CBGU D&C JV

# Erosion and Sediment Control Plan (Overarching)

## Cross River Rail Project – Tunnel, Stations and Development Package (TSD)

| REV | DATE | PREPARED BY NAME & SIGNATURE | REVIEWED BY NAME & SIGNATURE | APPROVED BY NAME & SIGNATURE | REMARKS |
|---|---|---|---|---|---|
| [redacted] | | | | | |

Document number: CRRTSD-EN-ENMP-CBGU-000016

Revision date: 14/09/2020

Revision: 5

# Compliance Matrix

*Table 1 Compliance matrix*

| CRRDA REFERENCE | REQUIREMENT | ADDRESSED IN SECTION |
|---|---|---|
| Coordinator-General's change report<br>Appendix 1 – Part C. – Condition 18 Erosion and Sediment Control | | |
| Coordinator-General's change report – whole of project refinements 2019<br>Appendix 1 – Part C. – Condition 15 Water Quality | | |
| (a) | Discharge of surface water and groundwater from Project Works must comply with the Brisbane River Estuary environmental values and water quality objectives (Basin no. 143 - mid-estuary) in the Environmental Protection (Water) Policy 2009. | This Plan |
| (b) | During construction monitor and report on water quality in accordance with the Water Quality Management Plan, a sub-plan of the Construction Environmental Management Plan. | This Plan |
| Coordinator-General's change report<br>Appendix 1 – Part C. – Condition 17 Water Quality | | |
| (a) | Project Works, and worksites, must be designed and implemented to avoid inundation from stormwater due to a 2 year (6hr) ARI rainfall event and flood waters due to a 5 year ARI rainfall event. | This Plan |
| (b) | Project works must be designed and implemented to avoid afflux or cause the redirection of uncontrolled surface water flows, including stormwater flows, outside of worksites. | This Plan |
| Coordinator-General's change report<br>Appendix 1 – Part C. – Condition 18 Erosion And Sediment Control | | |
| (a) | An erosion and sediment control sub-plan that is consistent with the Guidelines for Best Practice Erosion and Sediment Control (International Erosion Control Association, 2008) and the Department of Transport and Main Roads' Technical Standard MRTS52 – Erosion and Sediment Control must be submitted as part of the Construction Environmental Management Plan. | This Plan |
| CRRDA REFERENCE | REQUIREMENT | ADDRESSED IN SECTION |
| Coordinator-General's change report<br>Appendix 1 – Part C. – Condition 18 Erosion and Sediment Control | | |
| (c) | An erosion and sediment control sub-plan that is consistent with the Guidelines for Best Practice Erosion and Sediment Control (International Erosion Control Association, 2008) and the Department of Transport and Main Roads' Technical Standard MRTS52 – Erosion and Sediment Control must be submitted as part of the Construction Environmental Management Plan. | This Plan |

# Details of Revision Amendments

## Document Control

The CBGU Project Director is responsible for ensuring that this Plan is reviewed and approved. The Project Environment & Sustainability Manager is responsible for updating this Plan to reflect changes to the Project, legal and other requirements, as required.

## Amendments

Any revisions or amendments must be approved by the CBGU Project Director before being distributed / implemented.

## Distribution and Authorisation

The CBGU Project Director is responsible for the distribution of this Plan. The controlled master version of this document is available for distribution as appropriate and maintained on TeamBinder. All circulated hard copies of this document are deemed to be uncontrolled.

All personnel employed on the Project will perform their duties in accordance with the requirements of this Plan, supporting management plans, and related procedures.

# Table of Contents

# Table of Tables

# Referenced Documents

The following provides a list of referenced documents either as a sub-plan to this plan or referenced from.

*Table 2 Referenced Documents*

| Document Number | Document Name | Location of Controlled Version |
|---|---|---|
| Referenced Project Plans include: | | |
| CRRTSD-EN-ENMP-CBGU-000001 | Air Quality Management Plan | TeamBinder |
| CRRTSD-EN-MPL-CBGU-000019 | Construction Environmental Management Plan | TeamBinder |
| CRRTSD-TM-MPL-CBGU-000012 | Construction Traffic Management Plan | TeamBinder |
| CRRTSD-CS-MPL-CBGU-000036 | Construction Worksite Management Plan | TeamBinder |
| CRRTSD-TM-MPL-CBGU-000014 | Haulage Management Plan | TeamBinder |
| CRRTSD-EN-ENMP-CBGU-000004 | Social Amenity Management Plan | TeamBinder |
| CRRTSD-EN-ENMP-CBGU-000017 | Water Quality Management Plan | TeamBinder |
| CRRTSD-EN-ENMP-CBGU-000020 | Water Quality Monitoring Plan | TeamBinder |
| CRRTSD-EN-ENMP-CBGU-000011 | Acid Sulfate Soil Management Plan | TeamBinder |
| CRRTSD-EN-ENMP-CBGU-0000010 | Contaminated Land Management Plan | TeamBinder |

Note: this Management Plan may not contain the current version of the documents listed above. Refer to the 'location of controlled version' for the most current version.

