objective 3.21 and associated polices, Waikato Regional Policy Statement.

- Managing natural hazard effects on people, property, and environment;[5]
- Reducing adverse effects associated with air quality; [6]
- Ensuring the adverse effects of regionally significant industry and primary production are avoided, remedied or mitigated;[7]

4.2.3. Waikato Regional Plan

The Waikato Regional Plan (**WRP**) became operative on 28 September 2007. The WRP provides direction regarding the use, development and protection of natural and physical resources in the Waikato region.

The key themes within WRP that are of most relevance to the construction phase of the Project include seeking to ensure that:[8]

- soil productivity, versatility and capability is maintained;
- there are no adverse effects on water quality, aquatic ecosystems and wetlands that are inconsistent with water management outcomes sought within the WRP;
- there is no increase in the adverse effects of flooding or land instability hazards;
- accelerated infilling of rivers and wetlands is avoided and the rate of infilling of artificial watercourses, excluding structures designed to trap sediment, is minimised;
- significant adverse effects on natural character and ecological values associated with land is avoided;
- there are no adverse effects on air quality that are inconsistent with air quality outcomes sought by the WRP; and,
- damage to property and infrastructure is avoided.

4.3. High Level Analysis of Statutory Matters

As set out in sections 5 and 6 of this report, OGNZL is proposing to adopt the best practicable option (BPO) for erosion and sediment control principles and management techniques to ensure that the effects of construction phase activities are appropriately managed. In this regard, this report has been reviewed by technical experts in the fields of freshwater ecology, terrestrial ecology, water, contaminated land, landscape and air quality. Where necessary to avoid, remedy or mitigate the effects of construction phase activities and to meet the policy directives described in sections 4.2.1 to 4.2.3, further recommendations will be provided by the experts and incorporated into the final SSESCPs and CMTP (as relevant) prior to WRC certification and works commencing.

It is therefore anticipated that the aforementioned policy directives will be achieved.

5. ASSESSMENT

This ESCAR follows an overall BPO approach to the earthworks activities which combines the minimum design standard with appropriate staging and other controls, based on the characteristics of the individual component areas.

The ESC design approach is illustrated in Figure 6. This ESCAR provides the overarching principles of the ESC implementation, and the various procedures that will be implemented, including ESC Monitoring Plan and confirmation of the appropriate minimum ESC design standard. The ESCAR is developed in conjunction with other technical assessments and

[5] Objective 3.24 and associated polices, Waikato Regional Policy Statement.
[6] Policy 5, Waikato Regional Policy Statement.
[7] Policy 4.4, Waikato Regional Policy Statement.
[8] Objective 5.1.2, Waikato Regional Plan.

statutory provisions and informs the consenting process and the preparation of consent conditions. The consent conditions in conjunction with the relevant design standards inform the development of the SSESCPs.

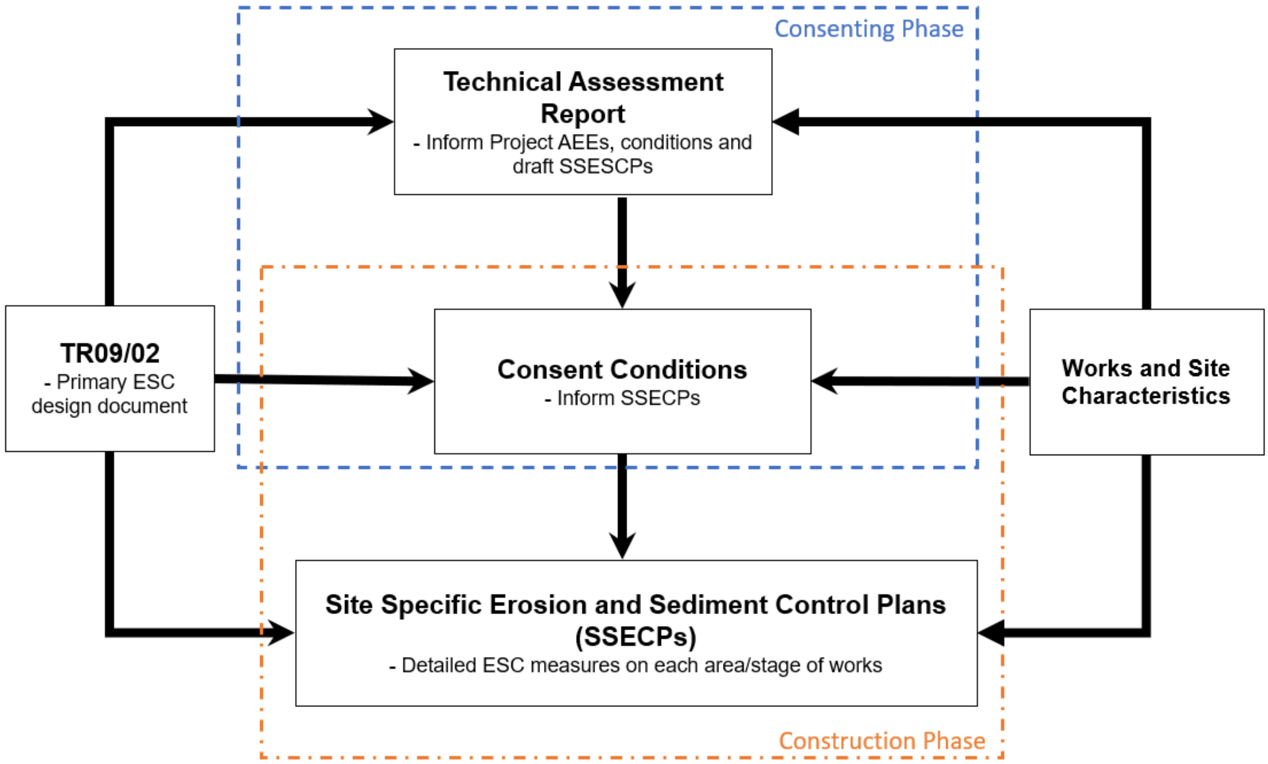

Figure 6: Erosion and sediment control design process.

This ESCAR addresses the construction methods to be used during streamworks. The ecological effects on streams and wetlands from disturbance, piping, reclamation and realignment, has been considered by the Project Ecologists.

6. EROSION AND SEDIMENT CONTROL PRINCIPLES

6.1. Design Standard

The principles of the Waikato Regional Council Technical Report No. 2009/02 *Erosion and Sediment Control Guidelines for Soil Disturbing Activities,* January 2009 (**TR2009/02**) have been adopted for the design, construction, maintenance, and decommissioning of ESC measures.

As a result of the scale and nature of the works proposed, deviations from that standard will be required. The alternative approaches are detailed in the corresponding SSESCPs and will be designed to achieve the same or better outcome than an approach that is completely consistent with TR2009/02.

6.2. Construction Water Management Objectives and Principles

Management of construction water will seek to achieve the following objectives:

- Minimise the potential for sediment generation and sediment yield by maximising the effectiveness of ESC measures; and
- Take all practicable steps to avoid or minimise potential adverse effects on freshwater and marine environments within or beyond the Project works boundary, with particular regard to reducing opportunities for sediment generation and discharge.

The following principles will apply and will be reflected in the SSESCPs prior to construction activities commencing:

1. Erosion control will be given emphasis at all sites to minimise the risk of sediment discharge. This will be achieved with structural (physical measures) and non-structural (methodologies and construction staging) erosion control measures.
2. Sediment-laden runoff from all exposed earthworks areas will be treated through sediment control measures.
3. PAF runoff, tunnel inflows, and sediment generated during production activities will be directed to the existing WTP. Sediment-laden runoff (including dewatering) arising from NAF material will be discharged via sediment control devices directly to the receiving environment to avoid compromising the capacity and efficiency of the WTP.
4. During the initial construction phases, the new Collection Ponds can be utilised as sediment retention ponds for NAF runoff, with treated runoff being discharged directly off site. Once PAF is to be placed, the Collection Ponds will be diverted to the WTP.
5. Earthworks and construction water management measures will be confirmed in the final SSESCPs which will allow for flexibility and practicality of approach to ESC and allow the ability to adapt appropriately to specific site conditions.
6. Progressive and rapid temporary and permanent stabilisation of disturbed areas using mulch, aggregate and geotextiles will be on-going during the earthworks phase. Temporary stabilisation will apply particularly with respect to stockpiles, ground improvement locations where topsoil is removed, concentrated flow paths and batter establishment. Stabilisation is designed for both erosion control and dust minimisation.
7. Stream works and works in the vicinity of streams will be undertaken in a manner that recognises the higher risk of this activity from a sediment generation and discharge perspective, and the sensitivity of the receiving environments. Works within active stream channels will, where practicable be undertaken in a "dry" environment by working off-line or diverting upstream flows.
8. Comprehensive site monitoring and management will allow for continuous improvement in response to monitoring outcomes on an ongoing basis. Monitoring will include visual inspection of the construction water management devices and the downstream environment.

6.3. Design of Erosion and Sediment Control Devices

6.3.1. Erosion Control - Construction Staging and Sequencing

The extent of exposed soil and length of time an area is exposed directly influences the sediment yield from a particular area. Earthworks and construction activities will be staged and sequenced in order to minimise open areas at any given time to the greatest extent practicable. Open earthworks areas will be progressively stabilised to reduce the potential for erosion to occur.

6.3.2. Erosion Control - Clean Water Control

Clean water diversions (**CWDs**) are diversion channels or bunds which divert clean water runoff away from the earthwork areas. Permanent and temporary CWDs will be used on the Project to prevent runoff from the undisturbed catchment above the works from entering the construction area to ensure the works are sufficiently protected from flows from the natural catchment outside of the work area.

The details of the temporary and permanent CWDs (including stream re-alignments) are described in the respective SSESCPs.

6.3.3. Sediment Control – Sediment Retention Ponds

Sediment retention ponds (**SRPs**) are impoundment devices that provide time for suspended solids to settle out before the runoff is discharged to the receiving environment. The key design criteria for all SRPs that are to be utilised across the Project are set out below.

- In general[9], a minimum storage volume sized at a ratio of at least 3% of the contributing catchment area (i.e. 300m^3 / ha of catchment) and an ideal length to width ratio of 3:1, but not exceeding 5:1. The TR2009/02 recommended maximum contributing catchment of 5ha is acknowledged and adopted where practicable. In some cases, identified in the Gladstone Pit, TSF3 and Willows Road SSESCPs, the contributing catchment exceeds that recommendation but is considered the best practicable option and will achieve the same level of treatment as anticipated by a 5ha catchment pond.
- Spillways formed to safely convey the 1% annual exceedance probability (**AEP**) rain event.
- T-bar floating decants with a mechanism to control outflow such as a manual decant pulley system or screw on end cap.
- Chemical treatment in accordance with the CTMP.

6.3.4. Decanting Earth Bunds

Decanting earth bunds (**DEBs**) will be utilised to treat sediment laden runoff from areas of up to 3000m^2. The DEB volumes will be sized at a ratio of 2% or 3% based on the slope steepness and slope length of the contributing catchment.

DEBs will be chemically treated in accordance with the CTMP.

6.3.5. Silt Fences and Super Silt Fences

Silt fences and super silt fences will be used to treat sediment-laden runoff from small areas that cannot be diverted to an alternative device.

6.3.6. Chemical Treatment

To maximise their efficiency, chemical flocculant will be added to the inflow of all SRPs and DEBs using a rainfall activated or flow activated system. A Chemical Analysis Reactivity Test (**CART**) report has been provided with the CTMP in Appendix A. Bench testing has been completed on supplied soils from the footprint of the TSF3 and the NRS. Results indicate that chemical treatment, using Polyaluminium Chloride (**PAC**), enhances the sediment removal efficiency and increases water clarity and decreases turbidity over the control tests to an extent that justifies the implementation of chemical treatment.

Chemical selection and recommended dose rate are based on the bench testing of soils and is discussed further in the CTMP and CART. The set-up for each device will be provided with the as-built documents and will include details of the chemical type and dosing rate.

6.3.7. Dewatering and Pumping

Wherever possible, gravity flow into the various sediment retention devices will be used in preference to pumping. However, it may not always be possible to achieve gravity flow to sediment control devices during construction. Floating decants incorporated in the design of each sediment retention pond will be fitted with a mechanism to control outflow, such as a

[9] The TFS3 and NRS sites require an alternative approach to SRP impoundment sizing. That is described in the SSESCP for that site as provided in Appendix C.

manual decant pulley system, which will enable the decants to be raised during pumping activities to these structures.

During pumping the decants will only be lowered once an acceptable standard of discharge quality, assessed as not less than 100mm visual clarity, has been achieved.

The pumping rates to SRPs will be controlled so that the SRP is not overloaded and that the appropriate water quality is achieved prior to discharging to the receiving environment.

6.3.8. Streamworks

NRS

The NRS will require various streamworks. The upper catchment streams above the footprint of the site will be diverted into a new permanent diversion channel that will be formed around the site and discharge into the lower reaches of the main tributary just upstream of its confluence with the Ohinemuri River. The diversion channel will require relatively significant earthworks including cuts through ridges, where dirty water runoff will be diverted back to sediment retention ponds until stabilised.

Temporary culverts will be installed to carry tributary flows across the works required to form the diversion and haul routes. These will be installed partially off-line, with the existing channel being used to carry flows until the pipe is installed, and flows are directed into it. Subject to detailed design and contractor input, pumping may also be used in conjunction with the diversion channel. On completion of the permanent diversion channel, those pipes will be plugged and sacrificed, and the earthworks across the site undertaken.

TSF3

As for the NRS, a permanent diversion channel will be installed to pick up all upper catchment flows and direct those to the Ruahorehore Stream downstream of the new stormwater ponds. Temporary clean water diversions will be used to divert upstream drainage around the initial works areas. A series of temporary clean water diversions will be required until the permanent uphill diversion drain is completed and stabilised. Existing clean water flows will be managed so that the permanent diversion channel can be installed largely ‘off-line’. Once the diversion is operational, the various minor stream channels and drainage channels within the TSF3 site will be managed within the footprint of the general earthworks.

Other minor channel works will be required that will also adopt the off-line methodology.

Services Trench

The works required along the Services Trench from the Willows Road site to the Processing Plant will require two crossings of Ohinemuri River. It is proposed that the utilities will be installed by separate pipe bridges. No works within streams are proposed.

7. EROSION AND SEDIMENT CONTROL IMPLEMENTATION

7.1. Site Specific Erosion and Sediment Control Plans

The SSESCPs will address the following information for each specific work area, which may be a site (e.g. NRS or TSF3) or a stage of a site. The SSESCPs will include:

i. the specific construction activity to be undertaken;
ii. the area and volume of earthworks, and/or the nature of the stream works at specific locations, and identification of the downstream receiving environment;
iii. the locations of all earthworks and/or stream works;

iv. methods for managing construction water effects for specific activities;
v. the duration of the earthworks and/or stream works;
vi. the time of the year that the stream works are to be undertaken, and where applicable, the measures to be implemented to respond to any heightened weather risks at that time;
vii. stabilisation methods and timing to reduce the open area at key locations to assist with a reduction in sediment generation; and
viii. chemical treatment (flocculation) at SRPs and DEBs.

Draft SSESCPs are provided as Appendix C. Each SSESCP will be finalised and submitted to WRC for certification prior to any earthworks occurring. Any deviation from TR2009/02 will be explained in the corresponding SSESCP.

7.2. Pre-construction Site Meeting

Pre-construction site meetings will be held between Project personnel (Environmental Manager and / or ESC Specialist, Project Manager, Contractor) and WRC staff before works commence at any site or re-commence in each earthworks season.

7.3. Construction of ESCs - Supervisions

The construction of the controls will be overseen by the Project Manager and/or an ESC Specialist.

Hold points for construction will be established for each control whereby the Project Manager (or ESC Specialist) will inspect the work completed, for example the installation of anti-seep collars or the installation of primary outlet.

7.4. As-built Certification

As-built certification of devices is a critical element of effective site management. As-built checklists and/or drawings will be prepared for all controls to ensure that they have been installed as designed. Works within the catchment of an ESC device will not commence until the as-built document for the device (or devices) has been certified by a suitably experienced and qualified ESC practitioner.

7.5. Monitoring and Maintenance

See Section 8 below.

7.6. Decommissioning

Erosion and sediment controls will only be decommissioned when contributing catchment is stabilised. WRC will be informed prior to controls being removed.

8. MONITORING AND RESPONSES

8.1. ESC Monitoring

Monitoring of the ESC measures and outcomes will be undertaken in accordance with the appended Erosion and Sediment Control Monitoring Plan (**ESCMP**) provided in Appendix B. It provides a programme and methodology to ensure that ESC measures have been designed, installed, and managed in accordance with the ESC management structure described above, and to monitor the effectiveness of ESC for the duration of the construction phases of the Project.

Environmental compliance and performance will be achieved through appropriate location, design, installation, as-built certification, maintenance, and monitoring of ESC measures. ESC management in this context is not restricted to physical structures but also includes work practices and methodologies.

Regular monitoring will be undertaken by the Environmental Manager, ESC Specialist or Project Manager to ensure ESC measures are operating as designed and are maintained in accordance with guidelines and consent conditions. This monitoring underpins the successful implementation of the ESC management system, to achieve the anticipated environmental outcomes and ensure compliance with the resource consent conditions. This monitoring includes pre- and post-rainfall checks and maintenance and is considered "business as usual".

The monitoring will also provide continual feedback to ensure successful ESC performance and early detection of activities or problems that have the potential to result in an adverse environmental effect.

The frequency of the monitoring will vary throughout each construction phase and reflect areas of changing activity and risk within the Project. During active construction in a given area, the monitoring will be undertaken daily as well and pre and post rainfall events. Monitoring will report any repairs or issues that need to be addressed and the timeframe for completion of those actions.

The regular monitoring will be supported by monitoring of the chemical treatment systems, weather, rainfall events, and will include wet weather responses and contingencies.

8.2. Performance Targets

The ESC design seeks to meet the following targets listed below. These reflect current best practice and has a focus on water clarity through the NPS: FM.

- Clarity of 100mm.
- pH between 6.0 and 9.0.

The parameters would be measured by manual sampling in response to a rainfall trigger event of 25mm / 24 hours. That event is of a size that places stress on the SRP i.e. it is 'working hard'. Water samples will be taken at those times and checked for water clarity and pH.

These targets should not be adopted as compliance standards as doing so would be inconsistent with the function of TR2009/02 compliant devices and would be unnecessary to achieve overall acceptable water quality performance.

9. ASSESSMENT OF EFFECTS

9.1. ESC Design

As stated, the principles of TR2009/02 will be adopted for the management of sediment-laden runoff from the works sites and whenever practicable, ESC measures will be designed and managed in full accordance with that guideline. Through necessity, deviation from specific TR2009/02 design will be required as follows.

9.1.1. Willows Road Site

The works associated with the Willows Road Site drain to the Mataura Stream, a tributary of the Ohinemuri River.

The surface works of the Willows Road Site will be undertaken as separate elements and treated by separate ESC measures. Sediment laden runoff generated during the earthworks for the main surface facilities (noise bunds, car parking, effluent disposal field, pipe storage/stockpiling area, offices, portacoms, and related facilities) will be treated through the Willows Silt Pond, which will be significantly oversized (10,000m^3) when compared to the 2%

of contributing catchment area minimum required by TR2009/02 (1,000m^3). Consequently, a high level of sediment retention efficiency is expected. The Silt Pond will be constructed first and used as the SRP for the site until the site works are completed.

The Collection Pond will be built to service the enabling earthworks associated with the access road construction, portal and Willows Rock Stack (**WRS**). A super silt fence will be installed below the footprint of the Collection Pond to capture any runoff during the construction of the pond. The Collection Pond has a design capacity of about 19,000m^3. The combined contributing earthworks area will be approximately 6ha. This significantly exceeds a minimum TR2009/02 sized pond, which at 3% would have a capacity of 1,800m^3.

Once the enabling earthworks are complete, the Collection Pond will continue to service the ongoing works of the WRS and construction of the internal access roads using PAF. Runoff directed to the Collection Pond will then be transferred to the WTP.

The topsoil stockpile, magazine storage areas and other access will be serviced by SRPs designed in accordance with TR2009/02, and other minor controls such as clean and dirty water diversion and silt fences, and progressive stabilisation.

Services, such as power, water (raw, potable and waste), and fibre optics must be installed from the existing Processing Plant site to the Willows Road site. The route from the Processing Plant crosses existing farmland, before progressing along State Highway 25, then turning into Willows Road to the Surface Facilities Area. Two stream crossings across the Ohinemuri River will be required. These works will be staged and progressively stabilised and will avoid works within streams.

9.1.2. TSF3

The SRP for the main stockpile (Stockpile 2) has been sized to service the full stockpile area of 12ha. This approach will allow a simplification of the management of the stockpile. The pond has been sized to provide for 4,000m^3 of storage volume and will exceed the minimum design capacity recommended in TR2009/02[10]. While TR2009/02 recommends a maximum SRP catchment area of 5ha, in this instance the increased capacity is expected to offset the larger catchment size.

Stockpile 1 will be managed through a separate SRP that will slightly exceed the recommended SRP catchment area (5.1ha proposed). The separation of that stockpile is necessary as it will be receiving different material.

Two borrow areas will be required to provide a suitable material source for the construction of the embankment. The borrow sites sit within the northern extent of the TSF3 footprint, within the steeper sections of the area. Clean water runoff will be managed by temporary clean water diversions and sediment laden runoff will be managed and treated using a SRP for each borrow site.

Once the paleo gully is excavated and the shear key and access road bund are formed, the permanent Collection Ponds will be formed. At that stage, runoff from the main gully stripping and initial filling with NAF will collect within the lower end of the valley and then be pumped to the stormwater pond for settlement before decanting or pumping from the site to the Ruahorehore Stream. Under that scenario, the management or sediment-laden runoff should be as good or better than that from a TR2009/02 device.

[10] 3% criteria i.e. 300m^3 of storage for each hectare of contributing catchment.

9.1.3. NRS

The establishment of the NRS, including stream relocations, stockpile management and main works will be managed with TR2009/02 compliant ESCs. The NRS establishment earthworks will utilise the existing North Collection Pond facilities where any collected water will report to the WTP. Once the new Collection Pond is constructed the existing Collection Ponds will be decommissioned and all water from the NRS will report to the new Collection Pond.

The permanent uphill clean water diversion requires the diversion of an existing stream to a new alignment to provide for the full extent of the NRS. A draft methodology has been provided in the SSESCP which will be finalised prior to the commencement of earthworks within this area and provided to WRC for certification.

9.1.4. Gladstone Open Pit

The establishment of the Gladstone Open Pit (**GOP**) will include the construction of two SRPs. One SRP will be constructed to service a stockpile area to the southeast of the GOP with a catchment area of approximately 1.2ha. The other SRP is proposed to be constructed in between Gladstone Hill and Winner Hill and capture runoff from a total catchment area of up to 7.0ha. This catchment area exceeds the recommended maximum catchment area in TR2009/02. The reason for deviating from the guidelines for the initial stripping and earthworks area is to take advantage of existing contours and the site low point. This will also simplify site management. This SRP has been sized to provide a minimum storage volume of 3% of the contributing catchment and is anticipated to achieve the same performance standard required in TR2009/02.

The GOP portal catchment area (approximately 1ha) will be managed on site until such time as the runoff can be contained within the GOP. The details for how the portal will be constructed is to be confirmed and the required ESC measures will be confirmed as part of the SSESCP.

Once the GOP becomes a void and all runoff is contained within the pit, water will be pumped to the existing WTP, and the SRP will be decommissioned.

For completeness, it is reiterated that all other ESCs associated with the GOP will be designed, constructed, and maintained in accordance with TR2009/02.

9.2. Estimate of Sediment Yield

Typically, an estimate of sediment yield is undertaken to assist in the assessment of potential sediment-related effects of significant earthworks activities for which consent is sought. Sediment yield is the amount of sediment that is discharged to the receiving environment. If no ESCs are implemented, sediment yield will be high.

The estimate of sediment yield is most commonly generated using the Universal Soil Loss Equation (**USLE**) which takes account of the following variables:

- Slope length and gradient
- Soil type
- Rainfall
- Surface cover
- Surface roughness
- Earthworks area
- Time of exposure

Table 3 below provides a summary of the estimated sediment yields (t/ha/yr), and loads (t/yr) derived from the USLE for some of the major earthwork areas proposes as part of the WNP. It presents the sediment yield estimated on an annual basis for the existing land use and presents the additional load that is predicted by the model to result from the earthworks over that period.

Undertaking an estimate of sediment yield for this Project is complex because as soon as PAF material is exposed and / or imported into a site, all runoff from those areas will be diverted to the Water Treatment Plant and will not contribute to a potential elevated sediment yield. Rather, any such areas will result in a reduction in sediment yield from the corresponding area, including when assessed against the existing vegetated land use. Large scale Collection Ponds will be constructed at the WRS, NRS and TSF3 which when commissioned will take over treatment from the temporary SRPs. This is reflected in the USLE where only the initial earthworks catchments and stages have been analysed.

The GOP has been excluded from the USLE because once the initial earthworks for the GOP are completed water runoff will accumulate in the pit. This water will be pumped to the WTP. The southern stockpile will be treated by a SRP and discharged directly off site. The catchment area of this SRP is significantly smaller than those proposed for the NRS and TSF3.

An estimate of sediment yield has been undertaken for three sites, the NRS, TSF3 and Willows Road which has taken account of these specific characteristics of the Project. The results are provided in Table 3 below, which compares the estimated sediment yield from the existing land area with the proposed earthworks phases/stages. Please refer to each SSESCP for staging details. As shown, increases in the catchment sediment yield during stages of earthwork that discharge off-site are predicted to vary, ranging from 0.2% to 13% for TSF3, 6% for NRS and 1% to 9% for Willows Road. When the NAF earthworks are completed and the importation of PAF is underway, the sediment yields will reduce by 8% at TSF3, 6% at the NRS and 16% at the Willows Rock Stack because those areas will discharge via the permanent Collection Ponds to the WTP.

The USLE undertaken at this stage is based on annual yields. It is conservative as it assumes that the earthworks stages will be exposed to erosion for the full year of calculation, whereas in practice those areas will be further staged and progressively stripped, earthworked and stabilised. Nor does it assume a winter works closedown period.

Table 3: USLE results.

Catchment	Earthworks area total (ha)	Sediment yield earthworks (t/ha/yr)	Sediment load earthworks (t/yr)	Sediment yield from existing land within earthworks footprint (t/ha/yr) (using same indicative USLE catchment)	Sediment load from existing land within Project earthworks footprint (t/yr)	Sediment load difference: existing minus earthworks (t/yr)	Stream Catchment (ha)	Catchment Sediment Load (based on USLE existing land assumptions)	Catchment sediment load increase (catchment sediment load + sediment load difference)	catchment t/yr increase	% catchment increase	average catchment t/ha/yr	Earthworks area as % of catchment
TSF3 (existing)							580	390.00	390.00	0.00	0.00	0.672	0%
TSF3 Stage 1	16.20	1.97	31.91	0.672	10.89	21.02			411.02	21.02	5%	0.709	3%
TSF3 Stage 2A	22.60	1.97	44.52	0.672	15.20	29.33			419.33	29.33	8%	0.723	4%
TSF3 Stage 2B	18.12	1.97	35.70	0.672	12.18	23.51			434.53	23.51	11%	0.749	3%
TSF3 Stage 2C	24.25	1.97	47.77	0.672	16.31	31.47			442.49	31.47	13%	0.763	4%
TSF3 Stage 2D	17.00	1.97	33.49	0.672	11.43	22.06			412.06	22.06	6%	0.71	3%
TSF3 Stage 3	5.00	1.97	9.85	0.672	3.36	6.49			396.49	6.49	2%	0.68	1%
TSF3 Stage 4	0.50	1.97	0.99	0.672	0.34	0.65			390.65	0.65	0.2%	0.67	0.1%
TSF3 Stage 5 (all site runoff to WTP)	51.70	0.1	5.17	0.672	34.76	-29.59			360.41	-29.59	-8%	0.62	9%
NRS (existing)				2.93			115	337.00	337.00	0.00		2.93	0%
steep upper catchment				3.11			95	295.90					
flat lower catchment				1.38			20	27.5					
NRS Stage 1	12.50	1.85	23.08	1.38	17.25	5.83			342.83	5.83	6%	3.0	11%
NRS Stage 2	15.80	1.85	29.18	1.38	21.80	7.38			344.38	7.38	6%	3.0	14%
NRS Stage 3 (Zone A pad site runoff to WTP)	27.00	0.1	2.70	1.38	37.26	-34.56			302.44	-34.56	-6%	2.6	23%
Willows Road (existing)				1.09			61.00	66.70	66.70	0.00		1.09	0%
Topsoil Stockpile	3.00	1.21	3.63	1.09	3.28	0.35			67.05	0.35	1%	1.099	5%
Surface Facilities Area (cut area)	1.50	1.7	2.55	1.09	1.64	0.91			67.61	0.91	1%	1.108	2%
Willows Rock Stack	3.20	2.9	9.28	1.09	3.50	5.78			72.83	5.78	9%	1.194	5%
Topsoil Stockpile 2	2.30	1.92	4.42	1.09	2.51	1.90			68.95	1.90	3%	1.130	4%
Magazine Storage	1.10	1.69	1.86	1.09	1.20	0.66			67.36	0.66	1%	1.10	2%
Willows Collection Pond	7.00	2.9	20.30	1.09	7.65	12.65			79.70	12.65	-16%	1.19	11%

In summary, the proposed earthworks will result in a small increase in sediment yield to the Ruahorehore Stream and Ohinemuri River during the initial stripping and establishment of each site. The outer batters of the new landforms created will be progressively stabilised. Once PAF is imported or used at the site, runoff will be diverted to the WTP and sediment yield from these areas will cease. At that time the sediment yield from each catchment will reduce from the existing vegetated situation and overall catchment load.

While works within the NRS, TSF3 and Willows Rock Stack sites will include earthworks across steep land, this work will be undertaken and stabilised progressively, particularly the construction of the permanent stream diversions which rely on being progressively stabilised as a key component of site management. The majority of the NRS, TSF3 and Willows Road sites have relatively low gradients. This reduces the erosion potential and likely sediment yield.

9.3. Streamworks

The streamworks sections are shown on the SSESCPs for the NRS and TSF3.

All new sections of stream channel (NRS diversion and TSF3 diversion) will be installed off-line and fully stabilised before flows are directed into them. Once the flows are diverted, the existing stream channels will be off-line and can be worked as part of the overall earthworks footprint, with sediment-laden runoff being treated via the main sediment controls.

The installation of temporary diversion pipes within the NRS footprint will be complex and will require specific design during construction. At this stage it is anticipated that those pipes can be installed at least partially off-line, with part or all of the stream channel remaining functional until such time as the flows are diverted into the pipes. Pumping may also be required at times, subject to confirmation by the contractor and certification via the corresponding final SSESCP.

9.4. Monitoring and Targets

This ESCAR is based on the average efficiencies of the chemically treated SRPs proposed in combination with erosion control and staged construction methodologies. The SRP efficiencies have been assumed to vary throughout various rainfall events and are based on the average performance of the sediment retention devices proposed rather than a specific discharge limit.

Further, the design and function of SRPs as recommended in TR2009/02 have been developed for Waikato conditions, which experience frequent and / or consecutive rainfall events, and sites that have steeper topography and spatial constraints. It is noted that this approach has now been adopted in the leading Australian ESC guideline[11].

The monitoring of the performance of SRPs, which are to service the largest earthworks areas, will be based on parameters that can be effectively measured in the field, with water samples taken after trigger rainfall events. Those events are the times when the ponds are 'working hard' but should be expected to achieve an average compliance with the targets.

The day-to-day monitoring and maintenance of the ESC measures throughout the construction period of the Project is the key element that will ensure that the anticipated level of performance and outcomes are achieved. The additional event-based monitoring will complement that daily site management and will allow ongoing review and adjustment of the management system as required. For the reason noted in Section 8.2, the performance targets cannot be imposed as performance standards because the compliant sediment retention devices do not function in a way that can comply with an absolute standard. Rather, they are anticipated to achieve average levels of sediment retention efficiency.

[11] *Best Practice Erosion and Sediment Control*; November 2008 (updated April 2018), IECA Australasia

10. CONCLUSION

The Waihi North Project earthworks have the potential to result in changes to receiving water quality during the construction phase as a result of the discharge of sediment from earthworks during both rain events and streamworks.

As part of the Project earthworks activities, the ESCs will be implemented to minimise sediment-related effects to an acceptable level.

To ensure that final construction management input is provided for and to also allow for flexibility with the specific ESC implementation on site, final SSESCPs will also be provided prior to earthworks commencing in a given works area. The final SSESCPs will confirm the detailed design, specific ESC locations, and the staging and sequencing of works for that location or activity and will provide a staged approach to the works within a site and across the Project.

The implementation of SSESCPs will enable the construction team to have ongoing input into the ESC design prior to and during construction, subject to compliance with the design and implementation standards specified in this report, and associated consent conditions.

