CHAPTER 3 DESCRIPTION OF PROPOSED DEVELOPMENT

3.1 INTRODUCTION

Boliden Tara Mines DAC (BTM) Environmental Department have undertaken the Description of the Proposed Development Chapter of the Environmental Impact Assessment Report (EIAR) for the proposed buttressing works to be undertaken on sections of the dam walls of the Randalstown Tailings Storage Facility (TSF) associated with the Tara Mine. The application site is the TSF located in the townlands of Simonstown, Randalstown and Sillogue, Navan, Co. Meath. The works are proposed to be undertaken with a view to increasing the stability of the embankment dam structure in line with recent enhancements of industry standards.

3.1.1 Company Background

Boliden Tara Mines DAC (Tara Mines), the largest operating zinc mine in Europe, is located at Knockumber, 2 km west of Navan in County Meath and 50 km northwest of Dublin. The mine exploits a zinc-lead orebody that lies between 50 and 1000 metres below the surface and extends over an area of 6.5 kilometres by 1.5 kilometres, which was discovered in 1970 by the Tara Exploration and Development Company Limited (a Company formed in Canada in 1953 by four Irishmen). Development of the orebody commenced in 1973 and production of zinc and lead concentrate commenced in 1977. The original ore reserves (calculated in 1971) amounted to 69.9 million tonnes grading 10.09% Zn, 2.63% Pb. Mining continues today at a rate of between 2.1 and 2.6 million tonnes of ore each year, resulting in approximately 400,000 tonnes of zinc and lead concentrate.

BTM is now part of the Boliden Group, acquired in 2004, which is a leading supplier of critical metals for climate transition infrastructure projects. Zinc, in particular, is a key metal in enabling green technologies such as solar and wind power. The organisation implements a range of policies and commitments to ensure responsible production methods and is accredited to international environmental, health and safety and energy standards ISO14001, ISO50001 and ISO 45001.

3.1.2 Background to this EIAR

This EIAR is submitted to An Bord Pleanála as a result of a third-party planning appeal (Ref: ABP-315173-22) following a grant of planning permission by Meath County Council (Ref:22/331) in October 2022. The original planning application was not accompanied by an EIAR. Notwithstanding this, an Environmental Report was submitted in support of P. Ref: 22/331.

During consideration of the appeal, An Bord Pleanála has deemed that a mandatory Environmental Impact Assessment (EIA) process was required and submission of an EIAR describing the conclusions of it would be necessary for the purpose of enabling determination of the appeal. The objective of this EIAR is to report on the findings of the assessments undertaken during the EIA process and to ensure that An Bord Pleanála fully understands the significant effects (if any) the proposed development is likely to have on the environment before making its decision.

3.1.3 Description of BTM Activities

BTMs main activities include exploration, mining, processing, shipping of concentrates and the storage of related tailings waste. The Tara Mine facility consists of the underground mine, an aboveground ore processing facility on a footprint of approx. 72 hectares, and an aboveground tailing storage facility on a footprint of 250 hectares (Figure 3.1 refers)

Ore production encompasses the drilling, blasting and removal of the ore from underground deposits. Broken ore is delivered to one of five underground primary crushers and reduced in size to <150 millimetres before being hoisted to the surface. Ore is then fed to an Autogenous grinding mill, which grinds the ore to a fine powder that is then pumped as aqueous slurry to metallurgic flotation cells in the main Processing plant.

Within the flotation cells, galena (Lead sulphide) and sphalerite (Zinc sulphide) are differentially separated, while undesirable minerals such as pyrite are depressed. The final products, *concentrates*, are pumped to separate dewatering circuits using thickening and filtration in pressure filters. Lead concentrate contains approximately 67% lead metal and zinc concentrate contains approximately 56% zinc metal.

Once the target minerals have been extracted the waste stream, otherwise known as *tailings* is cycloned to separate the coarse sand fraction from the finer slimes fraction. The coarse fraction of tailings is stabilised, chemically and physically, by mixing with cement and is pumped underground to backfill mined out areas. The remaining fines fraction tailings is pumped as an aqueous slime to the Tailings Storage Facility (TSF) located 2.8 km north of the processing plant in the townland of Randalstown.

On an annual basis approximately 1.2 million tonnes of tailings are deposited for permanent storage in the TSF. The TSF encloses a footprint area of approximately 250 hectares and serves as containment for tailings to settle and consolidate, as well as a treatment storage area for the water, which is circulated back to the processing plant for re-use. Overview of Mining process is presented in Figure 3.2.

The approximate National Grid Reference of the Knockumber mine site is 284877E, 267985N and of the Randalstown Tailings Storage Facility (TSF) is 285160E, 271557N.

Figure 3.1 Location Map of Mine Site and Randalstown TSF

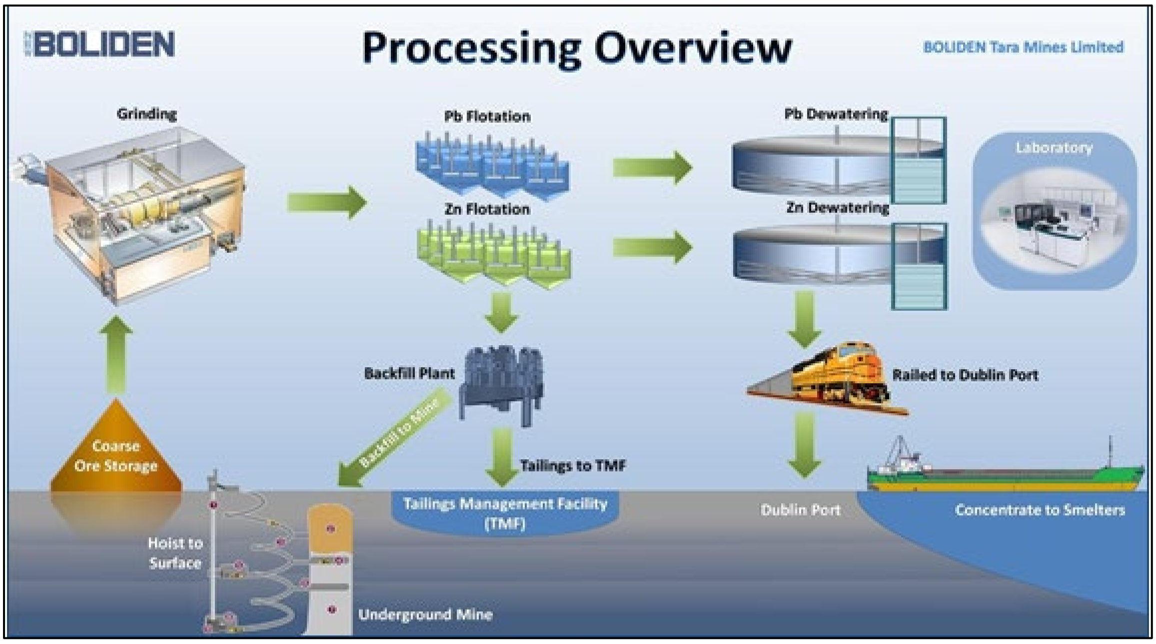


Figure 3.2 Mining and Processing Flow Diagram

3.1.4 Regulation of Activities at Tara

Regulation in the mining sector is administered by the Department of the Environment, Climate and Communications. Other bodies with responsibility include the Health Service Executive and the Health and Safety Authority.

Environmental management responsibility for improving and protecting the environment lies with the Environmental Protection Agency (EPA). All site activities are operated and controlled under Industrial Emissions License (IEL) P0516-04 issued by the EPA.

All existing activities at the Mine site, the TSF and its associated infrastructure are controlled by Meath County Council (MCC) through planning conditions associated with extant planning permissions. Monitoring data collected over the years as part of these requirements facilitates a valuable resource and network of baseline data on the environmental conditions in the vicinity of the facility and a sound basis to predict the likelihood of significant impacts from the proposed development.