# Glossary of Terms

*Table 3 Terms*

| Term | Meaning |
|---|---|
| AQMP | Air Quality Management Plan |
| BCC | Brisbane City Council |
| CBD | Central Business District |
| CBGU | Design & Construct Contractor comprising a joint venture with CPB Contractors Pty Ltd, BAM International Australia Pty Ltd, Ghella Pty Ltd and UGL Engineering Pty Ltd |
| CEMP | Construction Environmental Management Plan |
| CG | Coordinator-General |
| CGCR | Coordinator-General change reports |
| CRR | Cross River Rail |
| CSEP | Communications and Stakeholder Engagement Plan |
| CTMP | Construction Traffic Management Plan |
| CWMP | Construction Worksite Management Plan |
| DA | Delivery Authority |
| DEHP | Department of Environment and Heritage Protection (now DES) |
| Delivery Authority | Cross River Rail Delivery Authority |
| DES | Department of Environment and Science |
| DTMR | Department of Transport and Main Roads |
| EP Act | Environmental Protection Act 1994 (Qld) |
| EPP (Water) | Environmental Protection (Water) Policy 2009 (Qld) |
| ESC | Erosion and Sediment Control |
| ESCPO | Erosion and Sediment Control (Overarching) Sub-Plan |
| HMP | Haulage Management Plan |
| IECA | International Erosion Control Association |
| km | Kilometre |
| m | Metre |
| mm | Millimetre |
| MRTS | Main Roads Technical Standards |
| Project | Cross River Rail Project |
| PSTR | Project Scope and Technical Requirements |
| OEMP | Outline Environmental Management Plan |
| QLD | Queensland |
| QR | Queensland Rail |

| Term | Meaning |
|---|---|
| RNA | Royal National Agriculture and Industrial Association |
| SAMP | Social Amenity Management Plan |
| TeamBinder | Proprietary software used as part of the Project wide Electronic Document Management System |
| TMR | Transport and Main Roads |
| TSD | Tunnel, Stations and Development |
| WQMP | Water Quality Management Plan |

# 1 Introduction

## 1.1 Background

The Design and Construction Joint Venture comprising of CPB Contractors Pty Ltd, BAM International Australia Pty Ltd, Ghella Pty Ltd and UGL Engineering Pty Ltd (CBGU D&C JV or CBGU) is responsible for delivering the Cross River Rail (CRR) Project (the Project) on behalf of the Cross River Rail Delivery Authority (the Delivery Authority).

This Erosion and Sediment Control Plan should be read in conjunction with the Project's overarching Construction Environment Management Plan (CEMP).

The CEMP provides specific details regarding the background of the Project, the scope of the Project and the staging and timing of key milestones associated with the construction of the Project.

## 1.2 Context

This Erosion and Sediment Control Plan (Overarching) ESCPO forms part of the Construction Environmental Management Plan (CEMP) developed for the construction of the Project. The ESCPO describes how the CPBU D&C JV will manage erosion and sediment and minimise impacts during construction of the Project.

The ESCPO draws upon the best practices and principles to mitigate the overall environmental impact of the Project. The objective of the ESCPO is to minimise the pollution of ground and surface waters resulting from construction activities. This includes specific structures and measures to reduce erosion and off-site sedimentation, which are to be implemented in conjunction with various site management techniques. The following principles will apply to all areas and stages of the construction program:

1) Minimise ground disturbance;
2) Control CW around and through The Project;
3) Implement erosion control strategies to prevent the generation of sediment;
4) Implement sediment control strategies to avoid off-site pollution;
5) Progressive stabilisation following completion of each work area; and
6) Monitoring of controls & Treatment Train, including maintenance requirements.

## 1.3 Objectives

The objectives of this ESCPO which is a sub-plan of the CEMP are to:

- Provide measures to avoid, or minimise and manage the effects of soil erosion on the land and receiving waters in the vicinity of the Project Works
- Describe the erosion and sediment control (ESC) approach that will be employed by the Project
- Ensure controls and procedures are implemented during construction activities to avoid, minimise or manage potential adverse impacts resulting from erosion and the movement of sediment within and adjacent to the Project, including impacts to the downstream environment and waterways
- Nominate the Project's monitoring and reporting requirements in relation to ESC
- Monitor the effects of management and mitigation measures.

# 1.4 Legislative Framework

## 1.4.1 Commonwealth Legislation

No Commonwealth legislation is specifically relevant to this ESCPO.

## 1.4.2 State Legislation

State legislation that is relevant to the Project and this ESCP includes:

- *Cross River Rail Delivery Authority Act 2016*
- *Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP (Water)).*
- *City of Brisbane Act 2010*
- *Planning Act 2016*
- *Economic Development Act 2012*
- *State Development and Public Works Organisation Act 1971*
- *Environmental Protection Act 1994*
- *Building Act 1975*
- *Local Government Act 2009*
- *Transport Infrastructure Act 1994*
- *Work Health and Safety Act 2011.*

## 1.4.3 Approvals, Permits and Licences

CBGU will obtain licences, permits and approvals as required by law and maintain them as required throughout the delivery phase of the project. No condition of the Infrastructure Approval removes the obligation for CBGU to obtain, renew or comply with such necessary licences, permits or approvals.

