APPENDIX 18 – EROSION AND SEDIMENT CONTROL PLAN

NEW LENTON COAL PTY LTD

NEW LENTON COAL PROJECT

New Lenton Project

Erosion and Sediment Control Plan

Bowen Coking Coal Limited

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1 Introduction

1.1 Background

HydroBalance has been engaged by Bowen Coking Coal Limited (BCC) to prepare an Erosion and Sediment Control (ESC) Plan for New Lenton (the Project). New Lenton is a proposed open cut coal mine located approximately 50 kilometres (km) north of Moranbah, within the Bowen Basin in Central Queensland. The location of the mine in relation to surrounding mines and regional drainage features is shown in Figure 1.1. New Lenton is hereafter referred to in this document as NL or the Project. NL is subject to Environmental Authority (EA) EPML00475513.

New Lenton Coal Pty Ltd (NLC), a wholly owned subsidiary of BCC, is the proponent for the Project. A Referral for the Project, under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) was lodged In September 2020 (EPBC 2020/8778), with the delegate for the Minister for the Environment determining that the Project was a controlled action and would be assessed by public environment report (PER). A draft PER was submitted to the Department of Climate Change, Energy, Environment and Water (DCCEEW) in January 2024.

NL is proposing to develop open cut coal mining pits with supporting infrastructure on mining leases (ML) 70337, ML 700053 and ML 700054 (referred to as the New Lenton MLs), see Figure 1.2. Approximately 1.9 million tonnes per annum (Mtpa) of metallurgical run of mine (ROM) coal will be mined over a period of 18 years with a total of approximately 30 Mt over the life of the mine. In some years, including during ramp up phases, less than 1.9 Mtpa ROM coal will be mined. Overburden (also referred to as spoil in this ESC Plan) will be placed in in-pit and out-of-pit waste rock dumps, with a final void remaining at the end of mine life. Supporting infrastructure includes a mine infrastructure area (MIA), haul roads, realignment of a public road and water management infrastructure.

ROM coal will be hauled to Burton Mine for washing in Burton Mine’s coal handling and processing plant (CHPP). Product coal will be hauled to Burton Mine’s train load out (TLO) facility and railed to Dalrymple Bay Coal Terminal (DBCT). Rejects from washing of Project ROM coal will be stored within Burton Mine’s existing co-disposal areas within old mine voids.

Proposed key infrastructure for the Project comprises:

- The two open cut mining pits;
- Two levees (for Ti-Tree Creek and the Isaac River);
- A Ti-Tree Creek diversion;
- A realignment of the Suttor Developmental Road that includes a bridge spanning the Isaac River;
- A haul road adjacent to the Suttor Developmental Road;
- Sediment dams, mine affected water (MAW) dams and a clean water dam;
- ROM coal pad;
- Mine infrastructure area (MIA).

1.2 Purpose and scope

This ESC Plan has been prepared to meet the requirement of Conditions C39 of the Environmental Authority (EA) (EPML00475513), and sets out the principles and objectives for the management erosion and disturbed area runoff for NL.

EA Condition C39 - An Erosion and Sediment Control Plan must be developed by an appropriately qualified person for implementation in all stages of the mining activities on the site to minimise erosion and the release of sediment to receiving waters and contamination of stormwater.

This ESC Plan provides the information requested by DCCEEW in their adequacy review comments on the draft PER.

1.3 Surface water types and application of ESC Plan

Surface water at NL is categorised into six types, which are listed as follows:

- Mine affected water;
- Sediment water;
- Clean water;
- External (raw) water;
- Contaminated water; and
- Potable water.

The primary purpose of this document is to develop strategies to manage **sediment** water at NL. The management strategies for the remaining water types are described in in the NL Surface Water and Flood Impact Assessment (WRM 2024). With respect to sediment water, this ESC Plan:

- examines and addresses all issues relevant to the generation, management, and mitigation of erosion and sediment transport at NL;
- provides guidance on erosion and sediment related issues and management techniques applicable to NL;
- determines the appropriate requirements for sediment and erosion control and management for all land uses at NL; and
- complies with relevant environmental licences and other regulatory requirements.

1.4 Environmental objectives of the ESCP

The ESC Plan will contribute to effective environmental management of surface water runoff at NL through:

- minimising off-site impacts (by-products of erosion);
- delivering stable landforms that will not pollute downstream environments;
- providing clear, concise and standardised practices for operations;
- providing clarity for planners, supervisors and contractors; and
- improving auditability and conformance to standards.