3.1.5 Overview of TSF

3.1.5.1 Location

Randalstown Tailings Storage Facility (TSF) enclosed an area of approximately 250 Hectares in size and is located c. 2 km northwest of Navan, 2.8 km north of the mine site and c. 2 km southwest of the small village of Kilberry. The Site is industrial in character, with the surrounding area characterised primarily of agricultural land use, with the majority as pasture, farm dwellings and residential dwellings.

The topography of the Site lies at approximately 60m above Ordnance Datum (AOD) with the lowest areas being along the watercourses which border the TSF, and towards the Blackwater River to the south and southwest. Refer to Location data in Table 3.1.

Table 3.1 TSF Location Data

Description		Value	Source / Comment
Site information	Site Location	Randalstown, Navan, Ireland	BTMD
	Coordinate System	GPS DD Coordinates	1526.886m above 0 mOD
	Coordinates	53.68723N -6.71127W	
	Elevation System: mAMD metres above mine datum	1594 mAMD = 67.114 mOD (metres above Ordnance Datum)	
	Site Elevation	Approximately 1568 mAMD to 1578 mAMD (41 mOD to +51 mOD)	

The TSF is bounded by the Yellow River to the west, the Blakes stream to the northeast and the Simonstown Stream to the east and southeast. The new Boyne Valley to Lakelands (BVL) Greenway is located on the old railway line running approximately 100 m to the east of the TSF. It is part of a 30km walking and cycling amenity from Navan to Kingscourt, Co Cavan.

The primary access to the TSF site is via an access road that connects with the Donaghpatrick Local Road, L74141, via the R163 Kilberry Road (Kells to Slane Road). There is a good strategic road network in the immediate area, with the R163, R147 and R162 all surrounding the site, providing onward connection with a number of national routes, including the N51 and N52, and on to the M1 and M3 motorways.

3.1.5.2 Overview of TSF

The Randalstown Tailings Storage facility (TSF) exists as a ring-dike configuration specifically built to accommodate the permanent storage of waste material (fines fraction of tailings). Tailings resulting from the comminution and metal recovery process at the Mine Site are pumped via a HDPE pipeline as an aqueous slurry to the TSF.

The TSF is designed to operate as a large sedimentation/ aeration pond where solids settle and clear water at the surface is drawn off for recirculation (referred to as ‘reclaim water’) to the Reclaim Water Pond at the mine site The limestone in the tailings maintains the water at an alkaline pH, which allows the precipitation of all but traces of the metals remaining in solution following processing. The large surface area of the tailings facility provides adequate aeration for aerobic degradation of the organic reagents, so as to assure a low B.O.D. concentration in the water.

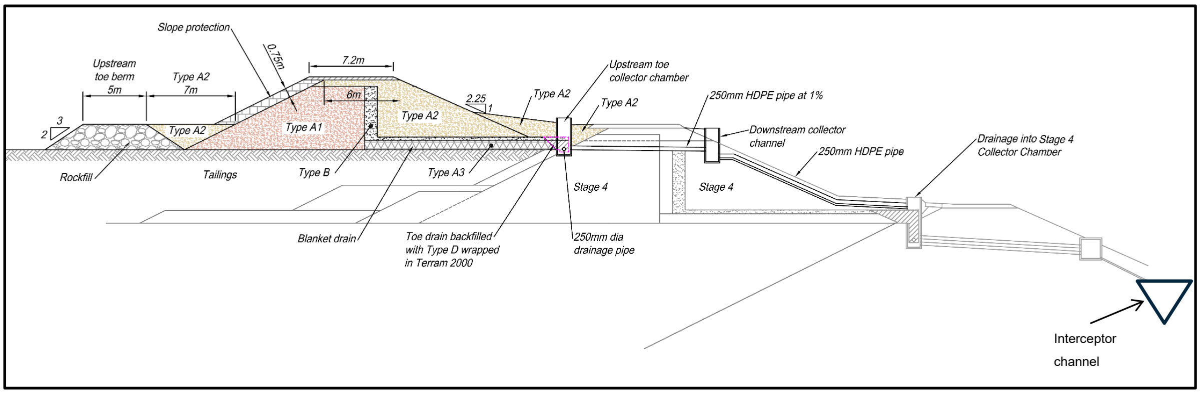
The tailings storage area is also used for temporary water storage and designed such that there is always an excess storage volume over and above that required for the storage of tailings, which can be used for the retention of water during low flow periods in the River Boyne. The excess water accumulates in the tailings pond during summer months when the flows in the River Boyne are low and discharge into the River Boyne is restricted (minimum dilution ratio of 100:1). When the river flow is high water is pump returned to the mine site for reuse in the processing plant and / or is discharged under strict conditions of the company’s Industrial Emissions License (IEL) P0516-04.

Stages 1 to 5 are enclosed by earth fill embankment walls constructed from locally sourced Quaternary glacial till which underlies the site to reduce the potential amount of seepage from the overburden material (tailings) into groundwater and adjacent surface watercourses, while Stage 6, a lateral extension north of stages 1 to 5, is a composite lined. Stages 1 to 5 embankment walls are constructed using glacial clay/ silt till with a granular internal drainage system consisting of a chimney and blanket drain. The embankment dam wall is constructed in zones where:

- the upstream section comprises low permeability glacial till (Type A1).
- the downstream section comprises a less clayey material (Type A2).

The perimeter interceptor channel (PIC) located at the toe of the embankment/ dam walls, is an integral component of the internal drainage system. A granular chimney drain lies between the upstream and downstream sections. The chimney drain reports to a rock fill drainage blanket. The drainage blanket drains the water to a collection chamber and then down gradient to the lower dam walls and eventually reports to the interceptor channel (Plate 3-1 refers).

Plate 3-1: Embankment wall



3.1.5.3 TSF Construction History

The TSF encloses an area of approximately 250 Hectares and has been enlarged in six extensions over its 46-year existence using combinations of permanent and temporary embankment dams. The main TMF construction stages are presented in Table 3.2:

- Stages 1 to 3 constructed between 1974 to 1987, which comprised an earth fill embankment constructed to a crest elevation of 57.3 mOD (metres above ordinance datum).
- Stage 4 was constructed in 2 stages (4A and 4B) between 1998 to 2006 and is an upstream raise embankment constructed on the tailings of Stages 1 to 3. The Stage 4 'upstream raise' is a 7.5 m high embankment above the tailings level, with a crest elevation of 163.3 mAOD.
- Stage 5, a similarly constructed upstream raise on the Stage 4 tailings, is a 5.5 m high embankment with a crest elevation of 67.3 mAMD. The height of the TMF at Stage 5 varies between approximately 18 m and 27 m above original ground elevation.

- Stage 6 is a composite lined, lateral extension to the north of the existing dams which was constructed in two phases. Phase 1 was completed and commissioned in 2019 and Phase 2 in 2022.

Table 3.2: Summary of Randalstown TSF Dam Construction and Operation

Stage	Construction Elevation (mAMD)	Construction Period	Status
1 (3 Phases)	1584	1975 to 1978	Filled and re-vegetated in 1988
2 (2 Phases)	1584	1980 to 1983	Filled and re-vegetated in 1988
4A	1590	1998 to 2000	Raised facility over Stage 1 and 2. Filled in 2006
5A	1594	2011 to 2013	Raised Facility over Stage 4A. Filled in 2017
3	1584	1985 to 1987	Filled in 2003
4B	1590	2003 to 2006	Raised facility over Stage 3. Filled in 2010
5B	1594	2014 to 2016	Raised Facility over Stage 4B. Filled in 2020
6 - Phase1	1586	2017 to 2019	Starter dam commission. Ongoing Filling
6 - Phase 2	1594	2019 to 2022	Raised downstream construction to Phase 2

3.2 SITE CONTEXT

This section provides the geological, seismic, climatic and hydrogeological context of the site.