All relevant approvals, permits and licences have been identified in the CEMP. None are related explicitly to erosion and sediment control.

## 1.4.4 Guidelines and Standards

Design, construction and commissioning of the works must be undertaken in accordance with the specific guidelines nominated in the relevant sub-sections within this management plan. Guidelines and standards related to erosion and sediment control that must be met include, but are not limited to:

- TMR standards, including:
  - MRTS52 Erosion and Sediment Control – TMR Specifications
  - MRTS16 Landscape and Revegetation Works – TMR Specifications.
- International Erosion Control Association Best Practice Erosion and Sediment Control Guidelines 2008 (IECA Guidelines)
  - International Erosion Control Association (IECA) Australasia 'Appendix B – Sediment basin design and operation' (June 2018)
- ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.www.waterquality.gov.au/anz-guidelines

- Environmental Protection Policy (Water) Brisbane River Estuary environmental values and water quality objectives (Queensland Government)
- Procedural guide, compliance notes: Standard work method for the assessment of the lawfulness of releases to waters from constructions site – South East Queensland.

### 1.4.5 Certification

[redacted] certify that this Erosion and Sediment Control Plan (ref: CRRTSD-EN-ENMP-CBGU-000016) has been prepared to satisfy the following requirements:

- The intent and minimum standards nominated within the IECA (2008) Best Practice Erosion and Sediment Control document
- MRTS51 and MRTS52 for relevant 'risk' classification

When implemented it will assist in compliance with the Environmental Protection Act 1994, Environmental Protection (Water) Policy 2009, Qld Water Quality Guidelines and the Coordinator-General's change report – refinements and condition changes 2020 (July 2020).

[redacted]

CPESC No [redacted]

## 1.5 Planning And Staging

It is intended that the project works are covered by a multi-tiered level of planning to not only facilitate and present the overarching strategy but also assist in the implementation and staging of controls according to current works on site. To capture this, the following framework has been adopted.

*Table 4 - Project ESC planning framework*

| TIER | INTENT |
|---|---|
| ESCPO | Present the general approach to ESC, including the installation sequence and timing of controls, deviation to IECA 2008, response strategy for managing significant rain events, and the monitoring and maintenance requirements for the project site, erosion and sediment controls and receiving environment. |
| Site-specific ESCPs (SESCPs) | Drawings prepared to indicate the location of controls for specific areas throughout all stages of construction, including 'clear and grub', earthworks, final levels and landscaping. |
| Progressive ESCPs | Progressive ESCPs will be developed by the project Certified Professional in Erosion and Sediment Control (CPESC) to address site specific changes as they occur in accordance with the Overarching ESCP scope. |

Site-specific ESCPs will be referenced within in the Construction Area Plans and accompanying Site Environment Plans. The CPESC approved Site-specific ESCPs for each of the Precincts will be provided to the IEM.

## 1.6 Project Summary

The Project Summary is detailed in Section 2 of the CEMP.

# 2 Required Outcomes

The following Imposed Conditions and environmental outcomes must be achieved throughout the construction of the Project. The environmental outcomes may be achieved by meeting the performance criteria in this ESCPO.

## 2.1 Coordinator-General Conditions

The Imposed Conditions relating to Erosion and Sediment Control for the Project can be found on the Coordinator-General's website (http://www.dsdmip.qld.gov.au/coordinator-general/assessments-and-approvals/coordinated-projects/completed-projects/cross-river-rail-project.html).

## 2.2 Environmental Outcomes

The following environmental outcomes in relation to erosion and sediment control are to be achieved for the Project:

- Construction activities minimise soil erosion and sedimentation and avoid adverse impacts on the environmental values of receiving waters
- Construction activities do not impact on the environmental values of the Brisbane River and other waterways

## 2.3 Performance Criteria

The following performance criteria must be achieved throughout the construction of the Project:

- The Project does not result in soil erosion beyond the boundaries of worksites. Soil erosion within a worksite is rectified as soon as practicable after a rainfall event to prevent the release of sediment offsite
- Soil erosion and sediment controls are implemented and maintained for each worksite in accordance with the guidelines for Best Practice Erosion and Sediment Control (International Erosion Control Association, 2008) and TMR's Technical Standard MRTS52 Erosion and Sediment Control

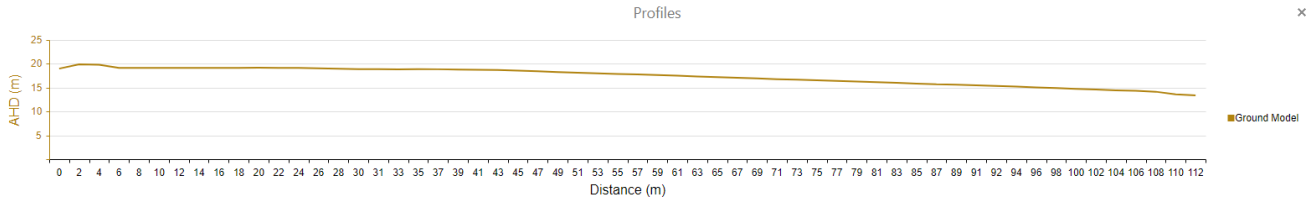
Runoff from worksites complies with the guidelines for Best Practice Erosion and Sediment Control (International Erosion Control Association, 2008) and TMR's Technical Standard MRTS52 Erosion and Sediment Control.