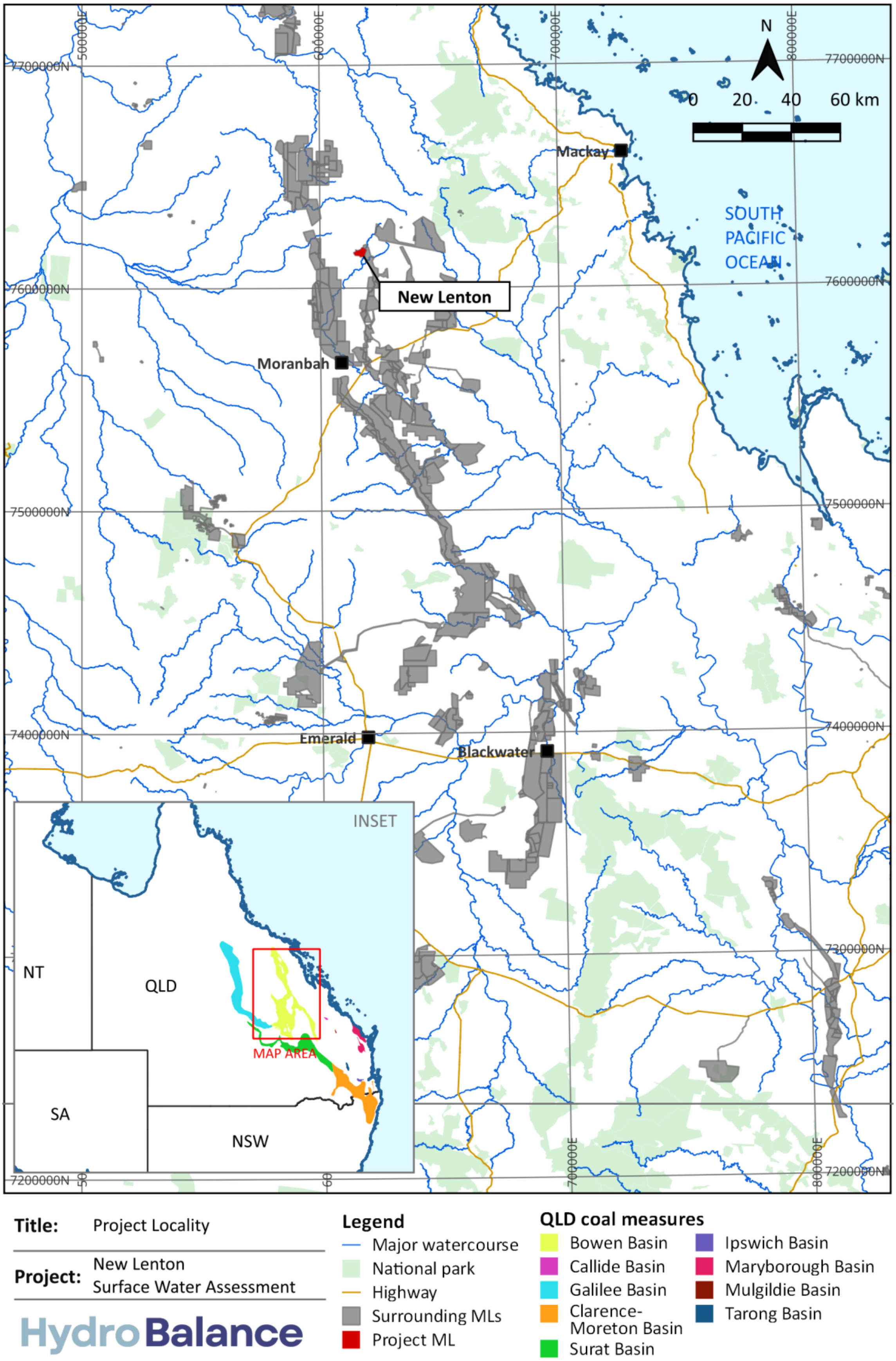

Figure 1.1 – Regional locality plan

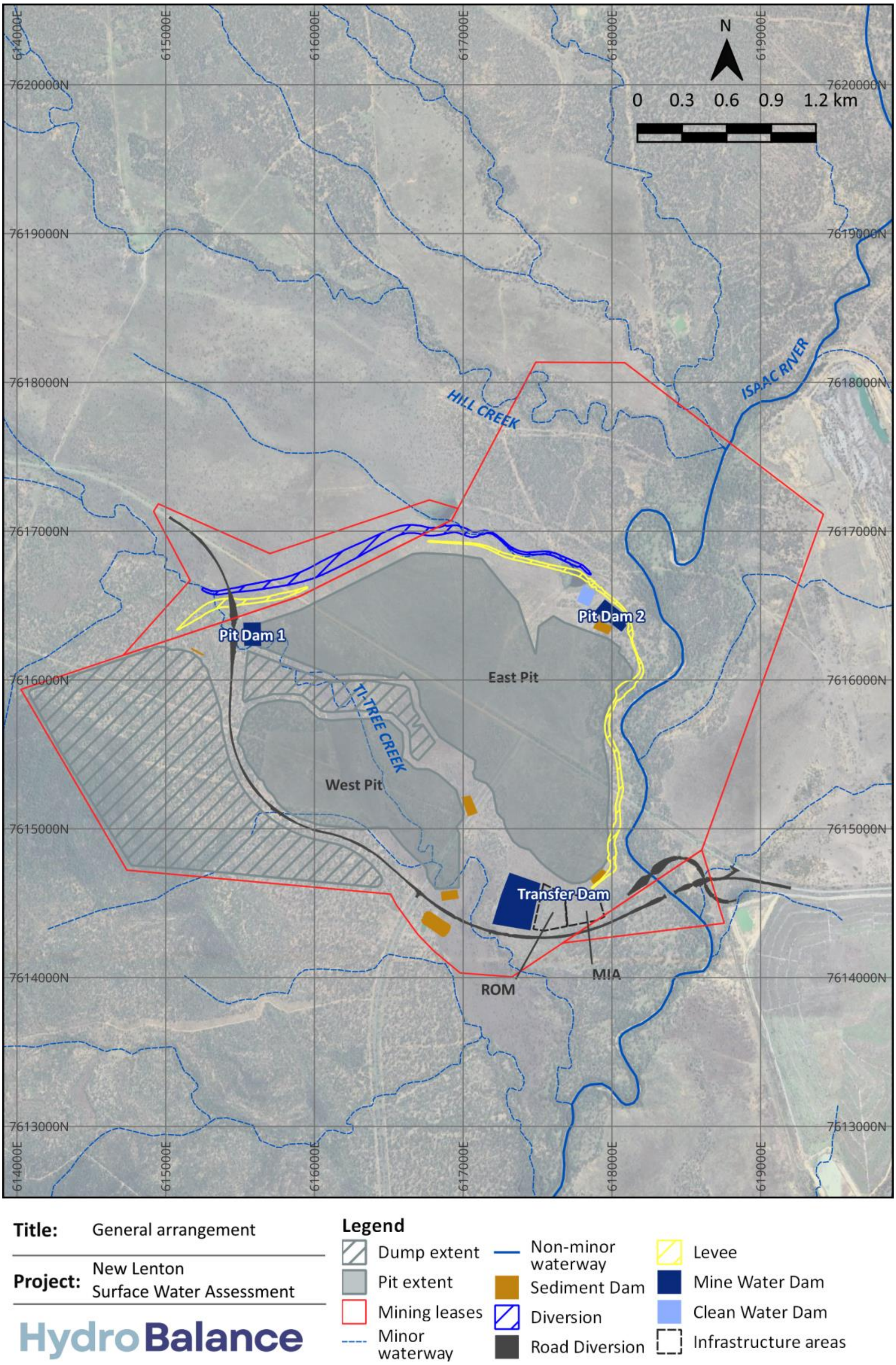

Figure 1.2 – Site layout and infrastructure

2 ESC framework

2.1 Regulatory framework and relevant guidelines

The following regulatory framework and relevant guidelines are applicable to the NL:

- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), as it relates to approval of EPBC 2020/8778 referral;
- Environmental Protection Act 1994 (EPA) and Environmental Protection (Water and Wetland Biodiversity) Policy 2019;
- Water Act 2000 and relevant Water Resources Plans (e.g. Water Resource (Fitzroy Basin) Plan 2011);
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018);
- Vegetation Management Act 1999 and Vegetation Management Regulation 2000;
- Soil Conservation Act 1986 and Soil Conservation Regulation 1998;
- Stormwater guideline – Environmentally relevant activities (DEHP, 2014);
- Best Practice Erosion and Sediment Control (IECA, 2008);
- Australian Soils and Landscapes Handbook (CSIRO, 2004); and
- Model Mining Conditions guideline (DES, 2017).

The NL specific statutory documents are:

- The New Lenton Environmental Authority (EPML00475513, dated 20 January 2021)
- The New Lenton Progressive Rehabilitation and Closure Plan (PRCP) Schedule (PRCP_EPML00475513_V1, 27/11/2023).

2.2 Strategic approach

This ESC needs to be evaluated and implemented for the following phases of work:

- Planning and design (non-operational); and
- Operation and construction.

This ESC Plan does not specifically include techniques for rehabilitation, although many of the given techniques are relevant.

All parties (both NL workers and contractors) involved in earthworks and civil construction (including mechanical, electrical and pipeline contractors) engaged onsite will be given access to the site environmental management documentation and this ESC Plan. All works will be required to adhere to all aspects of the ESC Plan unless abnormal circumstances prohibit their use.

In addition, consideration should be given to the inclusion of this ESC Plan into tender documents and provision to prospective tenderers for related activities to enable efficient incorporation into daily operational procedures.

2.3 Responsibilities and accountabilities

The management and implementation of the ESC Plan is administered through the following key personnel:

- Site General Manager – accountable for the application of this ESC Plan.
- Site Environmental Superintendent - responsible for documentation and revisions of the ESC Plan.
- Contractors engaged to undertake work at NL are responsible for implementation of this ESC Plan.

3 Existing site characterisation

3.1 Site drainage

The Isaac River is the main watercourse feature which drains through the eastern portion of the New Lenton MLs. Hill Creek joins the Isaac River from the west near the northern end of the New Lenton MLs. The Hill Creek channel is outside the Project Disturbance Area and will not be impacted by the Project. In addition to the Isaac River, key drainage features within the Project Disturbance Area are Ti-Tree Creek and an unnamed tributary of the Isaac River. The alignment of the Ti-Tree Creek channel and the unnamed tributary are shown in Figure 1.2. The Department of Natural Resources, Mines and Energy (DNRME) determined that Ti-Tree Creek is not a designated watercourse under the Water Act 2000.

The Project Disturbance Area is relatively flat and encompasses a section of the Isaac River floodplain. The Project Disturbance Area is located at an elevation of approximately 300 metres (m) to 340 m Australian Height Datum (AHD). The southern and eastern boundary of New Lenton MLs are generally between 300 and 315 m AHD with the highest point along the northeastern boundary.

3.2 Geology and soils

A site inspection of the Project area in April 2019 by SLR, in conjunction with a desktop assessment, has shown that cattle grazing of native and introduced pastures is the dominant agricultural enterprise on areas cleared of remnant vegetation.

The soil field program for the Project area was designed to satisfy a 1:25,000 survey scale intensity, with the survey area comprising approximately 618 hectares. Within the Project area, a total of three soil map units (SMUs) have been identified based on the dominant soil types. The three SMUs were surveyed within the majority of the Project disturbance area, and were identified as:

- SMU 1: Brown Sodosol – Within this SMU, the dominant soil unit is Brown Sodosol; however, there are minor soil units comprising Grey, Red and Yellow Chromosols. These are soils with strong texture contrast between the A horizon and B horizon, which, for Sodosols, is sodic but not strongly acidic (pH is greater than 5.5). The strongly sodic nature of the B horizon in Sodosols makes them prone to dispersion and tunnel erosion if left exposed for prolonged periods to water movement or rainfall. Both the topsoil and sodic subsoil of this SMU may be stockpiled/windrowed for use in rehabilitation; however, the topsoil would need to be stripped from 100 mm to 400 mm, as appropriate for each individual soil unit and ameliorated with organic matter (e.g. manure) and fertiliser, and the sodic subsoils would need to be treated with a considerable volume of gypsum to ameliorate the sodicity. Both materials should only be used to rehabilitate areas of SMU 1. SMU 1 has an area identified with significant amounts of surface and sub-surface rock located at the edge of an escarpment as there are no soil resources available for re-use.
- SMU 2: Black Vertosol - these are clay soils with shrink-swell properties that exhibit strong cracking when dry and at depth have slickensides and/or lenticular structural aggregates. These soils have topsoil material that can be stripped from 100 mm to 200 mm from the surface and subsoils that may be stripped from 100-200 down to 500-600 mm (exchangeable sodium percentage [ESP] <20) and from 500-600 down to 1,000 mm (ESP >20).
- SMU 3: Brown Vertosol - these are clay soils with shrink-swell properties that exhibit strong cracking when dry and at depth have slickensides and/or lenticular structural aggregates. These soils have topsoil material that can be stripped from 100 mm to 200 mm from the surface and subsoils that may be stripped from 100-200 down to 500-600 mm (ESP <20) and from 500-600 down to 1,000 mm (ESP >20).

All soil profiles were above pH 5.5 and are considered nil risk as Acid Sulfate Soils, given their landscape position and also vegetation types present across the Project area. All soil profiles contained moderately dispersive and dispersive horizons according to their ESP score, which will be likely require ameliorated (e.g using gypsum) for use of soils as growth medium in rehabilitation.

3.3 Overburden geochemistry

The area comprising ML 70337, and adjacent tenements, have been the subject of two previous geochemistry assessments. Within ML 70337, four drill holes were sampled and analysed. This section summarises the findings of the report Geochemical Characterisation and Assessment of Overburden and Reject Materials at the Lenton Coal Project (MEMS, 2005).

The geochemical assessment involved:

- Review of previous geochemical investigations conducted in the area;
- Geochemical testing of 18 overburden samples, including testing of pH (1:5), EC (1:5), acid neutralising capacity (ANC), total sulphur, sulphide-sulphur, net acid producing potential (NAPP), net acid generation (NAG) test, and sodicity; and
- Assessing the potential environmental risk associated with mine waste.

3.3.1 Geochemistry Methodology

A total of 37 drill chip and 14 drill core samples were selected from four drill holes to represent overburden (sandstone, mudstone and siltstone) and potential reject (coal seam roof and floor) samples. Sample selection was skewed towards the unweathered Permian material at a depth of greater than 25m (the indicated depth of weathering) as this material is more likely to be geochemically active (compared to weathered near-surface material) if exposed to oxidising conditions.

Drill chips were generally sub-sampled to generate a sample weight of approximately 2 kg. Reject samples consisted of full core generally taken from drill core intervals no greater than 1m. Samples were initially screened using a series of standard static geochemical tests including pH, Electrical Conductivity (EC), Acidity or Alkalinity, Total Sulfur, Sulfate Sulfur, Acid Neutralising Capacity (ANC) and Net Acid Producing Potential.

Following initial screening results, forty selected samples were combined into ten composite samples according to rock type and geochemical nature. Composite samples represented depth intervals of up to 10 m within specific rock types, the practical limit for material handling during overburden removal. The multielement composition of the composite samples was determined to identify the presence of any elements at concentrations of environmental significance. The Exchangeable Sodium Percentage (ESP) was also determined these samples. Water extracts from the composite samples were also subjected to multi-element analyses to determine the solubility and potential mobility of any elements of concern from materials.

3.3.2 Geochemistry Results

The results of the geochemical assessment are summarised below:

- Overburden has negligible sulphide-sulphur concentrations (<0.1 %);
- All samples tested were non-acid forming (NAF) or acid consuming (AC);
- Geochemical classification was not found to be dependent on rock type or sample depth;
- The risk of overburden materials causing significant water quality impacts in downstream receiving environments is low and is unlikely to cause any adverse effects on plant growth associated with postmining revegetation and rehabilitation; and
- Overburden material may be susceptible to dispersion during wet weather or after mechanical working.