3.2.1 Geology

The orebody, which comprises mostly sphalerite (ZnS) and galena (PbS), occurs within Lower Carboniferous limestone. Within the orebody, the sphalerite and galena are associated with subsidiary amounts of pyrite, marcasite, barytes, dolomite, calcite, and sulphonates.

From the Geological Survey of Ireland (GSI) website, the facility and borrow areas consist of the Lower Palaeozoic rocks termed the Rathkenny Formation. These are divided into four main rock types, consisting of Lower Palaeozoics, Red Beds, Mixed Beds and Pale Beds. The Randalstown Fault cuts from northeast to southwest across the site, as shown in Figure 3.3.

The major Randalstown Fault, running diagonally across the main tailings site area, trends in a northeast to southwest direction and brings the Pale Beds directly into contact with the Lower Palaeozoic rocks. This is a reverse fault which dips to the northwest at a steep 75° angle in the TMF area. Several minor faults are reported to exist beneath the tailings dam.

Palaeokarsts (inactive karstic features) are present in the Randalstown area. Site investigations carried in the area indicated that the karsts at the tailings area comprises an "immature" palaeokarst system, whereby the individual cavities are small and are unlikely to be interconnected.

The whole region was glaciated by ice sheets, in excess of 800 m thick, which covered Ireland during the Munsterian and Midlandian stages, approximately 15,000 years ago. These left behind Quaternary overburden deposits in the area of the tailings impoundment consisting of three main soil types. The basal unit is a Quaternary glacial till consisting of consolidated lower grey silty clay to clayey silt with sand, gravel and some cobbles and boulders. This is directly overlain by the upper brown weathered glacial till also consisting of silty clay to clayey silt with sand, gravel with some cobbles and boulders. This is essentially a weathering of the underlying grey material and as such tends to have a higher clay content. Overlying some areas of the glacial till are lenses of possibly fluvial, glacial lacustrine, alluvial or out-wash granular materials comprising silt, sand and gravels.

The general thickness of overburden deposits recorded at Randalstown varies from about 1 m to 8 m and follows the somewhat random profile of the bedrock surface. Groundwater hydrology and chemistry at Randalstown are expected to be influenced by the distribution and thickness of these materials, which vary in permeability.

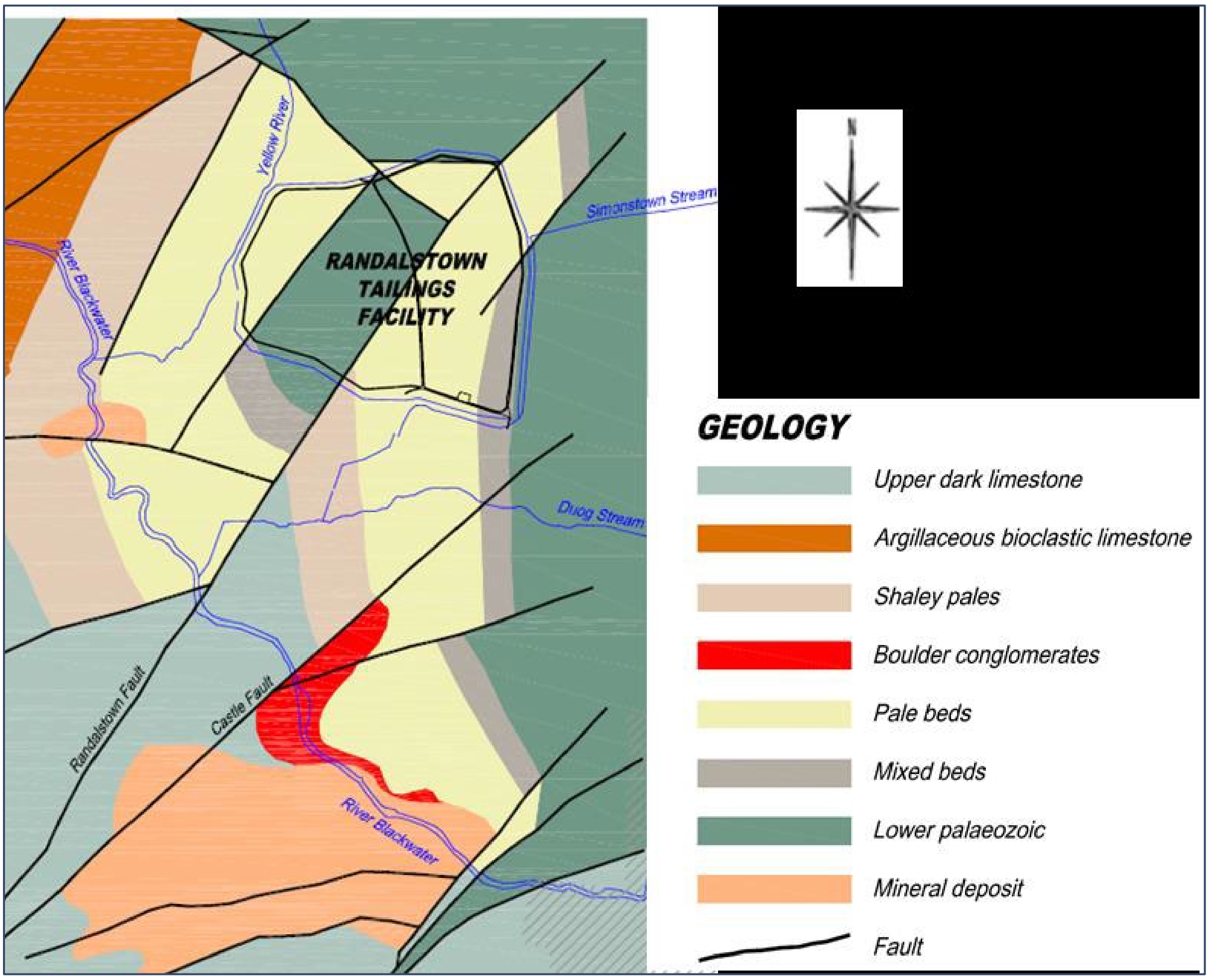


Figure 3.3 Regional Bedrock Surface Geology

3.2.2 Seismicity

Ireland lies at the north-west margin of Europe, adjacent to the continental shelf and is characterised by very low levels of seismic activity. This lack of seismic activity in Ireland has been demonstrated by the low number of historical observations, regional seismic assessments, and modern instrumental readings.

An initial seismic study was undertaken in April 1996 by the Global Seismology Group (GSG) of the British Geological Survey, Edinburgh. The seismic search radius was 100 km from Navan and only events greater than an earthquake magnitude of 3 were investigated. Based on the assessment, a design peak ground acceleration PGA = 0.06g was taken for the maximum credible earthquake (MCE) for the site.

3.2.3 Climate

The Randalstown TMF is situated within a temperate climatic zone of approximately 890.0 mm mean annual rainfall and 516 mm mean annual potential evapotranspiration. A summary of the main climate data for the Randalstown TSF site is presented in Table 2.3.

Table 3.3 Summary of Climate Data

Description	
Average Annual precipitation	890 mm
Average Annual Evaporation	516 mm
Mean Annual Relative Humidity	69 – 90%
Minimum Annual Daily Temperature	6.4 ºC
Maximum Annual Daily Temperature	13.6 ºC
Maximum Annual Temperature	19.0 ºC
Minimum Annual Temperature	-4.7 ºC
Mean Monthly Wind Speed	10.3 m/s

3.2.4 Hydrology

The Randalstown tailings facility is located in a topographically flat area at approximately 60 m above sea level. There are three main drainage regimes in the vicinity, the Yellow River, the Simonstown Stream and the Blackwater River, and two smaller streams, the Duog to the southeast and Blake’s stream to the north. These surface watercourses are tributaries of the Boyne which is located within the Eastern Basin District.