# 3 Site Description

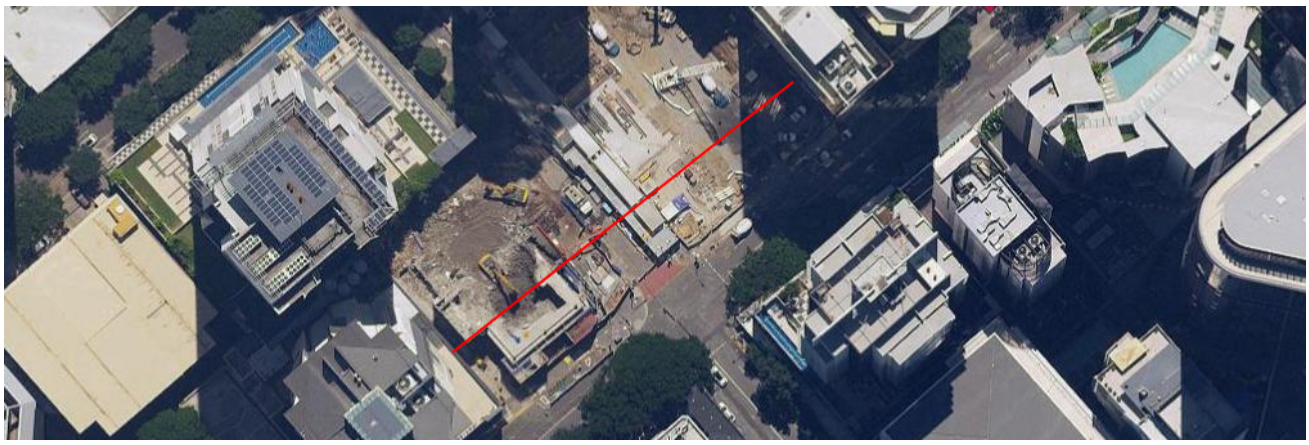
## 3.1 Topography

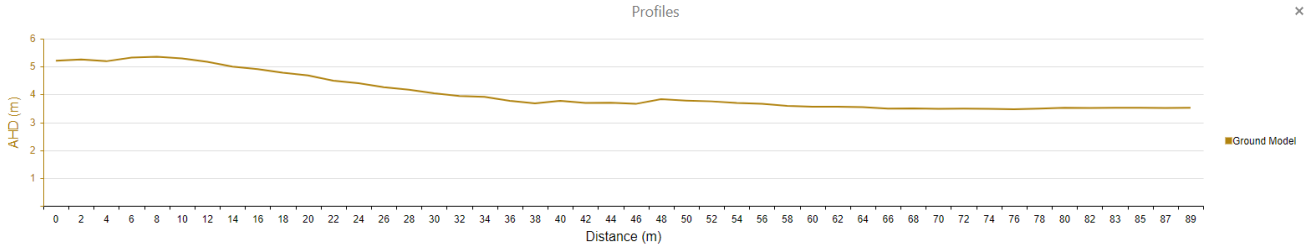
Topography along the project site is generally characterised by undulating terrain with several prominent high and low points. The topography and longitudinal profile of each work area/precinct are summarised/presented below:

- Northern Portal - Although most works are limited to the relatively flat existing rail corridor, it is bounded by moderate to steep slopes along Victoria Park and the Brisbane Grammar School, with a steep drop off to the Inner-City Bypass (ICB) in the North.
- Roma Street Precinct – Located adjacent and within the existing rail corridor where natural topography has been modified, and construction works limited to the relatively flat existing formation.

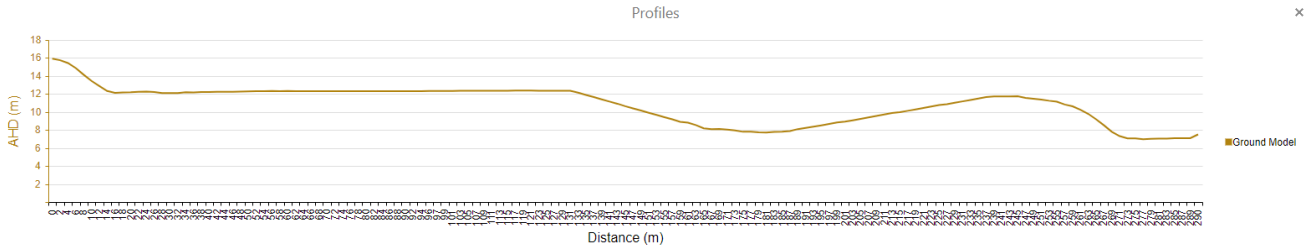




- Albert Street Precinct - Natural topography has been modified and construction works limited to the relatively flat existing formation.