The Project will utilise best-practice ESC measures that meet or exceed the outcomes anticipated by the TR2009/02 guideline. Various stages of the most significant sites are estimated to result in small, temporary increases in sediment load within the respective catchments, but then result in a reduction in sediment load once the establishment works are completed and PAF is being exposed and handled within NRS and TSF3 and treated via the WTP. The other works sites will be similarly managed to avoid or minimise sediment discharges.

An ESC management structure and monitoring plan will be adopted to ensure that the ESC measures are designed, constructed, maintained, and decommissioned in accordance with best practice and as anticipated by this ESCAR.

Overall, it is anticipated that the proposed BPO and ESC management approach will ensure that the earthworks are appropriately manage and sediment yield from the works will be minimised to an acceptable level and that any adverse sediment-related effects will be temporary and minor, and consistent with the NPS:FM and the relevant WRP provisions.

APPENDIX A: CHEMICAL TREATMENT MANAGEMENT PLAN

APPENDIX B: EROSION AND SEDIMENT CONTROL MONITORING PLAN

APPENDIX C: SITE SPECIFIC EROSION AND SEDIMENT CONTROL PLANS

SOUTHERNSKIES ENVIRONMENTAL

CHEMICAL TREATMENT MANAGEMENT PLAN

Waihi North Project

Prepared for OceanaGold New Zealand Limited

Date	18 May 2022
Document No:	CTMP
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This document has been produced for New Zealand consenting purposes only. Information contained herein must not be relied on for investment purposes.

Document Control

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Revision Details

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Table of Contents

1 Introduction

1.1 Purpose and Scope

This Chemical Treatment Management Plan (CTMP) applies to the earthwork's operations associated with the construction phase of Oceana Gold (New Zealand) Limited's Waihi North Project (the Project).

The CTMP sets out the methodology for determining the effectiveness and dosing rates for chemical treatment to enhance the sediment retention efficiency of the sediment retention ponds (SRPs) and decanting earth bunds (DEBs), that will be used throughout the Project.

The CTMP shall be implemented for the duration of the earthwork operations associated with the construction of the Project. It will support the overall erosion and sediment control (ESC) principles and methods described in the Erosion and Sediment Control Assessment Report (ESCAR) and will inform the development of Site-Specific Erosion and Sediment Control Plans (SSESCPs).

1.2 Implementation and Operation

Table 1 details the roles and responsibilities that will apply to the implementation and management of the chemical treatment systems across the Project.

Table 1: CTMP - roles and responsibilities

Name	Role	Contact details	Responsibility
	Project Construction Manager		Overall project responsibility
	Civil Construction Manager		Includes responsibility for earthworks
	Earthworks Manager		
	Construction Environmental Manager		Overall responsibility for Environmental Management and Performance
Zac Woods	Erosion and Sediment Control Technical Specialist	zac@southernskies.co.nz 021 597 799	Suitable qualified and experienced erosion and sediment control specialist who prepares the erosion and sediment control plans and audits their implementation

2 Methodology

In accordance with industry best practice, it is proposed to chemically dose the SRPs and DEBs, where necessary, to maximise sediment retention efficiency and ensure the quality of water discharging from the device is within the range anticipated in the assessment of effects for the Project (refer to Erosion and Sediment Control Assessment Report).

Soil sampling and bench testing (laboratory testing of chemical responses), and the management of the chemical treatment systems will be undertaken in accordance with Appendix F1 and Section F2.0 of Auckland Council Guideline 2016/005 *Erosion and Sediment Control Guideline for Land Disturbing*

Activities in the Auckland Region (GD05) as the Waikato Regional Council (WRC) guidelines do not currently address chemical treatment.

Preliminary soil samples and bench testing has been undertaken as part of early site investigations (refer to the Chemical Analysis and Reactivity Test (CART) Report, Appendix A) which indicates significant improvement of clarity and turbidity with the use of chemical treatment.

Ongoing soil sampling and bench testing will also be required as the earthworks progress. In this regard protocols have been established and are set out in Section 5.

Any sampling for bench testing of sub-soils (below topsoil) that is necessary will be taken from the contributing catchment of sediment controls devices to determine the optimum chemical response and dosing rate, balanced within an acceptable pH range.

Ongoing sampling will also be required as the earthworks progress.

Bench tests of soil samples will be undertaken using the following two chemicals supplied by IXOM Chemicals:

1. Polyaluminium Chloride (PAC - $[Al(OH)_aCl_b(SO_4)_c]_n$), The most common chemical widely used throughout New Zealand, a polymer originally tested and documented by the Auckland Regional Council during the construction of the ALPURT motorway extension development[1].
2. Superfloc – A blench of PAC and PolyDADMAC (Polydiallyldimethylammonium chloride–$[C_8H_{16}NCl]_n$).

GD05 states the recommended chemical and dose rate will be that which achieves the best settlement rate within the acceptable pH range of 5.5 to 8.5 and will not change the baseline pH beyond +/-1. To align with the conditions of consent the pH range, 6.0 to 9.0 will be adopted as part of this Project.

3 Implementation

The CART Report provided in Appendix A confirms the efficacy of chemical treatment of typical site soils, based on the testing methodology described below and in the CART.

A SSESCP will be prepared for each works area. Each SSESCP will identify and provide the sizing calculations and drawings for all ESC measures to be implemented in the corresponding area. Once a SSESCP has been certified by WRC, the ESC measures will be constructed in that works area.

If the works are within an area or soil type already sampled and reported on in the CART, the chemical treatment systems will be initially set up based on the CART recommendations. If the works area is not within the extent of the CART report, additional soils sampling and bench testing will be undertaken in accordance with this CTMP.

Confirmation of the recommended chemical, dose rates, roof tray sizes and header tank outlet spacings for each device will be submitted to WRC with the as-built certification of the devices and Appendix D of this CTMP will be updated with the recommended dose rates for that SSESCP area.

The relationship of the various management plans and procedures that apply to the chemical treatment system is shown in Figure 1.

[1] Auckland Regional Council Technical Publication 227 – *'The Use of Flocculants and Coagulants to Aid the Settlement of Suspended Sediment in Earthworks Runoff : Trials, Methodology and Design'* June 2004

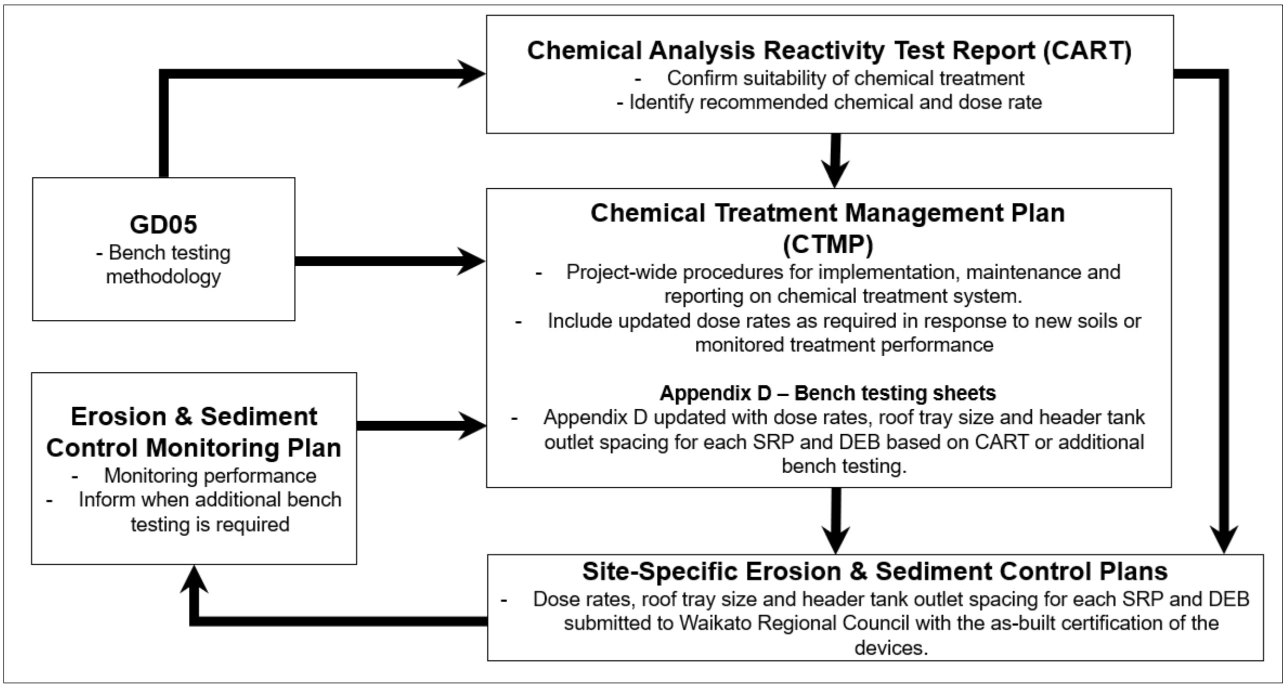

Figure 1: Implementation of the chemical treatment system.

4 Chemical Treatment Dosing System

Two dosing systems can be used.

The most common and cost-effective is a rainfall activated system where dosing is initiated by rainfall received at the dosing site.

The alternative option is a flow activated system, which activates by the flow rate entering the sediment control device. That type of system may be appropriate for areas where sediment laden water is pumped or piped from the excavation site to the treatment device.

4.1 Rainfall Activated Dosing System

The rainfall activated dosing system has been developed specifically for earthworks sites. The system described below uses a rainfall catchment tray to capture rainfall with the size of the tray being determined by the required chemical dose and the land catchment size. It is the most widely used system and is robust and simple to operate. It does not require a power source.

Rainwater caught by the catchment tray is piped into a header tank, and then into a displacement tank which floats in a larger tank containing the flocculant filled to the level of an outlet pipe leading to the sediment laden diversion about 10m upstream of the inlet of the sediment control device. The greater the rate of rainwater flow into the displacement tank the greater the flow of flocculant into the sediment laden runoff channel. The header tank is designed to provide for no dosing during the initial rainfall of up to 12mm of rain under dry conditions to reflect the lag time between the onset of rainfall and the arrival of runoff at the device. The dual outlet of the header tank outlet also attenuates chemical flow during the initial stages of a storm and after rain has ceased at the end of a storm.

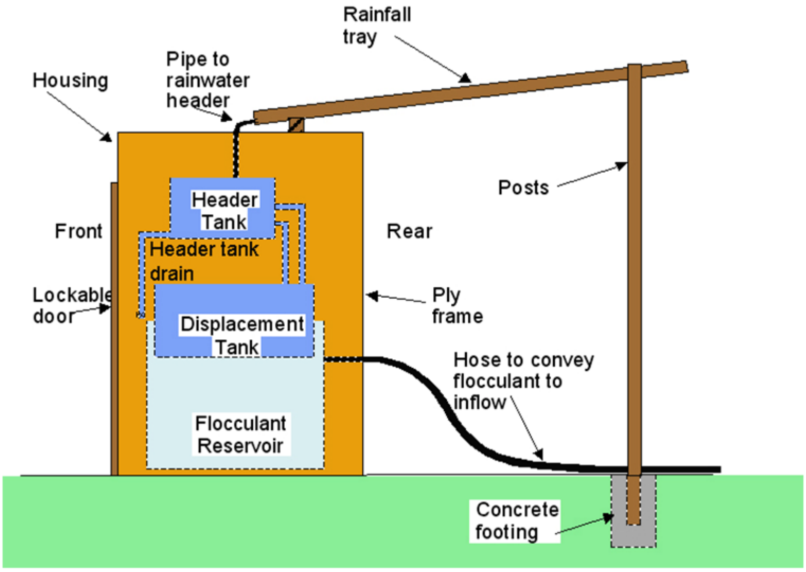

Figure 2: Traditional floc shed schematic.

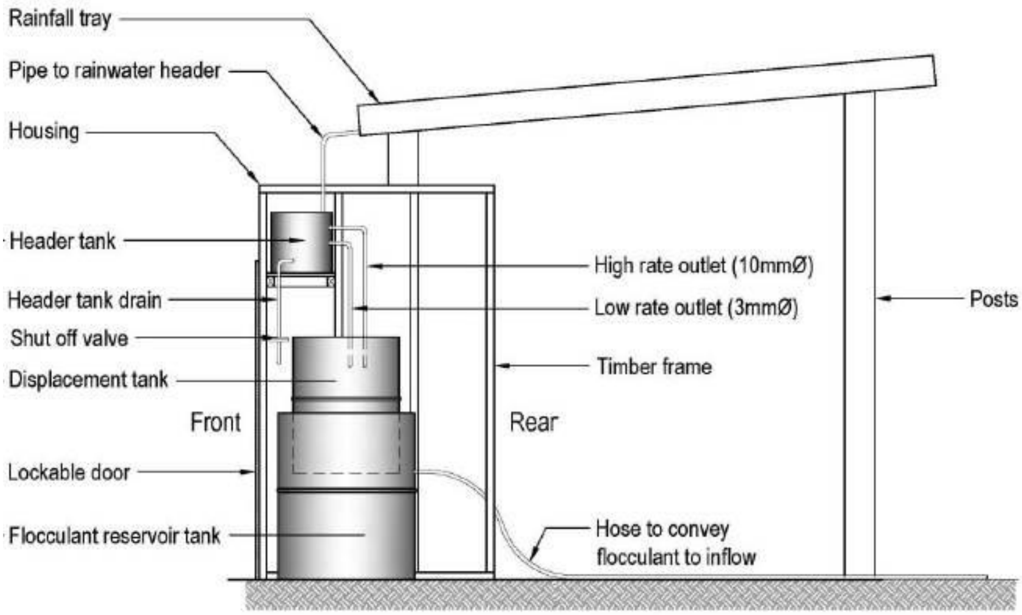

Figure 3: Components of the floc shed.

A mini Floc Shed (Figure 4) or Floc Box (Figure 5) is well suited for DEBs with catchment areas less than 3,000m^2 and are set up in a similar way to the traditional floc shed outlined above.

Figure 4: Mini floc shed.

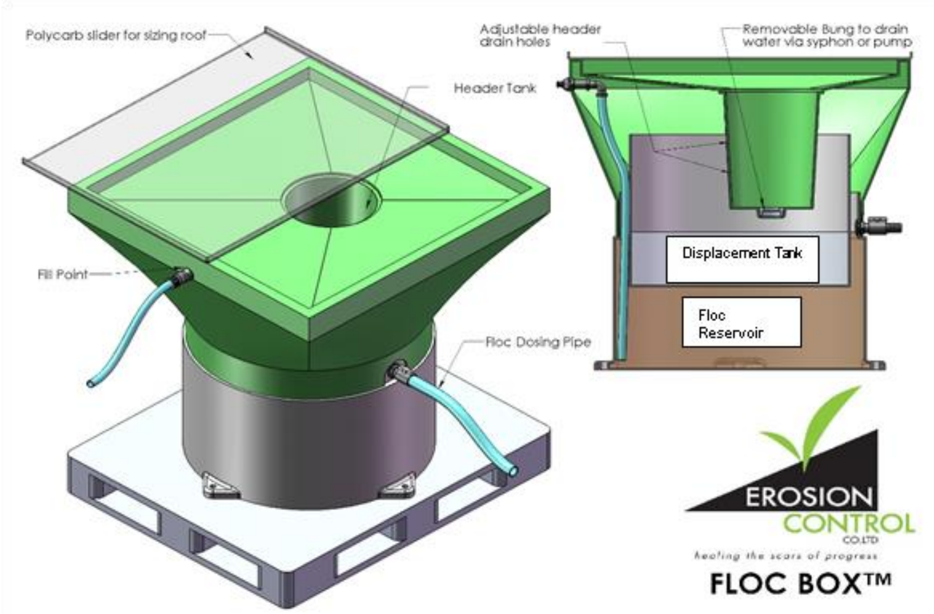

Figure 5: Erosion Control's floc box.

4.1.1 Area of rainwater catchment tray required for rainfall activated system

The area of the rainwater catchment tray is determined by the dose required, and the area of the earthwork catchment draining to the sediment control device.

The rainwater catchment tray size is determined by the total land catchment area draining to the sediment control device including both the ‘open’ area and stable areas. If the catchment area is changed, then the catchment tray size should also be changed in proportion. Reduction of the tray size is easily achieved by placing a piece of plywood on top of the upstand over the lower end of the tray, thereby allowing the rain which falls on the plywood to run to waste. Floc boxes include a sliding lid that adjusts the catchment tray size in a similar way.

The required tray size will be calculated and submitted with as-builts associated with each SSESCP and included in Appendix D.

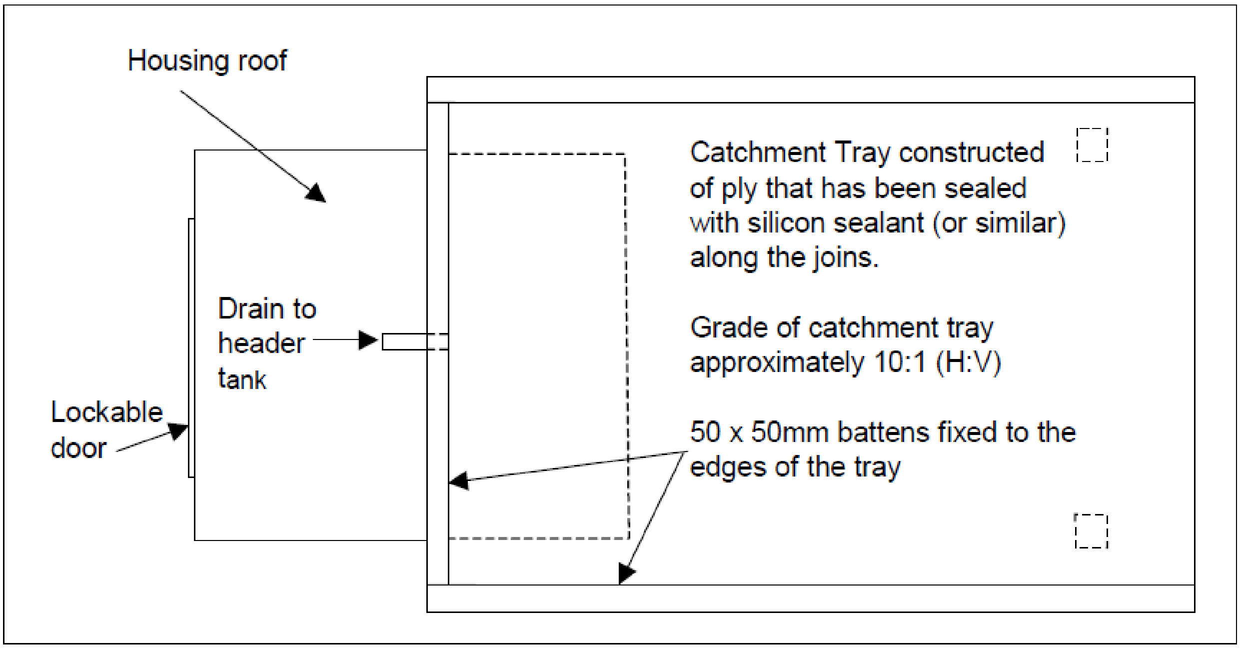

Figure 6: Roof tray design.

4.1.2 Header Tank Outlet Spacing

Rainfall from the catchment tray is drained into a header tank which has two outlets offset vertically. This provides a storage capacity that avoids dosing during initial rainfall following a dry period and to attenuate dosing at the beginning and end of a rainstorm event.

The volume between the drain (lowest) header tank outlet and the first dosing outlet is equal to the volume of 12mm of rain on the catchment tray and the volume between the first and second dosing outlets is the same.

The required header tank outlet spacing details will be calculated and submitted with as-builts associated with each SSESCPs and included in Appendix D.

Header tank management in summer months will be as per the GD05 guideline, which requires:

- After 3 days without rain – reduce volume by 50%.
- After 6 days without rain – empty completely.

4.1.3 Sediment Laden Runoff Channel and Dosing Point for Rainfall Activated System

The chosen chemical needs to be added to the sediment laden runoff channel to provide mixing with the sediment laden runoff before it reaches the area of ponded water in the forebay or the sediment control device itself.

All sediment laden runoff from the catchment should be combined into a single channel if possible before it reaches the chemical dosing point. To maximise mixing, the dosing point should be located at least 10 metres prior to the point where the runoff reaches the inlet of the device (in the case of a SRP, the inlet of the forebay).

The dosing point should be at a location where the chemical will fall into the sediment laden flow during periods of low flow. The end of the dosing tube should be only a few centimetres above the diversion channel to ensure that the chemical falls into the sediment laden runoff and is not blown away during periods of strong wind.

4.1.4 Alternative Rainfall Activated System

Alternative systems such as 'Auto-Floc' are available that are rainfall activated by a rainfall sensor located on the devices. Advice on the suitability of those systems is required on a case by case basis.

4.2 Flow Activated System

Various flow activated systems such as Erosion Control Dose Boxes or Green1 Technologies Electronic Dosing Device (EDD) or Inline Dosing Device (IDD) and are available depending on the circumstances of each site. These include pumping based systems set to the pumping rate, and systems that employ sensors to read the flow moving through the inlet channel to a sediment control device.

Again, these systems should be considered on a case by case basis.

4.3 Batch Dose Treatment

Batch dosing is largely undertaken as a reactive measure to treat impounded runoff that has not been treated to the correct standard. Batch dosing is achieved by adding liquid reagent to the surface of impounded runoff to increase the rate of settlement to achieve the required standard of discharge.

Batch dosing may be undertaken as a contingency measure in devices that have been treated by a rainfall activated system. Batch dosing can be utilised during dewatering / pumping processes.

The criterion to establish the need for batch dosing is the clarity of the sediment laden runoff. Clarity will be measured by either of the following two techniques:

- Black disc
  - A 50-80mm diameter disc is attached to a 1m long stick with a centimetre scale starting as the disc is lowered vertically into the water to be tested until it disappears, and then is raised until it just reappears. The depth of reappearance is recorded as the clarity of the water.

- Clarity Tube
  - A clarity tube containing a magnetic black disc will be filled with water from the device. The tube will be laid horizontal and the disc will be moved down the tube until it disappears, when viewed from the end of the tube and the distance is recorded. The disc is then moved back until it reappears, and the distance is recorded.
  - Readings should be taken in diffuse sunlight or shade. If it is impossible to avoid bright sunlight, work with the tube perpendicular to the sun's plane.
  - Readings will not be taken in very low light conditions, i.e. before sunrise or after sunset (insufficient for colour perception).

Water with a clarity of 100mm or greater is considered to be acceptable for discharge. Water with a clarity of less than 60mm should be batch dosed. If the sediment laden runoff has clarity between 60-100mm after rainfall has ceased, it should be left for 48 hours to settle. If the clarity has not reached 100mm after 48 hours, or if sediment laden runoff has to be discharged within 48 hours because the pond is full, the sediment laden runoff should be batch treated.

The batch dose rate will be based on the recommendations of the CART or specific bench testing for that area and calculated against the volume of the device to be treated. The batch dose rates will be provided in Appendix D of this CTMP.

4.3.1 Application Procedure for Batch Dosing

The chemical dose should be applied evenly over the surface of the sediment control device as quickly as practicable. It is best to apply the dose in one application, rather than going over the surface of the water two or more times.

The total dose may be applied in one of two ways.

a) Spray
   The chemical can be applied to the surface of the pond using a sprayer that produces large drops.
b) Bucket
   Place no more than 1 litre of chemical in a 10-litre bucket and throw the chemical onto the pond surface so that the chemical divides into drops before hitting the surface.

Settlement generally requires 1-2 hours.

4.3.2 Timing

As impounded water often develops marked temperature gradients during the day, which can inhibit mixing of the chemical that is added to the surface of the impounded water and the settlement of coagulated solids, batch treatment should be carried out in the early morning to optimise mixing of the chemical with the sediment laden runoff and the subsequent settlement of coagulated solids.

5 Determination of Dose Rate

Bench testing will be undertaken to determine the preferred chemical treatment system and optimum dose for suspended solids removal. The bench testing will also consider the effects on pH of the treated water for the sediment retention devices.

Bench testing will be undertaken as an ongoing and continual process throughout the life of the Project (refer to Section 3 of this plan "Implementation"). Ongoing monitoring will also be undertaken of the site's sediment retention devices as outlined in Appendix C. If the monitoring highlights any deficiencies further bench testing will be undertaken. All bench testing results will be recorded in the Bench Testing Result Sheets in Appendix D.

6 Monitoring and Maintenance Requirements

6.1 Routine Management and Maintenance

Instructions for routine management and maintenance of the chemical treatment system are provided in Appendix B. A copy of this table will be kept onsite and will be available for review.

All monitoring records and maintenance checks and actions will be recorded on the monthly record sheet provided in Appendix C. The systems will be checked after each rainfall event, and during dry periods the systems will be checked weekly.

It is also noted that chemical treatment increases the sediment removal efficiency of the sediment controls. The sediment controls will need to be regularly desilted to ensure that the maximum volume is re-established after rain events.

6.2 Contingency Management

Contingencies could include poor performance of the treatment system, or effects of other influences on sediment laden runoff quality, such as reduced pH, that might make the use of chemicals inappropriate.

If the treated water in the sediment control device is consistently very clear it could indicate overdosing, and the possibility of lowered pH which can present a risk to receiving waters as a result of elevated free aluminium concentration in the discharge. If the treated water is consistently clear the pH of the water in the sediment control device will be tested.

Contingencies such as poor treatment performance or consistently very clear treated water should be dealt with as part of the day to day environmental management of the site. Refer to the ESCMP for additional monitoring and maintenance procedures that are to be implemented across the Project.

A treatment chemical spill contingency procedure is provided in Section 6.6 below.

6.3 Record Keeping and Reporting

A copy of the maintenance record for the chemical treatment system will be kept on site (Appendix C).

A copy of the maintenance record for the chemical treatment system will be provided to WRC on request.

6.4 Procedure for Chemical Transportation

The use of flocculants will be in accordance with the Project / Site Health and Safety Plan.

PAC and Superfloc will be delivered to the site by commercial carriers in accordance with current Hazardous Goods, Traffic and Transport regulation. These chemicals can be requested from the supplier generally in 20 litre containers, 200 litre drums and/or 1,000 litre IBCs. Drums of PAC and Superfloc weigh about 250kg and is most easily moved within the site in a loader bucket. Transport around the site will be via suitable vehicles or machinery and containers will be sealed and secured such that the containers cannot topple over.

6.5 Storage of Chemicals on Site

Chemicals will be stored in accordance with the Hazardous Substances procedure. Bulk PAC and Superfloc supplies will be held in secure storage. 200L polyethylene drums or IBCs of PAC and Superfloc will be held beside each chemical treatment shed / floc box, on level ground and secured so that the container cannot topple over. Those drums will be under the overall security and control of the site as a secure workplace. Drums of chemical will always be stored on end with the screw caps uppermost. Topping up of flocculant chemical will be made weekly as part of the regular inspection regime.

6.6 Chemical Spill Contingency Procedure

Spills will be manged in accordance with the Emergency Spill Response Procedure.

If there is a spill of PAC or Superfloc onto the ground it should be immediately contained using earth bunds to prevent it entering water. The spilt chemical should be recovered if possible and placed in polyethylene containers. If the spilt chemical cannot be recovered, it should be mixed with a volume of soil equal to at least ten times the volume of spilt chemical. This will effectively neutralize the chemical. The soil with which the chemical has been mixed should be buried in the ground a minimum of 0.5 metres below the surface.

If there is a spill of chemical into ponded water, discharge from the pond to natural water should be prevented.

If there is any spill into flowing water:

1. The Waikato Regional Council should be advised immediately.
2. The volume of the spill should be recorded.

3. If possible, the water and spilt chemical should be pumped into a bund or sediment control device until all the spilt chemical has been removed from the watercourse.
4. If the chemical cannot be removed from the watercourse any downstream users should be identified and advised.

6.7 Chain of Responsibility for Monitoring and Maintenance

The Environmental Manager and the Environmental Technical Specialist will have overall responsibility for the chemical treatment systems.

The ESC Foreman and ESC Labourer(s) will check the effect of PAC and Superfloc dosing on the pH of the treated water once the pond has filled for the first time and monitor pH and overall performance throughout the duration of works.

6.8 Training of Person Responsible for Maintenance and Monitoring

If a person with experience in the monitoring and maintenance of the chemical treatment system is not available, the Environmental Manager will train a person nominated by the Project team to carry out the routine monitoring and maintenance of the chemical treatment system, and to keep the required records.

6.9 Procedure Modification

It is expected that as the Project progresses, performance checks of the chemical treatment systems may be required due to changing soil types etc. This will be undertaken following additional sampling and testing and approval from the Environmental Manager.

7 Appendices

7.1 Appendix A – Chemical Analysis and Reactivity Test Report

7.2 Appendix B – Instructions for Maintenance of Rainfall Activated Treatment Systems

Reducing the Header Tank Water Volume

The header tank is used to avoid dosing during the initial stages of rainfall when site conditions are dry, and no runoff is to be expected.

The volume in the header tank is lowered using the lowest of the three outlet tubes.

- After 3 days without rain - reduce volume to 50%.
- After 6 days without rain - reduce volume to empty (level at lowest outlet).

Refilling the Chemical Reservoir

The chemical reservoir tank should be refilled when the white displacement tank is half full, or sooner if heavy rain is predicted. This is done by first emptying the white tank (baling with a bucket is efficient), and then refilling the black reservoir tank until the PAC or Superfloc level is at the lower edge of the outlet.

Observation of Water Quality in Sediment Control Device

The pond water quality will be observed at least weekly, and the clarity determined using a black disc and recorded on the monitoring sheet. pH shall be recorded once the pond has filled up to ensure that chemical dosing does not have an unacceptable effect.

Periodic System Checks

Check that the rainfall catchment tray is not leaking – especially along the lower edge of the tray. This should be done after rainfall has ceased.

Check the lower hose with the small tube outlet, from the header tank to the displacement tank, is not blocked.

Monitoring Records

A separate sheet is provided for monitoring records for each month (see Appendix B). The information to be recorded is as follows:

Visual check - Check the tray for leaks, the plumbing, and the hoses from the header tank. Record 'ok' or if maintenance is required write 'M' and note requirement in Notes column.

How full is the header tank (%)? This is the volume between the lowest and middle outlets. After rain this should be either 100% after 12mm or more rain, or between 0-100% after less than 12mm rain. In summer: 50% when lowered after 3 dry days; 0% when emptied after 6 dry days.

Depth in Displacement Tank (%) - Measure depth of water in cm. Reduces to 0 when emptied.

Chemical volume added - Record the PAC or Superfloc volume added. 1 drum = 200L, 9cm in the 200L drum = 20L. The volume can also be calculated from change in water level in displacement tank where 1cm change = 4 litres of chemical.

Water Clarity - Record using black disc near device outlet. (Refer above).

7.3 Appendix C – Chemical Treatment Monitoring and Maintenance Record

Site:

Sediment Control Device Name: Month: Maintenance Person:

Date	Visual Check	% Header Tank Full	Water depth in Displacement Tank (cm)	Chemical Volume Added	Water Clarity (mm)	pH	Notes on maintenance required or additional information	Initial
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								
11								
12								
13								
14								
15								
16								
17								
18								
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20								
21								
22								
23								
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26								
27								
28								
29								
30								
31								

7.4 Appendix D – Bench Testing Results Sheets

1 Introduction

Soil samples were taken from the contributing catchments of (insert description of devices and catchment).

These two chemicals were tested: (delete any chemical that was not tested)

1. **Poly Aluminium Chloride (PAC)**
2. **Superfloc (a blend of PAC and PolyDADMAC).**

Bench test flocculation trials were undertaken to determine soil reactivity to chemical treatment in accordance with the Auckland Council Guideline GD05.

2 Bench Test Trials

2.1 Results of PAC Bench Test

Initially, bench tests using PAC. The results of the bench tests are as follows.

Sample 1, Catchment 1 Initial pH = Initial Turbidity =

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0					
2					
4					
6					
8					
10					

Sample 2, Catchment 1 Initial pH = Initial Turbidity =

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0					
2					
4					
6					
8					
10					

2.2 Results of Superfloc Bench Tests

Bench tests were also undertaken using Superfloc. The results of the bench tests are as follows.

Sample 1, Catchment 1 Initial pH = Initial Turbidity =

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0					
1.6					
3.2					
4.8					
6.4					

Sample 2, Catchment 1 Initial pH = Initial Turbidity =

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0					
1.6					
3.2					
4.8					
6.4					

3 Discussion

Insert discussion and conclusion based on the bench testing results.

Include recommendation / chemical to be used and dose rate.

3.1 Batch Dose Rate

Insert batch dose rate and requirements.