The Yellow River, to the west of the tailings facility, is close to the site and flows south joining the Blackwater River about 0.75 km southwest of the site. The original course of the Yellow River was realigned to facilitate the footprint of Stage 3 of the TSF. Blake's Stream, to the north of the facility, flows in a southerly direction adjacent to the east wall of the TSF feeding into the Simonstown Stream. The Simonstown stream originally crossed the tailings site as shown was diverted during the construction of the Stage 1 of the TMF into a channel on the eastern side of Stages 1 and 2. The stream flows into the Duog River which in turn flows into the Blackwater River (Figure 3.4 refers).

The Blackwater River flows southeast and into the River Boyne approximately 4 km downstream of the Randalstown TSF. The Blackwater River at Liscartan, downstream of inflow from the Yellow River and Randalstown Stream, drains a total catchment area of approx. 717 km^2 and follows a meandering south easterly course towards the confluence with the River Boyne east of Navan. The Blackwater River is used for potable water supply to the nearby town of Navan at a licensed abstraction rate of 10,560 m3/day, representing the largest surface water abstraction in County Meath. The abstraction point is approximately 2 km upstream of the mine site. The Blackwater River is a tributary of the River Boyne and is situated approximately 300 m to the north of the main mine site and flows in an easterly direction towards the town of Navan where it joins the River Boyne.

The River Boyne and the River Blackwater are designated as a Special Area of Conservation (SAC) designated for the following qualifying interests: alkaline fens, alluvial forests, river Lamprey, salmon, and otter.

The River Boyne and the River Blackwater are also designated as a Special Protection Area (SPA). These rivers are designated to provide protection for kingfisher (*alcedo atthis*) habitats.

The perimeter interceptor channel (PIC), close to the base of the existing Stages 1 to 5 embankment walls captures runoff, underdrainage from the dam and groundwater. Tailings water collected in the interceptor channel is then pumped back up to the tailings pond from one sump pump with automated level controls, located at the south of the interceptor channel/ dam. By returning tailings water back to the tailings pond, a closed water cycle system operates which helps to protect the local water environment. No surface drainage or runoff makes it way off site to the external surface water network.

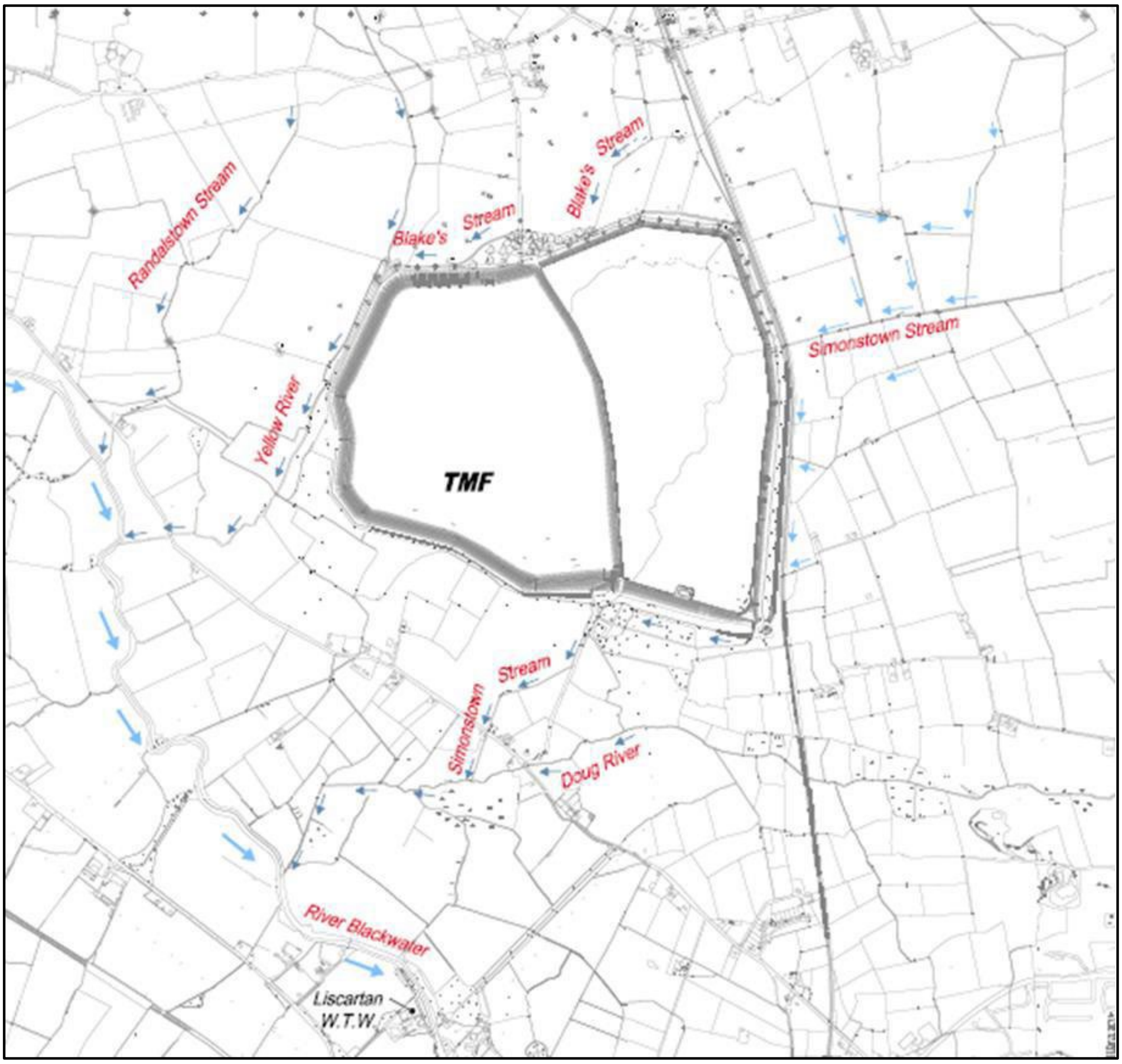


Figure 3.4 River and Stream Flow in the environs of TSF

3.2.5 Hydrogeology

Two hydrogeological units exist at the TSF site:

- Quaternary sands, gravels and clays with an average thickness of 8 m beneath the tailings pond; and
- Lower Palaeozoic greywacke and Lower Carboniferous limestone bedrock.

The units are expected to be in hydraulic connection naturally. Hydraulic conductivity for Quaternary sands and gravels is likely to be of the order of 1E-3 m/s to 1E-5 m/s. The glacial tills have a lower hydraulic conductivity and between 1E-5 m/s and 1E-6 m/s. The hydraulic conductivity range for the bedrock hydrogeological unit is likely to be 1E-4 m/s and 1E-5 m/s although results obtained from the two deep borehole investigations, indicated lower permeabilities at around 1E-6 m/s. The permeability of the rock will be dependent on frequency of fissuring and fissure infilling.

Groundwater flow in the Quaternary hydrogeological unit is expected to be restricted by the laterally discontinuous nature of the high hydraulic conductivity lenses. Groundwater flow in the bedrock is expected to be locally very fast through faults, fissures and solution features in the limestone.

Local groundwater flow is to the southwest towards the Yellow River. Both hydrogeological units are expected to be in hydraulic connection with the Yellow River.

Groundwater is generally encountered between 1 m to 3 m below ground level although the water levels rise during winter and fall in summer. Groundwater was encountered in all the borrow areas and drainage measures were installed to drain the sites. During the summer season, the groundwater drops and rises in wintertime.

3.2.6 Environmental Monitoring

Water Quality is monitored at Tara Mine in several key locations, from the water leaving the mine processing plant, tailings pond water, the perimeter interceptor channel and the wider environment including groundwater monitoring wells and surface streams and rivers.