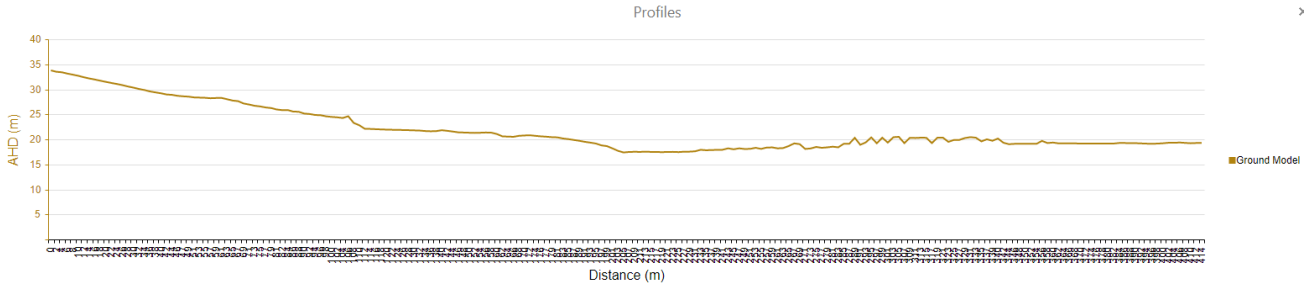





- Woolloongabba Precinct – The topography has been modified; however, the topography is generally flat with steeper sloops on the western, northern and eastern boundaries.




- Boggo Road Precinct – The topography is milder around outlook park and slopes increase to moderate as they progress south.




- Southern Portal - Much of the works associated with the project in the southern portal are located in the existing corridor, with very mild existing topography.

## 3.2 Climate

Various Early Works (such as clearing, demolition, service location, site establishment, earthworks, ground reinforcement works, shaft excavation, etc.) commenced during October 2019 or are underway. Completion of the project is anticipated in 2024.

The area is classified as a sub-tropical climate and receives a mean annual rainfall of 1011.5 mm per year (BOM, 2020). As shown in Table 5, rainfall is mostly associated with summer thunderstorms, while low-intensity rainfall is relatively infrequent. Seasonal variations are variable and unpredictable. Nevertheless, warm-season rainfall tends to be more reliable than the cool season.

Based on the topography, surrounding land uses and characteristics of creeks and drainage lines within the project alignment, it is anticipated that following runoff producing rainfall events flows will be conveyed quickly with a relatively short time of concentrations for external catchments. Careful planning and staging of works within and immediately surrounding creeks and drainage lines will be a critical component of managing ESC. Similarly, plans will identify contingency measures should works be underway within creeks and drainage lines to minimise the generation and export of sediment.

Based on historical rainfall data, the period between December to March presents the greatest rainfall for the Brisbane Region. Based on the construction duration, the project will extend through at least four (4) wet seasons. As far as practical, all effort should be made to reduce exposed areas to that reasonably manageable during these periods.

*Table 5 - Brisbane Historic Rainfall Data (source: BoM)*

| Brisbane Mean Rainfall Records | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
| Mean Rainfall | 140.5 | 150.4 | 115.3 | 58.8 | 59.7 | 66.9 | 24.7 | 36.2 | 28.4 | 77.8 | 91.4 | 129.2 | **1011.5** |
| Mean Rainfall Days | 8.2 | 9.7 | 9.7 | 6.9 | 5.5 | 6.6 | 3.6 | 3.6 | 3.8 | 6.9 | 7.8 | 8.9 | **81.2** |

Historic rainfall for the region, represented by the closest Bureau of Meteorology Station is presented below in Table 5 and graphically in Figure 2.