3.2 Rainfall Activated Dosing System Details

Floc Shed Tray Size

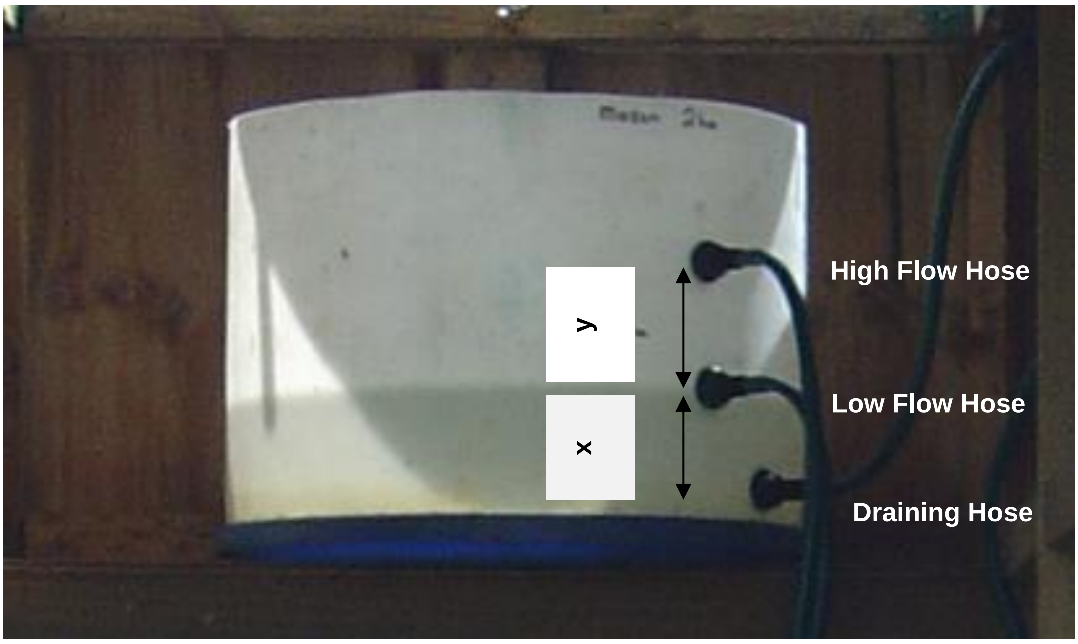
Based on the bench test results displayed in Appendix 3 undertaken on [insert date of testing] the required tray size is XXX square metres per hectare of exposed land catchment draining to the sediment control device. This is the area inside the upstand around the edge of the tray.

Sediment Retention Device	Catchment area (ha)	Tray Size (m^2)
XX	X	X
XX	X	X

Header Tank Outlet Spacing

The distance between the drain and first dosing outlet, and between the two dosing outlets, for a standard header tank made from a 200-litre drum with an internal diameter of 55 cm would be:

Sediment Retention Device	Catchment Area (ha)	Distance (x) (cm)	Distance (y) (cm)
XX	XX	X	X
XX	XX	X	X



CHEMICAL ANALYSIS AND REACTIVITY TEST REPORT

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Table of Contents

Appendices

1 Introduction

1.1 Purpose and Scope

This Chemical Analysis and Reactivity Test (CART) Report applies to the earthwork's operations associated with the construction phase of Oceana Gold (New Zealand) Limited's Waihi North Project (the Project).

The purpose of this report is to determine the effectiveness of chemical coagulants on common soil types identified within the Project area with the overall objective of minimising to the greatest extent practicable the discharge of suspended sediments into waterways during the construction phase of the project. It reports on initial testing undertaken, and the procedure for future testing to be undertaken during the Project.

Chemical treatment is now widely used throughout New Zealand to enhance the sediment removal efficiency of sediment retention devices implemented during the earthworks phase of infrastructure and development projects.

Chemical treatment is currently absent from the WRC erosion and sediment control guidelines and therefore Auckland Council's Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region, Incorporating Amendment 1'* has been adopted.

Soil samples have been tested with two common cationic coagulants, which neutralise the negatively charged soil particles to improve flocculation and settlement within the sediment control device. The two coagulants are complimentary, with one or other often showing a better response depending on the soils being tested.

1. Poly Aluminium Chloride (PAC).
2. Superfloc (a blend of PAC and PolyDADMAC).

These coagulants contain aluminium and therefore pH monitoring must be monitored during testing and application. GD05 states that the following limitations apply to chemical treatment:

- pH must be tested as part of the bench testing methodology and should be used as a control baseline. Whatever flocculant is being used must not change that baseline pH beyond +/-1 and must not fall outside of the range of 5.5 – 8.5, as measured from the primary spillway. To align with the conditions of consent the pH range, 6.0 to 9.0 will be adopted as part of this Project.
- Treatment should cease when the above pH limits cannot be met.

Additionally, a chitosan based flocculant was used in two tests to compare results to PAC and Superfloc. This product, supplied by Vital Chemicals, is pH stable and is composed of biodegradable organic compounds. TSF3 Sample 2 and TSF3 Sample 3 were tested with this product. Results are reported in Section 3.

This report presents the initial results of bench test trials undertaken to determine the effectiveness of the two coagulants and flocculant. Clarity, turbidity, and pH measurements were undertaken and recorded for each bench test and the results used to determine the optimum chemical and dose rate for each sample provided.

1.1.1 Chemical Treatment Management System

The relationship of this CART report within the overall chemical treatment management system for the Project is shown in Figure 1 below. The CART has informed the development of the Chemical Treatment Management Plan (CTMP) developed for the Project. The CTMP is the overarching plan for the management, maintenance, and reporting of the chemical treatment system to be implemented across the Project for the duration of earthworks phases. As the Project progresses, further bench testing will be undertaken as new areas are opened and earth worked. The overarching CTMP contains additional bench testing sheets as an appendix for future tests to be completed and supplied to Waikato Regional Council (WRC). It will also detail the specific set-up details for the chemical treatment of each sediment retention pond (SRP) to be implemented in an area i.e. roof tray and header tank outlet spacing.

Site Specific Erosion and Sediment Control Plans (SSESCPs) have been prepared for each earthworks area and or phase within the Project. The SSESCPs will be updated to provide the design details for all erosion and sediment control measure to be implemented within that area.

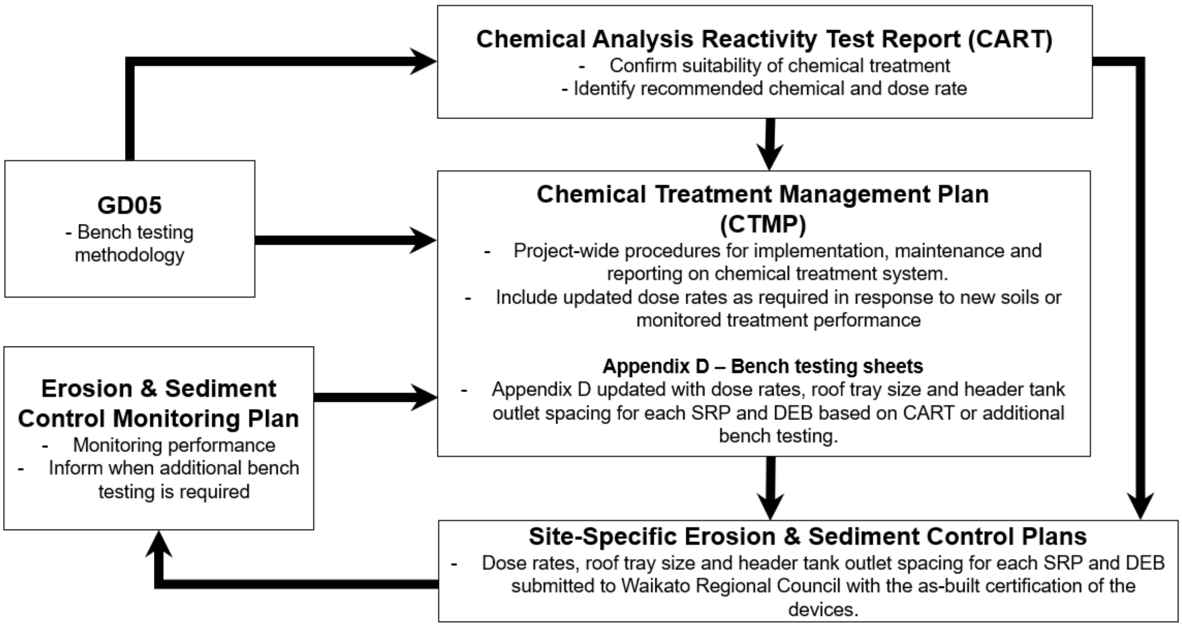


Figure 1: Chemical treatment management systems.

2 Methodology

The bench testing methodology provided in Appendix F1 of GD05 has been adopted. This methodology will be repeated for all future bench testing required in response to identified new soils, or where treatment performance is less than anticipated.

Testing of each sample involved the application of five dose rates (2mg/l to 10mg/l Al) and comparison to a control. Results are reported in the following tables.

2.1 Soil Samples

Engineering Geology Limited (EGL) supplied soil samples from the footprint of Tailings Storage Facility 3 (TSF3) and the Northern Rock Stack (NRS).

TSF3 – Drill Holes AP21a and AP22a (Refer Appendix A for locations). Depth ranging from 0 - 9m.

Figure 2: Drill hole AP21a.

Figure 3: Drill hole AP22a.

NRS – TPW5 and TPW6 (Refer to Appendix A for locations). Depth ranging from 0 – 5m.

Figure 4: Drill pit TPW5.

To date no soil samples from the Willows Road site have been tested. Additional bench testing of soil(s) acquired from the Willows Road site will be tested to confirm the required dose rate prior to commencement of earthworks. Appendix D will be completed for each new soil sample tested and results provided to WRC.

3 Bench Testing Results

Highlighted green rows indicate dose rates that could be used on site. Highlighted red rows should not be used on site due to the impact on the pH.

3.1 TSF3 Sample 1

Description: Ash – Combination of soil from AP21a and AP22a

PAC *Initial pH: 6.92* *Initial turbidity: 1962 NTU*

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	100	120+	120+	7.04	11
2	120+	120+	120+	6.93	11
4	120+	120+	120+	6.80	9
6	120+	120+	120+	6.60	10
8	120+	120+	120+	6.45	11
10	120+	120+	120+	6.22	11

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Superfloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	100	120+	120+	7.04	11
2	120+	120+	120+	6.99	15
4	120+	120+	120+	6.89	9
6	120+	120+	120+	6.77	11
8	120+	120+	120+	6.65	6
10	120+	120+	120+	6.53	8

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

3.2 TSF3 Sample 2

Description: Alluvium from AP21a

PAC *Initial pH: 6.91* *Initial turbidity: 1412 NTU*

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	10	10	10	7.05	1114
2	15	15	20	6.99	509
4	35	40	40	6.90	208
6	55	75	75	6.77	100
8	120+	120+	120+	6.67	34
10	120+	120+	120+	6.50	17

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Superfloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	10	10	10	7.05	1114
2	30	30	30	6.99	350
4	70	70	75	6.92	86
6	120+	120+	120+	6.84	36
8	90	105	105	6.77	63
10	70	70	75	6.70	128

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Vital Eco Superfloc

Dose Rate (ml/m³)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	10	10	10	7.05	1114
20	10	10	10	7.02	1212
50	10	10	10	7.00	1086
100	10	10	10	7.00	845
150	10	15	15	6.98	660
200	15	20	20	6.67	442
250	15	25	30	6.93	302

Control 20 50 100 (ml/m³) 150 200 250

3.3 TSF3 Sample 3

Description: Rhyolite combination from AP21a and AP22a

PAC *Initial pH: 7.07* *Initial turbidity: 2021 NTU*

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	15	25	30	7.13	338
2	55	75	80	7.11	87
4	95	110	120	7.06	42
6	120+	120+	120+	6.95	17
8	120+	120+	120+	6.78	34
10	120+	120+	120+	6.61	24

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Superfloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	15	25	30	7.13	338
2	110	115	120+	7.11	51
4	120+	120+	120+	7.04	44
6	110	110	110	6.96	64
8	115	115	120+	6.90	61
10	90	90	115	6.83	72

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Vital Eco Superfloc

Dose Rate (ml/m^3)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins

0	15	25	30	7.13	338
20	20	35	35	7.12	280
50	20	35	40	7.10	242
100	35	50	55	7.10	134
150	50	75	80	7.05	90
200	80	105	110	7.04	59
250	100	110	120	7.00	52

Control 20 50 100 150 200 250
(ml/m^3)

3.4 NRS Sample 1

Description – Volcanic ash (TPW5 and TPW6 depth 0.2-1.5m)

PAC *Initial pH: 7.37* *Initial turbidity: 1076 NTU*

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	40	50	60	6.99	90
2	95	120+	120+	6.93	25
4	120	120+	120+	6.88	14
6	100	120+	120+	6.75	15
8	100	120	120+	6.60	14
10	100	120	120+	6.42	16

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Superfloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	40	50	60	6.99	90
2	80	110	110	6.95	39
4	80	100	110	6.90	36
6	70	95	120+	6.83	28
8	65	80	120+	6.69	25
10	45	65	120+	6.55	30

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

3.5 NRS Sample 2

Description – Alluvium (TPW5 depth 1.3-2.2m and TPW6 depth 1.8-2.8m)

PAC *Initial pH: 7.26* *Initial turbidity: 1746 NTU*

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	15	30	40	6.75	275
2	50	80	80	6.70	73
4	90	110	115	6.65	43
6	105	120+	120+	6.58	35
8	110	120+	120+	6.50	40
10	120	120+	120+	6.30	42

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Superfloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	15	30	40	6.75	275
2	85	90	90	6.71	65
4	110	120+	120+	6.68	45
6	100	110	110	6.59	55
8	90	95	100	6.50	60
10	65	75	95	6.38	62

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

3.6 NRS Sample 3

Description – Alluvium Silty Organic Sand (TPW5 depth 2.9m)

PAC *Initial pH: 6.58* *Initial turbidity: 1447 NTU*

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins

0	10	15	15	6.30	877
2	25	30	35	6.21	259
4	50	60	65	6.15	90
6	120+	120+	120+	6.00	29
8	120+	120+	120+	5.90	10
10	120+	120+	120+	5.70	15

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Superfloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	10	15	15	6.30	877
2	40	45	50	6.27	156
4	120+	120+	120+	6.08	44
6	120+	120+	120+	6.00	44
8	60	70	70	5.91	120
10	35	45	45	5.82	230

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

3.7 NRS Sample 4

Description – Alluvium Grey Silty Clay (TPW6 depth 2.5m)

PAC *Initial pH: 6.81* *Initial turbidity: 1176 NTU*

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins

0	25	50	60	6.55	109
2	100	120+	120+	6.42	29
4	115	120+	120+	6.26	23
6	120+	120+	120+	6.07	21
8	120+	120+	120+	5.83	21
10	100	105	110	5.70	36

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Superfloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	25	50	60	6.55	109
2	110	110	110	6.46	32
4	100	105	110	6.30	35
6	70	75	80	6.24	54
8	60	60	70	6.16	65
10	45	50	60	6.01	101

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

3.8 NRS Sample 5

Description – Ignimbrite (TPW5)

PAC *Initial pH: 6.63* *Initial turbidity: 1475 NTU*

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins

0	50	80	95	6.84	38
2	110	120+	120+	6.62	22
4	105	120+	120+	6.43	22
6	110	120+	120+	6.21	20
8	100	120+	120+	5.92	21
10	80	120+	120+	5.60	26

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Superfloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	50	80	95	6.84	38
2	105	120+	120+	6.73	24
4	95	120+	120+	6.54	26
6	100	120+	120+	6.38	28
8	90	120+	120+	6.10	26
10	110	120+	120+	5.99	27

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

3.9 NRS Sample 6

Description – Dacite (TPW6)

PAC *Initial pH: 6.75* *Initial turbidity: 565 NTU*

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins

0	30	55	70	6.83	84
2	70	100	120+	6.74	34
4	75	110	120+	6.62	31
6	100	120	120+	6.52	27
8	80	110	120+	6.41	30
10	60	90	110	6.10	51

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Superfloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	30	55	70	6.83	84
2	65	90	100	6.77	52
4	55	90	110	6.68	39
6	60	80	120	6.55	35
8	50	65	105	6.49	49
10	40	60	70	6.28	95

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

4 Discussion

The most efficient dose rate achieves the best balance between settlement response, pH response and cost of chemical throughout the duration of the Project.

The soil samples generally retained persistently mobile fine colloidal particles and had variable clarity and turbidity responses. In most cases the coagulants provided significant improvement of clarity and turbidity compared to the control. Both PAC and Superfloc provided consistent rates of settlement for the soil types tested. Either of these chemicals could be used on site. The recommended chemical to be used on site is PAC, due to its rigorous testing undertaken by the Auckland Regional Council and cost advantage.

Taking account of the variability between samples, PAC at a dose rate of 4mg/l Al provided the most consistently high water quality treatment response. An indicative dose rate of 4mg/l Al equates to 62ml PAC / m^3 of sediment laden runoff.

The pH response to all low to moderate dose rates of PAC and Superfloc were within the acceptable range with respect to background pH and potential toxicity. High dose rates exceeding 8mg/L of Al are not recommended.

As stated in Section 1.2, the application and management for chemical at each site will be implemented in accordance with the CTMP and the dosing system setup for each device will be specified in the corresponding SSESCP. Where new soils are encountered, or responses are not as anticipated, additional bench testing will be undertaken in accordance with the GD05 methodology and included in the CTMP.

A

Appendix A – Chemical Analysis Soil Sample Locations

Oceana Gold (New Zealand) Limited

Waihi North Project

Erosion and Sediment Control Monitoring Plan

Project Manager:	Date:	20 November 2024
	Document No:	WAI-ESCMP
	Revision:	A
	Status	Final

Document History and Status

Revision	Date	Author	Reviewed by	Approved by	Status
A	20/11/24	Z Woods	M Parsonson		Final

Revision Details

Revision	Details
A	Issued for consent.

Document Details

Document Name:	Erosion & Sediment Control Monitoring Plan
Status:	Final
Document No:	WAI_ESCMP
Author:	Z Woods

Contents

1. INTRODUCTION

The purpose of this Erosion and Sediment Control Monitoring Plan (ESCMP) is to detail the erosion and sediment control (ESC) management and monitoring system that will be implemented for the duration of the site preparatory earthworks activities associated with Oceana Gold's Waihi North Project (the Project). The ESCMP includes details of process and procedures that will be followed and confirms how the ESC management and monitoring will be undertaken and the methods used in the context of the Project to ensure that effects and performances are managed appropriately.

This monitoring plan has been written to detail how Oceana Gold proposes to manage and monitor ESC measures during construction, to ensure the performance of the Project ESC and to provide rapid and real time information and control to the Project management team.

The ongoing monitoring and reporting that is proposed in this plan creates a continuous feedback loop of the performance of the Project ESC site and device management. This plan provides the approaches to be followed regarding ESC maintenance, monitoring, and reporting.

The ESCMP covers:

- Site management structures, practices, and procedures
- Weather Monitoring
- Erosion and Sediment Control Monitoring
  - Scheduled site visits, pre and post rain event monitoring and water sampling.
  - Rainfall event triggered water clarity and pH monitoring.
- Reporting
  - Rainfall trigger event reporting following a rainfall trigger event.
  - Recommendations of changes that need to be implemented onsite and modifications to any ESC will also be included.

Chemical treatment will be monitored in accordance with the Project's Chemical Treatment Management Plan (Appendix A to the Project Erosion and Sediment Control Assessment Report (ESCAR)).

2. SITE SPECIFIC EROSION AND SEDIMENT CONTROL IMPLEMENTATION

The construction of all erosion and sediment controls will be managed as follows:

- An ESC Technical Specialist will prepare the Site-Specific Erosion and Sediment Control Plans (SSESCPs) in conjunction with the relevant construction Project Engineer and the Environmental Manager.
- Each SSESCP will be approved by the Environmental Manager and then submitted to Waikato Regional Council (WRC) for certification against TR09/02.
- Once certified, the Environmental Manager will issue the certified SSESCP to the Project Manager (staff member) responsible for the implementation.
- A pre-construction meeting will be held by the Environmental Manager where the erosion and sediment controls to be built will be discussed and specific direction given on construction.
- The location of the controls and requirements of the relevant SSESCP will be confirmed on site with the construction team and the Environmental Manager.
- The construction of the controls will be overseen by the Environmental Manager and / or the ESC Technical Specialist.

- Hold points for construction will be established for each control whereby the Environmental Manager (or ESC Technical Specialist) will inspect the work completed, for example the installation of anti-seep collars or the installation of the primary outlet.
- Each control will be 'as built' certified by the Environmental Manager (or ESC Technical Specialist) to confirm compliance with the certified SSESCP prior to bulk earthworks commencing in the catchment of the device(s).
- Copies of the 'as-built' certifications will be submitted to WRC.

3. WEATHER MONITORING

3.1. Rain Forecast

Rain forecasts relevant to the site will be checked daily using the MetService / MetVuw online / NIWA forecasting systems. Close monitoring of the rain forecast will be necessary to ensure the appropriate site works can be implemented prior to rainfall trigger events.

During working days, daily weather forecast checks will be forwarded to all Project Engineers and recorded in the daily prestart job sheets.

If the forecasts show more than 25mm of rainfall over a 24-hour period, then this will trigger the pre-rain event inspections (rain event with forecast >25mm over 24 hours), refer to Section 4.1 for further details. The purpose of these inspections is to check that the ESC devices and controls are set-up and ready for the rain event. This is in addition to the routine pre-rain event inspections undertaken by Project Engineers.

3.2. Rain Gauges

Rainfall will be recorded at the existing weather station located near the Martha Pit. The Environmental Manager will monitor rainfall recorded at that site. Rainfall trigger responses will be based on recorded events at that location, which is sufficient close to the various earthworks packages to be undertaken during the Project.

4. EROSION AND SEDIMENT CONTROL MONITORING

The Environmental Manager or nominated environmental staff will conduct routine inspections of the sites. These inspections will take place with adequate time allocated and will be thorough and systematic. Members of the project construction team including the Project Engineer, will accompany the Environmental Manager or ESC Technical Specialist on these inspections so that the Environmental Manager or ESC Technical Specialist can better understand the work occurring at that time and that programmed to take place. It is also useful for the Project Engineers to be reminded of their ESC obligations and for both parties to recognise good performance and outcomes, and where performance has not been to the standard expected or required by consents. This is particularly relevant in identifying how communication between personnel can be improved to avoid a recurrence of an issue.

Communication is critical to the successful implementation of SSESCPs. Internal inspections will cover all areas of the Project, even those that may have been dormant for some time, to ensure that the erosion and sediment controls are still operating properly. These internal inspections will be captured in writing and will include actions and timeframes for close out.

4.1. Site Inspections

4.1.1. Internal Site Inspections

Routine inspections are undertaken during and post instalment of ESC devices. During construction, certain stages are identified for inspection, such as during the installation of anti-seep collars, level spreaders, and T-bars.

Post construction monitoring is undertaken once a sediment retention pond (SRP) or decanting earth bund (DEB) is operational, and the rainfall activated chemical treatment system is operational for the first time. Monitoring will take place as soon as practicable following the first rainfall event that generates runoff to the ESC device. This is to assess the performance of the device and chemical treatment system and the resulting quality of treated water being discharged from the site.

The site will be inspected weekly as a minimum by the Environmental Manager (or nominated person) and / or ESC Technical Specialist during the course of the works. These inspections will ensure that all ESC devices are installed correctly and then operate effectively throughout the duration of the works. This inspection programme will provide certainty to all parties that appropriate measures are being undertaken to ensure compliance with conditions of consent and the certified SSESCPs. The inspection regime will keep ESC management at the forefront of works on site. Any potential problems will be identified immediately, and remedial works will be promptly carried out.

The inspection programme shall consist of:

- **Weekly** site walkovers involving the environmental team to inspect all ESC measures, identify any maintenance or corrective actions necessary, assign timeframes for completion, and identify any devices that are not performing as anticipated through the certified SSESCP. Any maintenance actions will be undertaken that day where practical. Actions will be recorded and issued to the Environmental Manager with specific actions required and closeout timeframes. Once completed, the Environmental Manager will inspect the works and close-out the item.
- **Pre-rain event:** Prior to all forecast rainfall events, checks will be made of ESC devices, including chemical treatment systems, to ensure that they are fully functioning in preparation for the forecast event. These will be undertaken by the Project Engineers, Site Supervisors or Environmental Team.
- **Pre-rain event with forecast >25mm over 24 hours:** These inspections are additional to the 'business as usual' pre-rain inspections. They must be undertaken by the Environmental Manager or nominated and sufficiently experienced person.
- Prior to forecast rainfall "trigger" events, specific site inspections will be undertaken, targeted at any additional ESC measures that are required to be installed to ensure that the sites ESC management system performs effectively during an expected larger event.
- **Rainfall Trigger Inspections**: During or immediately after a rainfall trigger event of >25mm rainfall over any 24-hour period (subject to health and safety restrictions) inspections will be made of all discharging SRPs and the following actions taken:
    - Water clarity of the water within the device adjacent to the decant outlet, or taken from the outlet pipe will be measured using either a clarity tube or black disc indicator.
    - pH testing of the inlet and outlet flows undertaken along with a general inspection of the sediment control devices.
    - The rainfall trigger alerts will be monitored by the Environmental Manager.
    - Any issues identified will be remedied as soon as practicable, and remedial measures will be recorded.

The purpose of these inspections is to confirm the performance of devices under the stress of heavy rainfall and obtain a spot check efficiency of the device.

- **Post-rain event**: Following all rainfall events including rainfall trigger events, inspections will be made of all ESC measures to ensure that all controls have performed as expected and to identify any maintenance requirements. Any remedial works will be documented during these monitoring inspections and immediately addressed where practical.

4.1.2. External (Regional Council) Site Inspections

The Environmental Manager or Project Manager will accompany the WRC inspector in all programmed WRC audits. All ESC maintenance actions identified by the Council inspector will be recorded and issued to the Project Manager for actioning, based on WRC instruction. The Project Manager will report back the completion of those actions to the Environmental Manager will inspect the works and confirm that those actions have been completed. Confirmation will be emailed to the WRC inspector.

4.2. Water Quality Monitoring

Water quality monitoring will be undertaken during rainfall trigger event (>25mm of rain within a 24-hour period) site walkovers to provide a snapshot of the ESC performance.

Water quality will be monitored by:

- Clarity (measured at the outlet end of all discharging SRPs)
- pH (measured at the inflow and outflow of each chemically treated device)

The following water quality targets apply to the site's ESCs and will be measured during/after each rainfall trigger event (>25mm in a 24 hours period):

- Clarity of at least 100mm; and
- pH between 6.0 and 8.5 of a chemically treated device.

If either of the targets/thresholds identified are breached, then the management actions identified within Section 5.3 will be implemented.

5. MANAGEMENT RESPONSES

5.1. Regular Monitoring Responses

The key to successful implementation of ESC measures and minimising sediment yield will be through the daily and weekly visual monitoring of the site and maintenance of controls. This monitoring will be undertaken by the Site Foreman. The responses to that monitoring will be as follows.

- A checklist record will be made of each device inspected and its conditions, noting any maintenance requirements and timeframes of that to be undertaken. Maintenance will be based on ensuring compliance with TR09/02 requirements.
- Ensuring all sediment retention devices are cleaned out before they reach 20% full of sediment.
- Completion of maintenance actions as soon as possible, and typically within 24 hours for standard issues and 8 hours for urgent issues.
- Emphasis on maintenance necessary prior to forecast rain.
- Sign-off of all completed maintenance and reporting to the Environmental Manager.

5.2. Incident Responses

If one of the following occurs:

i. A failure of an erosion and/or sediment control (e.g. perimeter control, SRP or DEB) that results in visible discharge of sediment to a stream.
ii. Slumping / mass movement or erosion associated with the works, but which is outside the catchment of a sediment control device or has resulted in a device being over-topped by sediment, where that sediment has discharged to a stream.

The responses will be:

- Inform WRC.
- Remedy the failure or event to prevent further uncontrolled discharges.
- Determine if the discharge is an isolated case or is likely to be repeated; and
- Investigate and implement modifications. Modifications could include:
    - Make alterations to erosion and sediment control measures and methodologies;
    - Consider additional ESC;
    - Refinement of chemical treatment systems;
    - Progressive stabilisation in sub catchments;
    - Increase maintenance of controls; and
    - Amendments to methodologies and sequencing of works and refinement of controls necessary.

5.3. Threshold / Target Exceedance Responses

If either of the water quality targets or thresholds detailed in Section 4.2 are not met the following management responses will occur.

- Within 24hrs of a threshold exceedance, a full audit of the condition of the control device and its contributing catchment will be carried out and recorded in writing.
- Remedy and record any obvious causes on site that may have contributed to a threshold exceedance as soon as practicable.
- Identify any additional reasons for the exceedance and opportunities to modify the management of the site to improve overall performance which may include:
    - Consider additional ESC;
    - Refinement of chemical treatment systems; and
    - Increase maintenance of controls.

If either of the targets are breached, then that SRP will be deemed to be ‘high risk’ for the next rainfall trigger event.

High risk SRPs will be subjected to additional scrutiny during pre-forecast inspections (forecasts of >25mm/24 hrs) to ensure that repeat breaches do not occur.

<u>pH exceedance</u>

Typically, chemical treatment of sediment control devices will slightly lower pH. If pH is recorded to be below 6.0, the following actions will occur:

- The catchment area of the treatment device will be checked against the area assumed when the chemical dosing rate was set. The area and / or dose rate will be adjusted as needed.

- The does rate will be checked. Additional bench testing and adjustment of the dose rate will be made if required.
- The material exposed within the catchment of the device will be checked. If that incorporates PAF, all runoff from that catchment will be diverted to the treatment plant.
- The chemical treatment system will be reviewed and if necessary.

<u>SRP discharge clarity</u>

If the water clarity recorded at the outlet is less than 100mm, a review of the controls and catchment of the controls will be made. Generally, any maintenance requirements will have been identified during regular monitoring. Additional considerations will include the measures noted above i.e.:

- The catchment area of the treatment device will be checked against the area assumed when the chemical dosing rate was set. The area and / or dose rate will be adjusted as needed.
- The dose rate will be checked. Additional bench testing and adjustment of the dose rate will be made if required.
- The material exposed within the catchment of the device will be checked. If that incorporates PAF, all runoff from that catchment will report to Collection Ponds and be diverted to the Water Treatment Plant.
- The chemical treatment system will be reviewed and if necessary.

Additional response measures may include:

- Increased frequency of desilting of device(s).
- Reducing the contributing catchment area by temporary stabilisation.
- Installation of additional erosion controls, e.g. more contour drains, drop out pits etc.
- Increasing forebay ponding areas within the site.

6. REPORTING

6.1. Rainfall Trigger Event Report

Following a rainfall trigger event (>25mm in a 24hr period), a summary report of the performance of SRPs, and overall ESC system observed during the rainfall event report will be provided to WRC. The report will include:

- A summary of the rainfall (total and intensity)
- A summary of the manual monitoring undertaken and comparison of manual monitoring results to previously recorded results.
- A summary of the site performance against the performance targets.
- A record of any other matters which may have compromised the overall ESC performance during the rain event and the identified mitigation, maintenance, and management response.

The Rainfall Trigger Event Report will be provided to WRC within 10 working days of the rainfall trigger event.

Waihi North Project

Site Specific Erosion and Sediment Control Plan

Appendix C.1 – Willows Road

Prepared for OGNZL

Prepared by: Southern Skies Environmentals Ltd Date: 17 February 2025

CONTENTS

1. OVERVIEW

1.1. Scope

This Site-Specific Erosion and Sediment Control Plan (SSESCP) relates to the activities associated with the establishment of the Willows Road site, including, the Willows Portal to the Wharekirauponga Underground Mine, Willows Rock Stack, Magazine Storage Area, Topsoil Stockpile, Surface Facilities Area Heliport and associated access roads. These features are shown on Figure 1.

The total footprint for the works within the Willows Road site is approximately 18.1 hectares.