A comprehensive monitoring network is in place in the of the vicinity of the tailings facility. The existing groundwater monitoring network involves monthly sampling at 37 locations in superficial deposits/overburden (OB) and bedrock (BR) boreholes and quarterly sampling from 13 domestic wells. River and stream samples are taken monthly from 17 locations on the River Boyne, River Blackwater and its tributaries representing locations both upstream and downstream of the TSF, the mine site and the discharge point SW1 to the River Boyne and SW2 to the River Blackwater.

The EPA also monitors surface water quality at two river monitoring stations on the Yellow River, and two river monitoring stations on the Blackwater River.

An annual review and assessment of all hydrogeological, hydrological and water quality data collected at the TSF is undertaken and reported upon by AECOM. All data is reviewed for compliance with the EC Environmental Objectives (Surface Water) Regulations 2009 as amended and EC Environmental Objectives (Groundwater) Regulations 2010 as amended and compared with historic data to identify changes and trends in hydrogeological and water quality conditions. The Environmental Quality Standards (EQS) are used as a guide for comparison with measured concentrations in surface waters.

3.3. PROPOSED DEVELOPMENT

Boliden Tara Mines DAC (BTM) is proposing engineering works at the Randalstown Tailings Storage Facility (TSF): The construction of a rockfill reinforcement buttress to sections the extant embankment walls of the TSF with a view to strengthen the overall stability of the dam structure.

3.3.1 Background to Proposed Development

Boliden Tara Mines (BTM) has recently become a member of the International Council for Mining and Metals (ICMM) and is in the process of adopting the Global Industry Standard on Tailings Management (GISTM)[1] issued in 2020. A key objective of GISTM is to address the risk of tailings embankment failure through conservative design criteria, independent of trigger mechanisms, in order to minimise potential impacts. Previous industry best practice was to manage the facility to reduce and eliminate trigger mechanisms which could lead to brittle failure of the tailings using effective strength parameters. The TSF is not currently at risk for instability based on the operational practices in place and is designed and assessed to meet a target design criterion, for long-term static slope stability, with a Factor of safety (FoS) of >/= 1.5 using effective strength parameters. Since 2020, GISTM require that this risk is instead managed through the design.

3.3.1.1 Justification for Proposed Development

To ensure successful adoption of GISTM, BTM undertook various additional studies and investigation in 2019 and 2020 (see Technical Memo in Appendix 1.A) which resulted in a recommendation to construct a reinforcement buttress to ensure the long-term stability in line with higher standards of industry practice. This practice is to evaluate stability using peak undrained shear strengths and with further analysis using residual undrained shear strengths.

The proposed construction of a buttress around the perimeter of Stages 1 to 5 of the TSF as described hereafter in this Chapter has been endorsed by the Independent Tailings Review Board (ITRB). The original facility design and stability analyses were undertaken using

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[1] The Global Tailings Review convened by the United Nations Environment Programme (UNEP), the Principles for Responsible Investment (PRI) and the International Council on Mining and Metals (ICMM) launched the **Global Industry Standard on Tailings Management**.

effective strength parameters and monitored piezometric levels in the stack wall which is the traditional procedure. The facility was originally designed and assessed to meet a target design criterion for long-term static slope stability of FoS >/= 1.5.

However, current industry best practice is to evaluate the stability using peak undrained shear strengths and with further analysis using residual undrained shear strengths. Tailings undrained strength parameters simulates excess pore pressure within the tailings and is therefore, a more conservative analysis.

To comply with the criteria set out in GISTM and BTM membership of ICMM requirements, BTM needs to ensure the facility meets this higher threshold through an industry tried and approved mechanism i.e. construct supporting buttress to increase the factor of safety to:

- >/=1.5 for the peak strength undrained scenario and to
- >/=1.1 for the residual strength undrained scenario which is now required

In engineering terms, a factor of safety (FoS) indicates how much stronger a structure actually is compared to what it needs to be for an intended load, i.e. the higher the Factor of Safety, the greater the stability of the structure.

3.3.1.2 Examination of Alternatives

The requirement to improve the stability of the upstream raises of the TSF was identified based on the tailings being characterised as loose and contractive. Contractive tailings have the potential for brittle failure and potentially liquify either during dynamic or static liquification when subjected to a trigger event.

- Dynamic liquefaction occurs as a result of seismic activity, the risk of which is very low in Ireland.
- Static liquefaction occurs when the dam wall has already failed for other reasons and the tailings statically liquefy under the large strains as a result of loss of confinement.

Although the potential for this triggering to occur is considered unlikely, GISTM requires that this be addressed.

The three primary options available prevent brittle failure are the following:

- Densification of the tailings to prevent the potential for liquefaction to occur
- Desaturation of the tailings to similarly prevent liquefaction.
- Buttressing the embankment that prevents failure even if the tailings liquify

Both Densification and Desaturation of the tailings are invasive techniques and would pose an unacceptable risk to the existing raise foundation infrastructure of the facility. The construction of a buttress on sections of the extant embankment walls was, therefore, considered to be the best alternative to ensure long term stability with no risk to the facility and the option endorsed by the ITRB. Refer to Figure 3.5 for Tailings Facility and Proposed Buttress Layout Plan.

Figure 3.5 Tailings Facility and Proposed Buttress Layout Plan

3.3.1.3 Do Nothing Scenario

The 'do nothing' scenario would represent a situation where none of the potential environmental effects outlined in this EIAR would occur, but an opportunity to provide the highest level of stability of the TSF, taking into account climate change scenarios, would be lost. Whilst failure of the extant TSF embankment is considered unlikely in the 'do nothing' scenario, it is considered preferable to ensure the environmental risks of failure of the TSF are kept to the absolute minimum possible.

3.3.2 Proposed Construction Works

The proposed buttress is to be constructed on the downstream slope and at the crest of the Stage 1, 2 and 3 stater embankments. It will provide additional support to the Stage 4 dam embankment wall in order to increase the overall stability of the upstream raises i.e. Stages 4 and 5. The construction of the buttress will involve the placement of rock material on the crest of Stages 1, 2 and 3 supported by a widening of the side slope of Stage 1,2 and 3 using glacial till. The proposed buttress will be approximately 4 to 10m wide at the base of the starter embankment slope and 12 to 20m wide at the toe of the Stage 4 embankment. Refer to Figurers 3.6 and 3.7.

Figure 3.6 Exiting Embankment Walls

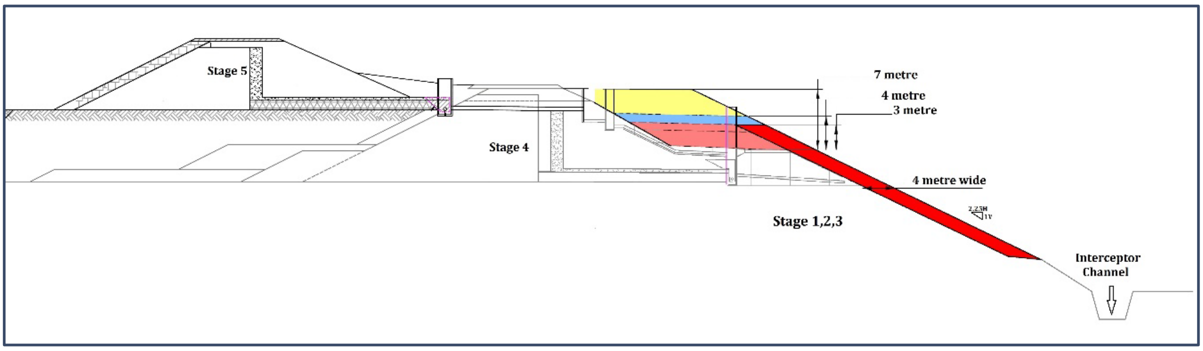


Figure 3.7 Cross section of facility embankment with proposed buttress

3.3.2.1 Construction period

Three possible options of varying duration, for the construction programme have been proposed. The predicted impacts of all three options on the surrounding road network was assessed in the Traffic and Transport Assessment in Chapter 5 of this EIAR in which;

- Option A proposes the shortest construction period of 1.5 years (823,296 tonnes per annum)
- Option B proposes a construction period of 2 years (617,472 tonnes per annum) and
- Option C proposes the longest construction period of 3 years (411,648 tonnes per annum).