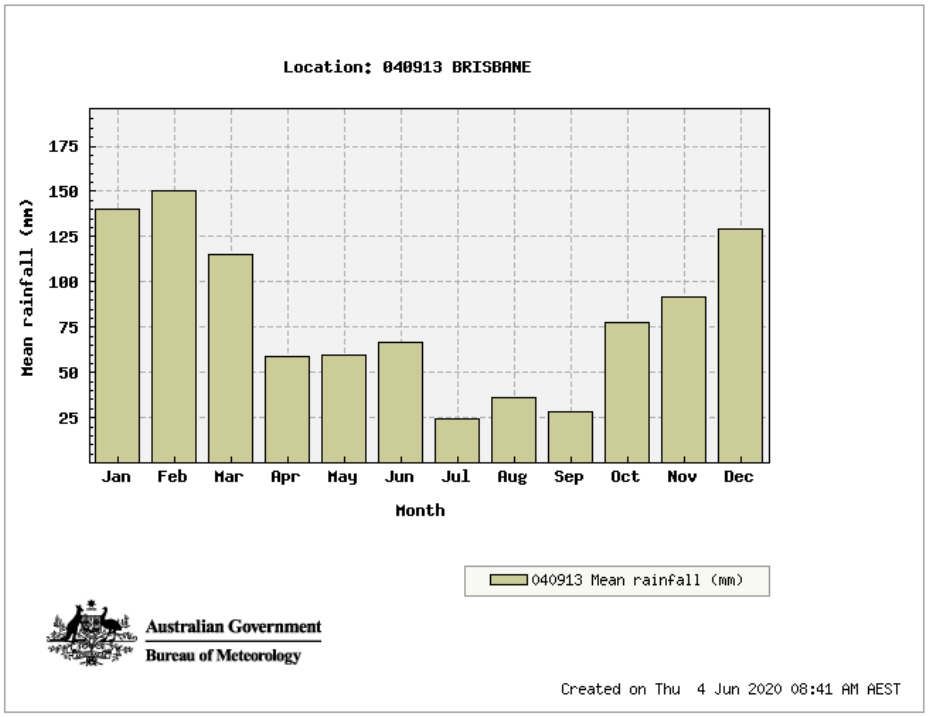



*Figure 1 Brisbane Historic Rainfall Data (source: BoM)*

## 3.3 Soils and Geology

A desktop assessment of soils and geology has been undertaken using available soil mapping, supported by field geotechnical testing, with the following information sourced from the Cross River Rail Environmental Impact Statement (EIS) 2011 – Volume 1 Chapter 7.

The methodology for the preparation of the description of the existing environment and potential impact assessment included:

- review of existing mapping and geotechnical data
- review of previous reports and investigations
- review of the design, feasibility and planning reports, constraints mapping and construction issues and geotechnical investigation reports.

### 3.3.1 Soil Mapping

A review of the Soil Landscapes of Brisbane and South-Eastern Environs (Beckman et al 1987) was completed for the identification of the soil landscapes mapped throughout the study corridor. This has been supported and verified by geotechnical investigations.

Within the project alignment, six soil landscapes have been identified (refer to Figure 2 Soil Landscapes of Brisbane and South-Eastern Environs (Beckman et al 1987) and Figure 3 Soil Landscapes of Brisbane and South-Eastern Environs (Beckman et al 1987)). Their characteristics and other corresponding attributes, including the ASS (NR&M, 2002) and erosion hazard assessment based on the soil characteristics are summarised in Table 6.

*Table 6 Soil landscapes within the project alignment*

| Soil landscape | Dominant soil groups | Landscape and parent rock | CSIRO Soil Order[2] and Australian Soil Classification Order[3] | ASS[4] | Erosion hazard[5] |
|---|---|---|---|---|---|
| Beenleigh | Red – yellow podzolic soils, with lithosols and some gleyed podzolic soils | Low hills of greywacke, phyllite and shale | Tb64 Rudosol/Podosol /Sodosol/Hydrosol | Possible | Moderate |
| Brisbane River | Prairie soils with some alluvial soils | Low undulating plain and terrace remnants | Tb64 Dermosol | Likely | Moderate to high – susceptible to wind erosion |
| Moggill Creek | Gleyed podzolic soils with minor prairie and alluvial soils | Creek flats of sandy and clayey alluvium | Tb64 Rudosol/Chromosol | Unlikely | Moderate |
| Chermside | Lithosols with shallow podzolic soils | Low hills, some with steep slopes of rhyolitic tuff | Tb64 Rudosol | Unlikely | Low to moderate - erosion is an active process within this soil landscape |
| Toowong | Red podzolic soils with lithosols | Low hills of phyllite | Tb64 ASC Order not determined | Unlikely | Moderate |
| Woodridge | Red – yellow podzolic soils, with lithosols, gleyed podzolic soils and lateritic podzolic soils | Low hills of sandstone and shales | Tb64 Rudosol | Unlikely | Moderate to high |

*Notes:*

*1. Beckmann, et al (1987)*

*2. CSIRO (2001)*

*3. Isbell (2002)*

*4. NR&M (2003)*

*5. Charman and Murphy (2001)*

Descriptions for each of the soil landscapes in Beckmann et al (1987) within the central section of the study corridor are summarised as follows.

The Beenleigh soil landscape is found covering large areas of Spring Hill and the Brisbane CBD with a small isolated area, at the eastern end of Queen Street, which is surrounded by the Brisbane River soil landscape. The soil is comprised of red – yellow podzolic soils with lithosols and some gleyed podzolic soils. It is characteristic of low hills of greywacke, phyllite and shale parent rock. Soils within this soil landscape generally show markedly differentiated profiles.