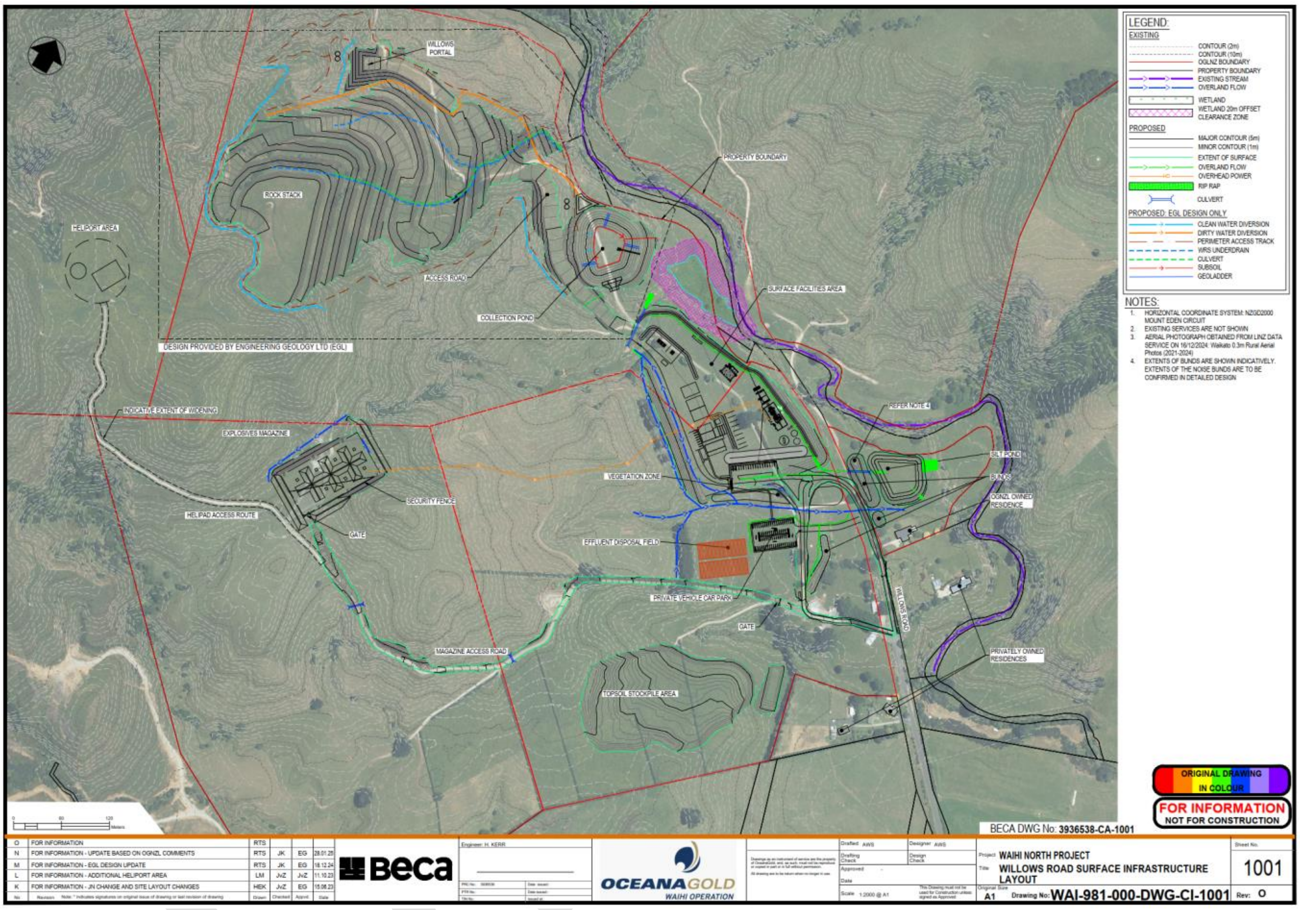


Figure 1: Willows Road Surface Facilities Area General Arrangements (Source: BECA).

This SSESCP provides design erosion and sediment control (ESC) measures indicating how the site will manage runoff during these construction activities. This document should be read in conjunction with the Assessment of Environmental Effects prepared by Mitchell Daysh and specialist reports prepared by others.

The Willows Road establishment works comprise the following four components:

Section 1 – Surface Facilities Area.

Section 2 – Mine Access Road and Willows Rock Stack.

Section 3 – Magazine Storage Area, access road, topsoil stockpile and heliport.

This SSESCP has been prepared in accordance with Waikato Regional Council Technical Report No. 2009/02 *Erosion and Sediment Control Guidelines for Soil Disturbing Activities, January 2009* (TR2009/02) and addresses the following earthwork activities:

- Establishment of the erosion and sediment controls;

- General earthworks, including stockpiling, road formation, establishment of the Willows Rock Stack, trenching; and
- Final landscaping and stabilisation.

The ESC measures will be used during the 'enabling works' phase which does not include mining or management of potentially acid forming (PAF) material. Once mining activities occur contact water will be pumped to the Water Treatment Facility.

2. DESCRIPTION OF WORKS

Earthworks are anticipated to be required over an area of 18.1ha (excluding mining activities). The expected areas are provided in Table 1.

Table 1: Earthwork areas.

ID	Area (ha)
Surface Facilities Area (including pond)	5
Magazine Storage Area	1.1
Magazine Access Road	0.6
Topsoil Stockpile	2.3
Heliport area	0.5
Mine Access Roads and portal	1.6
Willows Rock Stack	7.0
Total	**18.1**

Approximately 850,000m^3 of rock (mineralised and non-mineralised) will be generated during the development of the Wharekirauponga Underground Tunnel networks and hauled by truck for temporary storage in the Willows Rock Stack. The Willows Rock Stack is designed to take circa 876,000m^3 to account of the planned tunnel spoil.

The surface facilities area has been designed by BECA, while the willows rock stack, mine access road and rock stack collection pond have been designed by Engineering Geology Limited (EGL).

The key phases of earthworks relating to the erosion and sediment control include:

- Construction of the erosion and sediment controls.
- Construction of the Collection Pond and Silt Pond. Note, the Collection Pond and Silt Pond are separate structures to the temporary sediment retention ponds (SRPs) proposed as part of this SSESCP.
- Topsoil removal and the establishment of topsoil stockpiles.
- Establishment of the Willows Rock Stack.
- Contouring the Surface Facilities Area.

- Construction of access roads and Willows Portal.
- Contouring the Magazine Storage Area and Heliport.

The ESC measures are shown on the ESC drawings which are provided in Appendix B. Updated detailed ESC drawings will be prepared prior to these works commencing.

Some ESC design features have been included in the EGL and BECA reports, for example clean water diversion sizing. In this case, where requirements vary between, the more stringent will be adopted from the outset.

2.1. Surface Facilities Area

Refer to ESCP-WR-001-01 and ESCP-WR-001-02

The surface facilities include noise bunds, car parking, detention pond, effluent disposal field, pipe storage/stockpiling area, offices, amenities, and related facilities.

The Willows Silt Pond, designed by BECA, will be built to service the earthworks within the Surface Facilities and broader disturbed farm areas. A super silt fence will be installed below the footprint of the pond to capture any runoff during the construction of this pond.

A cut area may need to be established to provide suitable material for the construction of the Silt Pond. If required, a sediment retention pond (SRP-1) will be constructed below the cut area to capture and treat runoff from this cut area. A clean water diversion bund will be constructed above the cut area and dirty water diversions will direct sediment laden runoff to SRP-1.

The Silt Pond has a design capacity of 5,000m^3 and will act as a sediment retention pond for the approximately 5ha Surface Facilities Area during construction and for the life of mining. This Silt Pond may also need to be used to treat sediment laden runoff for the enabling works of the Willows Rock Stack (refer to Section 2.2 and 2.3) In accordance with TR2009/02 a sediment retention pond (SRP) constructed for this area would require a total volume of 1,500m^3 (3% of the contributing catchment area). In this case the detention pond has an excess of 3,500m^3 of storage volume. Refer to BECA engineering report for Silt Pond design details.

During the earthworks phase the Silt Pond will be fitted with a concrete manhole, 300mm outlet pipe and 3x T-bars. The concrete manhole will need to be weighted down.

Once the earthworks are completed, the facility areas will be sheeted with aggregate. Landscaped areas, including the noise bunds (if remaining in place) will be topsoiled and stabilised with grass seed and mulch. The T-bars will be removed from the Silt Pond manhole, and discharge orifice and weir installed as per BECA design details.

2.2. Wharekirauponga Underground Mine

Refer to ESCP-WR-002-01 and ESCP-WR-002-02

The Wharekirauponga Underground Mine portal will be formed on the northern side of the Willows Rock Stack (WRS). The initial works will involve a box cut and slope stabilisation. During this time, sediment laden runoff will be directed along the dirty water diversions installed along the edge of the access road to the Willows Silt Pond.

Where practical, clean water diversions will be constructed around the portal to divert clean water away from the box cut.

The excavation of the box cut will make the area self-impounding and water collected in the box cut will then need to be pumped out.

The access roads to the mine portal will be progressively formed and sheeted with rock. Roadside table drains will act and dirty water diversions to convey runoff to the Willows Silt Pond. Once the Collection Pond has been constructed and commissioned, runoff will be diverted to the Collection Pond. Refer to Section 2.3 for details.

2.3. Willows Rock Stack

Refer to ESCP-WR-002-01 and ESCP-WR-002-02

The Willows Rock Stack will be established to stockpile approximately 876,000m^3 of rock excavated during tunnelling for the underground mine.

The lower portion of the WRS will be established at the same time as the tunnel portal, access road, and the Willows Collection Pond.

In terms of the erosion and sediment control measures proposed for the Willows Rock Stack, specific measures are proposed for the construction of the Collection Pond and enabling earthworks during the setup phase of the Rock Stack before any PAF material is placed. Refer to the *Willows Rock Stack and Surface Facilities Geotechnical Assessment,* prepared by EGL for specific staging and construction details.

Initially, a super silt fence will be installed below the footprint of the Collection Pond to enable the construction of the Pond. The Collection Pond catchment area will be isolated by water table drains (dirty water diversions) formed alongside the access road that will need to convey runoff down to the Willows Silt Pond until the Collection Pond is constructed and commissioned. The catchment area diverted to the Willows Silt Pond is approximately 3.2ha.

The box cut for the tunnel portal will provide a source of NAF fill for the construction of the toe of the WRS and for the Collection Pond construction. Cut from within the Collection Pond footprint may also be used to build its embankment. Excess or unsuitable cut will go into the WRS.

The toe embankment of the WRS is required to be constructed early to stabilise and retain the slope above. Clean water diversions will be constructed to isolate the toe embankment excavation area.

During a period of fine weather and super silt fence will be installed below the toe embankment excavation. The gully will be mucked out and suitable material from the portal box cut placed to form the embankment. The embankment will continue to be built up and will form the WRS Initial Silt Pond (design and volumes TBC). Once the Initial Silt Pond is constructed, the subsoil drainage and culvert will continue to be extended up the gullies.

The Collection Pond has a design capacity (to the spillway level) of 18,435m^3.

Once the Collection Pond is constructed and commissioned all runoff will be directed into the forebay of the Collection Pond. During the enabling earthworks, the Collection Pond can serve purpose as a sediment retention pond, discharging treated sediment laden water to the receiving environment. Once the enabling earthworks are complete the Collection Pond will receive mine water that may contain PAF material. Water collected with then report to the Water Treatment Plant.

Material placed in the Willows Rock Stack is planned to start being used as tunnel backfill from approximately Year 6 with complete removal of the Rock Stage by Year 10.

2.4. Topsoil Stockpile

Refer to ESCP-WR-003-01

An area of approximately 2-3ha will be used to stockpile topsoil generated from the project.

Clean water diversions will be installed around the top of the stockpiling area.

A sediment retention pond (SRP-1) will be constructed near the base of the topsoil stockpile which will capture and treat runoff from the stockpile as well as runoff during the construction of the Magazine Access Road. The maximum contributing catchment area is 3ha and this will be managed on site to ensure that no more than 3ha is directed to this pond at a time.

The stockpile will be progressively stabilised with grass seed and hay mulch. SRP-1 will be retained to manage runoff quality during topsoil recovery and site rehabilitation.

2.5. Magazine Storage Area, Access Road and Heliport

Refer to ESCP-WR-003-01, ESCP-WR-003-02, and ESCP-WR-003-03,

The establishment of the Magazine Storage Area (Explosives Magazine) requires earthworks across a total area of approximately 1.1ha.

An existing farm race will be upgraded to an 885m long, 6m wide access road to service the Magazine Storage Area. Majority of the earthworks associated with the Magazine Access Road upgrade will be cut into the bank on the northern side of the access road, with some areas of fill required below the access road.

Clean water diversions will be installed around the Magazine Storage Area to direct upper clean water catchment away from the earthworks area. An existing farm culvert installed beneath the farm track will be upgraded to a 450mm diameter pipe to cater for the flows from the upper clean water catchment.

A sediment retention pond (SRP-3) will be constructed below the Magazine Storage Area to capture majority of the runoff during its construction.

A small area to the northeast of the Magazine Storage Area will not fall to the SRP, including the fill area. It is anticipated that a super silt fence or decanting earth bund (DEB) could be utilised for this section of the work. Preference will be super silt fence due to the steep slopes and gully system below this area.

The Magazine Access Road will be constructed in two sections (in terms of erosion and sediment control methodology). The first section of approximately 350m from Willows Road requires minimal earthworks. This section will be completed as a cut and cover operation where the road will be cut to grade and stabilised with aggregate within the same day. Batters formed above the road will be progressively stabilised (e.g. hydroseeded or mulched).

The second section of work up to the Magazine Storage Area requires more earthworks to widen the road and provide suitable access. As the road is cut out a roadside table drain will be formed. Runoff from the road will be sloped/cambered towards the table drain and will flow down to SRP-2 constructed below the topsoil stockpile. The access road will be progressively sheeted with aggregate. Batters formed above the road will be progressively stabilised.

From the Magazine Storage Area, the access road will continue to be upgraded and widened to the proposed Heliport Area. Roadside table drains will be installed along the edge of the access road and will be used to convey runoff to SRP-3. Minor earthworks will be required to form a flat pad for the heliport. Runoff can either be directed down the road to SRP-3 or treated at source. Details will be provided as part of the Final SSESCP.

Once the construction of the Magazine Storage Area is complete it will be sheeted with aggregate. SRP-3 will either remain in place as a water collection pond or decommissioned.

3. EROSION AND SEDIMENT CONTROL DETAILS

The erosion and sediment control methodology has been designed in accordance with best practice and the principles outlined in TR2009/02.

Specific erosion and sediment control calculations and drawings can be found within the appendices.

Appendix A – Erosion and sediment control calculations and typical details.

Appendix B – Erosion and sediment control drawings:

ESCP-WR-001-00

ESCP-WR-001-01 ESCP-WR-002-01 ESCP-WR-002-02

ESCP-WR-003-01 ESCP-WR-003-02 ESCP-WR-003-03

3.1. Clean Water Diversions

Upper catchment clean water will be diverted where possible and practical using clean water diversions, at the approximate locations depicted on the drawings.

TR2009/02 recommends that clean water diversions are designed to carry the flow from the 20% annual exceedance probability (AEP) rain event (plus 300mm freeboard). Where possible the clean water diversions have been increased in size to convey the 5% AEP storm event, including a freeboard of 300mm. Table 3 provides the clean water diversion sizing details.

Clean water diversion design details have also been provided by BECA and Golder, where requirements vary between the ESC designs, the more stringent will be adopted from the outset.

Table 2: Clean water diversion input parameters.

Parameter	Input
Rainfall depth (24hr 5% AEP)	290mm
Freeboard	300mm
Base width	0.5m (unless otherwise specified)
Stabilisation type (TBC on site)	Grass, rock lined, geotextile

All clean water diversions shall discharge to stable flow paths beyond each works site.

Table 3: Clean water diversion sizing details for Willows Road.

Clean Water Diversions					
Site reference	Catchment area (maximum)	Peak flow (m^3/s)	Diversion slope (minimum)	Channel capacity (m^3/s)	**Design Flow Depth (including 300mm freeboard)**
CWD - SFA	1ha	0.452	2%	0.85	**500**
Mine Access Road	2ha	0.904	2%	0.92	**550**

CWD					
CWD channel - Willows Rock Stack (Year 1 – maximum area)	6ha	2.71	5%	3.01	**700**
WRS CWD North	2ha	0.904	2%	0.92	**550**
WRS CWD South	1.25ha	0.565	2%	0.92	**550**
CWD bund – Topsoil stockpile	2ha	0.904	2%	0.92	**550**
CWD bunds – Magazine Storage Area	2ha	0.904	2%	0.92	**550**

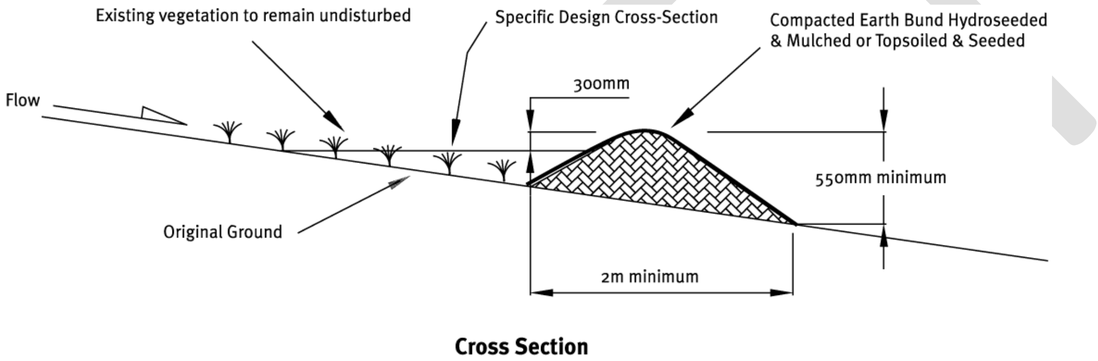


Figure 2: Cross-section of a clean water diversion bund.

Where a clean water diversion channel is required to be constructed then the following schematic is provided for a maximum clean water catchment of 6ha (WRS – Year 1 maximum catchment area). In this case the total flow depth would be 700mm (400mm plus 300mm freeboard).

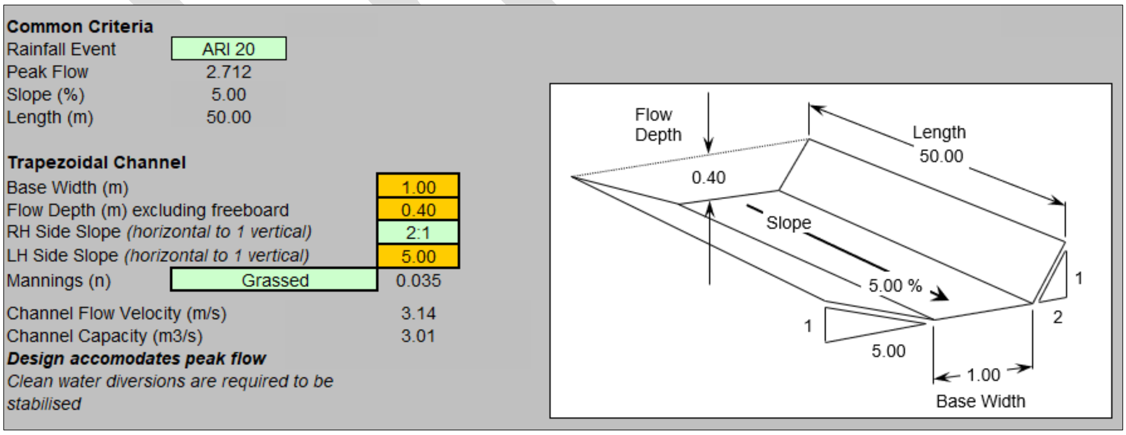


Figure 3: Design details of a clean water diversion channel for up to 6ha.

3.2. Dirty Water Diversions

Dirty water diversions will direct sediment laden runoff to the sediment control measures. The dirty water diversions have been sized to provide diversion capacity up to the 5% Annual Exceedance Probability (AEP) storm event, plus a freeboard of 300mm.

Calculations are provided in Table 4.

Table 4: Dirty water diversion details assuming maximum dirty water catchment area.

Dirty Water Diversions							
Area	5% AEP rainfall depth (mm)	Catchment area (maximum)	Peak flow (m^3/s)	Base width (m)	Diversion slope (minimum)	Channel capacity (m^3/s)	**Design flow depth (including 300mm freeboard)**
Facilities Surface Area	290mm	5.5ha	2.587	1	3%	2.78	**600**
Willows Rock Stack	290mm	6ha	2.822	1	3%	3.10	**750**
Magazine Access Road and Topsoil Stockpile	290mm	3ha	1.411	0.5	3%	2.32	**600**
Magazine Storage Area	290mm	1.2	0.564	0.5	3%	0.86	**500**

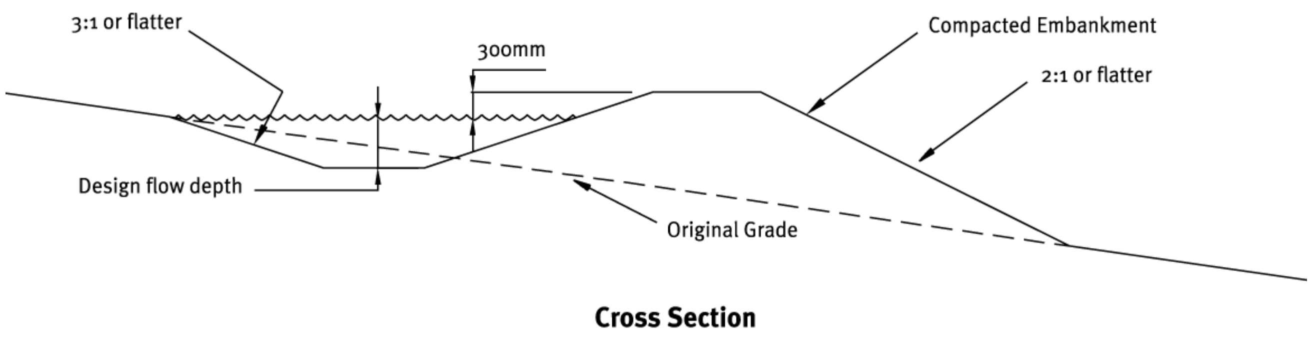


Figure 4: Cross-section of a dirty water diversion.

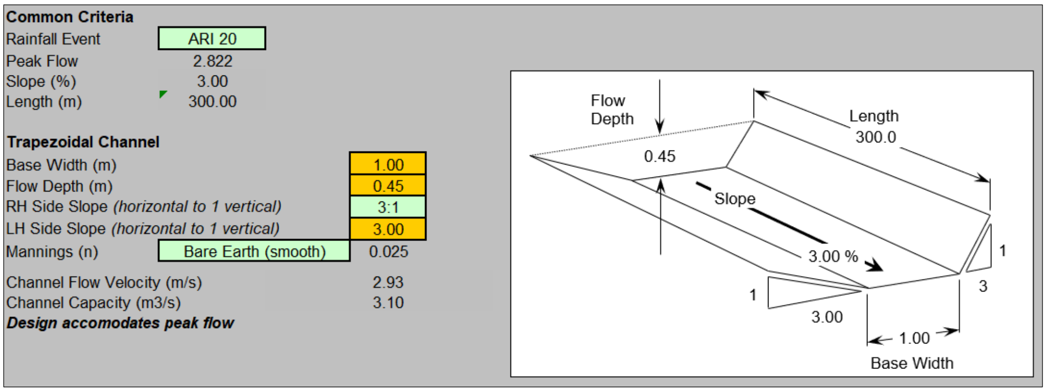


Figure 5: Design details of a dirty water diversion channel for up to 6ha.

3.3. Sediment Retention Ponds

In addition to the Detention Pond and Collection Pond (designed by BECA and Golder) three TR2009/01 Sediment Retention Ponds (SRPs) will be used where catchment areas exceed 0.3ha and generally be limited to a maximum catchment area of 5ha.

The initial design details for these SRPs have been provided in Appendix A. Updated design details will be provided if required and submitted to the Waikato Regional Council prior to the commencement of earthworks within each area.

The SRPs will be sized in respect to their contributing catchment area and slope steepness.

- Where slopes are less than 10% and less than 200m in length, the SRP will be constructed with a minimum volume of 2% of the contributing catchment.
- Where slopes are greater than 10% and/or more than 200m in length, the SRP will be constructed with a minimum volume of 3% of the contributing catchment.

An additional 10% of this volume is to be used as a forebay.

The SRPs will be located to allow access for removing sediment from the pond.

The details of the Collection Pond and Detention Pond have been described in Sections 2.1 and 2.2 above. They provide significant excess capacity beyond that required by TR2009/01.

Any pumping of sediment laden water required throughout the duration of the earthworks will be to a SRP forebay or to the Detention Pond for treatment prior to being discharged from the site.

3.4. Decanting Earth Bunds

Decanting earth bunds (DEBs) may be used to capture runoff from earthwork areas of up to approximately 0.3ha (or as otherwise stated). Decanting earth bunds will be sized in accordance with TR2009/02 in respect to their contributing catchment area and slope steepness.

- Where slopes are less than 10% and less than 200m in length, the DEB will be constructed with a minimum volume of 2% of the contributing catchment.
- Where slopes are greater than 10% and/or more than 200m in length, the DEB will be constructed with a minimum volume of 3% of the contributing catchment.

The total storage volume of a DEB will be split into 50% live storage and 50% dead storage.

3.5. Chemical Treatment

The Chemical Treatment Management Plan (CTMP) provided as Appendix A of the Erosion and Sediment Control Assessment Report provides the methodology for determining the effectiveness and dose rates for chemical treatment to enhance the sediment retention efficiency of sediment retention ponds, decanting earth bunds and other water impoundment devices that will be used throughout the project. It is intended that all SRPs will be chemically treated if necessary and monitored in accordance with the CTMP

While the Collection Pond and Detention Pond service their respective areas during the enabling earthworks (Non-Acid Forming soils) chemical treatment will likely be employed. Once the Surface Facilities earthworks are complete the area will be stabilised, and chemical treatment removed for the Detention Pond. Once the mining operations commence PAF water will report to the Collection Pond and pumped to the Water Treatment Plant.

3.6. Silt Fences and Super Silt Fences

Silt fences or Super Silt Fences may be used to capture runoff from small areas that cannot actively drain to a SRP, DEB, Collection or Detention Pond.

Super silt fences will be installed below the footprint of all SRPs, Collection Pond and Detention Pond to capture any runoff during the construction phase of these devices. Once the device is constructed then the super silt fence will either be returned up either side of the emergency spillway or removed.

3.7. Stabilisation

Progressive stabilisation will be undertaken throughout the earthwork operations. Both temporary and permanent stabilisation measures will be employed on site. Common stabilisation measures include spreading of aggregate, grassing (with a full cover of grass), applying mulch and the use of geotextiles.

Once the catchment area for a particular ESC device is stabilised in accordance with TR2009/02, or the runoff directed to a different water management system (i.e. the Water Treatment Plant) then the ESC monitoring and maintenance will cease, and the ESC device could be decommissioned.

3.8. Dust Management

Dust will be managed in accordance with the Air Quality Management Plan.

3.9. Dewatering and Pumping

Dewatering (pumping) will be required during the Project. A Dewatering Management Plan is proposed to be provided to the Waikato Regional Council for certification prior to the commencement of earthworks.

The Dewatering Management Plan will identify activities that will require dewatering/pumping as well as the procedures involved, monitoring and maintenance requirements and record keeping.

3.10. General

Prior to bulk earthworks commencing, as-builts for the erosion and sediment controls will be provided to the Waikato Regional Council. The as-built certification will confirm that the controls have been constructed in accordance with the approved SSESCP.

This SSESCP is intended to be a live document and if the earthworks methodologies or erosion and sediment control measures for the anticipated work changes then an update / review of the SSESCP drawings will be made before the earthworks commence. Any changes to the SSESCP will be confirmed in writing and provided to the Council for certification, prior to the implantation of any changes proposed.

3.11. Monitoring and Maintenance

All erosion and sediment control measures will be maintained in accordance with TR2009/02 throughout the works until the site is stabilised against erosion.

All erosion and sediment control measures and methodologies will be monitored during the works in accordance with the Erosion and Sediment Control Monitoring Plan (ESCMP). Monitoring will be undertaken at least weekly, and before and immediately after rain events as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

Sediment deposits and bulges against the silt fences will be removed when sediment accumulation reaches 20% of the fabric height.

The SRPs will be cleaned out before accumulated sediment volume reaches 20% of the total volume. Forebays will be cleaned out if there is any evidence of sediment deposition.

Once an area is stabilised, or placement of PAF material is underway, the operational requirements commence and monitoring under the ESCMP will cease.

4. APPENDIX

4.1. Appendix A – Erosion and Sediment Control Design Details

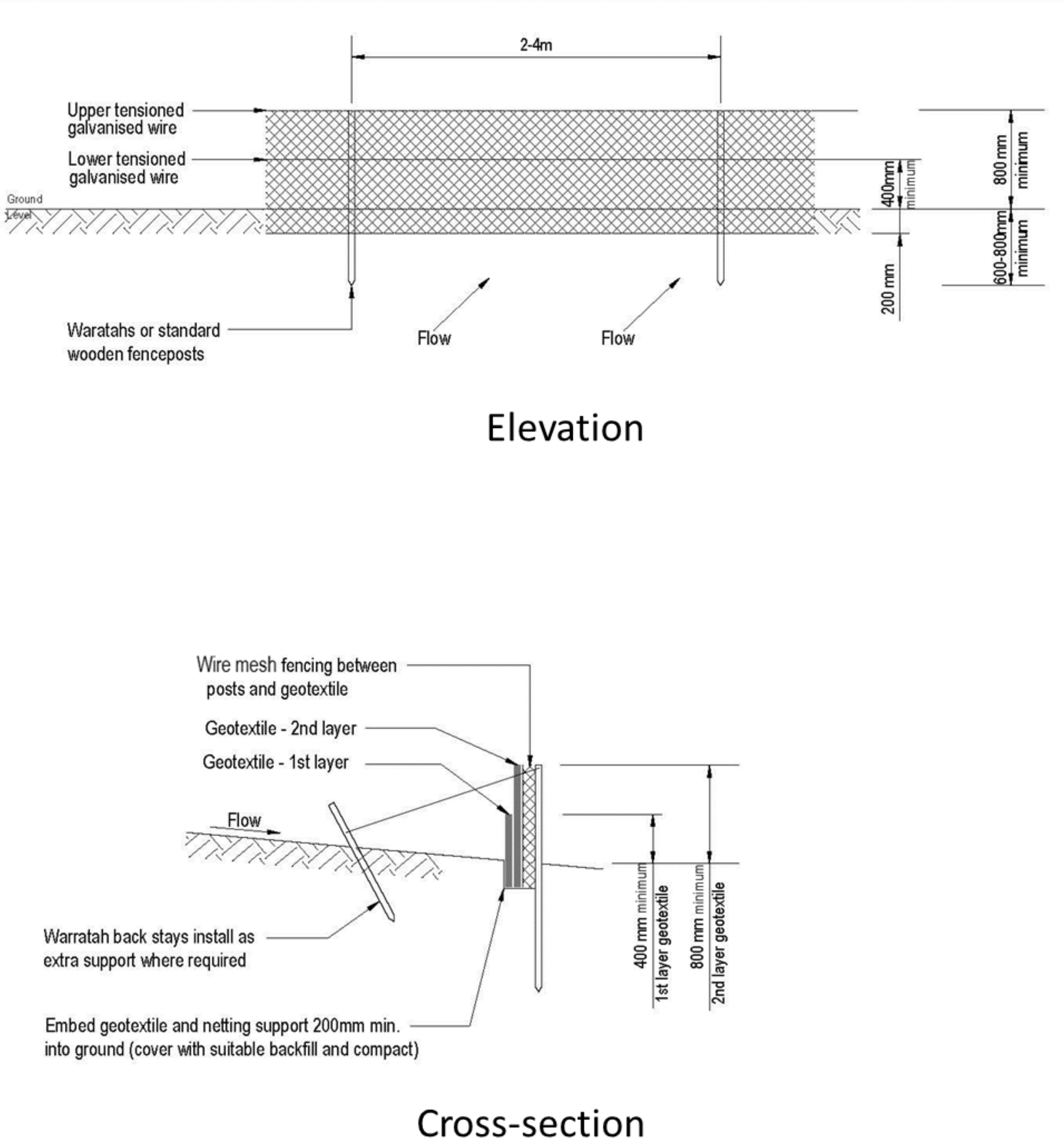


Figure 6: Schematic of a super silt fence.

Table 4: Super silt fence design criteria.

Slope steepness %	Slope length (m) (maximum)	Spacing of returns (m)	Super silt fence length (m) (maximum)
0 – 10%	Unlimited	60	Unlimited
10 – 20%	60	50	450
20 – 33%	30	40	300
33 – 50%	30	30	150
> 50%	15	20	75

Size criteria	Length Ratio	Side slopes	Depth from Emergency	R.L. of Pond Base
Auto	4:1	2:1	1.80	0.00

SRP-1

Storage Volume Criteria	2%
Contributing Catchment (ha)	1.50
Minimum Storage Volume (m3)	300
Dead storage (m3)	90
Live storage (m3)	210
Length at Spillway Level	33.53
Width at Spillway Level	11.27
Spillway base width (300mm deep)	3.05
Primary Spillway diameter (min)	150mm
Number of decants	2
Number of holes per decant	100
Minimum outlet diameter	300mm
RL Emergency Spillway	1.80
RL Primary Spillway	1.50
RL Level Spreader (min)	1.95
RL Base Decant	0.64
RL Top Decant	1.07
Length at Base	24.53
Width at Base	4.07

Forebay

Volume	30 m3	min. volume
Depth	1.2 m	min. depth
Width	11.27 m	full width of pond
Length	3 m	min. length

Refer to TR2009/02 for cross-sections and plan views.