Acid-base test results determined that overburden at the Project is non-acid forming. Acid-Base test results for the thirty-seven overburden samples representing specific lithological rock types are summarised below:

- The pH of the samples is moderately alkaline (median pH 9.0) and ranges from 8.1 to 9.6. The alkalinity is relatively low (ranges from 0.2 to 1.2 kg H2SO4/t) and has a median value of 0.4 kg H2SO4/t; and

- The conductivity is relatively low and ranges from 190 to 690 µS/cm, with a median value of 350 µS/cm.

The total sulfur content of the samples ranges from low to moderate (<0.01 to 2.10%, median 0.03%), and is mostly present in the sulfide (unoxidised) form.

To evaluate the immediate solubility of multi-elements in solids, water extract tests were completed for ten composite samples. These results indicate that initial leachate from composite samples contains metal concentrations well within those recommended in the ANZECC guidelines.

3.3.3 Geochemistry Conclusions

- Overburden at the Project is likely to be benign and will generate moderately alkaline and fresh (nonsaline) runoff following surface exposure;
- Majority of the overburden will have very low sulfur content (<0.1%) and can be classified as barren;
- A small amount of overburden has elevated sulfur content and is located close to coal seams;
- Acid generation from overburden is unlikely given the high acid neutralising capacity of the materials;
- The concentration of metals in overburden is unlikely to present any environmental risks for revegetation and overall rehabilitation of any out-of-pit overburden dump;
- The concentration of soluble metals and salts in runoff and seepage from overburden is likely to remain well within relevant water quality guideline concentration limits and has a low risk of impacting upon downstream water quality;
- Some overburden (mudstone) is likely to be sodic and could therefore be prone to crusting;
- Most rejects generated should be relatively benign and will initially generate moderately alkaline and nonsaline runoff following surface exposure (noting that rejects will be managed at the Burton Mine by disposal within the existing void utilised for that purpose); and
- Total sulfur content and buffering capacity of rejects is variable. Most reject will remain alkaline.

4 Erosion and sediment control

4.1 Overview

This ESC Plan is intended to assist in the management, reduction and mitigation of erosion and consequent sediment transport within and from NL.

Preventing unacceptable levels of sediments and contaminants from entering receiving waters is one of the most important functions of ESC. The three cornerstones of ESC are as follows:

- **Erosion control** – prevention or minimisation of soil erosion (from dispersive, non-dispersive or competent material) caused by rain drop impact and exacerbated overland flow on disturbed surfaces.
- **Drainage control** – prevention or reduction of soil erosion caused by concentrated flows and appropriate management and separation of the movement of clean and dirty water through the area of concern.
- **Sediment control** – trapping or retention of sediment either moving along the land surface, contained within runoff (i.e. from up-slope erosion) or from windborne particles.

Catchments that drain internally to the mine water management system (i.e. into MAW dams or pit) do not require ESC management measures.

4.2 Principals of ESC

For ESC to be effective at NL, the following fundamentals will be applied:

- ensure ESC measures are designed and constructed effectively;
- minimise the duration and extent of soil exposure;
- promptly stabilise disturbed areas;
- maximise sediment retention on the site;
- control water movement through the site;
- utilise existing topography and adopt construction practices that minimise soil erosion and sediment discharge from area;
- integrate erosion and sediment control issues / measures into the planning phases of operations;
- choose the ESC technique to account for site conditions such as soil, weather and construction conditions;
- maintain all ESC measures in proper working order at all times; and
- monitor the site and adjust ESC practices to maintain the required performance standard.

4.3 Potential sources of erosion

Operations at NL may result in the alteration of existing surface water flow patterns by proposed activities and through diversion drains. Erosion may occur due to the following activities:

- ex-pit spoil dump;
- externally draining spoil used in backfilling the pit, which is subsequently rehabilitated.
- topsoil and subsoil stockpiles;
- cleared land ahead of pit activities;
- installation of services and infrastructure;
- changes to drainage lines and/or catchment;

- runoff from construction and maintenance on haul roads;
- runoff from the construction of and maintenance of internal access roads;
- vehicle and equipment movements; and
- disturbed areas not yet rehabilitated.

Potential erosion and sediment sources as well as the potential contaminants, impacts and applicable period at NL are presented in Table 4.1.

Table 4.1 – Potential erosion and sediment sources

Disturbance category	Substrate characterisation	Potential erosion mechanisms and impacts	Applicable period
Spoil			
Unrehabilitated spoil	Unconsolidated material with varying quantities of low to moderate salinity and sediment pre-disposition.	Sheet and rill erosion of potentially alkaline / low to moderate salinity deposits leading to deposition of contaminants and sediment volumes. Sediments causing damage to receiving waters through reduction in water quality and degradation of in-stream habitats.	During mine operations period
Topsoiled spoil (to be revegetated)	Unconsolidated materials. Runoff from these areas may contain sediments and elevated turbidity.	Sheet and rill erosion leading to sedimentation of waterways and loss of valuable rehabilitation material.	During rehabilitation period
Topsoiled spoil, ripped and seeded	Unconsolidated materials. Runoff from these areas may contain sediments and elevated turbidity.	Minimal once vegetation established.	During rehabilitation period
Topsoil			
Topsoil stripping area	Unconsolidated materials.	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, impacting on receiving waters.	During mine operations period
Topsoil stockpiles	Unconsolidated materials. Runoff from these areas may contain sediments and elevated turbidity.	Sheet, rill erosion leading to sedimentation of waterways and loss of valuable rehabilitation material.	During mine operations period
Peripheral lands			
Haul Roads	Disturbed materials from surface of the road.	Erosion of table drain material vulnerable to storm activity, leading to sedimentation of nearby watercourses	During mine operations period
Sediment runoff from hardstand areas (other than those reporting to the mine water management system).	Runoff from these areas may contain sediments and elevated turbidity.	Sedimentation of nearby watercourses.	During mine operations period

Disturbance category	Substrate characterisation	Potential erosion mechanisms and impacts	Applicable period
Exploration Activity	Disturbed materials. Runoff from these areas may contain sediments and elevated turbidity.	Sedimentation of nearby watercourses.	During mine operations period
Land clearing	Disturbed materials and exposed in-situ subsoils. Runoff from these areas may contain sediments and elevated turbidity.	Sedimentation of nearby watercourses.	During mine operations period
Drainage channels	Exposed in-situ subsoils. Runoff from these areas may contain sediments and elevated turbidity.	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, impacting on receiving waters.	During mine operations period

4.4 Erosion potential

Undertaking an assessment for risk of erosion is essential to determine the appropriate ESC technique to apply. There are five main categories that need to be taken into consideration, all of which influence the erosion potential and the type of control measure(s) applicable:

- soil/spoil classification;
- average slope of disturbance area;
- extent and duration of soil disturbance;
- location within the catchment (and whether run-off from upslope can be controlled); and
- proximity to waterways.

4.4.1 Soils/spoil

Soils/spoil are classified into three categories:

- dispersive soil;
- non dispersive soil; and
- blocky / competent material.

The following is provided as background to identifying soil / material types.

Dispersive soils are structurally unstable in water and tend to break down into their constituent particles which consequently cloud the water. Dispersive soils are highly susceptible to erosion on slopes and drains when exposed.

Non-dispersive soils are characterised by large, water-stable aggregates separated by large pore spaces that absorb water rapidly. These soils are typically high in clay content although some clays are highly dispersive and break down when wet making them highly erodible (i.e. dispersive). Sandy soils are generally non-dispersive on gently sloping land, however are dispersive on steep slopes.

Blocky / competent soil material is structurally sound and typically does not contribute a large portion of erosion problems or sediment runoff. These materials may be used to construct various erosion and sediment control techniques.

Based on the available historical soil classification information, it expected that:

- The overburden dumps material will contain mostly dispersive material; and
- The surface disturbance areas will include a mix of dispersive and non-dispersive material.

If there is uncertainty surrounding the soil type for any area of activity where this ESC Plan needs to be referenced, the NL environmental personnel should be contacted and appropriate steps undertaken to determine soil type. This may include undertaking suitable soil assessment as per published documentation (e.g. IECA 2008).

4.4.2 Slope

The steepness of the slope and slope length are important determinants in the erosion risk of a site. The externally draining side slopes of the dump will generally be at overall slope of 15% or less. The top surface of the dump will be relatively flat, some smaller sections may up to 20%.

Drainage and sediment control measures will be installed, including plateau drains to intercept flow from the top of the dump, contour drains to direct water from the slopes to the chutes, chutes to convey this water down the sides of the dump, and collection drains to direct the runoff to sediment dams. Surface run-off and seepage from the overburden dump will be directed to sediment dams.

4.4.3 Area and duration

A principle of ESC is to minimise the extent and duration of soil disturbance. Therefore, mining schedules should aim to minimise the duration for which open soils are exposed to the erosive elements (wind, rain and flowing water). Reducing the period where soils are exposed to erosive elements during the construction phase lessens opportunity for displaced sediment to enter into the surrounding environment.

Strategies to minimise increased risk of erosion during the operational phase of the mine site include:

- minimise the extent of the disturbance;
- prompt revegetation of non-operational disturbed area;
- ensure both temporary earthworks and permanent land-shaping provide a landform that minimises erosion; and
- design temporary runoff collection, conveyance and disposal systems to minimise erosion prior to commencement.

4.4.4 Location within the localised catchments

One of the major principles in achieving effective erosion and sediment control across any site is the necessity to separate run-off from undisturbed catchments and disturbed catchments. Disturbed sites positioned low in a localised catchment with the potential to receive overland or flood flows represent an increased erosion risk. It is therefore necessary to establish site drainage works to convey overland flows safely through or around a site during the disturbance period.

4.4.5 Waterways

The proximity to watercourses may trigger an increased level of planning. Disturbances to existing waterways should be avoided wherever practical.

During operational phases the proximity of ESC measures to watercourses should be undertaken where practicable and reasonable. Design should take into account floodplain extent, soil conditions and flood immunity of the selected ESC measure.