Red – yellow podzolic soils generally have distinct to prominent horizon contrasts in colour, texture, structure and related properties, mainly between the surface (A) and subsoil (B) horizons. Red – yellow podzolic soils

have pronounced texture contrast and a clear to gradual boundary between weakly structured sandy to loamy A horizons and red or yellow-brown clay B horizons of moderate blocky or polyhedral structure and firm to friable consistence. Generally nutrient status of these soils tends to be low (Beckman et al, 1987) and erodibility can range between moderate to high, but this would be dependent on other factors such as the location of the soil within the landscape, the slope steepness and length exposure to high intensity rainfall or high velocity runoff and methods/effectiveness of surface stabilisation (Charman and Murphy, 2001).

Alternately, Lithosols tend to be stony and gravelly soils of sandy, loamy or clayey texture usually overlying fragmented and weathering rock at shallow depth (40 to 60 cm), occurring mainly on ridge crests or steep to moderate upper slopes where continual removal of fine earth by erosion limits profile development (Beckman et al 1987 p11). These soils tend to occupy locations within the landscape where erosion is active (Charman and Murphy, 2001) and is a key characteristic/determining factor of this soil type.

During the geotechnical investigations for the Project, observations of soils from a number of bore logs in the Beenleigh soil landscape were reviewed. However the observations recorded in the bore logs were not considered to be consistent with the attributes of the Beenleigh soil landscape due to the disturbed nature of the surface and near surface profiles and the depth and characteristics of the material observed.

The Brisbane River soil landscape is found on the northern banks of the Brisbane River within the Brisbane CBD. This soil landscape is comprised of prairie soils with some sandy alluvial soils.

Brisbane River soils are associated with low undulating plain and terrace remnants of sandy alluvium parent rock and is characterised by markedly differentiated profiles.

During the geotechnical investigations for the Project, observations within the Brisbane River soil landscape were recorded at one borehole location within the central section of the study corridor, on the northern side of the Brisbane River channel, within the City Botanic Gardens. Observations of the soil profile and characteristics at this location were considered to be consistent with the attributes of this soil landscape.

The Moggill Creek soil landscape has been identified in an isolated area in the vicinity of the Roma Street Station, in the low point of the topography between Spring Hill and the Brisbane CBD. This soil landscape is generally comprised of gleyed podzolic soils, with minor prairie and alluvial soils. They are characteristic of creek flats of sandy and clayey alluvium parent material and generally indicate an influence of poor drainage. These soils usually show a pronounced texture contrast and clear to gradual boundaries between A and B horizons, a pale or bleached A2 horizon and acid reaction throughout, or acid and becoming neutral in the deep subsoil (Beckmann et al 1987).

In the natural state the gleyed podzolic soils have marked deficiencies of major plant nutrients but their water regimes generally ensure available water for plant growth for longer periods than occur in freely drained podzolic soils (Beckmann et al 1987).

During the geotechnical investigations for the Project, observations within the Moggill Creek soil landscape were recorded at one borehole location, in the vicinity of Roma Street Station. However the observations recorded at this location were not considered consistent with the Moggill Creek soil landscape due to the level of disturbance and observed attributes and characteristics of the soil profile description.

The Chermside soil is intercepted in a number of locations within the study corridor. In the central section the Chermside soil landscape is identified on the southern side of the Brisbane River, in the vicinity of Kangaroo Point and Woolloongabba. The soil is comprised of lithosols with shallow podzolic soils. These are associated

with high hills and steeply sloping areas. Soils within this soil landscape generally show little profile development.

During the geotechnical investigations for the Project, observations of soils from a number of bore logs in the Chermside soil landscape were reviewed for the central section of the study corridor. Soil profile descriptions observed were generally consistent with the Chermside soil landscape.

The Toowong soil is intercepted on the southern side of the Brisbane River west of the Kangaroo Point cliffs. This soil landscape shows a distinct to prominent horizon contrasts in colour, texture, structure and related properties, mainly between the surface (A) and subsoil (B) horizons. Soils are characterised as red – yellow podzolic soils on low hills of phyllite, that have pronounced texture contrast and a clear to gradual boundary between weakly structured sandy to loamy A horizons and red or yellow-brown clay B horizons of moderate blocky or polyhedral structure and firm to friable consistence.

No geotechnical investigations for the Project have been undertaken for this soil landscape. However, this soil landscape is unlikely to be disturbed by any Project works, so is not described further in this EIS.

The Woodridge soil landscape is intercepted in areas east of the Park Road Station and the Dutton Park Station. This soil landscape is comprised of red – yellow podzolic soils, with lithosols, gleyed podzolic soils and lateritic podzolic soils and is generally situated on low hills of sandstone and shales (Beckman et al 1987 p.11). Lateritic podzolic soils are similar to mottled intergrade form of red and yellow podzolic soils but with large amounts of ironstone nodules in the lower part of the thick sandy A2 horizon and mottled upper B horizon. They are usually of greater depth (more than 2 m) than the red and yellow podzolic soils and have prominent red and light grey coarse mottling toward the base of the solum. The upper B horizons are usually strongly blocky to polyhedral and friable to firm when moist but structure becomes coarser and consistence may be very firm in the deep subsoil (Beckmann et al 1987).