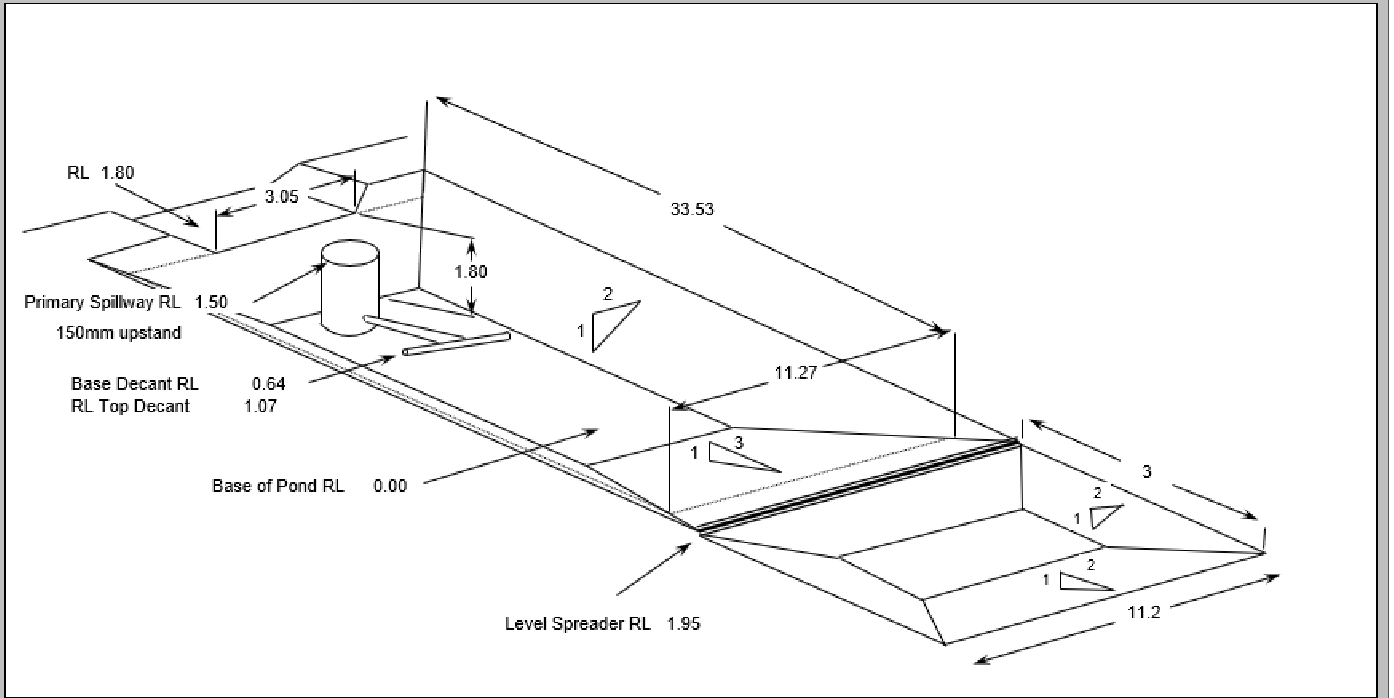


Figure 7: Design details for SRP-1.

SRP-2

Size criteria	Length Ratio	Side slopes	Depth from Emergency	R.L. of Pond Base
Auto	4:1	2:1	2.00	0.00

Storage Volume Criteria	3%
Contributing Catchment (ha)	3.00
Minimum Storage Volume (m3)	900
Dead storage (m3)	270
Live storage (m3)	630
Length at Spillway Level	51.77
Width at Spillway Level	16.10
Spillway base width (300mm deep)	6.09
Primary Spillway diameter (min)	150mm
Number of decants	2
Number of holes per decant	200
Minimum outlet diameter	300mm
RL Emergency Spillway	2.00
RL Primary Spillway	1.70
RL Level Spreader (min)	2.15
RL Base Decant	0.66
RL Top Decant	1.18
Length at Base	41.77
Width at Base	8.10

Forebay

Volume	90 m3	min. volume
Depth	1.2 m	min. depth
Width	16.10 m	full width of pond
Length	6 m	min. length

Refer to TR2009/02 for cross-sections and plan views.

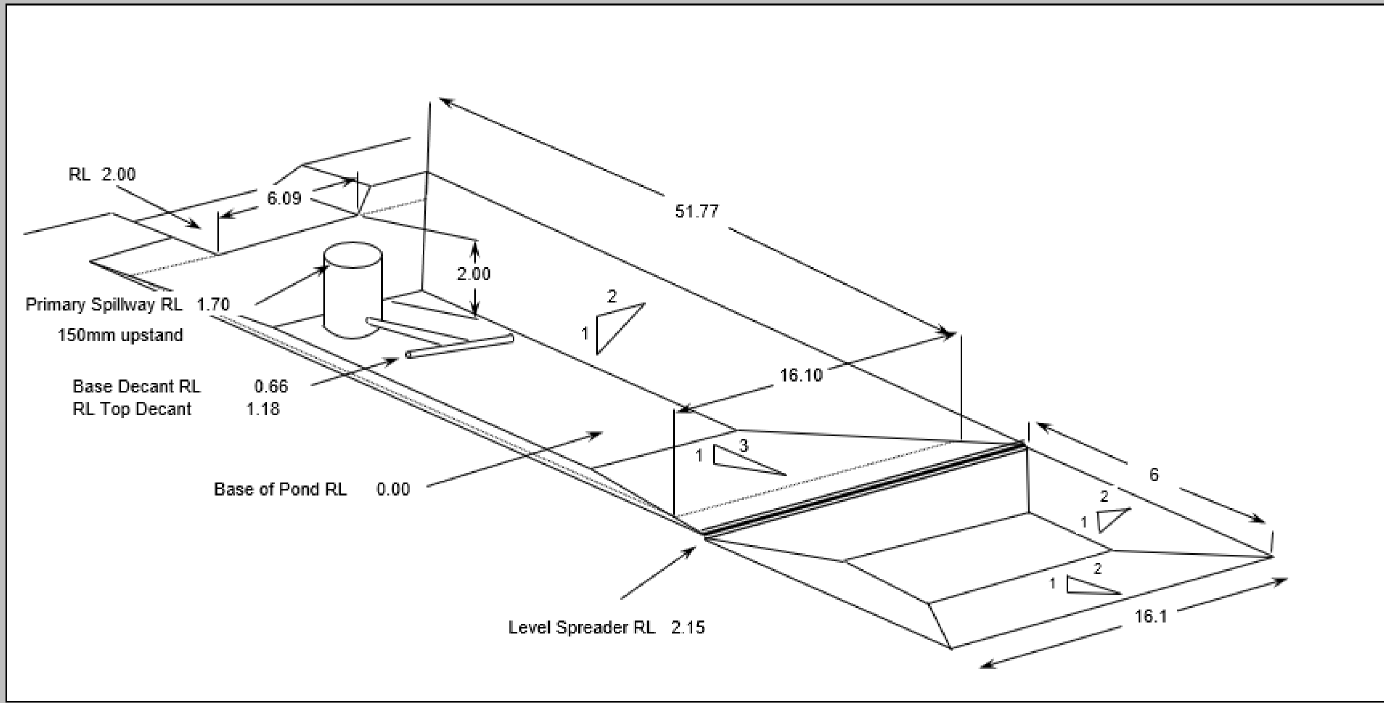


Figure 8: Design details for SRP-2.

SRP-3

Size criteria	Length Ratio	Side slopes	Depth from Emergency	R.L. of Pond Base
Auto	4:1	2:1	1.80	0.00

Storage Volume Criteria	2%
Contributing Catchment (ha)	1.20
Minimum Storage Volume (m3)	240
Dead storage (m3)	72
Live storage (m3)	168
Length at Spillway Level	30.55
Width at Spillway Level	10.52
Spillway base width (300mm deep)	2.44
Primary Spillway diameter (min)	150mm
Number of decants	1
Number of holes per decant	160
Minimum outlet diameter	150mm
RL Emergency Spillway	1.80
RL Primary Spillway	1.50
RL Level Spreader (min)	1.95
RL Base Decant	0.66
Length at Base	21.55
Width at Base	3.32

Forebay

Volume	24 m3	min. volume
Depth	1.2 m	min. depth
Width	10.52 m	full width of pond
Length	2 m	min. length

Refer to TR2009/02 for cross-sections and plan views.

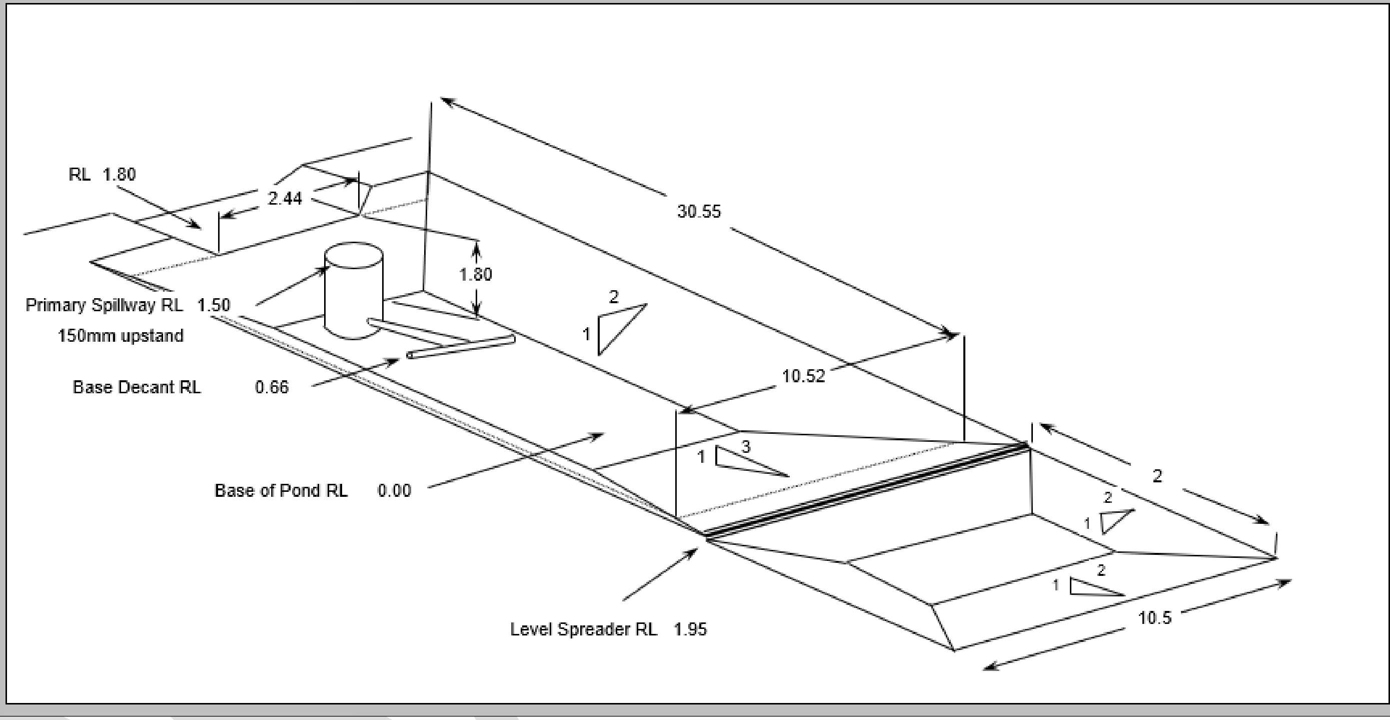


Figure 9: Design details for SRP-3.

Refer to TR2009/02 for sediment retention pond cross sections.

4.2. Appendix B - Erosion and Sediment Control Drawings

Drawing number	Drawing title	Date	Revision	Sheet
ESCP-WR-001-00	Erosion and Sediment Control Plan – Willows Road Overview	17.02.25	A	0
ESCP-WR-001-01	Erosion and Sediment Control Plan – Surface Facilities Area	17.02.25	A	1
ESCP-WR-001-02	Erosion and Sediment Control Plan – Surface Facilities Area	17.02.25	A	2
ESCP-WR-002-01	Erosion and Sediment Control Plan – Willows Rock Stack	17.02.25	A	3
ESCP-WR-002-02	Erosion and Sediment Control Plan – Willows Rock Stack	17.02.25	A	4
ESCP-WR-003-01	Erosion and Sediment Control Plan – Topsoil Stockpile	17.02.25	A	5
ESCP-WR-003-02	Erosion and Sediment Control Plan – Magazine Access Road	17.02.25	A	6
ESCP-WR-003-03	Erosion and Sediment Control Plan – Magazine Storage Area	17.02.25	A	7

Waihi North Project

Site Specific Erosion and Sediment Control Plan

Appendix C.2 – Gladstone Open Pit

Prepared for OGNZL

Prepared by: SouthernSkies Environmental Ltd Date: 17 June 2022 Rev: 0

WAI-985-000-REP-LC-0041_Rev0
TECHNICAL REPORT
WAIHI NORTH PROJECT – SITE SPECIFIC EROSION AND SEDIMENT CONTROL PLAN
GENERAL AERA 000

CONTENTS

1. OVERVIEW

1.1. Scope

This Site Specific Erosion and Sediment Control Plan (SSESCP) relates to the activities associated with the establishment of the Gladstone Open Pit (GOP). Additional components associated with this SSESCP include the Martha Underground Mine (MUG) and Wharekirauponga Underground Mine (WUG) portals, the Alternative Martha Underground Portal (also known as Gladstone Portal), a temporary stockpile (Southern Stockpile) and the installation and relocation of the Water Treatment Discharge pipes. These features are shown on Figure 1.

The latest iteration of the GOP entails an open pit that would be converted to an in-pit tailings storage facility (TSF) following the completion of mining.

The GOP will be situated over Gladstone Hill and part of Winner Hill. The pit will disturb an area of approximately 18.7ha and will be about 95m deep, 375m wide and 625m long.

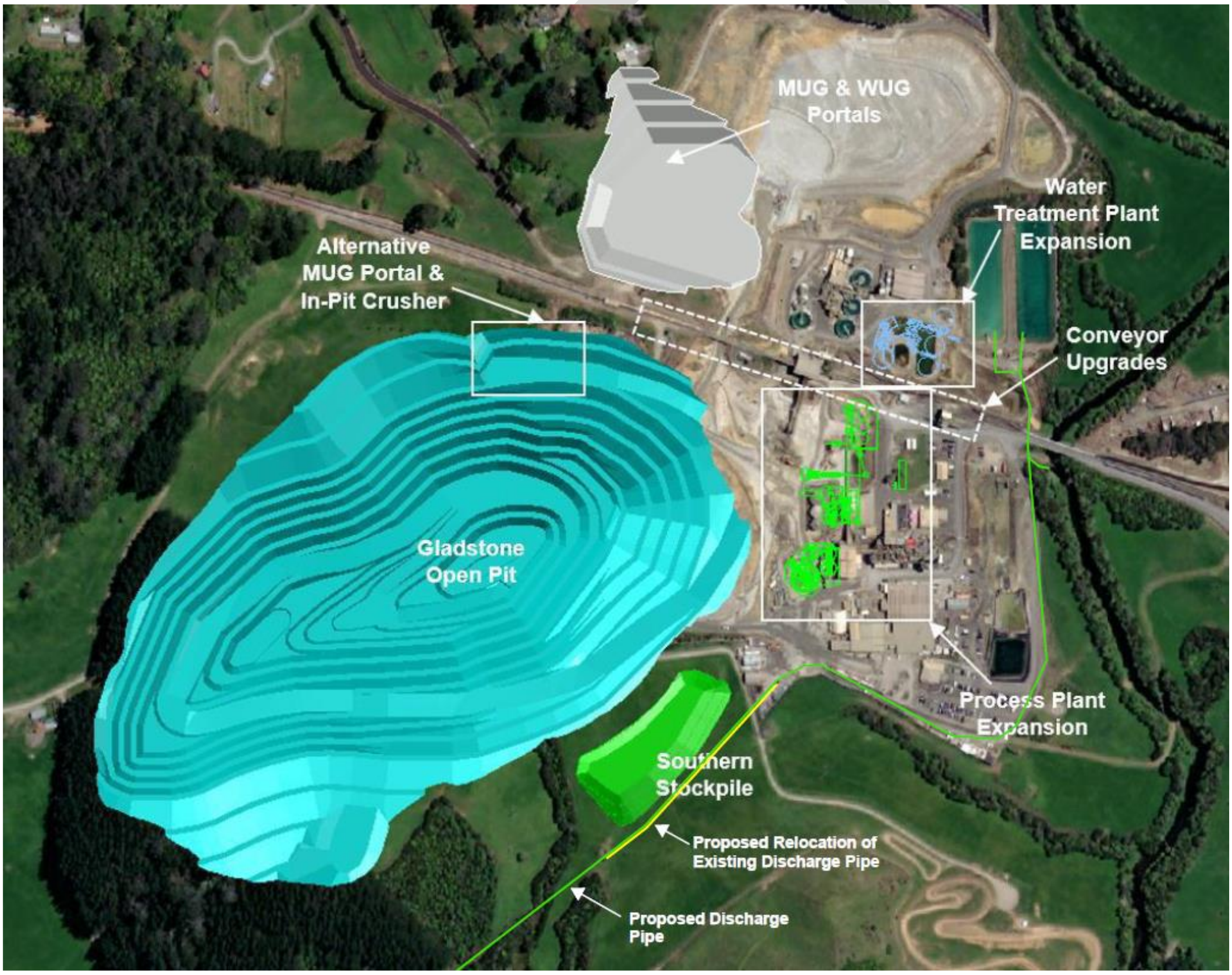


Figure 1: Gladstone Open Pit and Surface Infrastructure (source: OceanaGold).

This SSESCP provides design erosion and sediment control (ESC) measures indicating how the site will manage runoff during these construction activities. This document should be read in conjunction with the Assessment of Environmental Effects prepared by Mitchell Daysh and specialist reports prepared by PSM and GHD including:

- *Waihi North Project, Gladstone Pit – Geotechnical Assessment*; 19 May 2022, prepared by PSM Consult Pty Limited (PSM).
- *Gladstone Pit TSF, Design Report*; 30 May 2022, prepared by GHD Pty Limited (GHD).

The Gladstone Open Pit works comprise the following earthworks components:

- Removal of topsoil from the pit footprint and storage at the Southern Stockpile.
- Establishing a portal to the Wharekirauponga Underground Mine (WUG).
- Establishing a new MUG portal within the Gladstone Pit (the Gladstone Portal) or adjacent to the new WUG Portal, and in-pit crusher.
- Excavation of ore and/or non-ore bearing rock.

This SSESCP has been prepared in accordance with Waikato Regional Council Technical Report No. 2009/02 *Erosion and Sediment Control Guidelines for Soil Disturbing Activities, January 2009* (TR2009/02) and addresses the following earthwork activities:

- Establishment of the erosion and sediment controls;
- General earthworks involved in the establishment of the pit;
- Stockpiling; and
- Conversion to an in-pit TSF upon completion of mining.

The ESC measures proposed as part of this SSESCP will be used during the 'enabling earthworks' phase which does not include mining. Once mining activities occur the operational requirements commence, and contact water will report to the Water Treatment Plant.

2. DESCRIPTION OF WORKS

Gladstone Open Pit will include earthworks over an anticipated area of 18.7ha and will be about 95m deep comprising 2.6Mt of ore and 18.7Mt of non-ore-bearing rock. The open pit mining operation will commence in Year 1 and will be completed in Year 6; at an average mining rate of 3.5Mt per year.

Topsoil stripped from the pit footprint will be stored at the Southern Stockpile area which has a capacity of 52,500m^3.

Approximately 5Mt of rock will be used to partially backfill the pit in preparation for its use as a tailings storage facility.

The GOP is proposed by be mined over six years (2024 – 2029). The tailings storage development is scheduled to begin in Q4 of 2029, with tailings Stage 1 and Stage 2 completed by Q4 2031. Gladstone Pit will then function as an operating TSF until the end of the year 2036.

The construction sequence and methodology are described by OceanaGold which briefly includes the following stages:

- Clearing of vegetation on Gladstone and Winner Hills;
- Establishing clean water diversions and ponds required for sediment controls;
- Stripping of topsoil at Gladstone and Winner Hills and storage at Southern Stockpile;
- In parallel, relocation of site infrastructure i.e., the overhead powerline, new MUG portal cutback.

- Initial pit development to access the in-pit crusher location and installation of the in-pit crusher circuit; and
- Commencement of open pit mining.

The key phases of earthworks relating to the ESC include:

- Enabling works including the construction of the ESC measures.
- Vegetation and topsoil removal and the establishment of the southern stockpile.
- Excavation of the Gladstone and Winner Hills to create the GOP.

The ESC measures are shown on the ESC drawings provided in Appendix B. Updated detailed ESC drawings will be prepared prior to these works commencing.

2.1. Year 1

<u>Refer to ESCP-GOP-001-01</u>

Year 1 will involve initial preparatory activities (e.g. clearing of vegetation) site establishment works, construction of the ESC measures and set-up of the southern stockpile area.

In total approximately 7.9ha area will be worked during Year 1, which includes 5.5ha of the Gladstone Hill, 1.3ha of Winner Hill and 1.1ha for the Southern Stockpile.

Once the ESCs are established topsoil stripping will commence. Suitable topsoil will be stored in the southern stockpile. As the stockpile is filled to capacity it will be seeded and grassed.

A Sediment Retention Pond (SRP-GOP-01) will be established for the excavation works to Gladstone and Winner Hills. This pond will be located between the two hills. Both hills will be excavated in a way that ensures runoff will fall to the SRP. Additional perimeter bunds may also be required to divert clean water away from the site and to convey dirty water runoff to the SRP.

Due to the location of the proposed excavations, being on top of hills, clean water diversions will not likely be required.

A SRP (SRP-GOP-02) will be established for the Southern Stockpile as detailed on the attached drawings.

SRP-GOP-01 – will capture and treat runoff from the Gladstone and Winner Hills. The area of disturbance is approximately 6.8ha. This pond will be built with a maximum catchment area of 7ha. The catchment area for this SRP exceeds the maximum catchment area recommended by TR2009/02. However, in this case a single 7.0ha SRP is suitable and the following components will be incorporated, consistent with TR2009/02.

- The SRP will be sized with a minimum storage volume of 3% of 7ha, which is slightly oversized for its 6.8ha contributing catchment area, plus a forebay with an additional 10% storage volume.
- Two 1050mm concrete manholes and five T-bars (total) to maintain the required 3L/sec/ha discharge rate. Each concrete manhole will be weighed down with additional concrete, or similar, to stop the manhole from floating.
- A 450mm outlet / discharge pipe from each manhole. Rock riprap erosion protection will be installed under the outlet of both outlet pipes.
- An emergency spillway sized to convey the 1% AEP rain event.
- Chemical treatment to enhance the sediment removal capacity. Multiple floc sheds will likely be required to provide chemical treatment for the 7.0ha catchment area.

SRP-GP-02 – will capture and treat runoff from the Southern Stockpile. The area is approximately 1.1ha. This pond will be built with a maximum catchment area of 1.2ha. This SRP will be designed and constructed in accordance with TR2009/02.

Refer to Appendix B for the SRP design details.

Earthwork's activities will commence with construction of the access to the Gladstone Portal. The final design and earthworks staging details are yet to be confirmed. These details will be confirmed as part of the final SSESCP. Until such time that the runoff is contained within the GOP runoff could either be directed to the existing contingency pond within the Processing Plant and water directed to the Water Treatment Plant (TBC based on capacity) or by additional ESC measures, such as a separate SRP.

As a separate earthwork's operation, during Year 1 earthworks associated with the construction of MUG and WUG portals (location shown on Figure 1) will be undertaken to the north of GOP. All water runoff from this area will be either be directed to the existing Water Treatment Plant or separate ESC measures will be installed. The details will be provided as part of the final SSESCP.

As part of the Water Treatment Plant upgrade a new discharge pipe will be laid from the Water Treatment Plant and the existing discharge pipe will also be relocated. The proposed alignments are shown on the drawing titled *Waihi North Water Treatment Plan Outfall Discharge Upgrade – Civil Set Layout View, drawing number 2210983-203-SK1;* prepared by BECA.

Both pipes are 250mm diameter and extend from the Water Treatment Plant ponds to the Ohinumuri River outfalls. The discharge locations are shown on the BECA drawings.

A brief construction methodology for the pipe installation is as follows:

- The pipes will be installed as a typical open trenching operation, generally utilising a cut and cover methodology. The methodology involves the excavation of the trench in no more than 100m sections, laying pipe and backfilling the trench within the same day. Any exposed area will be covered with hay mulch.
- An approximately 1300mm deep by 600mm wide trench will be excavated with spoil stockpiled on the high side of the trench for later reuse as backfill.
- Pipes will be laid within the excavated trench.
- If any water impounds within the trench, it will be pumped to a sediment control device for treatment prior to discharging.
- Stockpiled spoil will be used to backfill the trench. Any excess spoil will be placed on a truck and transported back to site for disposal.
- The disturbed and exposed area will be covered with hay mulch. Reinstatement at ground level will match existing.

Outlet structures are proposed to be installed within the Ohinemuri River.

2.2. Year 2

Refer to ESCP-GP-001-02

Year 2 involves much of the same in terms of the ESCs. No additional ESC measures are proposed.

2.3. Year 3 to Year 6

Refer to ESCP-WR-001-03

Once the GOP has been excavated to inversion and once all water runoff is contained within the pit, SRP-GP-

01 will be decommissioned to allow for the full excavation of the GOP. Excavation will continue in a way that ensures all runoff falls into the pit and is impounded within the pit.

Pit water will be captured within the pit and pumped to the Water Treatment Plant.

The SRP associated with the Southern Stockpile (SRP-GOP-02) will either be retained for future use during the pit rehabilitation or decommissioned and reconstructed at a later date. Management of this SRP will be confirmed in the SSESCP.

2.4. TSF Conversion and Rehabilitation

Approximately 5Mt of rock will be used to partially backfill the pit to prepare it for use as a Tailings Storage Facility (TSF). During the development and operation of the TSF all pit water will continue to be pumped to the Water Treatment Plant.

The Southern Stockpile SRP (SRP-GP-02) will be recommissioned for the rehabilitation phase before the stockpile is reworked. Once the stockpile has been exhausted and the area stabilised, the SRP will be decommissioned.

3. EROSION AND SEDIMENT CONTROL DETAILS

The erosion and sediment control methodology has been designed in accordance with best practice and the principles outlined in TR2009/02.

Specific erosion and sediment control calculations and drawings can be found within the appendices.

Appendix A – Erosion and sediment control calculations and typical details.

Appendix B – Erosion and sediment control drawings:

ESCP-GOP-001-01 ESCP-GOP-001-02 ESCP-GOP-001-03

3.1. Clean Water Diversions

It is unlikely that major clean water diversions will be required, due to the nature and location of the work. Perimeter bunding will be used, as required, to divert areas of clean water away from the site. The perimeter bunds will generally be constructed using stripped topsoil and will be stabilised immediately following construction.

TR2009/02 recommends that clean water diversions are designed to carry the flow from the 20% annual exceedance probability (AEP) rain event (plus 300mm freeboard). Where possible the clean water diversions have been increased in size to convey the 5% AEP storm event, including a freeboard of 300mm.

Perimeter bunds will be a minimum of 600mm high as discussed in Section 3.2.

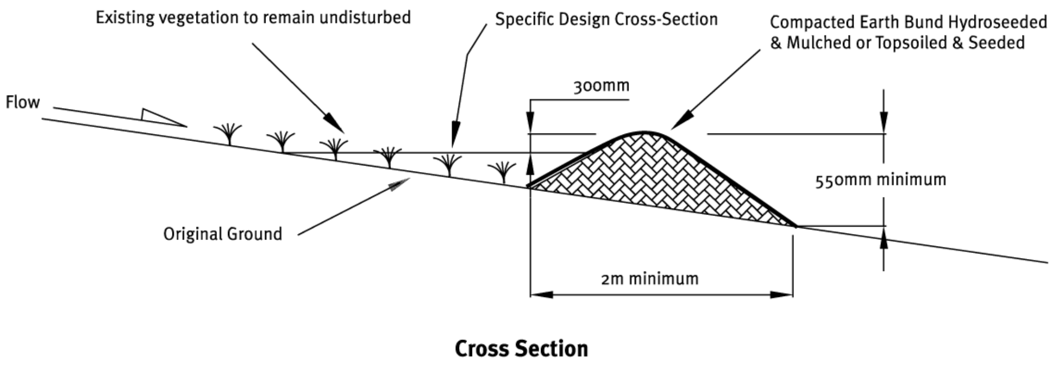


Figure 2: Cross-section of a clean water diversion bund.

3.2. Dirty Water Diversions

Dirty water diversions will direct sediment laden runoff to the sediment control measures. The dirty water diversions have been sized to provide diversion capacity up to the 5% Annual Exceedance Probability (AEP) storm event, plus a freeboard of 300mm. Perimeter bunds located around the GOP excavation area and Southern Stockpile will be a minimum of 600mm high.

Calculations are provided in Table 3.

Table 3: Dirty water diversion details assuming maximum dirty water catchment area.

Perimeter Bunds (dirty water diversion)							
Area	5% AEP rainfall depth (mm)	Catchment Area (maximum)	Peak Flow (m^3/s)	Base Width (m)	Slope (minimum)	Minimum Design Flow Depth (mm)	**Including Minimum 300mm Freeboard**
Gladstone Open Pit	263mm	7.0ha	2.416	0.6	5%	300	**600**
Southern Stockpile	263mm	1.2ha	0.414	0.6	2%	150	**450**

For simplicity, the earthworks associated with the GOP will adopt the larger of the two dirty water diversion sizing and construction dirty water diversion at a minimum of 600mm high.

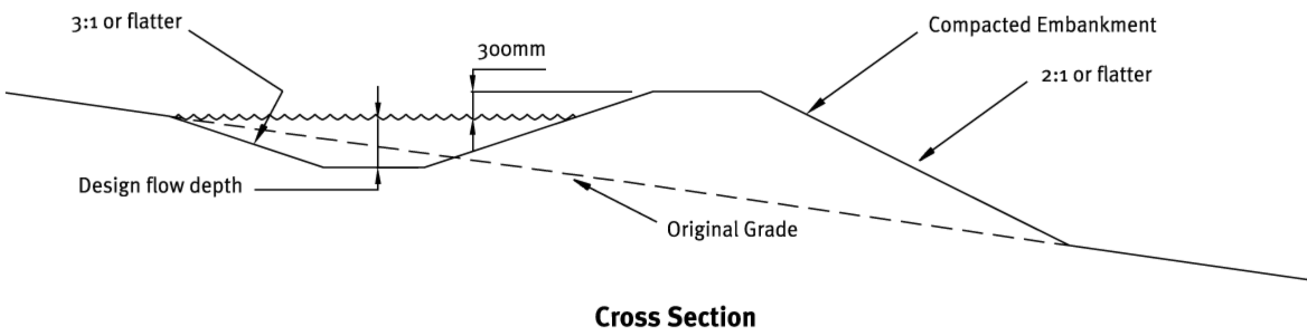


Figure 3: Cross-section of a dirty water diversion.

3.3. Sediment Retention Ponds

Two Sediment Retention Ponds (SRPs) will be constructed to capture sediment laden water during the earthworks associated with the GOP.

SRP-GOP-01 will capture runoff from an area of approximately 7.0ha during the earthworks associated with Gladstone Hill and Winner Hill. This pond has a designed minimum storage volume of 2,100m^3 with an additional 210m^3 forebay. The 7.0ha pond will incorporate two 1050mm concrete risers and a total of five T-bars divided between the two manholes. Both concrete manholes will need to be weighed down appropriately to ensure they do not float or tilt during periods when the pond is full of water. Each manhole will have a minimum 450mm diameter outlet pipe discharging to an existing overland flow path. Scour protection (e.g. rock riprap) will be placed below and around the outlets to minimise erosion.

Contour drains will be installed prior to rain events by the Contractor to break up slope length and reduce erosion. Drop out pits (approximately 1m by 1m by 1m deep excavations) will be excavated at regular periods along the main dirty water diversions to promote deposition of heavy sediments prior to entering the SRP forebay.

Additional erosion protection will be provided on dirty water diversions that exceed a grade of 2% where required. This may include lining steep sections with a geotextile, installing rock check dams, constructing pipe/flume drop structures.

While TR2009/02 recommends that the maximum catchment area of a SRP is 5ha. In this case, to progress the earthworks efficiently and appropriately manage the earthworks during the initial excavation of both Gladstone Hill and Winner Hill, one SRP is the most efficient option, constructed between the two hills, rather than constructing two SRPs in this location.

The benefits of this include:

- One SRP is easier to manage for the construction team.
- The open pit will be self-impounding earlier than if the works had to be staged.

Once the GOP is inverted, then all runoff will be captured in the base of the pit and pumped to the Water Treatment Plant.

A second SRP, SRP-GOP-02, will be constructed below the Sothern Stockpile. This SRP will capture runoff from an area of approximately 1.2ha.

The initial design details for both SRPs has been provided in Appendix A.