Within this process any mitigation works required to minimise erosion and sediment transport will be detailed. Any discharges to a watercourse may be conditional based on the licence or conditions of the approval to operate.

5 Erosion control measures

5.1 Overview

Soil erosion is the process through which the effects of wind, water or physical action displace soil particles, causing them to be transported. This section discusses the potential measures to mitigate or reduce erosion caused by water. The most common forms of water erosion are:

- **Splash erosion** is the spattering of soil particles cause by the impact of raindrops on soil;
- **Sheet erosion** is the uniform removal of soil in thin layers from sloping land;
- **Rill erosion** is the removal of soil by water concentrated in small but well-defined channels; and
- **Gully erosion** produces channels deeper and larger than rills (generally greater than 300 mm deep).

5.2 Erosion control techniques

5.2.1 Soil stabilisation and protection

A list of general erosion control techniques is provided in Table 5.1.

Table 5.1 – Summary of erosion control techniques

Technique	Typical use
Gravelling[1]	Protection of non-vegetated soils from raindrop impact erosion.
	Stabilisation of office area, parking areas and access roads.
Heavy mulching[2]	Stabilisation of soil surfaces that are expected to remain non-vegetated for medium to long periods.
	Suppression of weed growth on non-grassed areas.
Light mulching[2]	Control of raindrop impact erosion on flat and mild slopes. May be placed on steeper slopes with appropriate anchoring.
	Control water loss and assist seed germination on newly seeded soil.
Revegetation[3]	Temporary and permanent stabilisation of soil.
	Stabilisation of long term stockpiles.
Rock mulching[4]	Stabilisation of long term, non-vegetated banks and minor drainage channels.
Soil binders[5]	Dust control.
	Stabilisation of unsealed roads.

[1] https://www.austieca.com.au/documents/item/98
[2] https://www.austieca.com.au/documents/item/100
[3] https://www.austieca.com.au/documents/item/101
[4] https://www.austieca.com.au/documents/item/102
[5] https://www.austieca.com.au/documents/item/227

During the pit backfilling and rehabilitation phase, erosion control will primarily be achieved through revegetation of the dump and pit footprints across a stable landform that is similar to the pre-mine landform.

5.2.2 Control of erosion on slopes

A list of appropriate erosion control measures to be used on flat, mild and steep slopes is given in Table 5.2.

Table 5.2 – Erosion control measures on slopes

Flat land (flatter than 1 in 10)	Mid slopes (1 in 10 to 1 in 4)	Steep slopes (steeper than 1 in 4) – not applicable to dump slopes at the Project
Gravelling[1]	Mulching[2]	Cellular confinement systems[5]
Mulching[2]	Revegetation[3]	Revegetation[3]
Revegetation[3]	Rock mulching[4]	Rock armouring

[1] https://www.austieca.com.au/documents/item/98
[2] https://www.austieca.com.au/documents/item/100
[3] https://www.austieca.com.au/documents/item/101
[4] https://www.austieca.com.au/documents/item/102
[5] https://www.catchmentsandcreeks.com.au/docs/E-CCS-1.pdf

Given the mid steep slopes of the sides of the overburden dump, erosion control measures will be applied to direct and control runoff through these areas.

5.2.3 Dispersive soil management

Dispersive insitu soils and subsoils were identified onsite by SLR (2019). The overburden emplacements are also expected have dispersive properties (SLR, 2019).

The following actions in dispersive soil should be avoided wherever possible:

- Expose dispersive subsoils to rain;
- Allow water to pond on dispersive soils;
- Stockpile or spread untreated dispersive soils; and
- Concentrate stormwater in drainage lines containing dispersive soils.

Exposed dispersive soils are highly erodible even at low flow velocities and therefore must be managed using a combination of the following:

- Identification and avoidance where possible by using alternative drainage techniques such as drainage bunds rather than cutting channels;
- Minimise the amount of time land is exposed;
- Discharge stormwater and runoff into relatively erosion resistant areas;
- Treatment with gypsum if required (note that the application of chemical treatments including gypsum should avoid harmful changes to pH levels, particularly within 20 m from the top of bank of a waterway. The mechanical application of chemical amelioration should also be avoided in areas intended for tree/vegetation retention); and
- Cover exposed dispersive soils with stable topsoil (at least 200 mm deep) and/or use geotextile barriers followed by revegetation.

6 Drainage control measures

6.1 Overview

This section outlines the measures to be taken when constructing drainage channels at NL (excluding Ti-Tree Creek Diversion, which is subject to diversion design criteria) to minimise erosion and downstream sedimentation. Control measures for two different drainage channels are discussed as follows:

- temporary drainage in low gradient areas such as catch drains, diversion channels or flow diversion banks that either collect concentrated flow or overland flow.
- temporary drainage down slopes such as chute drains.

6.2 Operational drainage controls

Operational drainage is considered temporary and only used during the operational period. All operational drainage shall be decommissioned and rehabilitated.

The key drainage controls at NL are as follows:

- Upslope catchment diversion drain, which diverts the natural catchment around the site;
- Plateau drains, which convey runoff from the top of the dump towards the chutes and runoff collection drains;
- Overburden dump rock chutes, which collect runoff from the top and sides of the dump and convey the flow to the collection drains.
- Collection drains, which convey flow from the dump and infrastructure areas to the sediment dams.

6.2.1 Design standards

Table 6.1 shows the proposed design standard of operational drainage structures at NL. Operational drainage controls that are anticipated to last longer than 24 months would be designed to cater for a 20-year Average Recurrence Interval (ARI) design storm to provide effective separation of sediment water. This may involve a combination of channels and compacted embankments.

Table 6.1 – Drainage design standards for temporary drainage works

Anticipated design life (months)	Design standard (years ARI)
< 12	2
12 to 24	5
> 24	20

6.2.2 Drainage design technique

In accordance with IECA (2008), drainage channels, whether permanent or temporary, should be designed and constructed at a gradient that limits the maximum flow velocity for the adopted design event standard (refer Table 6.2) to a value not exceeding the maximum allowable flow velocity for the given surface material. The principal factor in the selection of drainage control measures is the design discharge peak velocity. In accordance with IECA (2008), drainage channels, whether permanent or temporary, should be designed and constructed at a gradient that limits the maximum flow velocity to a value not exceeding the maximum allowable flow velocity for the given surface material.

The velocity limit for a drain depends on its gradient and the channel material. Channel material needs to be taken into consideration for erosion/scour resistance and Manning's 'n' roughness, which has an impact on velocity. Table 6.2 shows the typical velocity limits for different drainage material.

Table 6.2 – Velocity limits for drain material types (IECA, 2008)

Material types	Velocity limit (m/s)
Sandy/dispersive soil/spoil	0.3
Non-dispersive soil/spoil	0.7
70% grass cover	1.3
100% Grass cover	1.7
Erosion control blankets	1.5
Erosion control mesh/rock check dams	1.7
Rock armour (D50 = 200 mm)	2.0
Rock armour (D50 = 300 mm)	2.5
Rock armour (D50 = 400 mm)	3.5

Excessive flow velocities can cause channel erosion, usually along the invert of the drain, which can then lead to bank slumping and widening of the channel. The flow velocity can be reduced by either:

- reducing the depth of flow (increasing the width of the channel);
- reducing the bed slope;
- reducing the peak discharge (reducing catchment area); and/or
- increasing channel roughness.

If the channel width, depth or gradient cannot be altered, then there are two options for controlling erosion as follows:

- reduce the flow velocity through the placement of rock check dams; and/or
- increase the effective scour resistance in the channel through the placement of an effective channel liner (e.g. rock amour).

6.2.3 Drain velocity control structure

A list of appropriate check dam velocity control structures is given in Table 6.3. Figure 6.1 shows a typical rock check dam configuration.

Table 6.3 – Velocity control structures for channels and drains

Technique	Typical use
Fibre roll[1,2,4]	• Biodegradable logs. • Used in wide shallow drains where logs can be successfully anchored down. • Used in locations where it is desirable to integrate into the vegetation, such as vegetated channels. • Minor sediment trap.
Rock check dams[3,4]	• Used in drains with a depth exceeding 0.5 m and a gradient less than 10%. • Minor sediment trap.
Recessed rock check dams[4]	• Used in wide, high velocity, shallow channels where sandbag check dams would likely wash away. • Recessed into the soil to maintain hydraulic capacity in the channel. • Minor sediment trap.

Technique	Typical use
Sandbag check dams[4]	• Used in shallow drains with a depth less than 50 mm and gradient less than 10%. • These check dams are small and less likely to divert water out of the drain. • Minor sediment trap.
Triangular ditch check[4]	• Commercially available, reusable product. • Commonly used to stabilise newly formed table drains. • Used in drains with less than 10% gradient. • Minor sediment trap.

[1] https://www.austieca.com.au/documents/item/124
[2] https://www.austieca.com.au/documents/item/196
[3] https://www.austieca.com.au/documents/item/82
[4] https://www.catchmentsandcreeks.com.au/docs/CDT-1.pdf

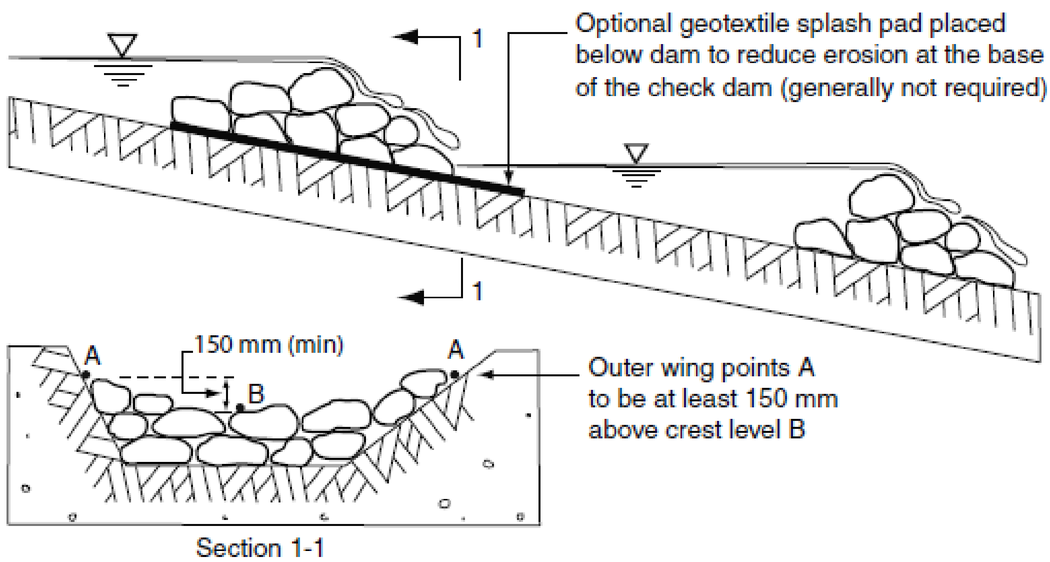

Figure 6.1 – Typical rock check dam configuration (IECA, 2008)

6.2.4 Chute and channel linings

Chutes are typically short in length and steep (greater than 5% slope) and therefore additional erosion protection may be required. A list of appropriate channel and chute linings to provide effective scour protection is given in Table 6.4. Figure 6.2 and Figure 6.3 shows a typical chute configuration.