3.3.2.2 Plant Requirement for proposed works

The plant required to carry out the proposed Works is detailed in table 3.4.

Table 3.4: Plant required for the proposed construction works.

No. Plant	Plant Type	Purpose during Construction
1	Excavator: Komatsu PW160-7	Tasked to instrument relocation and upgrades
1	Hydraulic Excavator: Komatsu HB215LC-1 - Hybrid	Working on drainage systems
2	Hydraulic Excavator: Komatsu PC 210/LC/NLC - 8	Strip vegetation from embankment walls and loading into dumper
1	Hydraulic Excavator: Komatsu PC 360/LC/NLC - 10	Loading stone fill material from where stockpiled
1	Crawler Dozer D65EX/WX/PX-17	Placing glacial fill material
2	Self-propelled Vibratory Roller: JCB Vibromax VM146D/VM146PD	Compacting glacial till material
4	Dumper: Volvo A25D 5 x 4	Drawing material to point of use (if it is not placed at source upon delivery to site)

3.3.2.3 Construction Working Hours

The normal working hours during the construction period of the proposed works will be as stated by the Engineering and Construction (E&C) Contractor at the Pre-Construction meeting. The maximum site working hours including summer months that will be permitted, irrespective of day light conditions, is:

- Monday to Friday 07.00 to 20.00
- Saturday 07.00 to 14.00

To avoid impacting on local roads during school drop off and pick up periods, deliveries times to the site will be reduced during the following hours: between 09.30 and 14.00 and from 15.30 to 18.00.

No work on Sundays or Bank Holidays will be permitted unless previously agreed. No work will be undertaken before dawn and after dusk. Work will only be undertaken during daylight hours. Consideration may be given to some activities within acceptable noise and vibration levels, to be carried out outside the working hours specified above following approval by BTM.

3.3.2.4 Site Access and Security

Access to the site is via the main entrance on the L74141 and through the weighbridge via BTM operated Security. Contractors and Sub- Contractor(s) staff shall access and enter and exit the site only via the main site access gates. A sign in / out access procedure will be in operation at security. The TSF is surrounded by a permanent perimeter fence.

Appropriate measures and working practices shall be adopted by the E&C Contractor to ensure the security and safety both of the general public and operatives at the TSF. Contractors and Sub-Contractor(s) are responsible for the security of their own plant and equipment. This includes responsibility for the following:

- The security of own plant and materials;
- The security of existing and new permanent works ; and
- The prevention of any unauthorised entry

3.3.3 Sequence of Works

Execution of the proposed works will comprise a series of scheduled steps, including material importation, site preparation, material placement in compacted layers, drainage management, and mitigation measures.

The proposed development is to add additional material to approximately 3858.8 linear metres of the existing embankment walls around the southern, south-western, south-eastern and eastern perimeter of the Randalstown TSF site (Figure 3.4 refers).

The construction of the buttress will follow the sequence of works detailed below:

1. Preparatory Works including cleaning the crest of the Starter Dams, removal of any topsoil, shrubs / scrub from the side-slopes over the footprint of the proposed buttress and to facilitate plant access;
2. Installation of the Phase 1 Buttress (toe of stage 4); and
3. Installation of the Phase 2 Buttress (at ground level starter embankments)

The construction works will be sequenced in two phases which may run concurrently They will commence at the eastern extremity of the site and proceed westward:

- Phase 1 will proceed on a horizontal basis along Stage 4 of the tailings dam. Works will begin at the level of the toe of the Stage 4 upstream raise against the embankment wall and will vary between 3, 4 and 7 metres in height (Figure 2). The material will be placed in layers along 500m sections, with each 500 m section taking approximately one month to complete. It is envisaged that the Phase I works will take approximately 30 weeks; and
- Phase 2 will proceed on a horizontal basis at ground level against the embankment wall of stages 1,2 and 3 (starter dams). The material will be placed in layers along 500m sections, with each 500 m section taking approximately one month to complete. It is envisaged that the Phase 2 works will take approximately 80 weeks.

3.3.4 Preparatory Works

3.3.4.1 Importation of material

The Construction Phase of the proposed works will involve the sourcing, placement, compaction and performance monitoring of suitable fills with the design quantities totalling 265,700 m^3 of 'Rock Fill' and 295,650 m^3 of 'Greenfield Soil' to form the buttress.

Source of Construction Material

The 'Rock Fill' component will be sourced from Mine Rock produced from development mining operations at the main mine site. BTM will seek approval from the EPA to use mine rock as a construction material in the proposed construction works under existing IEL conditions. Approval for the use of mine rock as a construction material was approved by the EPA for Stage 6 lateral extension of the TSF with specific conditions to include testing of its suitability at a frequency of 1 sample per 10,000 tonnes. If there is a shortfall of suitable materials, or if operationally required, suitable products will be imported from nearby quarries.

Suitable 'Soil' fill will be sourced from independent suitable third-party greenfield development sites. These soils will be provided under Article 27 of the European Communities (Waste Directive) Regulations 2011 and will require a review of the waste material to determine if it is fit to be classed as a by-product. These applications to the EPA (visible on EPA By-Product Register) will be conducted by the Engineering and Construction (E&C) contractor. In addition, BTM have robust procedures in places for the acceptance of greenfield soil at the facility that fulfil the requirements of Conditions 8.13.23 to 8.13.28 and Schedule A of Industrial Emissions (IE) licence Reg. No. P0516-04.

No waste from the processing of the ore will be used in the construction of the Proposed Development.

3.3.4.2 Site Clearance

Site clearance works will involve:

- removal /grubbing of vegetation/organic material for entire footprint of the Buttress Construction Works. The organic material shall be stockpiled at a designated location and reinstated upon completion of construction works;

- removal / grubbing of organic material from the footprint of finger drains and the PIC areas designated for infilling, grading and/or profiling. The organic material shall be stockpiled at a designated location and reinstate upon completion of construction works;
- Removal of rock armour / boulders at the outlet of the finger drains and exposure of existing drain material. Large boulders may be temporarily stockpiled for use elsewhere in the works. and may be either broken up and reused as Type F material or used as barrier protection for access roads;
- .Removal and stockpiling of granular material in the footprint of the existing ramps that will be encapsulated within the new buttress if required. Existing horizontal road surfaces will be overlaying with new buttress fill and removal is not required. Vertical or inclined road surfaces will be removed for re-use in the works;
- Removal of all obstacles in the footprint of the works will be carried out including existing HDPE pipelines, old powerline poles, large boulders or other items deemed as unsuitable;
- Extension or otherwise accommodation of a number of geotechnical instruments which will be impacted by the works. These include Casagrande standpipes, environmental monitoring wells, vibrating wire piezometers and flow measurement weirs;
- Existing drainage works will be either demolished, removed, or filled with drainage material as needed. Demolition material will be sorted for reuse or disposed of via proper waste management channels; and
- Concrete channels (9 in total) located within the footprint of the Buttress Works will require to be demolished and removed. These concrete channels are located on the downstream side slope of the existing dam walls and convey seepage to the PIC, which exist from a manhole ring. The entry point from these channels to the PIC also contain a concrete causeway (for erosion protection) that also require to be demolished and removed. These concrete channels consist of in-situ concrete and precast structures.