The SRPs will be sized in respect to their contributing catchment area and slope steepness.

- Where slopes are less than 10% and less than 200m in length, the SRP will be constructed with a minimum volume of 2% of the contributing catchment.
- Where slopes are greater than 10% and/or more than 200m in length, the SRP will be constructed with a minimum volume of 3% of the contributing catchment.

An additional 10% of this volume is to be used as a forebay.

The SRPs will be located to allow access for removing sediment from the pond.

Any pumping of dirty water required throughout the duration of the Project will be to a SRP forebay or to the Water Treatment Plant for treatment prior to being discharged from the site.

3.4. Decanting Earth Bunds

Decanting earth bunds (DEBs) are not proposed as part of this SSESCP.

3.5. Chemical Treatment

The Chemical Treatment Management Plan (CTMP) provided as Appendix A of the Erosion and Sediment Control Assessment Report provides the methodology for determining the effectiveness and dose rates for chemical treatment to enhance the sediment retention efficiency of sediment retention ponds, decanting earth bunds and other water impoundment devices that will be used throughout the project.

Appendix A of the CTMP details the provides the chemical analysis and test report which confirms the efficacy of chemical treatment of typical sites' soils, based on the testing methodology described in the CTMP.

3.6. Silt Fences and Super Silt Fences

Silt fences or Super Silt Fences may be used to capture runoff from small areas that cannot actively drain to a SRP.

Silt fences will be installed below the footprint of all SRPs to capture any runoff during the construction phase of these devices. Once the device is constructed then the silt fence will need to be returned up either side of the emergency spillway.

3.7. Monitoring and Maintenance

All ESC measures will be maintained in accordance with TR2009/02 throughout the works until the site is stabilised against erosion.

All ESC measures and methodologies will be monitored during the works in accordance with the Erosion and Sediment Control Monitoring Plan (Appendix B of the Erosion and Sediment Control Assessment Report). General monitoring of the ESC measures will be undertaken at least weekly, and before and immediately after rain events as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

Sediment deposits and bulges against the silt fences will be removed when sediment accumulation reaches 20% of the fabric height.

The SRPs will be cleaned out before accumulated sediment volume reaches 20% of the total volume. Forebays will be cleaned out if there is any evidence of sediment deposition.

3.8. Stabilisation

Progressive stabilisation will be undertaken throughout the earthwork operations. Both temporary and permanent stabilisation measures will be employed on site. Common stabilisation measures include spreading of aggregate, grassing (with a full cover of grass), applying mulch and the use of geotextiles.

Once the catchment area for a particular ESC device is stabilised in accordance with TR2009/02, or the runoff directed to a different water management system (i.e. the Water Treatment Plant) then the ESC monitoring and maintenance will cease and the ESC device could be decommissioned.

3.9. Dust Management

Dust will be managed in accordance with the Air Quality Management Plan.

3.10. General

Prior to bulk earthworks commencing, as-builts for the ESCs will be provided to the Waikato Regional Council. The as-built certification will confirm that the controls have been constructed in accordance with the approved SSESCP.

This SSESCP is intended to be a live document and if the earthworks methodologies or ESC measures for the anticipated work changes then an update / review of the SSESCP drawings will be made before the earthworks commence. Any changes to the SSESCP will be confirmed in writing and provided to the Council for certification, prior to the implantation of any changes proposed.

APPENDIX

3.11. Appendix A – Erosion and Sediment Control Design Details

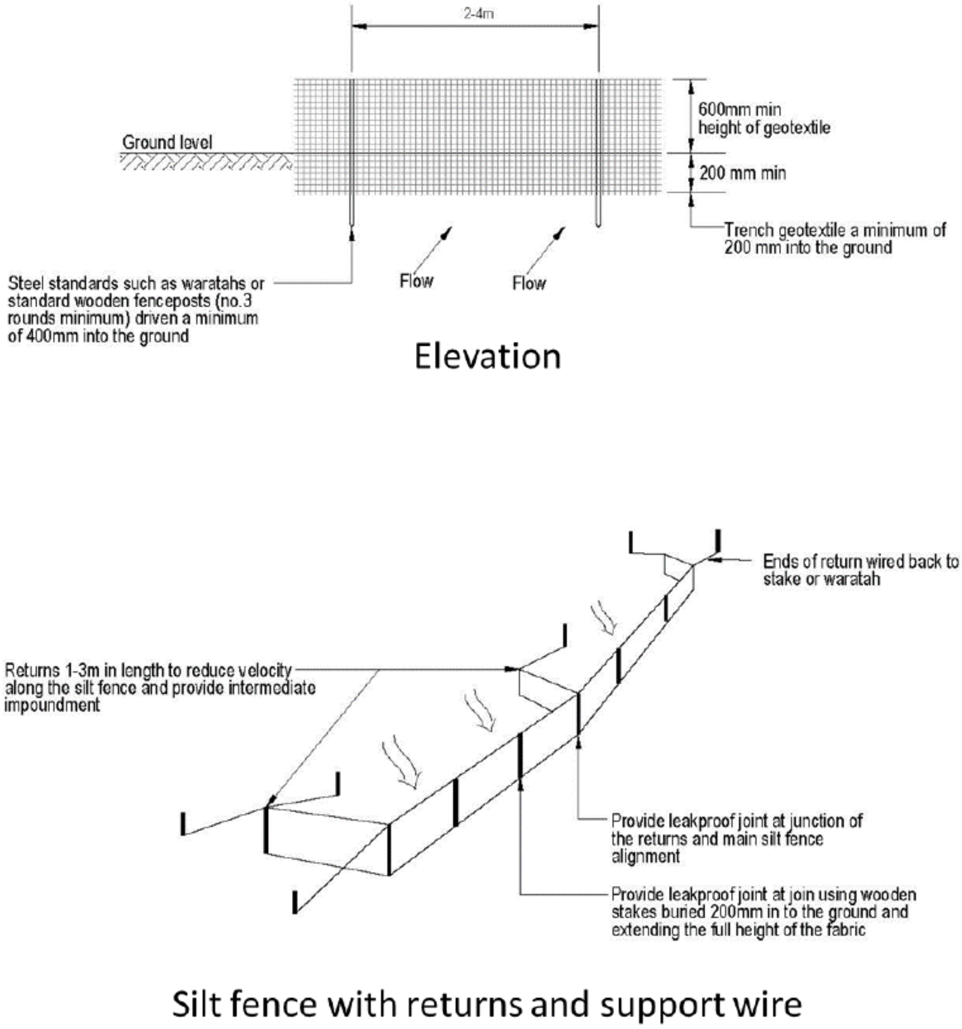


Figure 4: Schematic of a silt fence.

Table 4: Silt fence design criteria.

Slope Steepness (%)	Slope Length (m) (Maximum)	Spacing of Returns (m)	Silt fence Length (m) (Maximum)
Flatter than 2%	Unlimited	N/A	Unlimited
2 - 10%	40	60	300
10 - 20%	30	50	230
20 - 33%	20	40	150
33 - 50%	15	30	75
> 50%	6	20	40

Size criteria	Length Ratio	Side slopes	Depth from Emergency	R.L. of Pond Base
Auto	3:1	2:1	2.00	0.00

SRP-GOP-01

Storage Volume Criteria	3%
Contributing Catchment (ha)	7.00
Minimum Storage Volume (m3)	2100
Dead storage (m3)	630
Live storage (m3)	1470
Length at Spillway Level	74.00
Width at Spillway Level	24.89
Spillway base width (300mm deep)	14.21
Primary Spillway diameter (min)	Manhole Required
Number of decants	5
Number of holes per decant	186
Minimum outlet diameter	450
RL Emergency Spillway	2.00
RL Primary Spillway	1.70
RL Level Spreader (min)	2.15
RL Base Decant	0.60
RL Middle Decant	0.97
RL Top Decant	1.33
Length at Base	56.63
Width at Base	16.89

Forebay

Volume	210 m3	min. volume
Depth	1.2 m	min. depth
Width	24.89 m	full width of pond
Length	9 m	min. length

Refer to TR2009/02 for cross-sections and plan views.

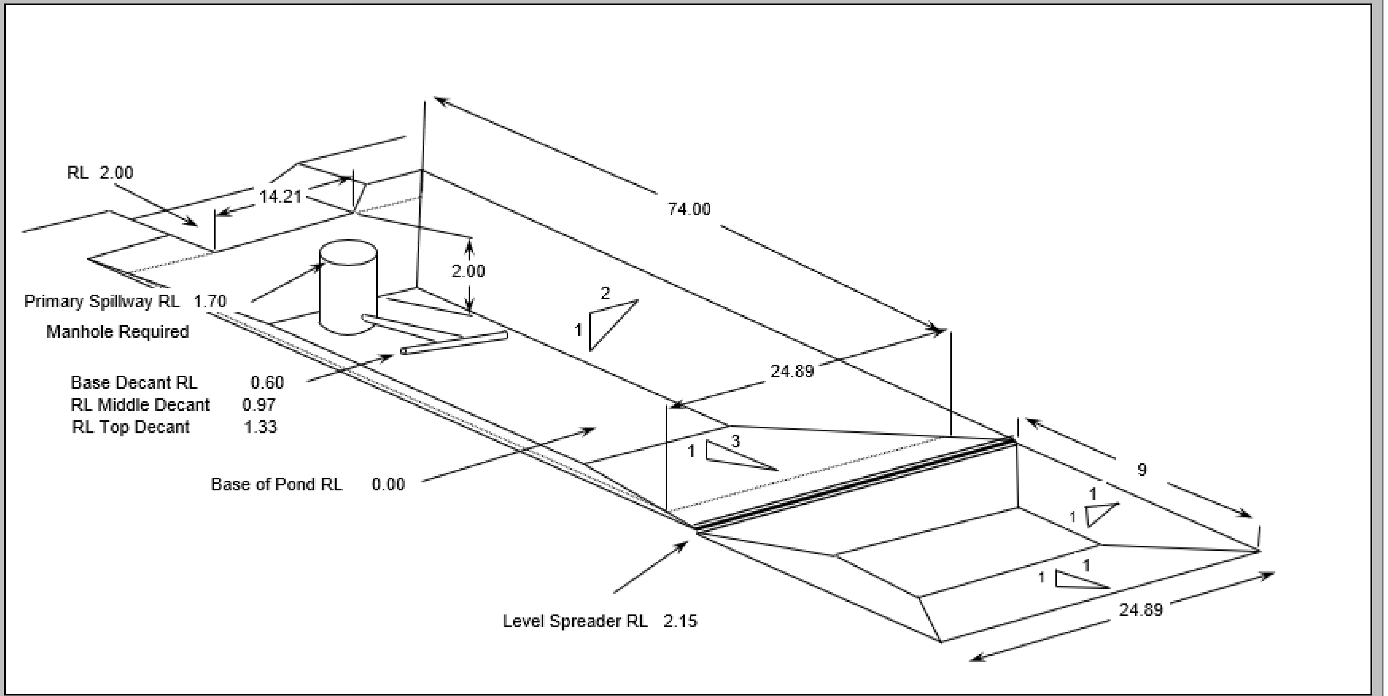


Figure 5: Design details for SRP-GOP-01.

Note, final design to be provided prior to commencement of earthworks which will incorporate additional features such as dual manholes and outlet pipes and five T-bars for a 7.0ha SRP. 7

Size criteria	Length Ratio	Side slopes	Depth from Emergency	R.L. of Pond Base
Auto	4:1	2:1	1.80	0.00

SRP-GOP-02

Storage Volume Criteria	2%
Contributing Catchment (ha)	1.20
Minimum Storage Volume (m3)	240
Dead storage (m3)	72
Live storage (m3)	168
Length at Spillway Level	30.55
Width at Spillway Level	10.52
Spillway base width (300mm deep)	2.44
Primary Spillway diameter (min)	150mm
Number of decants	1
Number of holes per decant	160
Minimum outlet diameter	150mm
RL Emergency Spillway	1.80
RL Primary Spillway	1.50
RL Level Spreader (min)	1.95
RL Base Decant	0.66
Length at Base	21.55
Width at Base	3.32

Forebay

Volume	24 m3	min. volume
Depth	1.2 m	min. depth
Width	10.52 m	full width of pond
Length	3 m	min. length

Refer to TR2009/02 for cross-sections and plan views.

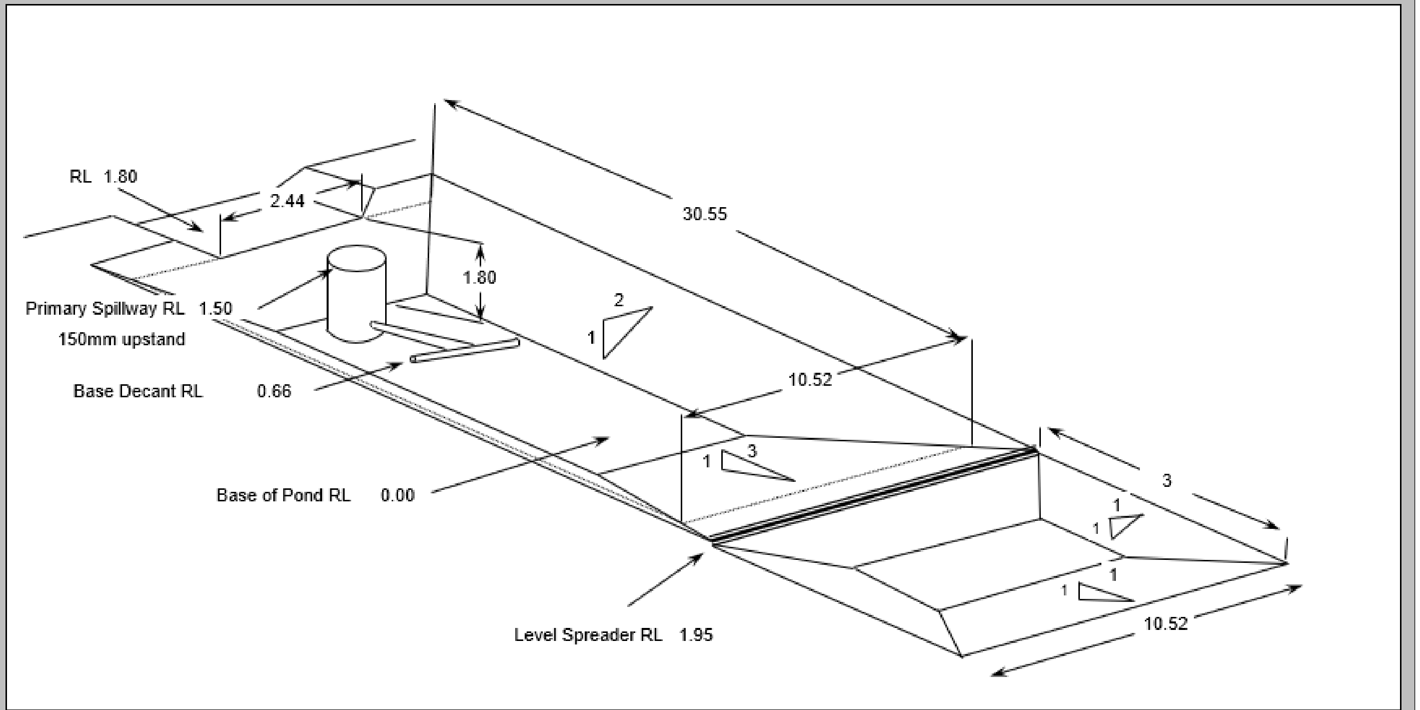


Figure 6: Design details for SRP-GOP-02.

Refer to TR2009/02 for sediment retention pond cross sections.

3.12. Appendix B - Erosion and Sediment Control Drawings

Drawing number	Drawing title	Date	Revision	Sheet
ESCP-GOP-001-01	Erosion & Sediment Control Plan – Gladstone Open Pit – Year 1	17.06.22	0	1
ESCP-GOP-001-02	Erosion & Sediment Control Plan – Gladstone Open Pit – Year 2	17.06.22	0	2
ESCP-GOP-001-03	Erosion & Sediment Control Plan – Gladstone Open Pit – Year 3 – 6	17.06.22	0	3

Waihi North Project

Site Specific Erosion and Sediment Control Plan

Appendix C.3 – Northern Rock Stack

Prepared for OGNZL

Prepared by: Southern Skies Environmentals Ltd Date: 19 February 2025

CONTENTS

1. OVERVIEW

1.1. Scope

This Site Specific Erosion and Sediment Control Plan (SSESCP) relates to the activities associated with the establishment of the Northern Rock Stack (NRS). Overburden, including Non Acid Forming (NAF) and Potentially Acid Forming (PAF) rock surplus to requirements will be disposed of to the engineered landform referred to as the NRS.

The NRS is located to the east of the existing Processing Plant and to the north of Tailings Storage Facility 2 (TSF2). The NRS is proposed to occupy an area of approximately 25ha. It is designed to a nominal elevation of RL 173 m to accommodate up to 7.0 million cubic meters of rock. Its footprint encompasses the existing northern stockpile, workshop, haul roads and farmland as shown in Figure 1.

An unnamed stream currently bisects the proposed NRS footprint. This stream is a tributary of the Ohinemuri River and currently flows from southeast to northwest. This stream is proposed to be diverted around the northern perimeter of the proposed NRS.

Farmland is the dominant land use on the northern side of the stream. This area will be used for stockpiling rehabilitation and topsoil material.

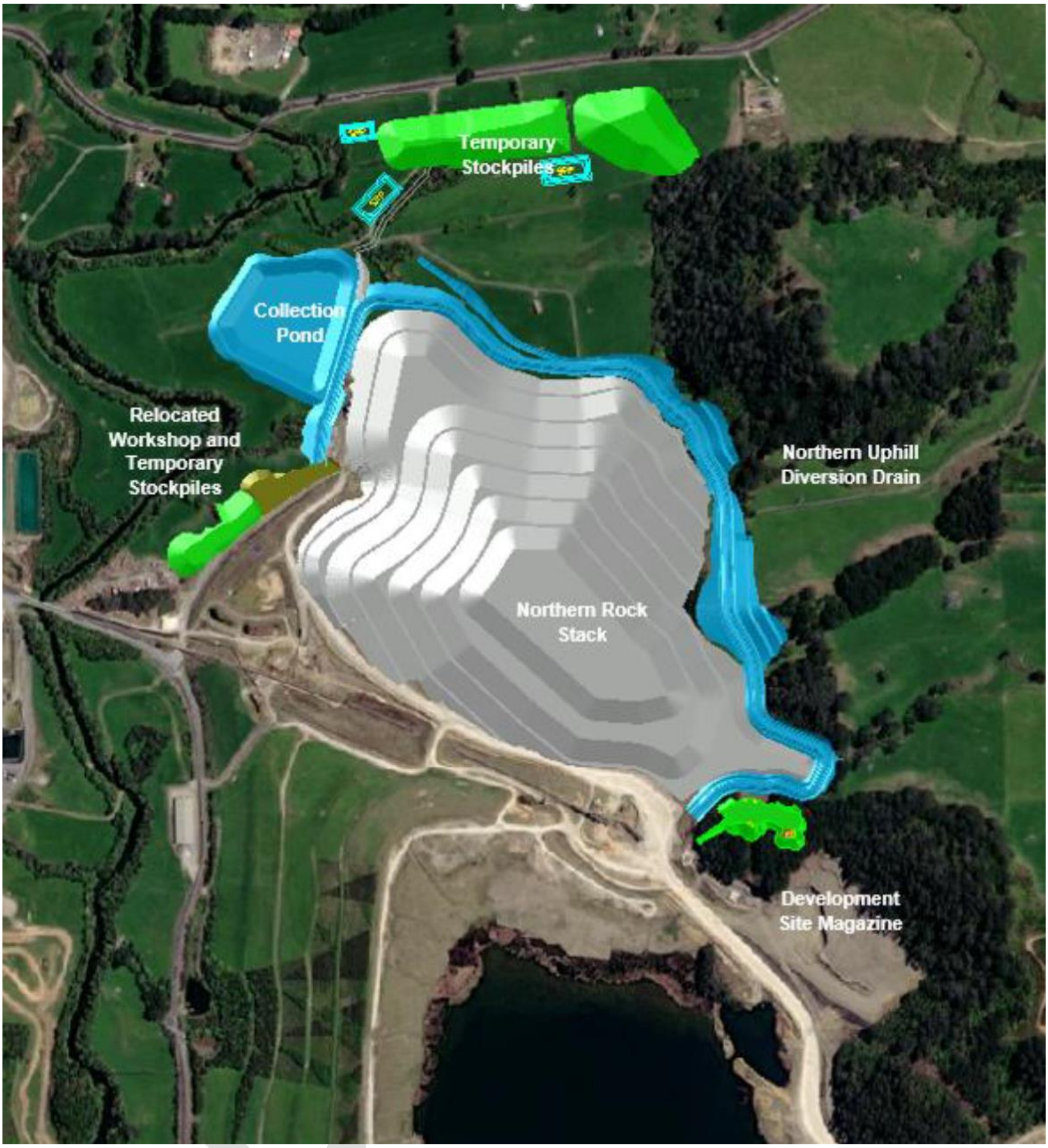


Figure 1: Northern Rock Stack and associated surface infrastructure (source: Oceana Gold).

This SSESCP provides design erosion and sediment control (ESC) measures indicating how the site will manage runoff during these construction activities. This document should be read in conjunction with the Assessment of Environmental Effects prepared by Mitchell Daysh and Engineers Report (*Tailings Storage and Rock Disposal – Northern Rock Stack*), prepared by Engineering Geology Limited.

The NRS has been broken up into three stages, in brief:

Stage 1 – Establishment of topsoil stockpiles and the construction of a new workshop platform and Collection Pond

Stage 2 – Construction of the uphill clean water diversion and establishment of the western borrow area.

Stage 3 – Full perimeter infrastructure and site establishment.

This SSESCP has been prepared in accordance with Waikato Regional Council Technical Report No. 2009/02 *Erosion and Sediment Control Guidelines for Soil Disturbing Activities, January 2009* (TR2009/02).

This SSESCP addresses the following earthwork activities:

- Establishment of the erosion and sediment controls;
- Clean water diversions and stream diversions;
- General earthworks; and
- Rehabilitation, landscaping and stabilisation.

2. DESCRIPTION OF WORKS

The NRS is proposed to store a nominal capacity of 7.0 M m^3 of rock and will involve establishment earthworks across a total area of approximately 38ha. A breakdown of the approximate earthworks areas are provided in Table 1.

Table 1: Approximate earthworks footprint associated with the NRS.

	Area (ha)
Northern Rock Stack footprint	25
Collection Pond	3
Northern stockpiles	3.2
Rehab stockpile and workshop area	1.1
Uphill diversion drain, perimeter drain, perimeter access road and western borrow area	5.3
Total	**37.6**

To facilitate the NRS the existing workshop, fuel bowser and grease storage facilities will need to be relocated approximately 160m to the southwest. Part of the proposed workshop area falls within a flood zone and may require some filling and flood protection.

An indicative alignment for the perimeter drain, perimeter access road and northern permanent uphill clean water diversion drain / stream diversion is shown in blue in Figure 1. The northern permanent uphill clean water diversion drain collects clean water from upslope and upstream of the NRS and diverts all flows into the Ohinemuri River. Dirty water runoff will be collected from the NRS footprint and diverted to the Collection Pond via the perimeter drain which is then pumped to the Water Treatment Plant. The clean water and dirty water drains are separated by a 6m wide perimeter access road.

A Collection Pond is proposed to be constructed to the northwest of the NRS. The Collection Pond will capture runoff from the NRS footprint and will have capacity of up to approximately 100,000m^3.

Two stockpiling areas are proposed to the north of the NRS, bordering Golden Valley Road. One stockpile will consist of 86,500m^3 of non-acid forming material and a second stockpile of topsoil to service 84,000m^3 of the same material. The total footprint for the two stockpiles is approximately 3.2ha. The material will be used for future rehabilitation of the NRS site.

The construction methodology is described in the Engineers Report:

The ESC measures are shown on:

- *ESCP-NRS-001-01*
- *ESCP-NRS-001-02*
- *ESCP-NRS-001-03*
- *ESCP-NRS-002-01*
- *ESCP-NRS-002-02*
- *ESCP-NRS-002-03*
- *ESCP-NRS-003-01*

Updated detailed ESC drawings will be prepared prior to these works being established.

2.1. Stage 1

Refer to ESCP-NRS-001-01, ESCP-NRS-001-02, and ESCP-NRS-001-03

Stage 1 will involve initial preparatory activities (e.g. clearing of vegetation and topsoil stripping), construction of the erosion and sediment control measures, establishment of the northern stockpiles, formation of a new workshop platform and the construction of the Collection Pond.

The two stockpiles are proposed to be established along the northern extent of the site, adjacent Golden Valley Road covering a total footprint of 3.2ha. Three SRPs will be established to capture runoff from these stockpiles.

Perimeter bunds will be constructed around the footprint of the stockpiles to divert runoff to the SRPs. As the stockpiles are filled to capacity they will be seeded and grassed.

The current workshop will need to be relocated to a new platform shown on ESCP-NRS-001-02. A rehab stockpile will also be placed to the north of the proposed workshop platform. The total footprint is approximately 1.1ha. The platform partially includes filling within the floodplain and the SRP will also be located within the floodplain. As such, the outlet pipe for SRP-NRS-04 will need to be fitted with a flood gate to ensure one-way flow of water from the pond (detail shown on Figure 2). Once the workshop platform is constructed it will be sheeted with aggregate to stabilise the area.

During this stage of work all site runoff from the current NRS footprint will continue to flow to the existing collection ponds.

A new Collection Pond is proposed to be constructed to the north-west of the NRS. The Collection Pond is designed to capture runoff from an area of 25ha and will provide capacity of up to 100,000m^3. During construction of the Collection Pond a temporary SRP will be constructed below the footprint of the Collection Pond to capture and treat any runoff (overland flow and pumped flow). The 5ha SRP is partially located within the floodplain. As such, the outlet pipe for SRP-NRS-05 will also need to be fitted with a flood gate to ensure one-way flow of water from the pond (detail shown on Figure 3). Perimeter bunds will be formed around the footprint of the Collection Pond to direct any overland runoff to the SRP.

Once the Collection Pond is commissioned, the SRP will be decommissioned and any runoff from the NRS can be directed to the Collection Pond.

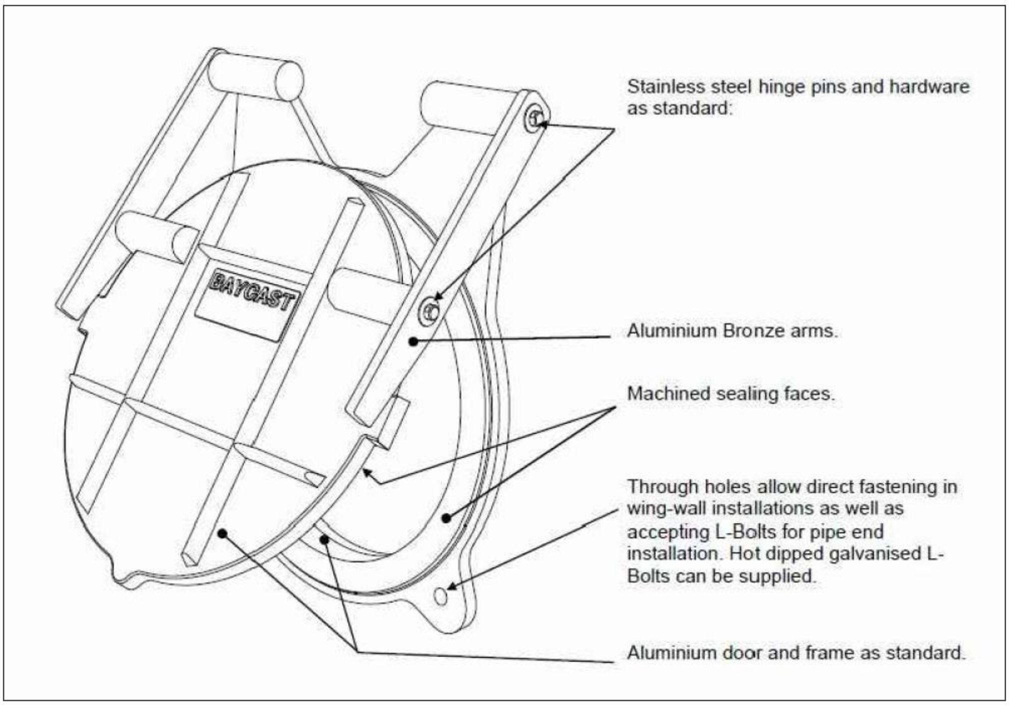


Figure 2: Example of a flood gate proposed to be installed on the outlet pipe of SRP-NRS-04.

2.2. Stage 2

Refer to ESCP-NRS-002-01, ESCP-NRS-002-02, and ESCP-NRS-002-03.

Stage 2 largely involves the construction of the permanent uphill clean water (stream) diversion, perimeter access road and NRS diversion channel. A cross section of the proposed structure is provided in Figure 3. In total the uphill diversions and perimeter access road spans 22m in width and will be approximately 1.2km in length, providing perimeter access around the NRS.

A western borrow area is also proposed to be established between the uphill diversion drain and the existing stream alignment.

A draft methodology which will be finalised prior to the commencement of earthwork is provided.

The permanent uphill clean water diversion is proposed to be constructed in two sections, with the upper section to be constructed first. Two SRPs will be constructed to service this section of work (SRP-NRS-06 and SRP-NRS-07). Perimeter bunds, both clean water and dirty water, will be constructed upslope and downslope of the works area.

SRP-NRS-06 will also be used to treat sediment laden runoff from the western borrow area. This SRP will be sized appropriately to service the catchment area. Access to the borrow will be confirmed as part of the Final SSESCP. This is likely to include a crossing over the existing stream.

Initially, a temporary stream diversion pipe will need to be placed within the base of the gully to allow any clean water to continue downstream via the existing stream channel. Once the temporary pipe has been installed SRP-NRS-07 can be built on top of it to service the earthworks required to fill the gully and construct the permanent uphill clean water diversion. The pipe size can be confirmed through detailed design and a stabilised bund can be constructed immediately downslope of the pipe inlet to significantly increase the headwater depth if the capacity of a pipe was exceeded.

The earthworks associated with the magazine storage facility could also be completed during this stage of works which would allow runoff from this area to flow to SRP-NRS-07. Staging details will be confirmed as part of the Final ESCPs.

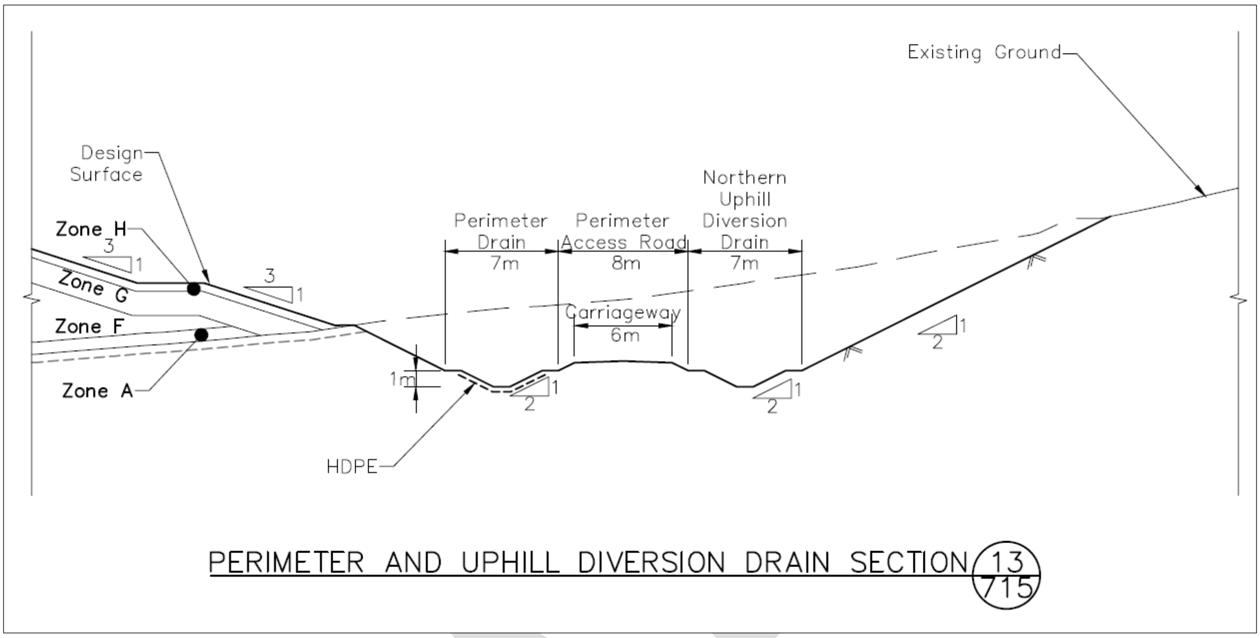


Figure 3: Cross-section of the perimeter and uphill diversion drain from approximate chainage 820 (Source: Engineering Geology Limited).