Table 6.4 – Scour protection and lining types for chutes and channels

Technique	Typical use
Cellular confinement system[1]	• Typically used to stabilise chutes when the only local supply of rock consists of rock smaller than 200 mm. • May be filled with small rocks and grassed to form a permanent reinforced grassed chute. • Also used to form a temporary construction access across dry sandy bed streams.
Grass lining[2]	• Permanent protection of low to medium velocity chutes and channels.

Technique	Typical use
	• Requires suitable growing medium and time to establish.
Hard armouring[3]	• Hard armouring systems include corrugated sheet metal, reinforced concrete and shotcrete.
Rock mattresses[4]	• Suitable high velocity chutes and spillways.
Rock lining[5]	• High velocity drainage channels. • Drainage chutes. • Sediment basin spillways

[1] https://www.catchmentsandcreeks.com.au/docs/E-CCS-1.pdf
[2] https://www.austieca.com.au/documents/item/309
[3] https://www.austieca.com.au/documents/item/311
[4] https://www.austieca.com.au/documents/item/299
[5] https://www.austieca.com.au/documents/item/300

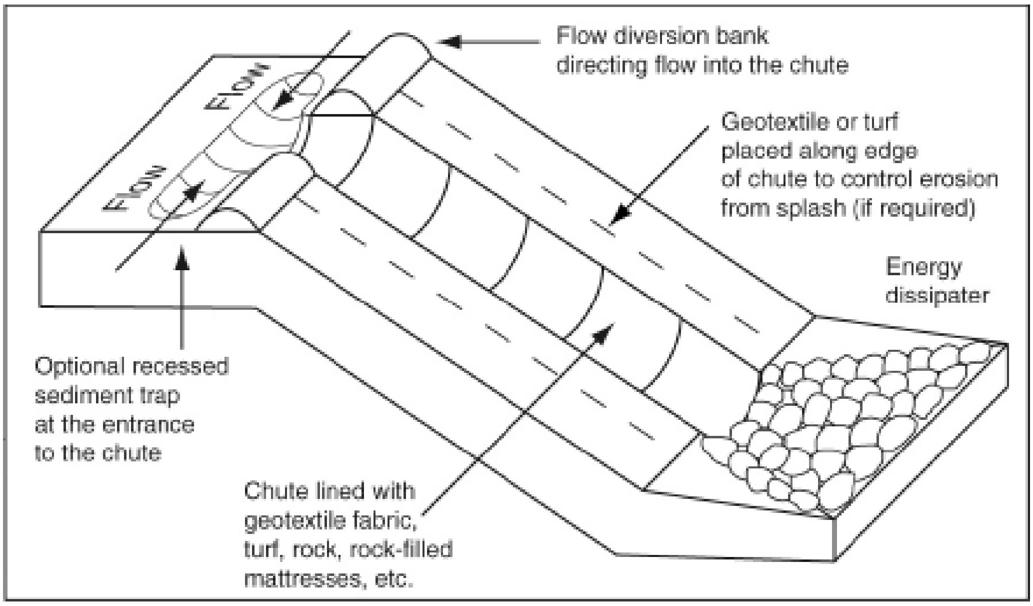

Figure 6.2 – Typical chute configuration (IECA, 2008)

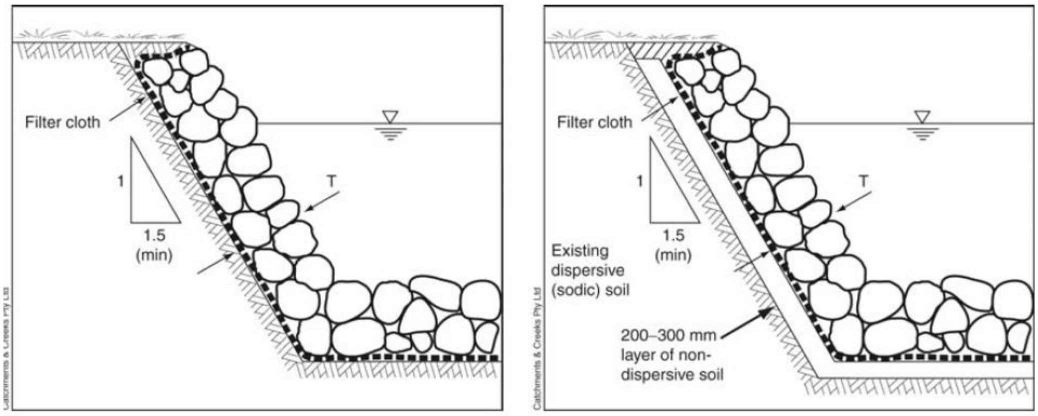

Figure 6.3 – Typical rock placement in a chute (IECA, 2008)

6.2.5 Outlet structures

All drains require an outlet structure, unless they flow directly into a sediment basin. A list of appropriate outlet structures to be used at the end of chutes to provide effective scour protection is given in Table 6.5. Figure 6.4 and Figure 6.5 show a typical level spreader and energy dissipator configuration.

Table 6.5 – Outlet structures for scour protection

Technique	Typical use
Level Spreader[1]	• Conversion of minor concentrated flows back to sheet flow. • Catchments less than 1 hectare or maximum design discharge of 0.85 m3/s. • Level and very gently Inclined slopes.
Energy dissipator (rock protection)[2]	• Used at the end of chute drains to dissipate energy and control scour. • Used as a permanent energy dissipater on pipe and culvert outlets.

[1] https://www.austieca.com.au/documents/item/309
[2] https://www.austieca.com.au/documents/item/307

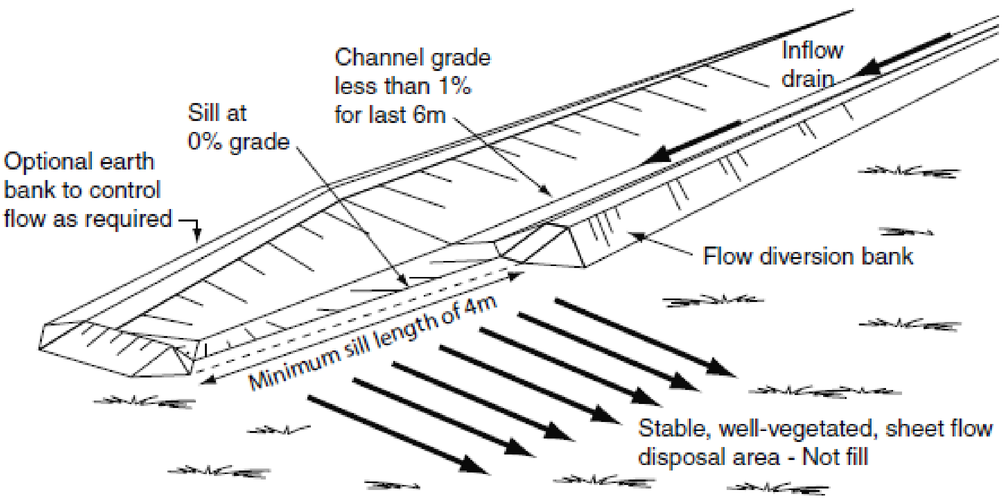

Figure 6.4 – Typical level spreader configuration (IECA, 2008)

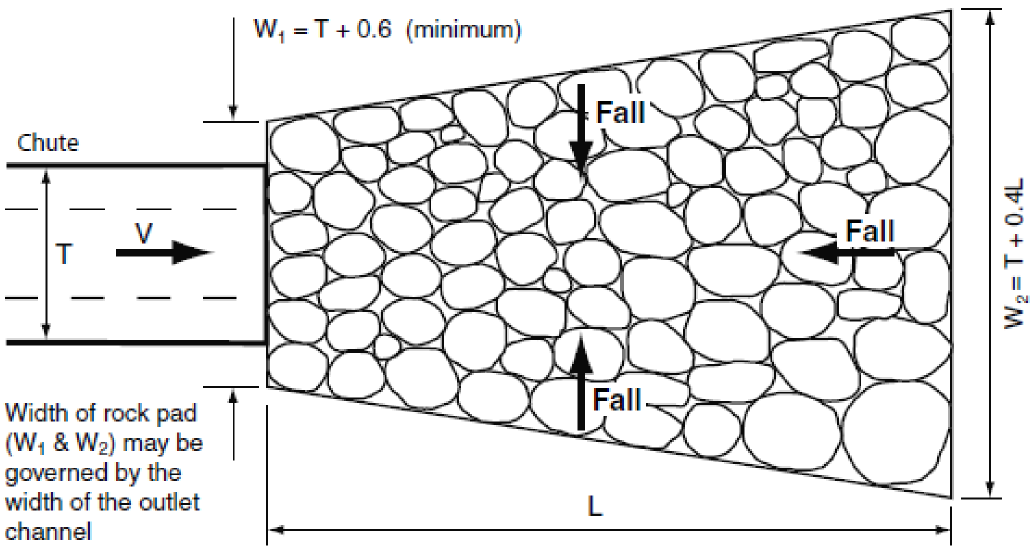

Figure 6.5 – Typical energy dissipater configuration (IECA, 2008)

6.2.6 Drainage control on unsealed roads

The following general principles should be followed in the design of drainage controls for unsealed roads:

- Stormwater runoff from unsealed roads should be allowed to shed at regular intervals. The runoff should be discharged into a sediment trap or released as sheet flow via a level spreader into adjacent grassland.
- Where stormwater runoff from unsealed roads collects within table drains adjacent to the roadway, this water should ideally be discharged from the table drain at regular intervals.
- Where table drains are steep and water cannot shed, such as through a cutting or into a river channel, the controls given in Table 6.3, Table 6.4 and Table 6.5 should be considered.
- When access is required across a slope, the road should be sited as close as possible to the contour of the land. This allows upslope water runoff to pass evenly across the track, thus avoiding concentrated flow.
- When an access road diagonally traverses a slope, the road will likely collect and concentrate upslope stormwater runoff. The collected runoff will need to shed at regular intervals using a level spreader or drainage channels constructed.
- Wherever practical, table drains should form wide U-shaped drains to minimise potential invert erosion. Deep V-shaped drains should be avoided where roads are constructed on steep slopes along a cutting.