The waste Hierarchy will be followed. A site-specific Waste Management Plan for approval to BTM and prior to the demolition works been undertaken and included in the CEMP. Separate skips will be provided for sorting and recycling of materials and disposal via appropriate and authorised waste handlers.

3.3.4.3 Phase 1 Construction

The proposed Phase 1 buttress overlies the crest of the Starter Dams, (Stages 1, 2 and 3). The crest of this road includes a layer of rockfill material as capping and surface dressing. It is proposed that this material be salvaged where possible and where the quality of the material permits. This shall be done by either stockpiling the material temporarily for re-use or preferably, through the re-use of the material as a capping layer on a section where the buttress works have already been completed. Removal of topsoil from the footprint of the area adjacent to the crest road, i.e. the area above the Stage 4 toe drain and the Stage 4 slope shall be completed prior to commencement of the buttressing works.

3.3.4.4 Phase 2 Construction

For the Phase 2 buttress, it will be necessary to remove the topsoil from the entirety of the starter dam perimeter slope as well as the footprint of the buttress at the toe of Stage 4. Topsoil shall be either stockpiled temporarily for re-use or preferably, through the direct re-use of the topsoil on sections where the buttressing works have already been completed.

Following excavation to the Formation Level, the footprint will require trimming, grading and compaction prior to the placement of the compacted fill. The final excavated surfaces shall be trimmed and rolled to provide a clean, even and firm foundation to permit the movement of construction vehicles without causing rutting or other deleterious effects. Benching will be employed where buttress materials are being placed onto slopes to ensure that a sufficient key-in is achieved between the buttress and the dam walls.

A specified number of passes of a suitable vibratory roller will be required for the underlying soils. Soft spots and areas of unsuitable materials identified shall be excavated and replaced with suitable material placed and compacted and / or shall be improved in-situ via compaction or the installation of appropriate geosynthetics as approved by the E&C contractor.

Typical sections of the proposed Buttress Raises can be seen in Plate 4.2 to 4.5 with the Proposed Buttress Construction Cross Section Plan in Figure 3.8.

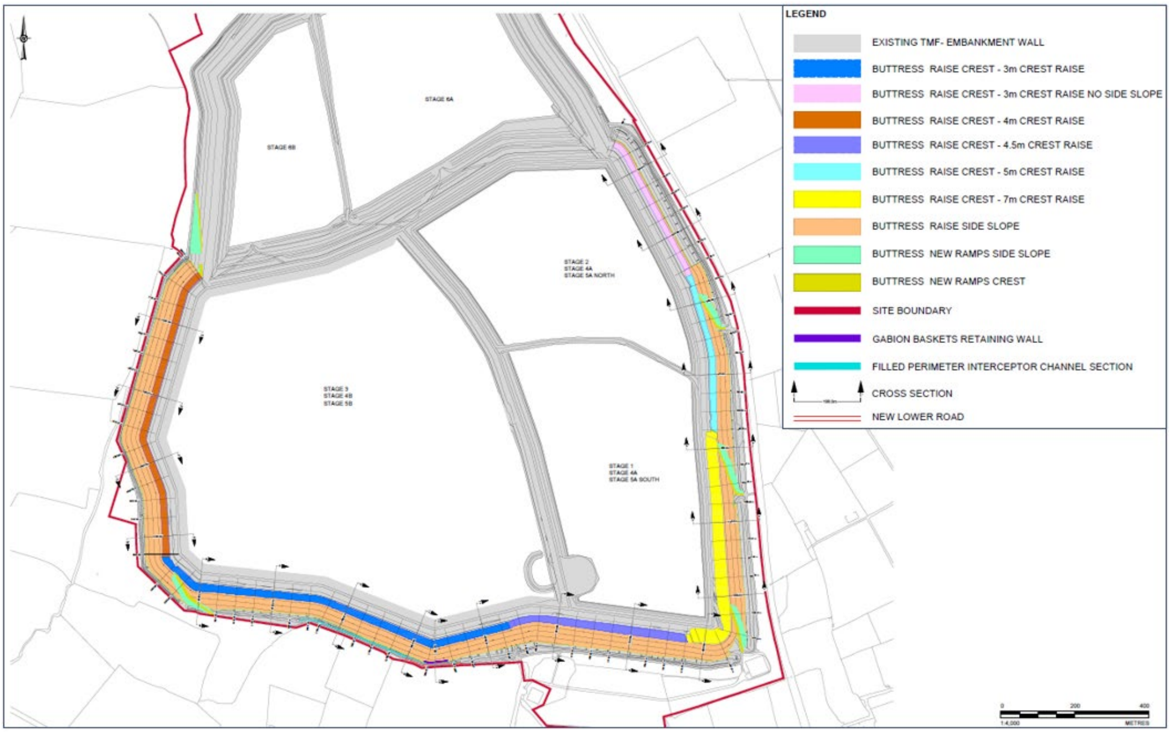


Figure 3.8: Proposed Buttress Construction Cross Section Plan

3.3.4.5 Completion of Works

On completion of phase 1 and 2 construction works, crest access roads will be reinstalled, consisting of reused material from the site road clearance works and topped off with imported road granular material.

All monitoring instruments required to facilitate the ongoing monitoring of the facility will be installed and/or upgraded and left accessible for continued monitoring.

The completed buttress embankment walls will be seeded and vegetated.

Plate 3.2: Typical section showing 3M Buttress Raise, Chainage 0 -400m.

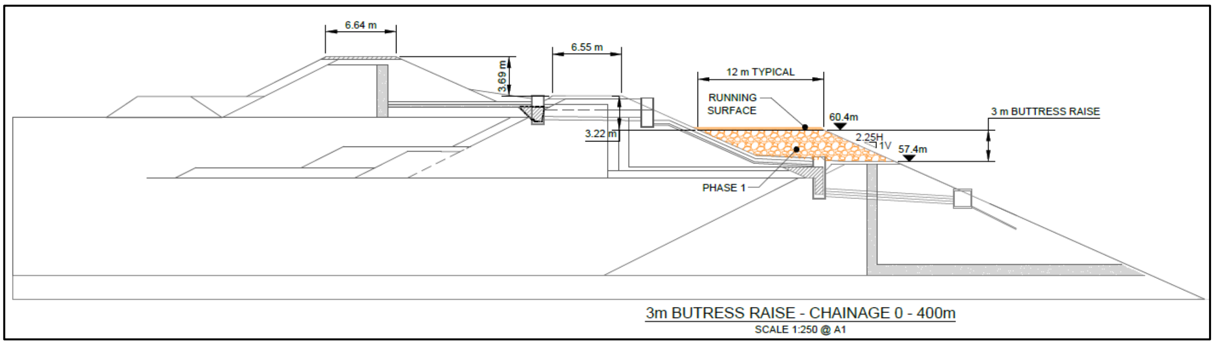


Plate 3.3: Typical section showing 4M Buttress Raise, Chainage 400-800m and 1550-2025m.

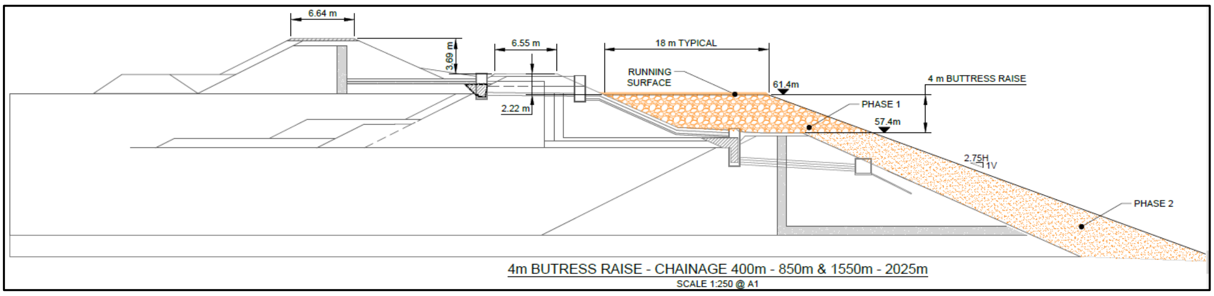


Plate 3.4: Typical section showing 4M Buttress Raise, Chainage 850m – 1550m.