Once constructed and stabilised the upper section of the permanent uphill clean water diversion will be made live, but the clean water will discharge back to the existing stream channel at approximate chainage 650. From here, the lower section will be constructed from the base, working up towards CH 650.

SRP-NRS-08 will be built at the base of the permanent uphill clean water diversion to collect runoff during the construction of the lower section. Perimeter bunds and temporary clean water pipes will be installed where required. Once the permanent diversion and perimeter access road are constructed and stabilised, the SRP will be decommissioned and the works to tie in the upper and lower section of the diversion will be completed.

With the existing stream flowing through the new permanent uphill clean water diversion, the final section of the perimeter access road will be constructed across the gully that was formally the stream channel. A stabilised dam can be installed below the extent of earthworks. Any dirty water runoff will be pumped to the Collection Pond for treatment.

2.3. Stage 3

Refer to ESCP-NRS-003-01

With the Collection Pond commissioned and the perimeter access road and permanent uphill clean water diversion completed and stabilised, the full NRS extent will be utilised and set up ready to receive PAF material. All runoff from the NRS footprint is directed to the Collection Pond.

2.4. Rehabilitation

Rehabilitation of the NRS includes:

- Use of rehab stockpiles to create suitable contour across the site including rehabilitation of the workshop platform and magazine platform.

- Converting the Collection Pond into a wetland.
- NRS closure profile to max crest RL of 148 m.

The uphill diversion drains and perimeter access road are proposed to remain.

3. EROSION AND SEDIMENT CONTROL DETAILS

The erosion and sediment control methodology has been designed in accordance with best practice and the principles outlined in TR2009/02.

Specific erosion and sediment control calculations and drawings can be found within the appendices.

Appendix A – Erosion and sediment control calculations and typical details.

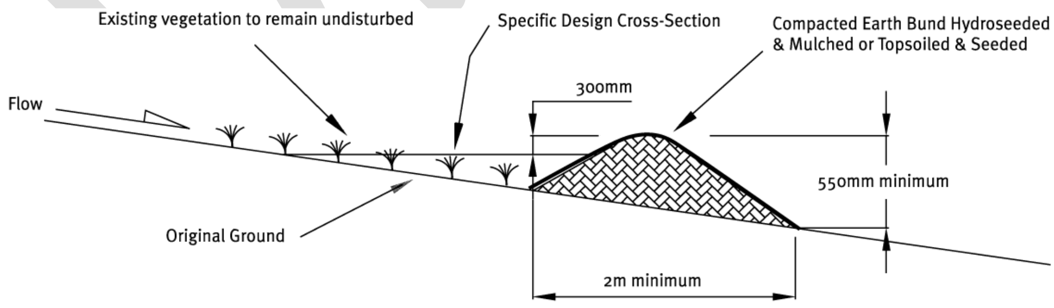
Appendix B – Erosion and sediment control drawings:

ESCP-NRS-001-01	ESCP-NRS-001-02	ESCP-NRS-001-03
ESCP-NRS-002-01	ESCP-NRS-002-02	ESCP-NRS-002-03
ESCP-NRS-003-01		

3.1. Clean Water Diversions

Perimeter bunding will be used, as required, to divert areas of clean water away from the site. The perimeter bunds will generally be constructed using stripped topsoil and will be stabilised immediately following construction.

TR2009/02 recommends that clean water diversions are designed to carry the flow from the 20% annual exceedance probability (AEP) rain event (plus 300mm freeboard). Where possible the clean water diversions have been increased in size to convey the 5% AEP storm event, including a freeboard of 300mm. Calculations are provided in Table 2.



Cross Section

Figure 4: Cross-section of a clean water diversion bund.

Table 2: Clean water diversion calculations and sizing details.

Perimeter Bunds (clean water diversion)							
Area	5% AEP rainfall depth (mm)	Catchment Area (maximum)	Peak Flow (m^3/s)	Base Width (m)	Slope (minimum)	Minimum Design Flow Depth (mm)	**Including Minimum 300mm Freeboard**
Perimeter bunding above the uphill clean water diversion drain	263mm	7.6ha	2.622	0.5	3%	400	**700**
General site activities	263mm	5ha	1.725	0.5	2%	250	**550**

The permanent uphill clean water diversion design details are provided by Engineering Geology Limited.

3.2. Dirty Water Diversions

Dirty water diversions will direct sediment laden runoff to the sediment control measures. The dirty water diversions have been sized to provide diversion capacity up to the 5% Annual Exceedance Probability (AEP) storm event, plus a freeboard of 300mm. Perimeter bunds located around the NRS site and northern stockpiles will be a minimum of 600mm high.

Calculations are provided in Table 3.

Table 3: Dirty water diversion details assuming maximum dirty water catchment area.

Perimeter Bunds (dirty water diversion)							
Area	5% AEP rainfall depth (mm)	Catchment Area (maximum)	Peak Flow (m^3/s)	Base Width (m)	Slope (minimum)	Minimum Design Flow Depth (mm)	**Including Minimum 300mm Freeboard**
General site activities	263mm	5.0ha	2.121	0.5	2%	300	**600**
Northern Stockpiles	263mm	3.2ha	1.358	0.5	2%	250	**550**

For simplicity, the earthworks associated with the GOP will adopt the larger of the two dirty water diversion sizing and construction dirty water diversion at a minimum of 600mm high.

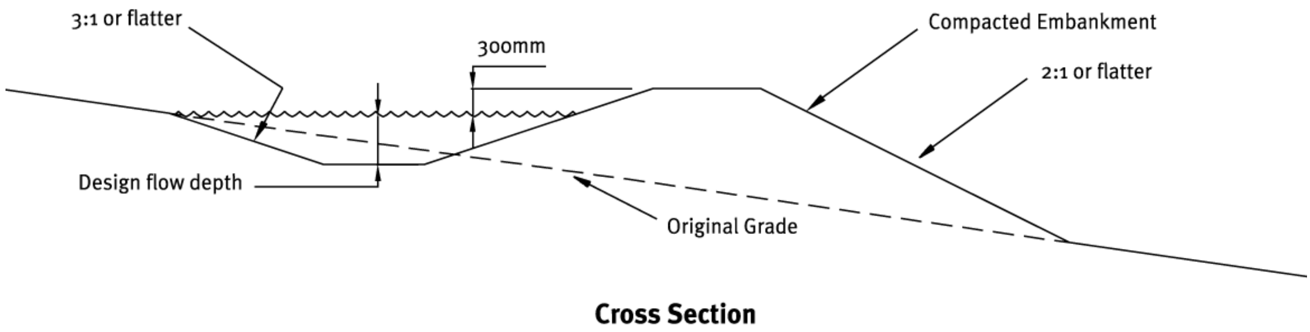


Figure 5: Cross-section of a dirty water diversion.

3.3. Sediment Retention Ponds

Multiple Sediment Retention Ponds (SRPs) are proposed to be constructed to capture sediment laden water during the earthworks associated with the NRS site establishment.

The size of the SRPs has generally been sized based on a 3% storage volume capacity, where practical. Where space is limited, and the contributing slope length is less than 200m and steepness less than 10% the SRP has been designed to provide a minimum storage volume based on 2% of the contributing catchment area.

An additional volume of 10% will be provided in the forebay of each SRP.

These devices have been sized in accordance with TR2009/02. Final design details will be provided as part of the Final SSESCP for the NRS. A draft design for SRP-NRS-01 proposed to capture runoff from the northern stockpile has been provided in Appendix A.

3.4. Decanting Earth Bunds

Decanting earth bunds (DEBs) are not proposed as part of this SSESCP.

3.5. Chemical Treatment

The Chemical Treatment Management Plan (CTMP) provided as Appendix A of the Erosion and Sediment Control Assessment Report provides the methodology for determining the effectiveness and dose rates for chemical treatment to enhance the sediment retention efficiency of sediment retention ponds, decanting earth bunds and other water impoundment devices that will be used throughout the project.

Appendix A of the CTMP details the provides the chemical analysis and test report which confirms the efficacy of chemical treatment of typical sites' soils, based on the testing methodology described in the CTMP.

3.6. Silt Fences and Super Silt Fences

Silt fences or Super Silt Fences may be used to capture runoff from small areas that cannot actively drain to a SRP.

Silt fences will be installed below the footprint of all SRPs to capture any runoff during the construction phase of these devices. Once the device is constructed then the silt fence will need to be returned up either side of the emergency spillway.

3.7. Stabilisation

Progressive stabilisation will be undertaken throughout the earthwork operations. Both temporary and permanent stabilisation measures will be employed on site. Common stabilisation measures include spreading of aggregate, grassing (with a full cover of grass), applying mulch and the use of geotextiles.

Once the catchment area for a particular ESC device is stabilised in accordance with TR2009/02, or the runoff directed to a different water management system (i.e. the Water Treatment Plant) then the ESC monitoring and maintenance will cease, and the ESC device could be decommissioned.

3.8. Dust Management

Dust will be managed in accordance with the Air Quality Management Plan.

3.9. Dewatering and Pumping

Dewatering (pumping) will be required during the Project. A Dewatering Management Plan is proposed to be provided to the Waikato Regional Council for certification prior to the commencement of earthworks.

The Dewatering Management Plan will identify activities that will require dewatering/pumping as well as the procedures involved, monitoring and maintenance requirements and record keeping.

3.10. General

Prior to bulk earthworks commencing as-builts for the erosion and sediment controls will be provided to the Waikato Regional Council. The as-built certification will confirm that the controls have been constructed in accordance with the approved SSESCP.

This SSESCP is intended to be a live document and if the earthworks methodologies or erosion and sediment control measures for the anticipated work changes then an update / review of the SSESCP drawings will be made before the earthworks commence. Any changes to the SSESCP will be confirmed in writing and provided to the Council for approval, prior to the implantation of any changes proposed.

3.11. Monitoring and Maintenance

All erosion and sediment control measures will be maintained in accordance with TR2009/02 throughout the works until the site is stabilised against erosion.

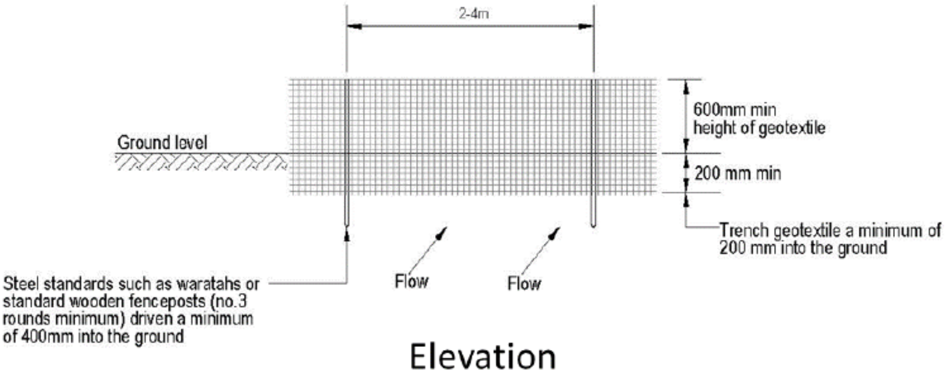
All erosion and sediment control measures and methodologies will be monitored during the works in accordance with the Erosion and Sediment Control Monitoring Plan (ESCMP). Monitoring will be undertaken at least weekly, and before and immediately after rain events as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

Sediment deposits and bulges against the silt fences will be removed when sediment accumulation reaches 20% of the fabric height.

The SRPs will be cleaned out before accumulated sediment volume reaches 20% of the total volume. Forebays will be cleaned out if there is any evidence of sediment deposition.

4. APPENDIX

4.1. Appendix A – Erosion and Sediment Control Design Details



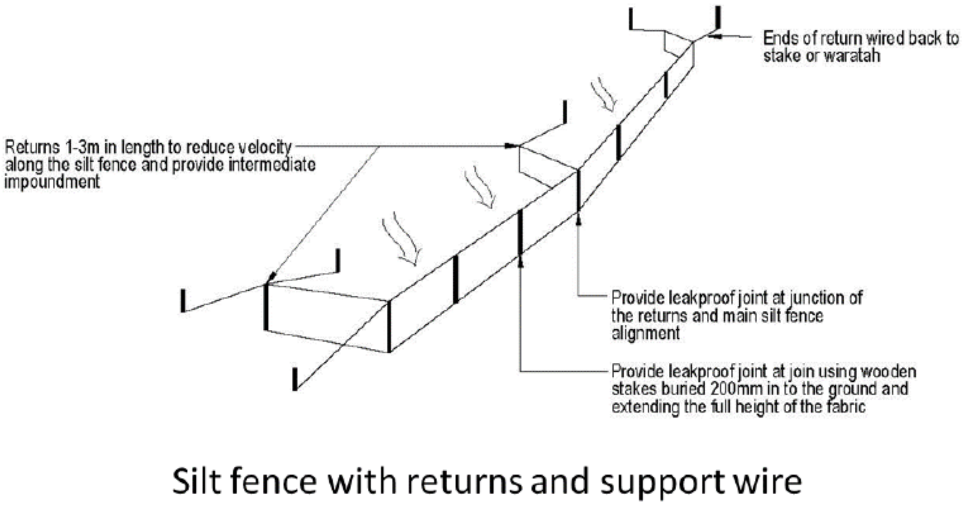


Figure 6: Schematic of a silt fence.

Table 4: Silt fence design criteria.

Slope Steepness (%)	**Slope Length (m) (Maximum)**	**Spacing of Returns (m)**	**Silt fence Length (m) (Maximum)**
Flatter than 2%	Unlimited	N/A	Unlimited
2 - 10%	40	60	300
10 - 20%	30	50	230
20 - 33%	20	40	150
33 - 50%	15	30	75
> 50%	6	20	40

SRP-NRS-01

Size criteria	Length Ratio	Side slopes	Depth from Emergency	R.L. of Pond Base
Auto	3:1	2:1	1.80	0.00

Storage Volume Criteria	3%
Contributing Catchment (ha)	1.00
Minimum Storage Volume (m^3)	300
Dead storage (m^3)	90
Live storage (m^3)	210
Length at Spillway Level	29.74
Width at Spillway Level	12.36
Spillway base width (300mm deep)	6.00
Primary Spillway diameter (min)	150mm
Number of decants	1
Number of holes per decant	133
Minimum outlet diameter	150mm
RL Emergency Spillway	1.80
RL Primary Spillway	1.50
RL Level Spreader (min)	1.95
RL Base Decant	0.62
Length at Base	20.74
Width at Base	5.16

Forebay

Volume	30 m^3	min. volume
Depth	1 m	min. depth
Width	12.36 m	full width of pond
Length	3 m	min. length

Refer to TR2009/02 for cross-sections and plan views.

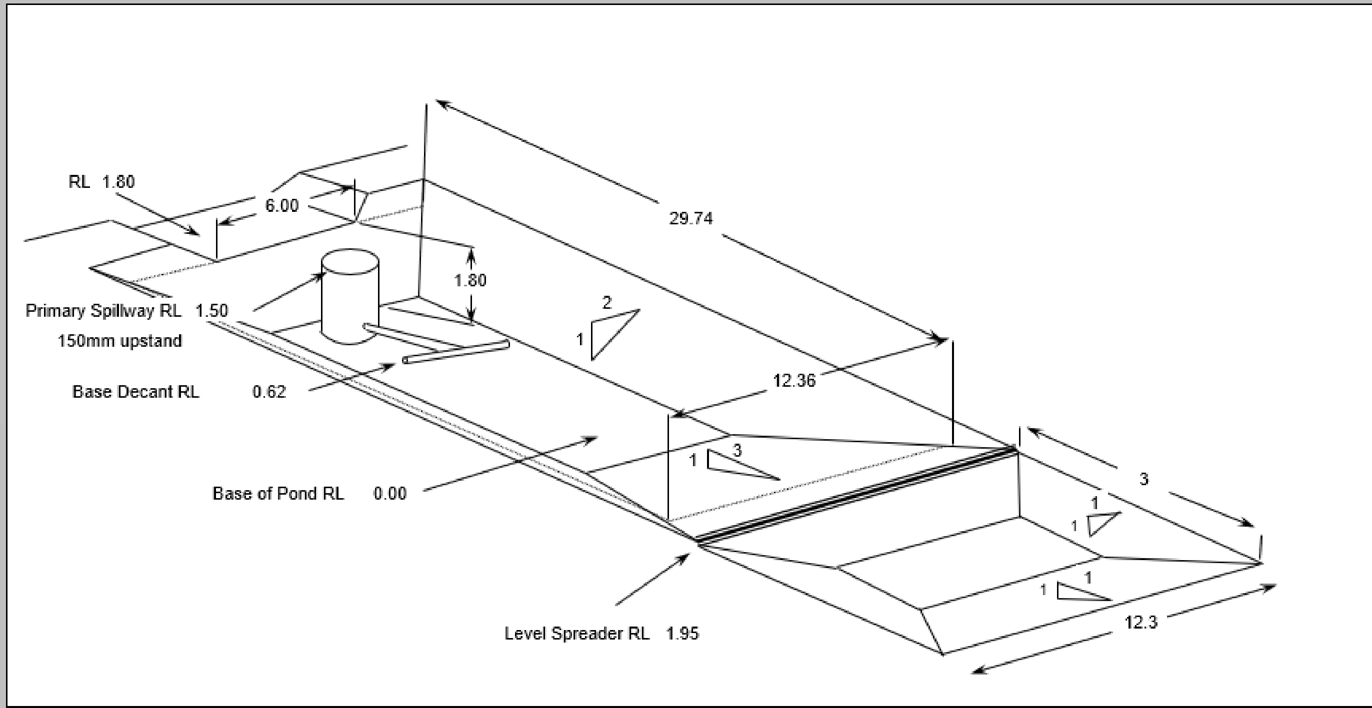


Figure 7: Design details for SRP-NRS-01.

Example SRP design details that will be provided for each SRP as part of the Final SSESCP.

Refer to TR2009/02 for sediment retention pond cross sections.

4.2. Appendix B - Erosion and Sediment Control Drawings

Drawing number	Drawing title	Date	Revision	Sheet
ESCP-NRS-001-01	Erosion and Sediment Control Plan – Northern Rock Stack – Stage 1	03.02.22	A	1
ESCP-NRS-001-02	Erosion and Sediment Control Plan – Northern Rock Stack – Stage 1	03.02.22	A	2
ESCP-NRS-001-03	Erosion and Sediment Control Plan – Northern Rock Stack – Stage 1	03.02.22	A	3
ESCP-NRS-002-01	Erosion and Sediment Control Plan – Northern Rock Stack – Stage 2	19.02.25	A	4
ESCP-NRS-002-02	Erosion and Sediment Control Plan – Northern Rock Stack – Stage 2	03.02.22	A	5
ESCP-NRS-002-03	Erosion and Sediment Control Plan – Northern Rock Stack – Stage 2	03.02.22	A	6
ESCP-NRS-003-01	Erosion and Sediment Control Plan – Northern Rock Stack – Stage 3	03.02.22	A	7

Waihi North Project

Site Specific Erosion and Sediment Control Plan

Appendix C.4 – Tailings Storage Facility 3

Prepared for OGNZL

Prepared by: SouthernSkies Environmental Ltd   Date: 19 February 2025

CONTENTS

1. OVERVIEW

1.1. Scope

This Site-Specific Erosion and Sediment Control Plan (SSESCP) relates to the activities associated with the construction of a new Tailings Storage Facility (TSF3).

TSF3 will be constructed to the east of the existing TSF1A to accommodate additional tailings volume from the processing of ore. The proposed crest height for the embankment is RL155, forming a 46m high embankment above the existing ground at the downstream toe (RL109). The RL155 crest height provides a total storage volume of approximately 7,000,000m^3.

TSF3 will occupy land currently used for as a dairy farm and vegetated with pastural grasses, scattered trees, and shelterbelts. The footprint of TSF3 will require topsoil and subsoil to be progressively stripped from the area, including several unnamed stream beds and drains which are tributaries of the Ruahorehore Stream. The layout of TSF3 to RL155 is shown in Figure 1. This figure also includes the proposed stockpiling areas, two borrow areas and the alignment of the permanent uphill diversion drain.

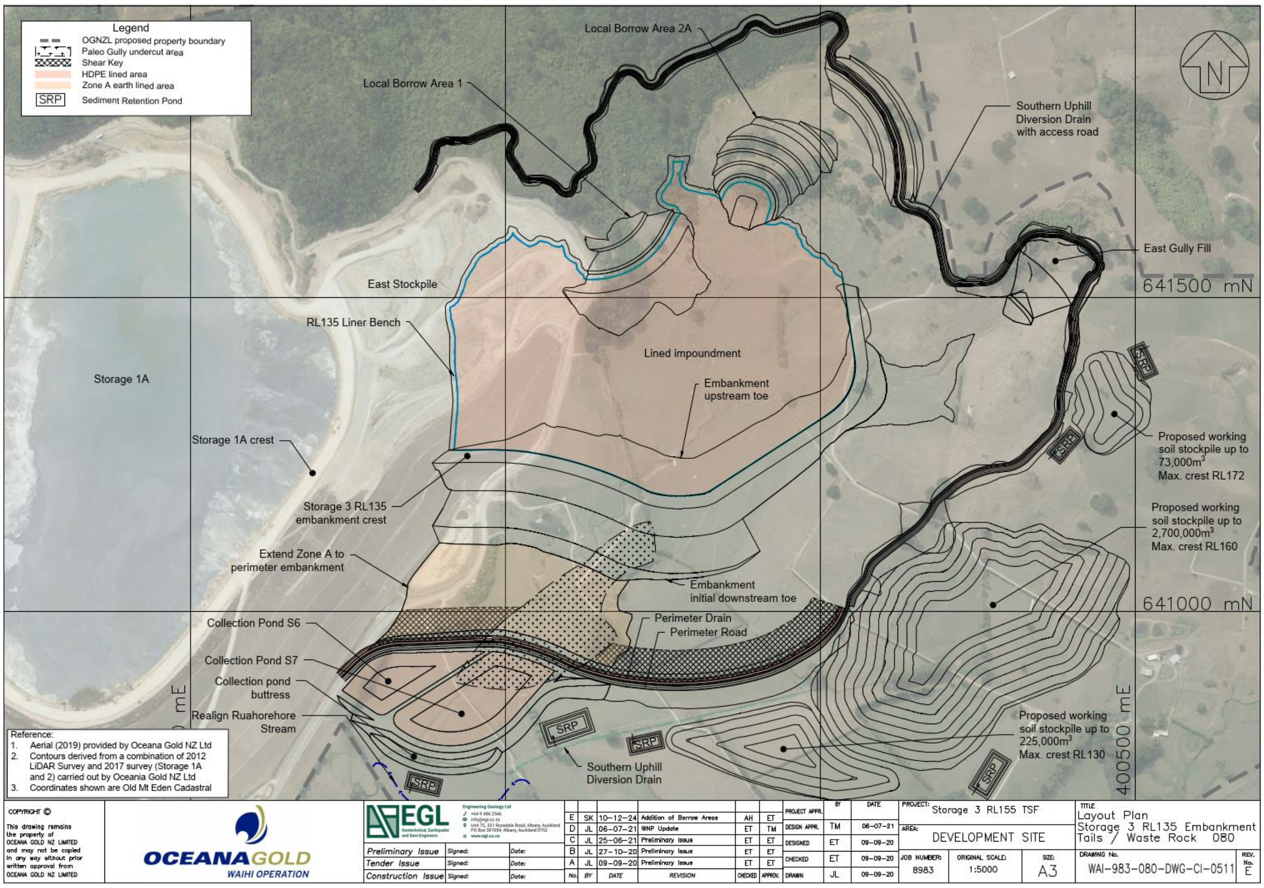


Figure 1: TSF3 location and associated infrastructure (Source: Engineering Geology Limited).

This SSESCP provides design erosion and sediment control (ESC) measures indicating how the site will manage sediment laden runoff during the preparatory earthwork activities. This document should be read in conjunction with the Assessment of Environmental Effects, prepared by Mitchell Daysh and *Tailings Storage and Rock Disposal Volume 3 Proposed Tailings Storage Facility Storage 3 RL155, Technical Report*, prepared by Engineering Geology Limited (Engineers Report) that have been prepared for the application.

This SSESCP has been prepared in general accordance with Waikato Regional Council Technical Report No.

2009/02 *Erosion and Sediment Control Guidelines for Soil Disturbing Activities, January 2009* (TR2009/02) and addresses the following earthwork activities:

- Establishment of the erosion and sediment controls;
- General earthworks;
- Establishment of two local borrow areas and several stockpiles;
- Construction of the permanent uphill clean water diversion drain and haul road;
- Realignment of 310m of Ruahorehore Stream to allow for the construction of the Collection Pond; and
- Rehabilitation, landscaping, and stabilisation.

The ESC measures will be used during the 'enabling works' phase which does not include mining or management of potentially acid forming (PAF) material. PAF contact water will be pumped to the Water Treatment Facility.

2. DESCRIPTION OF WORKS

The total footprint of TSF3 is approximately 115ha. Of this area 20ha is already part of the existing footprint of TSF1A and East Stockpile. The new proposed footprint of TSF3 is 95ha. The earthworks areas associated with TSF3 are provided in Table 1.

Table 1: Approximate earthworks footprint associated with the TSF3.

ID	Area (ha)
TSF3 construction Including Paleo undercut, borrow areas and east gully fill	95
Collection Pond	4.3
Stockpile 1 and 2	17
Permanent uphill diversion drain and perimeter access road	6

The construction sequence and methodology are described in the Engineers Report, in summary this includes:

- Clearing of existing vegetation and structures (farm sheds, races, fences etc).
- Progressively establish erosion and sediment control measures.
- Establish stockpiles.
- Establish borrow areas.
- Topsoil stripping. Topsoil stripping will be required over an area of approximately 80ha. Topsoil will be stockpiled preferentially in the smaller west and east TSF3 stockpiles.
- Undertake paleo gully undercut.
- Commence construction of TSF3 impoundment area and embankment. Both NAF and PAF material will be used through the construction of TSF3.
- Shear key excavations. Shear key excavation is likely to be 50m wide (at base) and 3-7m deep.
- Progressively line impoundment area with a geomembrane (HDPE).

- Construct Collection Ponds.
- Progressively raise embankment/facility.
- Establish permanent uphill diversion drain.
- Complete site infrastructure and full site establishment.

The ESC measures are shown on design drawings provided in Appendix A. Updated detailed ESC drawings will be prepared prior to these works commencing.

2.1. Stage 1

Refer to ESCP-TSF3-001-01, ESCP-TSF3-001-02, ESCP-TSF3-001-03 and ESCP-TSF3-001-04.

Stage 1 will involve initial preparatory activities (e.g. clearing of vegetation), progressive construction of the ESC measures, establishment of the stockpiles and borrow areas, realignment of the Ruahorehore Stream and Paleo Gully undercut.

Stockpiles

Three stockpiling areas are proposed to the east and southeast of the TSF3. Stockpiles 1 and 2 are proposed to be located to the southeast of the TSF3. Stockpile 1 covers an area of approximately 5.5ha to contain up to 225,000m^3 of material with a max crest height of RL130. Stockpile 2 covers approximately 12ha to contain up to 2,700,000m^3 with a max crest height of RL160.

A third stockpile, located to the north of Stockpiles 1 and 2 will cover an area of 1.5ha and contain 23,000m^3 of material at a max crest height of RL172. Note, this stockpile is shown in the Stage 4 drawings (ESCP-TSF3-004-01 and ESCP-TSF3-004-02).

Perimeter bunds will be constructed around the footprint of the stockpiles to divert runoff to the SRPs as well as diverting clean water from above catchment areas away from the fill areas.

SRPs will be used to treat runoff from each of the stockpiles.

The catchment area for SRP-TSF3-01 will slightly exceed the maximum recommended catchment area in TR2009/02 at approximately 5.1ha for Stockpile 1. SRP-TSF3-01 has been designed with a minimum storage volume of 1,650m^3 to provide for a maximum contributing catchment area of 5.5ha.

SRP-TSF3-02 has been designed to capture runoff from the entire 12ha Stockpile 2 area. This SRP has been designed with a total volume of 4,000m^3, exceeding the minimum storage requirement of 3% of the contributing catchment area. Dual manholes and outlet pipes will need to be incorporated into the SRP, as well as eight T-bars to maintain the recommended discharge rate of 3L/sec/ha. Additional weight will be required to be placed in the base of the manholes to keep them securely in place in the event that the pond fills with water. The manholes will also be built into the pond's internal embankment if possible. While the SRP has been designed to cater for the full 12ha catchment area, it is not likely that the entire area will be 'open' at one time. The stockpile will be progressively stabilise to minimise the amount of open area and sediment load of runoff flowing to the SRP.

SRP-TSF3-03 will be constructed within a natural low point on the southwestern side of Stockpile 2. A clean water diversion will be required to divert clean water around the footprint of this pond. This 2ha SRP will be constructed to enable the earthworks associated with the stockpile, while not all runoff will flow to SRP-TFS3-02. Contour drains and diversion drains/bunds will be used through the Stockpile 2 area to ensure that majority of runoff is directed to SRP-TSF3-02 and limiting catchment area to 2ha draining to SRP-TSF3-03.

SRP-TSF3-03 will also be used to treat runoff during the construction of the permanent uphill clean water diversion drain.

The stockpiles will be progressively stabilised (e.g. with grass seed and grassed).

Borrow Areas

It is expected that the construction of TSF3 will precede mining of the Gladstone Open Pit and Martha Open Pit. Waste rock to construct the TSF3 embankment will be initially sourced from material borrowed from within the TSF3 footprint and on the eastern side of the Northern Rock Stack.

Two borrow areas will be located within the footprint of TSF3, the Central Borrow Area, covering approximately 2.8ha and the Eastern Borrow Area 2A and 2B. Stage 2A covers an area of approximately 3.62ha and Stage 2B covers an area of approximately 6.05ha.

Sediment Retention Ponds will be constructed below the footprint of the borrow areas to treat runoff.

Paleo Gully Undercut

To maximise the TSF3 site and provide for a structure of similar geotechnical integrity as the existing TSF1A and 2 embankments, some excavation of areas of weak and compressible soils and backfilling with a structural fill will be undertaken. An undercut to 20m depth is proposed in an area termed the Paleo Gully, which is the controlling geological feature limiting the downstream toe position. The Paleo Gully undercut specifically removes 140,000m^3 of soft alluvium and 120,000m^3 of sensitive reworked rhyolite tuff material. Alluvium suitable for reuse will be sent to the stockpiles to dry out and any unsuitable alluvium and sensitive tuff is proposed to be placed up the east gully. This work will require bulk excavation and dewatering. The undercut will need to start at the shallow northern end of the Paleo Gully and progressively work to the south. The excavated material will be NAF.

Pumped water from the excavation will be discharged to SRP-TSF3-04 and then discharged to the Ruahorehore Stream. SRP-TSF3-04 will have minimal overland flow runoff as majority of water will be pumped from the excavation. Therefore, this SRP has been sized based on the predicted pumping rates provided by EGL. Dewatering rates of up to 2,500m^3/day is predicted (refer to EGL Engineers Report for further details). If SRP-TSF3-04 cannot adequately cope with the volume of pumped water, then it will be pumped to nearby sediment ponds or the TSF1A existing storage ponds.

Realign Ruahorehore Stream

The Ecological Assessment prepared by Boffa Miskel states that the construction of TSF3 will result in the diversion of a tributary of the Ruahorehore Stream. Approximately 2.111km of stream length will be diverted to form a 2.95km permanent uphill diversion drain. The construction of the permanent uphill clean water diversion is discussed in Stage 5.

Additionally, sections of the Ruahorehore stream are proposed to be realigned below the proposed Collection Ponds measuring approximately 311m. These sections of stream diversion will be undertaken within Stage 1 (refer to ESCP-TSF3-001-04).

Initially, a silt fence will be installed below the footprint of SRP-TSF3-06. This SRP will be constructed at this stage to provide impoundment for dirty water during the stream realignment but will also be utilised during the construction of the Collection Ponds.

The sections of stream realignment will be constructed offline (i.e. in the dry) with no effect on the existing stream channel. Any dirty water will be pumped to the SRP for treatment.

Once the new offline stream sections are completed and stabilised as per the Ecologists recommendations, then the downstream tie in, followed by the upstream tie in with the Ruahorehore Stream will be completed.

The tie ins will utilise a dam and over-pump methodology during day works. Each tie in will likely be completed within 1-2 days.

2.2. Stage 2

Refer to ESCP-TSF3-002-01, ESCP-TSF3-002-02, ESCP-TSF3-002-03 and ESCP-TSF3-002-04.

Stage 2 will largely involve the progressive construction of the TSF3 impoundment area and embankment upstream toe.

Initially, a clean water diversion will be constructed around the Stage 2 TSF3 impoundment area. Multiple stages and alterations of the clean water diversions will be required as the impoundment area increases in size.