6.2.7 Watercourse crossings

Proposed watercourse crossings at NL consist of the following:

- 4 culvert crossings of the Suttor Developmental Road on Ti-Tree Creek and the Ti-Tree Creek diversion.
- 1 level crossing of the haul road on Isaac River.
- 1 bridge of the Suttor Developmental Road on Isaac River.

The following general principles for culvert and level crossing should be followed in the design of drainage controls for watercourse crossings:

- Culvert designs should always consider the effects of debris blockages and potential erosive forces caused by overtopping flows. Ideally, culverts should have a flow capacity at least equal to the normal channel capacity of the watercourse when the water level is just below the crest of the culvert deck.
- Where possible, crossings of streams should be constructed at right angles to the flow and in locations where the channel is straight and has well defined banks.
- Crossings should be covered with a non-erodible material such as rock or gravel and the upstream and downstream batters should be armoured with rock to control erosion caused by overtopping flows.

Figure 6.6 shows a typical watercourse crossing configuration.

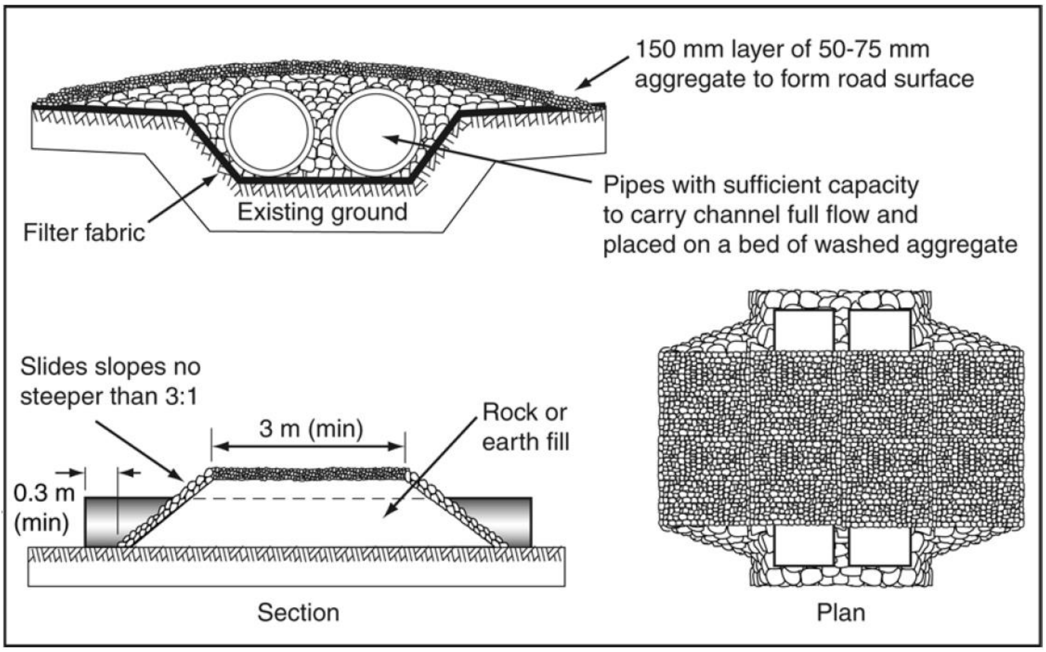

Figure 6.6 – Typical watercourse crossing configuration - culverts (IECA, 2008)

6.2.8 Typical drain configurations – channel

The configuration (dimensions) of the upslope catchment drain will be dependent on the upslope catchment area and slope. Drain design can be broken into two categories of low flows and high flows based on the upslope catchment and slope of the drain. The drain should typically contain the following features identified below and shown in Figure 6.7:

- Trapezoidal channel;
- Bank batters of between 1:2 (V:H) and 1:7 (V:H);
- Channel batters at least 1(V):2(H), but preferably 1:4 (V:H);
- Where necessary rock check dams will be used to maintain specified channel grades;
- Channel grades should not exceed 5%;
- Bank bottom widths will vary depending on the adopted bank batters;
- Diversion banks will be constructed to appropriate engineering standards.
- The channel outlet (level spreader) will be flared out to a minimum width of 1.5 x channel base width. Ground slopes below the channel outlet shall be less than or equal to the channel grade; and
- Stable grass cover to be maintained in the bed and banks of the channel and below the channel outlets (as much as possible).

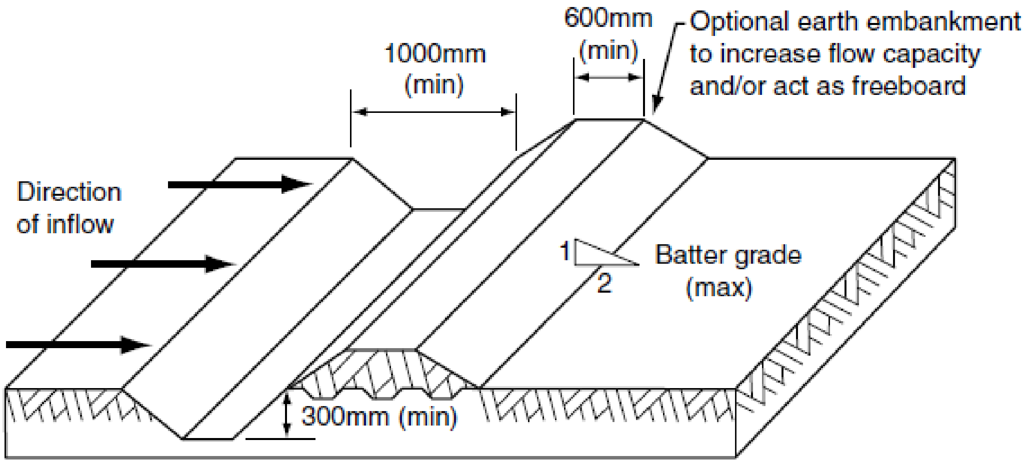

Figure 6.7 – Typical drainage configuration – channel (IECA, 2008)

7 Sediment control measures

7.1 Overview

The primary function of sediment control measures is to trap the coarser sediment fraction. To manage finer sediments, priority should be given to the use of effective erosion control measures wherever practical.

There are six sediment dams proposed as part of the NL operations:

- SD1 - will capture runoff from the northern portion of the western spoil dump.
- SD2 - will capture runoff from the southern portion of the western spoil dump.
- SD4 - will capture runoff from the northern portion of the central spoil dump.
- SD5 – will capture runoff from the southern portion of the central spoil dump.
- SD6 - will capture runoff from the southern portion of the eastern spoil dump.
- SD7 - will capture runoff from the northern portion of the eastern spoil dump.

The location of the proposed sediment dams is shown in Figure 7.1 and Figure 7.2 at different stages of the mine life. Additional minor sediment control structures will be constructed as part of the out of pit dump development.