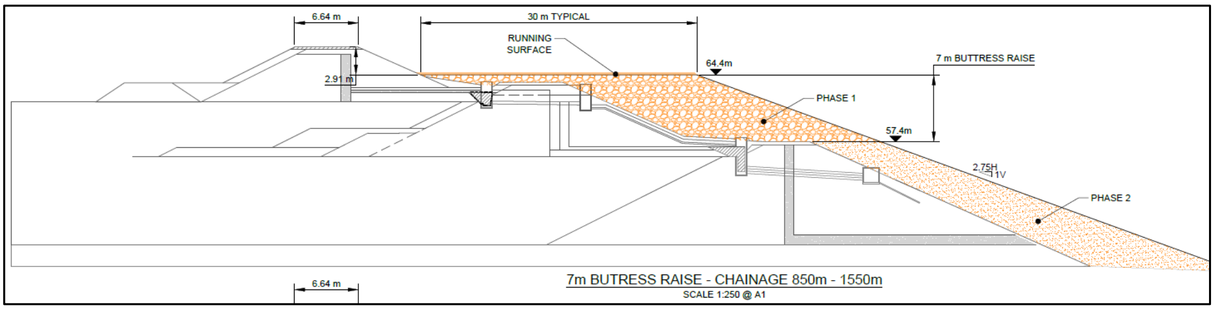
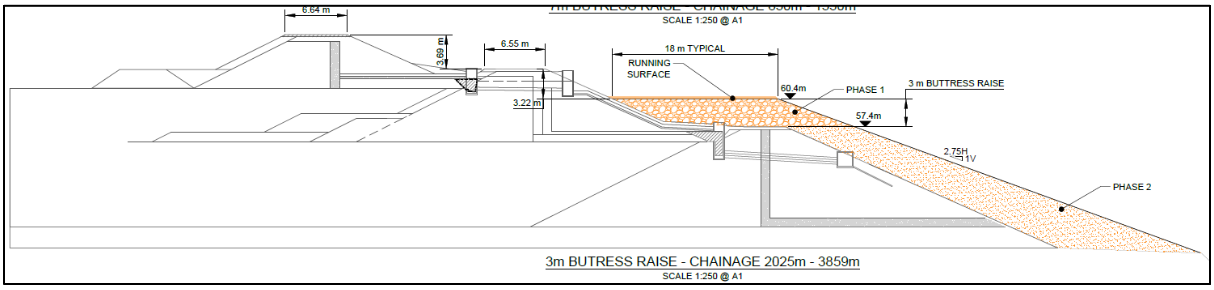


Plate 3.5: Typical section showing 4M Buttress Raise, Chainage 2025m – 3859m.



3.3.5 Drainage Management

As part of the Phase 1 buttress construction works, the material which overlies the Stage 1,2 and 3 chimney drains shall be removed intermittently. This will allow sub-surface water drainage in the section to drain into the Stage 1,2 and 3 chimney drain. This water will then report into the PIC and from there will be pump returned back to the TSF. Measures to include the management of fine sediments in surface water runoff as a result of construction activities will be included in the Construction Environmental Management Plan (CEMP). Construction works will be undertaken at 10m as a minimum distance from any water course.

A new foundation drainage layer will be implemented to manage water and maintain structural integrity. Drainage material will be sourced from a local quarry (Slane or O'Reilly) and stockpiled on-site.

3.3.5.1 Surface Water / Groundwater Drainage System

Measures to ensure that no contamination of the natural ground water or the surrounding surface waters will take place as a result of run-off from the site during any works to be undertaken.

Surface water cut-off drains, ditches, swales and sumps will be constructed as required to ensure that the works are maintained free from standing water and to divert surface water and ground water gathered to the drainage system via gravity and/or pumping. The cut-off drains shall be a minimum of 500 mm deep and 400mm wide at the base and shall have side slopes of no steeper than 1(V):2(H). The operation and maintenance of the surface water / groundwater drainage system (drains, ditches, swales, sumps, pipework and pumps) for the duration of the contract shall be the responsibility of the E&C contractor.

3.3.5.2 Perimeter Interceptor Channel

The PIC surrounds the existing TSF and intercepts seepage from the facility and brings it to a collection point located on the south wall at Ch 2100 approximately, where it is pumped back into the TSF. During construction, water that accumulates in the footprint of Buttress Works shall be captured by temporary drains, ditches, swales, sumps, pipework and pumps and either pumped into the PIC or flow directly into the PIC.

3.3.6 Stockpiles

Temporary stockpiles of materials formed by the contractor during the Works shall be preserved by the contractor in their classifications and groups without deterioration or contamination while being placed, stored and taken from the stockpiles. The stability, sealing and maintenance of stockpiles will be managed through the proper construction of and seeding of the stockpile as required.

3.3.7 Existing Concrete Channels

There are nine concrete channels in total, located within the footprint of the Buttress Works that are required to be demolished and removed from the works. These concrete channels are located on the downstream side slope of the existing dam walls and convey seepage to the PIC, which exist from a manhole ring. The entry point from the channels to the PIC also contain a concrete causeway for erosion protection, these are also required to be demolished. The concrete channels consist of in-situ concrete and precast structures that are required to be demolished. Separate skips will be provided for sorting and recycling of materials and disposal via appropriate and authorised waste handlers.

3.3.8 Spoil from Site Clearance

All materials derived from the site clearance works excluding combustible material which are not required, or unacceptable for use in the Permanent Works shall be placed to form site clearance spoil heaps. Combustible material shall not be burned anywhere on the site. Vegetation shall be chipped and composted for reuse during restoration. Spoil heaps formed from materials derived from the site clearance works shall be compacted by the passage of earthmoving plant and trimmed such that the side slopes are at a safe angle. Measures will be undertaken to ensure spoil heaps are not allowed to dry out and dust.

3.3.9 Waste Management

The Engineering and Construction (E&C) contractor shall prepare and submit a site-specific Waste Management Plan for approval prior to any works been undertaken. This should be included in the Construction Environmental Management Plan (CEMP).

This plan should detail, at a minimum, the recovery and processing of materials for re-use in the works and estimated volumes of segregation and disposal of waste streams expected e.g., wood, metal, plastic, concrete etc. A proposed list of authorised waste collection permit holders and list of proposed waste facilities at which wastes may be disposed of recovered.

3.3.10 Tailings Pipeline Management

Pipelines and services located within the buttress construction works zone will be removed/ re-routed as required to maintain ongoing process and production needs.

3.3.11 Traffic Management

The E&C Contractor shall adequately cover traffic management both on the Site and for their supply vehicles delivering to and from the Site in the Construction Stage Safety and Health Plan and the Construction Stage Traffic Management Plan (CSTMP). The E&C Contractor will be responsible for any cleaning and dust suppression of the haulage routes and allow for the supply of plant for dust suppression. Equipment will be maintained on site at all times during the execution of the works and the application of water spray to any area within the site that, in the opinion of the E&C contractor and CQA Team, requires dust control. Dust control measures shall be sufficient and scalable as required.

3.3.12 Public Access Roads

All access roads must be kept in a clean state at all times. Under no circumstances will mud be allowed on internal access roads, public roads or access roads beyond the Site boundary. All vehicles exiting the Site shall do so through the existing wheel wash facilities. Provision for desludging the existing wheel wash facilities and treatment by licensed waste contractor will be put in place.