SRP-TSF3-07 will be constructed below the impoundment area to capture runoff during this stage of work. The SRP has been sized to cater for a maximum catchment area of 7.5ha which is shown on ESCP-TSF3-002-02. This SRP has been designed with a total volume of 2,250m^3, 3% of the contributing catchment area. Dual manholes and outlet pipes will need to be incorporated into the SRP, as well as five T-bars to maintain the recommended discharge rate of 3L/sec/ha. Additional weight will be required to be placed in the base of the manholes to keep them securely in place in the event that the pond fills with water. The manholes will also be built into the pond's internal embankment if possible. It is anticipated that with the construction of the embankment and progressive lining of the impoundment area with a geomembrane, a 3% storage volume will be sufficient.

The embankment will be progressively constructed for the upstream toe forming a large impoundment volume. The embankment crest will be constructed to an RL of 116.6. This will construct an embankment downstream height of 3.6m and an upstream height of 3.1m. The calculated storage volume to RL 116.6 is 19,120m^3.

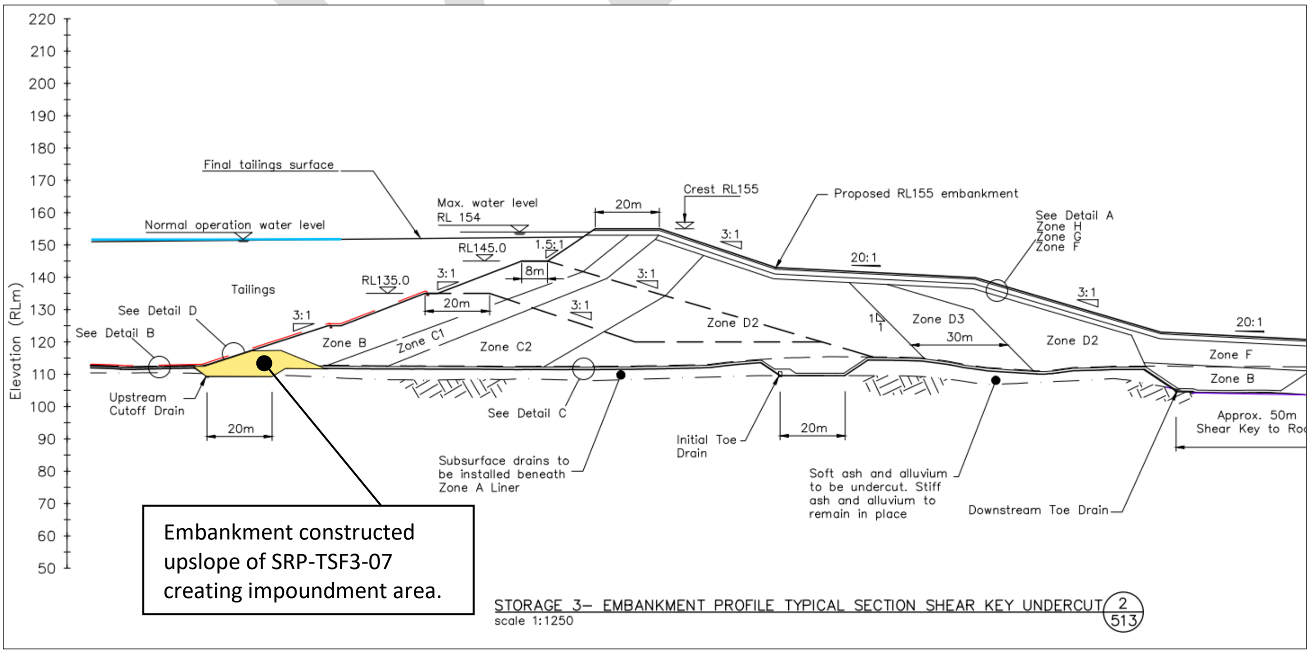


Figure 2: TSF3 embankment upstream toe (modified from drawing WAI-983-080-DWG-CI-0517, Rev D, prepared by Engineering Geology Limited).

Once the embankment is constructed (ESCP-TSF3-002-03) water impounded against the embankment will be pumped to the SRP. This SRP will then only capture overland flow during rain events from the downslope batter of the embankment.

The tailings impoundment is to be fully lined with an earth liner. Additionally, a 1.5mm HDPE geomembrane liner is proposed within the tailings impoundment and up to the initial starter embankment height (RL135) to further minimise tailings seepage. During this stage the geomembrane will be progressively installed.

2.3. Stage 3

Refer to ESCP-TSF3-003-01

Stage 3 includes the construction of Collection Ponds S6 and S7 to the south of TSF3. Note, while indicated on the SSESCPs as Stage 3, the Collection Pond could be constructed concurrently with earlier phases of TSF3.

The Collection Pond S6 is designed to capture runoff from the East Stockpile and Storage 1A Slopes (14.73ha) while S7 captures the runoff from the TSF3 open embankment working area below uphill diversion drains (36.94ha).Collection Pond S6 has a capacity of 38,621 m3 (-10% dead storage) = 34,758m3 and S7 has a capacity of 89,807 m3 (-10% dead storage) = 80,826m3

SRP-TSF3-06 will be utilised during construction of the Collection Ponds (constructed during Stage 1). This SRP is designed to capture and treat any runoff (overland flow and pumped flow). Perimeter bunds will be formed around the footprint of the Collection Ponds to direct any overland runoff to the SRP.

During the construction of the Collection Ponds significant impoundment will be constructed (during the initial undercut as well as during the construction of the ponds) which aids the management of runoff and that can be periodically pumped to SRP-TSF3-06 for treatment prior to discharging to the Ruahorehore Stream.

2.4. Stage 4

Refer to ESC-TSF3-004-01 and ESCP-TSF3-004-02

Stage 4 involves the continued construction of the TSF3. Once the Collection Pond is operational PAF material could be imported. All water is directed to the Collection Pond.

Stage 4 ESC drawings show the construction of the permanent uphill diversion drain and haul road around TSF3, but these are likely to be installed concurrently with Stage 2 and will be constructed before Stage 2C.

In total, the earthworks associated with the permanent uphill diversion and perimeter access road spans an average of 20m in width and will be approximately 2,950m in length, providing perimeter access around the TSF3.

Clean run-on water from the hills above the TSF will be diverted around the facility to the Ruahorehore Stream. This diversion will be an extension to the existing Southern Uphill Diversion Drain which currently starts behind TSF1A and runs behind the East Stockpile. This drain is set at a level which allows for future potential raising to a crest of RL177. Accordingly, there will be a section of vegetation which will remain between the impoundment level (RL155) and the uphill drain cuts and fills.

During construction of the permanent diversion drain large portions will be treated by typical ESC devices. Where this is not possible runoff will flow into the impoundment area of TSF3 and be captured by the Collection Ponds.

A draft methodology which will be finalised prior to the commencement of earthwork is provided.

The permanent uphill clean water diversion is proposed to be constructed in three sections, with the lower section (section 1) to be constructed first.

SRP-TSF3-03 will be utilised to capture sediment laden runoff from the construction of section 1. Section 1 will extent to the East Gully Fill and catchment area of SRP-TSF3-05. This section will be constructed and progressively stabilised.

A portion of the Section 2 permanent diversion drain will be able to be diverted to SRP-TSF3-05 for treatment. Where this is not possible silt fences or decanting earth bunds (DEBs) will be used to capture runoff. As works progress uphill more of the diversion drain will flow down to SRP-TSF3-05. The drain will be progressively stabilised.

Section 3 is within the bush area and steep topography. The temporary clean water diversion constructed as part of the works shown on ESCP-TSF3-002-03 will be removed. A focus through this section will be on constructing the permanent diversion drain using a cut and cover methodology. Where this is not possible, silt fences, DEBs may be used, or runoff could be diverted down into the impoundment area of TSF3 and ultimately captured by the Collection Ponds.

2.5. Stage 5

<u>Refer to ESC-TSF3-005-01</u>

Full TSF3 infrastructure establishment.

2.6. Rehabilitation

Engineering Geology Limited have provided a rehabilitation plan for TSF3 which includes:

- Rehabilitation of stockpiles.
- Permanent diversion drain remains but flow directed into closure pond/wetland.
- Impoundment area of TSF3 converted into a closure pond/wetland.
- Converting the Collection Ponds into a wetland with an open channel to the Ruahorehore Stream.

This detail is provided on drawing WAI-983-080-DWG-CI-0960, prepared by Engineering Geology Limited.

3. EROSION AND SEDIMENT CONTROL DETAILS

The erosion and sediment control methodology has been designed in accordance with best practice and the principles outlined in TR2009/02.

Specific erosion and sediment control calculations and drawings can be found within the appendices.

Appendix A – Erosion and sediment control drawings:

ESCP-TSF3-001-01	ESCP-TSF3-001-02	ESCP-TSF3-001-03	ESCP-TSF3-001-04
ESCP-TSF3-002-01	ESCP-TSF3-002-02	ESCP-TSF3-002-03	ESCP-TSF3-002-04
ESCP-TSF3-003-01			
ESCP-TSF3-004-01	ESCP-TSF3-004-02		
ESCP-TSF3-005-01			

3.1. Clean Water Diversions

Perimeter bunding will be used, as required, to divert areas of clean water away from the site. The perimeter bunds will generally be constructed using stripped topsoil and will be stabilised immediately following construction.

TR2009/02 recommends that clean water diversions are designed to carry the flow from the 20% annual exceedance probability (AEP) rain event (plus 300mm freeboard). Where possible the clean water diversions have been increased in size to convey the 5% AEP storm event, including a freeboard of 300mm. Calculations are provided in Table 2.

Where the gradient of the clean water diversion gradients exceeding 2% or the design velocity exceeds 1m^3/s channel lining or additional erosion protection will likely be required.

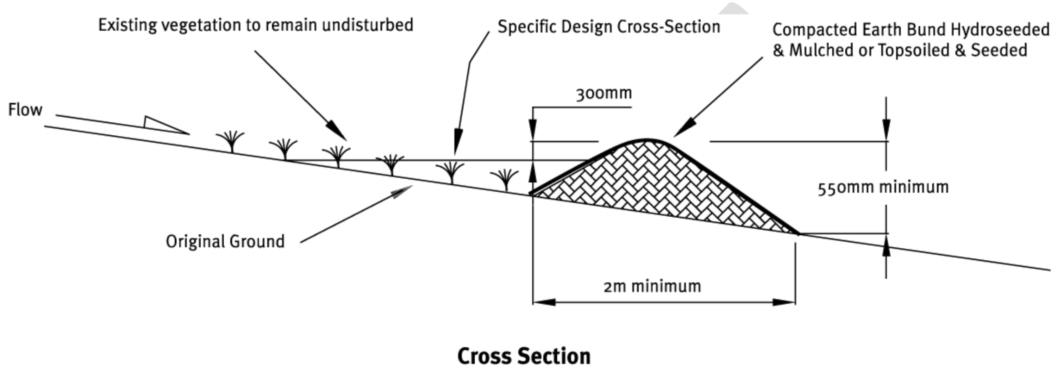


Figure 3: Cross-section of a clean water diversion bund.

Table 2: Clean water diversion calculations and sizing details.

Clean water diversion							
Clean water detail reference	Catchment area	5% AEP rainfall depth (mm)	Peak Flow (m^3/s)	Base Width (m)	Slope (minimum)	Minimum Design Flow Depth (mm)	**Including Minimum 300mm Freeboard**
CWD-1	<5ha	263mm	1.819	0.5	2%	300	**600**
CWD-2	5-10ha	263mm	3.638	0.5	2%	400	**700**
CWD-3	10-15ha	263mm	5.457	0.5	2%	450	**750**
CWD-4	15-20ha	263mm	7.276	0.5	2%	500	**800**

Clean water diversion capacity sized using a mannings (n) figure of 0.035 for grass.

The permanent uphill clean water diversion design details are provided by Engineering Geology Limited.

3.2. Dirty Water Diversions

Dirty water diversions will direct sediment laden runoff to the sediment control measures. The dirty water diversions have been sized to provide diversion capacity up to the 5% Annual Exceedance Probability (AEP) storm event, plus a freeboard of 300mm.

Dirty water diversions with slopes greater than 2% will likely require stabilisation to prevent significant erosion. Drop out pits (approx. 1m x 1m) should also be constructed within the dirty water diversion to allow heavier sediment particles to drop out before they enter the sediment retention device.

Calculations are provided in Table 3.

Table 3: Dirty water diversion calculations and sizing details.

Dirty water diversions							
Dirty water detail reference	Catchment area	5% AEP rainfall depth (mm)	Peak Flow (m^3/s)	Base Width (m)	Slope (minimum)	Minimum Design Flow Depth (mm)	**Including Minimum 300mm Freeboard**
DWD-1	<5ha	263mm	2.121	0.5	2%	350	**650**
DWD-2	5-10ha	263mm	4.243	0.5	2%	450	**750**
DWD-3	10-15ha	263mm	6.364	0.5	2%	500	**800**

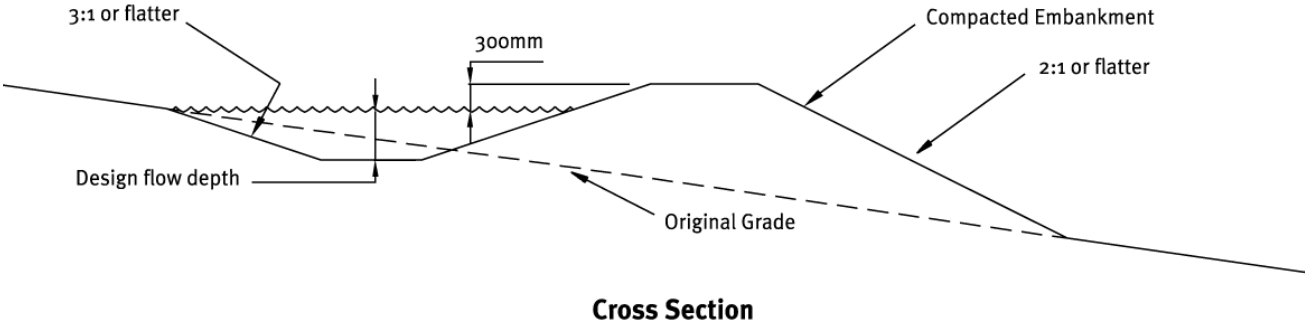


Figure 4: Cross-section of a dirty water diversion.

3.3. Sediment Retention Ponds

Several Sediment Retention Ponds (SRPs) are proposed to be constructed to capture and treat sediment laden water during the earthworks associated with the TFS3 site establishment.

The SRPs will be sized in respect to their contributing catchment area and slope steepness.

- Where slopes are less than 10% and less than 200m in length, the SRP will be constructed with a minimum volume of 2% of the contributing catchment.
- Where slopes are greater than 10% and/or more than 200m in length, the SRP will be constructed with a minimum volume of 3% of the contributing catchment.

An additional volume of 10% will be provided in the forebay of each SRP.

It is noted that TR2009/02 recommends that that maximum contributing catchment area for a SRP is 5ha. This SSESCP proposes the use of SRPs with catchment areas that exceed 5ha. In these cases, the volume of each SRP maintains the relevant sizing criteria. For example, SRP-TSF3-02 which will be constructed to treat runoff from the stockpile, has a contributing catchment area of 12ha and will provide a minimum volume of 3,600m^3 (3% of contributing catchment).

One SRP has been favoured over two or three SRPs in order to simplify the design, minimise the number of controls to construct, maintain and monitor and reduce cost. A single device also takes up the least amount of space without the device being in the way or restricting the earthworks operations.

The SRPs will be located to allow access for removing sediment from the pond.

Final design details will be provided as part of the Final SSESCP. A draft design for SRP-TSF3-01 is provided in Figure 5.

Any pumping of sediment laden water required throughout the duration of the earthworks will be to a SRP forebay or to the Collection Pond for treatment prior to being discharged from the site.

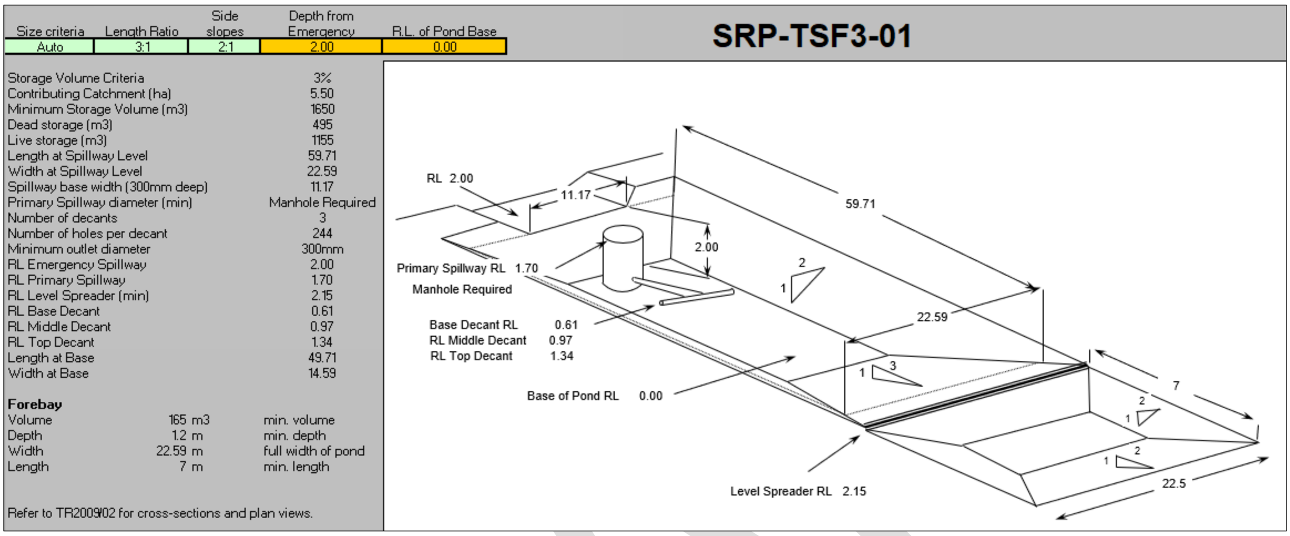


Figure 5: Example design details for SRP-TSF3-01.

Refer to TR2009/02 for cross-sections and plan view details.

3.4. Decanting Earth Bunds

Decanting earth bunds (DEBs) may be used during the construction of the permanent uphill diversion drain. DEBs will generally be limited to 3,000m^2 of contributing catchment area.

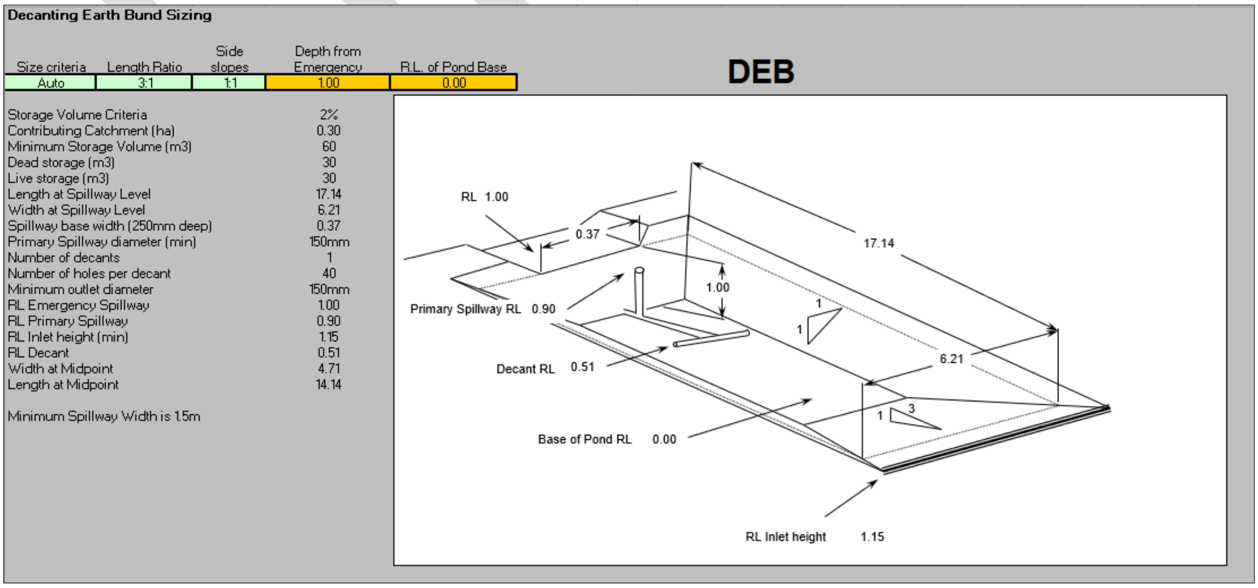


Figure 6: Example design of a decanting earth bund with a contributing catchment area of 3,000m^2.

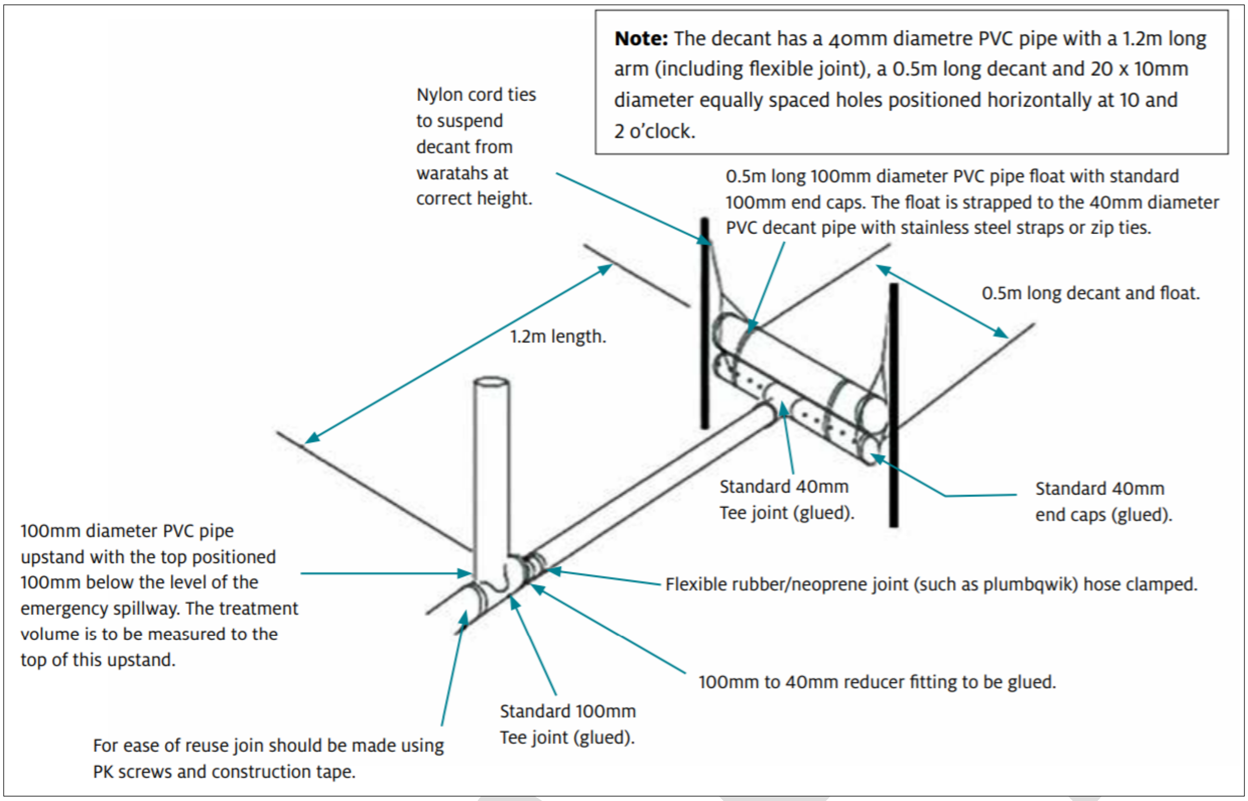


Figure 7: Cross-section of a T-bar used in a decanting earth bund.

3.5. Chemical Treatment

The Chemical Treatment Management Plan (CTMP) provided as Appendix A of the Erosion and Sediment Control Assessment Report provides the methodology for determining the effectiveness and dose rates for chemical treatment to enhance the sediment retention efficiency of sediment retention ponds, decanting earth bunds and other water impoundment devices that will be used throughout the project. It is intended that all SRPs will be chemically treated if necessary and monitored in accordance with the CTMP

While the Collection Pond and Detention Pond service their respective areas during the enabling earthworks (Non Acid Forming soils) chemical treatment will likely be employed. Once the Surface Facilities earthworks are complete the area will be stabilised, and chemical treatment removed for the Detention Pond. Once the mining operations commence PAF water will report to the Collection Pond and pumped to the Water Treatment Plant.

3.6. Silt Fences and Super Silt Fences

Silt fences or Super Silt Fences may be used to capture runoff from small areas that cannot actively drain to a SRP or DEB.

Silt fences will be installed below the footprint of all SRPs to capture any runoff during the construction phase of these devices. Once the device is constructed then the silt fence will need to be returned up either side of the emergency spillway or removed.

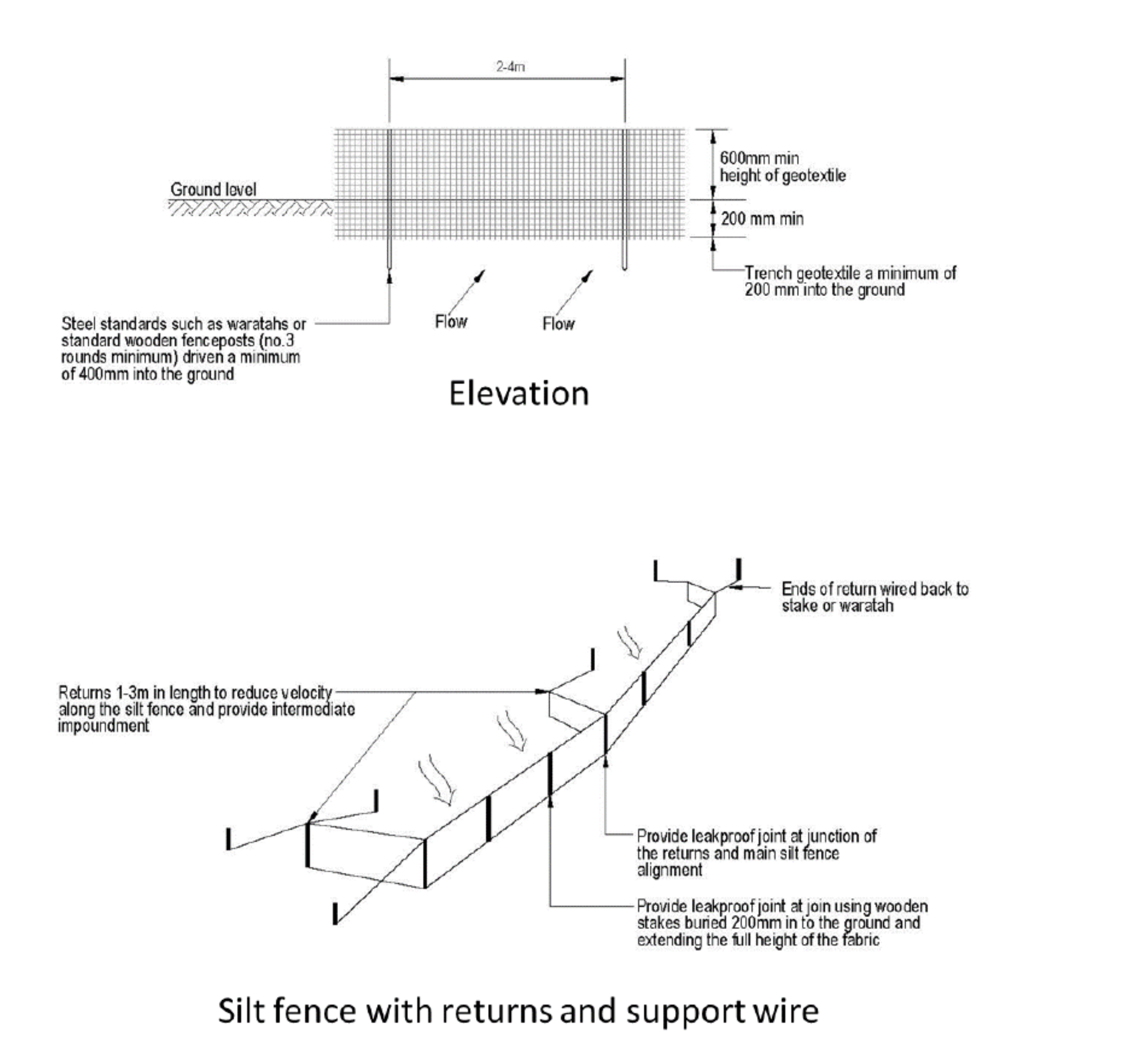


Figure 8: Schematic of a silt fence.

Table 4: Silt fence design criteria.

Slope Steepness (%)	Slope Length (m) (Maximum)	Spacing of Returns (m)	Silt fence Length (m) (Maximum)
Flatter than 2%	Unlimited	N/A	Unlimited
2 - 10%	40	60	300
10 - 20%	30	50	230
20 - 33%	20	40	150
33 - 50%	15	30	75
> 50%	6	20	40

3.7. Stabilisation

Progressive stabilisation will be undertaken throughout the earthwork operations. Both temporary and permanent stabilisation measures will be employed on site. Common stabilisation measures include spreading of aggregate, grassing (with a full cover of grass), applying mulch and the use of geotextiles.

Once the catchment area for a particular ESC device is stabilised in accordance with TR2009/02, or the runoff directed to a different water management system (i.e. the Water Treatment Plant) then the ESC monitoring and maintenance will cease, and the ESC device could be decommissioned.

3.8. Dewatering and Pumping

Dewatering (pumping) will be required during the Project. A Dewatering Management Plan is proposed to be provided to the Waikato Regional Council for certification prior to the commencement of earthworks.

The Dewatering Management Plan will identify activities that will require dewatering/pumping as well as the procedures involved, monitoring and maintenance requirements and record keeping.

3.9. General

Prior to bulk earthworks commencing as-builts for the erosion and sediment controls will be provided to the Waikato Regional Council. The as-built certification will confirm that the controls have been constructed in accordance with the certified SSESCP.

This SSESCP is intended to be a live document and if the earthworks methodologies or erosion and sediment control measures for the anticipated work changes then an update / review of the SSESCP drawings will be made before the earthworks commence. Any changes to the SSESCP will be confirmed in writing and provided to the Council for certification, prior to the implementation of any changes proposed.

3.10. Monitoring and Maintenance

All erosion and sediment control measures will be maintained in accordance with TR2009/02 throughout the works until the site is stabilised against erosion.

All erosion and sediment control measures and methodologies will be monitored during the works in accordance with the Erosion and Sediment Control Monitoring Plan (ESCMP). Monitoring will be undertaken at least weekly, and before and immediately after rain events as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

Sediment deposits and bulges against the silt fences will be removed when sediment accumulation reaches 20% of the fabric height.

The SRPs will be cleaned out before accumulated sediment volume reaches 20% of the total volume. Forebays will be cleaned out if there is any evidence of sediment deposition.

Once an area is stabilised, or placement of PAF material is underway, the operational requirements commence and monitoring under the ESCMP will cease.

4. APPENDIX

4.1. Appendix A – Erosion and Sediment Control Drawings

Drawing number	Drawing title	Date	Revision	Sheet
ESCP-TSF3-001-01	Erosion and Sediment Control Plan – Tailings Storage Facility – Stage 1	19.02.25	A	1
ESCP-TSF3-001-02	Erosion and Sediment Control Plan – Tailings Storage Facility – Stage 1	19.02.25	A	2
ESCP-TSF3-001-03	Erosion and Sediment Control Plan – Tailings Storage Facility – Stage 1	19.02.25	A	3
ESCP-TSF3-001-04	Erosion and Sediment Control Plan – Tailings Storage Facility – Stage 1	19.02.25	A	4
ESCP-TSF3-002-01	Erosion and Sediment Control Plan – Tailings Storage Facility – Stage 2	19.02.25	A	5
ESCP-TSF3-002-02	Erosion and Sediment Control Plan – Tailings Storage Facility – Stage 2	19.02.25	A	6
ESCP-TSF3-002-03	Erosion and Sediment Control Plan – Tailings Storage Facility – Stage 2	19.02.25	A	7
ESCP-TSF3-002-04	Erosion and Sediment Control Plan – Tailings Storage Facility – Stage 2	19.02.25	A	8
ESCP-TSF3-003-01	Erosion and Sediment Control Plan – Tailings Storage Facility – Stage 3	19.02.25	A	9
ESCP-TSF3-004-01	Erosion and Sediment Control Plan – Tailings Storage Facility – Stage 4	19.02.25	A	11
ESCP-TSF3-004-02	Erosion and Sediment Control Plan – Tailings Storage Facility – Stage 4	19.02.25	A	12
ESCP-TSF3-005-01	Erosion and Sediment Control Plan – Tailings Storage Facility – Stage 5	19.02.25	A	13