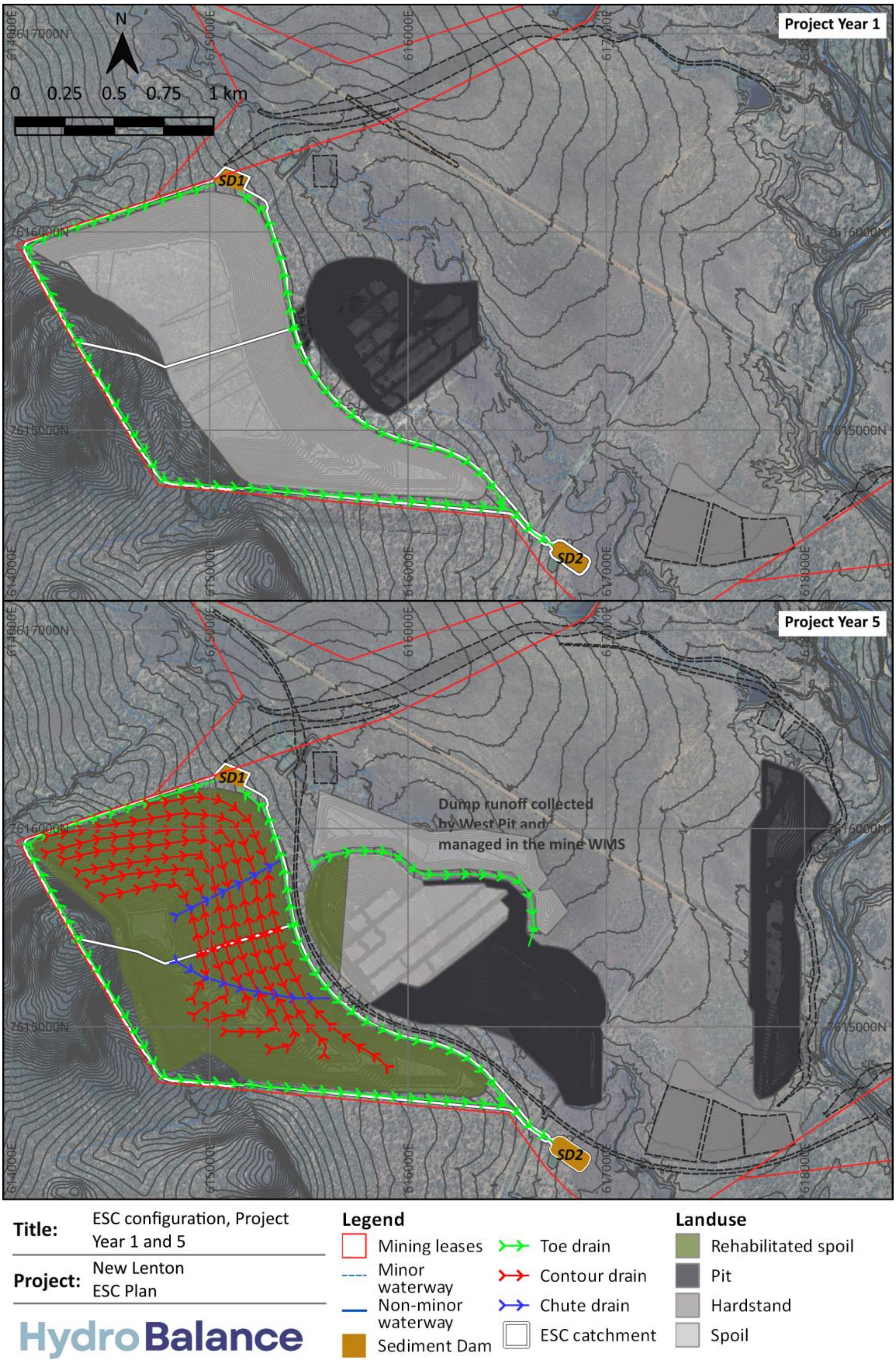

Figure 7.1 – Locality plan – sediment dams and drains, Project Year 1 and 5

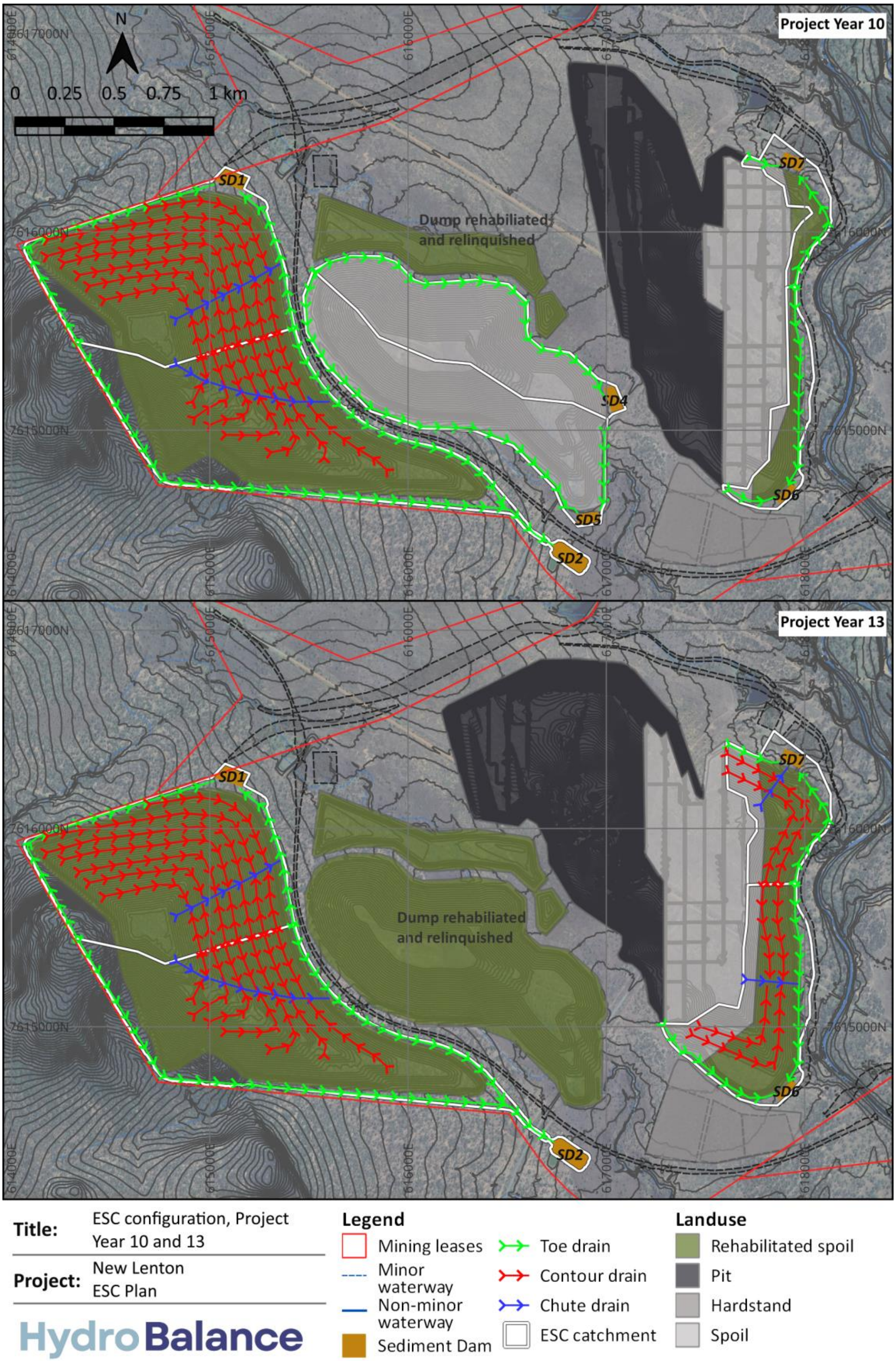

Figure 7.2 – Locality plan – sediment dams and drains, Project Year 10 and 13

7.2 Sediment control techniques

7.2.1 Primary controls – sediment dams

The proposed NL sediment dams have been sized in accordance with the IECA method (IECA, 2018), and have been based on the following design standards and methodology:

- "Type D" sediment dams;
- Total sediment dam volume = settling zone volume + sediment storage volume (shown in Figure 7.3). The sediment storage volume is the portion of the dam storage volume that progressively fills with sediment until the dam is de-silted. The settling zone is the minimum required free storage capacity that must be restored within 5 days after a runoff event.
- sediment dam settling volume based on 85th percentile 5-day duration rainfall (36.7 mm) with an adopted volumetric event runoff coefficient for disturbed catchments of 0.49 (Group C soils – loamy clay); and
- solids storage volume = 50% of settling zone volume.

Sediment dams are not intended to be full containment storages, and the adopted design standard does not provide 100% containment for runoff from disturbed areas. It is likely overflows will occur from sediment dams if rainfall exceeds the design standard (this is further assessed in WRM, 2024). Further, the water collected by the sediment dams could be captured and retained for reuse on-site where possible (e.g. dust suppression) if water quality is suitable for the intended use.

A summary of the conceptual sediment dam capacities and the surface areas (based on average 5 m depth) is provided in Table 7.1.

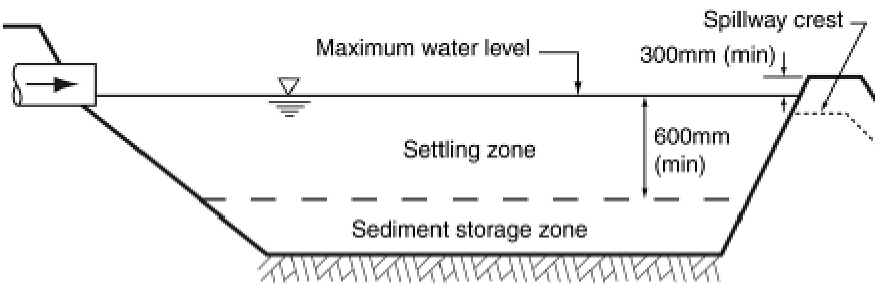

Figure 7.3 – Typical Type D sediment dam cross section (IECA, 2008)

A summary of the proposed sediment dam capacities and surface areas is provided in Table 7.1.

Table 7.1 – Proposed sediment dam capacities and surface areas

Dam name	Maximum catchment area (ha)	Settling volume (ML)	Solids storage volume (ML)	Total capacity (ML)	Dam surface area (ha)
SD1	88.8	15.9	7.9	23.8	0.63
SD2	102.7	18.4	9.2	27.6	0.74
SD4	50.1	9.0	4.5	13.4	0.36
SD5	59.9	10.7	5.4	16.1	0.43
SD6	44.9	8.0	4.0	12.1	0.32
SD7	27.7	5.0	2.5	7.4	0.20

7.2.2 Supplementary sediment control techniques

Supplementary sediment controls are used in areas where the sediment producing catchment is small or the potential for producing sediment laden runoff is low. A list of appropriate primary and secondary supplementary sediment control techniques is given in Table 7.2.

These supplementary sediment control techniques may be applied to the overburden dump, however they are more likely to by suitable to be implemented to assist with sediment control from the haul roads and topsoil stockpiles.

Table 7.2 – Summary of supplementary sediment control techniques

Technique	Typical use
Rock filter dam[1]	• Locations where there is sufficient room to construct a relatively large rock embankment. • The incorporation of a filter cloth is the preferred construction technique if the removal of fine-grained sediment is critical (high maintenance).
Check dam sediment trap[2]	• Supplementary sediment trap in minor concentrated flow areas. • Trapping sediments in table drains and minor drainage lines. • Check dams may be constructed of rock, sand bags or compost filled socks.
Buffer zones/ grass filter strips[3]	• Mostly suited to sandy soils. • Can provide some degree of turbidity control while the buffer zone remains unsaturated.
Sediment fence[4]	• Supplementary device for sheet flow from minor catchment areas. • Suitable for all soil types. • Require maintenance after every runoff event.

1 https://www.austieca.com.au/documents/item/270
2 https://www.austieca.com.au/documents/item/247
3 https://www.austieca.com.au/documents/item/246
4 https://www.austieca.com.au/documents/item/277

7.3 Technical notes

The following technical notes are adopted from IECA (2008) to provide general guidelines that should be followed for correct implementation of sediment controls:

- Every opportunity should be taken to trap sediment within the site, and as close as practicable to its source.
- The potential safety risk of a proposed sediment trap to site workers and the public must be given appropriate consideration, especially those devices located within publicly accessible areas – Hazardous Structure assessments must be completed where necessary in accordance with the DES Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (DES, 2016).
- All reasonable and practicable measures must be taken to prevent, or at least minimise, the release of sediment from the site.
- Suitable all-weather maintenance access must be provided to all sediment control devices.
- Materials, whether liquid or solid, removed from sediment control devices during maintenance or decommissioning, must be disposed of in a manner that does not cause ongoing soil erosion or environmental harm.
- Settled sediment must be removed from sediment basins when the volume of the sediment exceeds the designated sediment storage volume, or the design maximum sediment storage elevation.

8 Proposed ESC measures

The primary method of ESC control at the proposed NL disturbed catchments will be through the implementation of 6 new sediment dams, with associated erosion and drainage controls. The conceptual sizing of the dams is provided in Section 7.2.1.

The conceptual arrangement and location of the proposed sediment dams and drains are shown in Figure 7.1 and Figure 7.2.

Final design and sizing of the proposed ESC controls for the NL mining development areas will be undertaken by the mining contractor in accordance with the methodologies set out in this ESC Plan. This will include details of ESC controls during the construction phase of the new development areas.

9 ESC planning

The key area of ESC planning for NL is associated with the overburden dumps. Other areas include the haul roads and topsoil stockpiles. While this document covers proposed ESC measures for NL, it is possible that any changes to the proposed layout during the detailed design and construction phase may require a review of the ESC controls.

The following section outline the typical planning process for ESC, from the initial decision process through to implementation and decommissioning of works.

9.1 ESC decision process

The following outlines the steps required to determine the applicable ESC techniques for a catchment:

1. Identify the ESC catchment boundary and outlet;
2. Define the land disturbance associated with where the control measure will be implemented (catchment area, area of disturbance, soil type, slope, duration of disturbance etc.)
3. Determine if the catchment will be able to implement erosion controls during operations:
    a. spoil emplacement will consider erosion controls; and
    b. peripheral areas such as laydown areas can be stabilised through gravel pads etc.
4. Determine if a diversion drain is required and if any drainage controls are required:
    a. short term sediment controls shall be installed until the diversion drain is stabilised;
5. Conceptually align and size drainage:
    a. the drain material type, length, catchment area and bed slope are required to conceptually size the drain; and
    b. the conceptual sizing is used to determine the drain peak velocity and depth which determines if additional drainage controls (or an alternate material type) is needed.
6. Determine what type of sediment control is required:
    a. the catchment area and design rainfall depth are required to conceptually size the sediment basin;
    b. an assumed dam depth of at least 3 m should be used to conceptually size the basin footprint;
    c. the 5-day pump rate is calculated which is applicable to dewater Type D sediment basins; and
    d. the outlet should be located where it will not cause erosion or impacts to operational areas.
7. Prepare a plan of the area identifying the adopted techniques and document the measures within GIS that shows the following information:
    a. significant landmark/project boundary;
    b. general soil description;
    c. existing and final contours - including location of spoil dump or topsoil stockpiles;
    d. existing and final drainage paths;
    e. limits of clearing where applicable;
    f. location of vegetated buffer strips;
    g. haul roads and light vehicle tracks;
    h. location of all proposed temporary drainage control measures;
    i. location of all proposed erosion and sediment control measures; and
    j. details on installation sequence/
8. Implement maintenance requirements and inspection regime using the ESC Inspection Proforma.

9.2 Installation sequence

The sequence for installation of ESC measures should occur as follows:

1. Establish the entry and exit points;
2. Divert upslope catchment around the planned disturbance and appropriately stabilise any drainage channels (and supplementary sediment control structure/s if required);

3 Install sediment control structure/s;
4 Construct drainage controls to the sediment control structure/s;
5 Clear only areas approved under the site disturbance permit;
6 Stockpile soil within the sediment-controlled area;
7 Stabilise exposed earth with erosion control structures where possible;
8 Commence works;
9 Maintain all control structures in good working order; and
10 Revegetate or otherwise stabilise the site (not applicable to overburden dump during operations period).

9.3 Decommissioning sequence

Decommissioning of ESC measures is part of returning the site to a natural landform which is safe, stable and non-polluting. The objective of decommissioning is to remove the operational structures and establish revegetation. The sequence for decommissioning of ESC measures should occur as follows:

1 The catchment shall have achieved at least 80% ground cover (IECA, 2008) as determined by annual rehabilitation monitoring;
2 Decommission all up-slope drainage controls (contour banks and drop structures) and revegetate;
3 Once vegetation is established on the decommissioned up-slope drainage, decommission the catchment boundary drains (toe drains);
4 De-water the sediment basins and remove any sediment from the sediment storage zone;
5 Decommission the sediment basin, by removing walls, filling any voids and revegetating the disturbance area. The sediment basin shall not be able to contain water; and
6 Continue rehabilitation monitoring of the decommissioned ESC measures and conduct maintenance of the rehabilitation as required.

9.4 ESC criteria

The decision as to which combination of ESC measures, as described in this ESC Plan, will be adopted lies with the site General Manager with input from the Environmental representative onsite and the contractors. The decision will be based on several factors as follows:

- site topography;
- material / soil / surface / strata type – where the control measure will be implemented and downstream of the control measure;
- current disturbance category;
- site specific constraints e.g. proximity of local watercourse;
- length of time that area will remain at this disturbance category;
- overall purpose of implementing ESC at a particular location; and
- applicability of ESC measure as per ESC Matrix.

The selection criteria that should be applied when choosing the most appropriate ESC measure(s) are (refer IECA, 2008):

- applicability to the full range of site conditions considered reasonable (construction phase and operational phase of ESC measure);
- availability of materials from onsite operations;
- cost-effectiveness based upon overall life of the work involved;
- durability in relation to hydraulic and structural design during the life of the control measure performance in relation to purpose and control standard requirements; and
- performance in relation to purpose and control standard requirements.

9.5 ESC matrix

Table 9.1 shows a matrix of land uses and ESC measures developed to assist in determining which ESC measure may be applicable. Not all ESC measures will be applicable to the relevant land use type.

This tool for selecting appropriate ESC measures is based on:

- the phase of the site (operational, non-operational or construction);
- land use type, adjacent land usage / classification and proximity to watercourses; and
- level of priority in providing ESC measures.

Where multiple ESC measures can be applied to the same situation, the Environment representative shall be consulted. Once an ESC measure has been selected from the matrix, reference can be made to the IECA (2008) guidelines, which summarise design aspects for each of the ESC measures.

9.6 ESC implementation

The site should maintain a GIS layer showing the area within each ESC Catchment Plan to demonstrate that all sediment water within the New Lenton ML areas is covered. The ESC Catchment Plan should be given a unique number which is listed on both the Plan and the electronic file holding each Plan. The ESC Catchment Plan will be prepared listing all ESC structures within the area. These assets will be located in a GIS map and a unique identification number (asset number) will be given to them.

9.7 ESC inventory register

An asset register database will be prepared for all ESC structures at the site. These assets will be located in a GIS map and a unique identification number (asset number) will be given to them.

Table 9.1 – ESC matrix

ID	Phase (O = Operational; N = Non-operational;	Landuse type	ESC Priority (L= low, M = Medium, H = High, HH = top	Drainage control									Erosion control							Sediment control				
				Catch Drains	Check Dams (incl. fibre rolls)	Grass	Cellular Confinement systems	Hard Armouring	Rock Mattress	Rock Lining	Level Spreader	Rock Protection	Cellular Confinement systems	Compost Blanket	Gravelling	Mulching	Revegetation	Rock Mulch	Soil Binders	Rock Filter Dam	Check Dam Sed. Trap	Sediment Basin	Buffer Zone	Sediment Fence
1	O	Spoil - Draining Externally	HH	✓									✓	✓	✓	✓	✓	✓	✓			✓		
2	O	Spoil - Draining Internally	M	✓	✓											✓						✓		
3	O	Spoil Topsoiled (to be revegetated)	H	✓	✓											✓	✓		✓	✓	✓	✓	✓	✓
4	O	Spoil Topsoiled, ripped and seeded	L	✓	✓	✓														✓	✓	✓	✓	✓
5	O	Topsoil stripping area	M	✓	✓											✓				✓	✓	✓	✓	✓
6	O	Topsoil Stockpiles	M	✓	✓	✓								✓	✓	✓	✓			✓	✓	✓	✓	✓
7	O	Exploratory and access tracks	M	✓	✓	✓	✓				✓		✓		✓	✓	✓	✓	✓	✓	✓		✓	✓
8	O	Haul Roads	H	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓					✓	✓	✓	✓	✓
9	O	Infrastructure Areas	L	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
10	N	Exploration Activity	M	✓	✓	✓	✓				✓			✓	✓	✓	✓		✓	✓		✓	✓	✓
11	C	Land clearing (woody vegetation)	M	✓	✓						✓					✓				✓		✓	✓	✓
12	O	Drainage channels	HH	✓	✓	✓	✓	✓	✓	✓	✓	✓								✓				
13	C	Construction / excavation work	M	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

10 Monitoring and emergency reporting

10.1 Monitoring and maintenance inspections

An effective monitoring program will be implemented to assess the effectiveness of the ESC measures. The monitoring methodology for all onsite activities is detailed in the license or conditions of the approval to operate and the internal processes at NL.

Maintenance and routine inspection options are:

- Prior to 1 November each year (prior to onset of wet season);
- After each significant rainfall event that may have impacted the functionality of the ESC measure; and
- A routine inspection mid-way through the wet season (e.g. February).
- For sediment control structures (e.g. sediment dams), check for sediment deposition and the requirement for its removal.

The ESC Inspection Proforma will state the maintenance and inspection frequency. The inspection and monitoring regime will collect and record the following key information:

- The previous condition of the infrastructure and any recommendations or works actioned since the last inspection;
- The current condition of the ESC infrastructure;
- The ESC controls currently in place, and their condition; and
- Recommendations on remedial measures or additional ESC controls.

Any failure of effectiveness of a structure will be reported to the Senior Environmental Advisor. The implementation plan will include the recommendations for the incident report.

10.2 Incident reporting procedures

Incident reporting procedures will be managed in accordance with the site Environmental Management System. No additional measures are required by this Standard.

10.3 Revisions and updates

This ESC Plan is to be reviewed by an appropriately qualified person each calendar year and regularly updated to ensure it remains current in relation to applicable reference documents, ESC techniques and application.

11 References

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