These podzolic soils are moderately to strongly acid, the clays are dominantly kaolin and exchange capacity and base saturation are low. Available water and nutrient status tend to be low (Beckmann et al 1987). Erodibility can range between moderate to high, but this would be dependent on other factors such as the location of the soil within the landscape, the slope steepness and duration of exposure to high intensity rainfall or high velocity runoff and methods/effectiveness of surface stabilisation (Charman and Murphy, 2001).

During the geotechnical investigations for the Project, observations of soils from a number of bore logs in the Woodridge soil landscape were reviewed for the central section of the study corridor. Soil profile descriptions observed were generally consistent with the Woodridge soil landscape.

### Erosion hazard

Areas of high erosion risk and steep areas (eg greater than 10% gradient) have been identified within the central section of the study corridor at Spring Hill, Woolloongabba and Dutton Park.

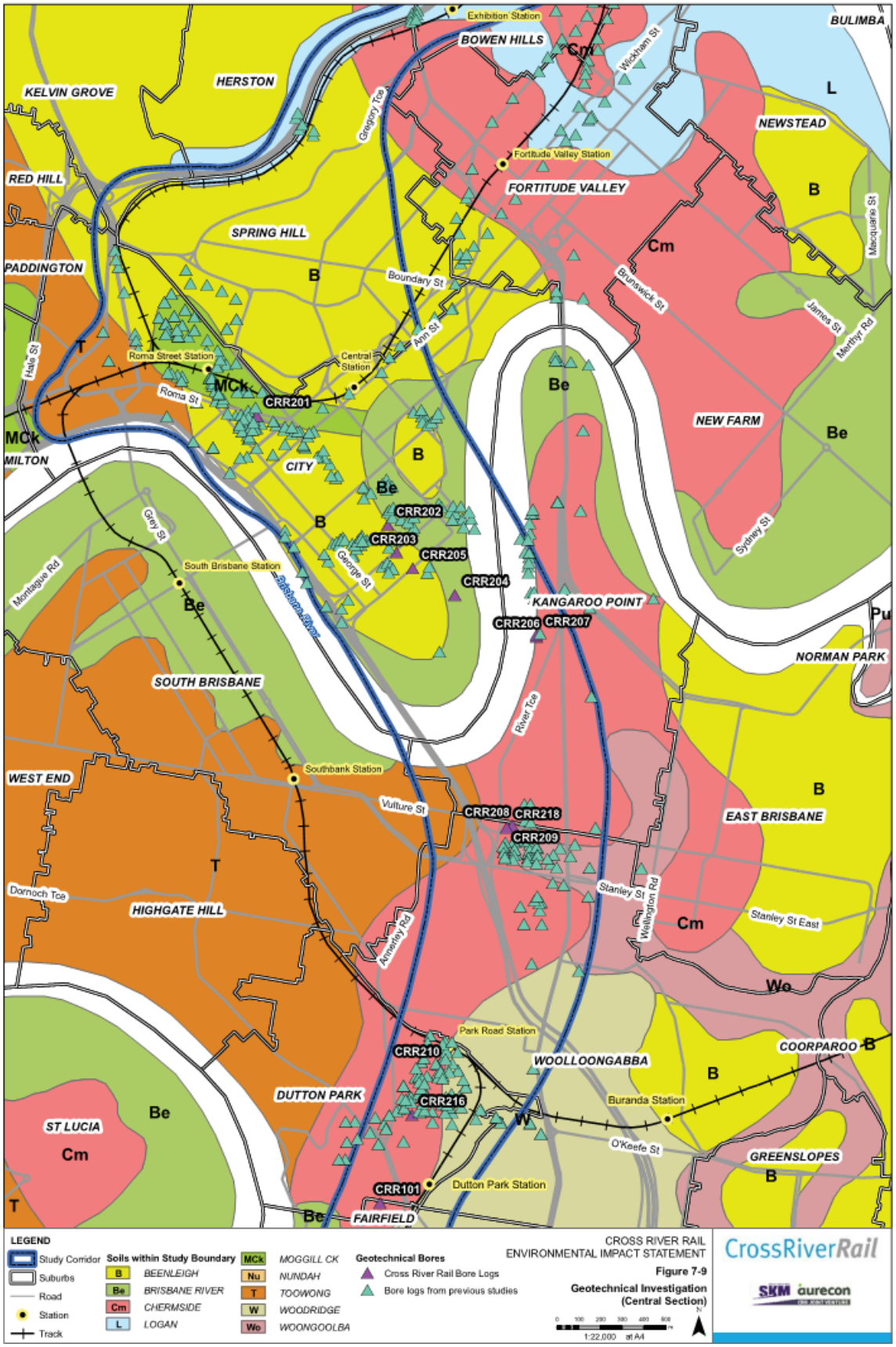



*Figure 2 Soil Landscapes of Brisbane and South-Eastern Environs (Beckman et al 1987)*

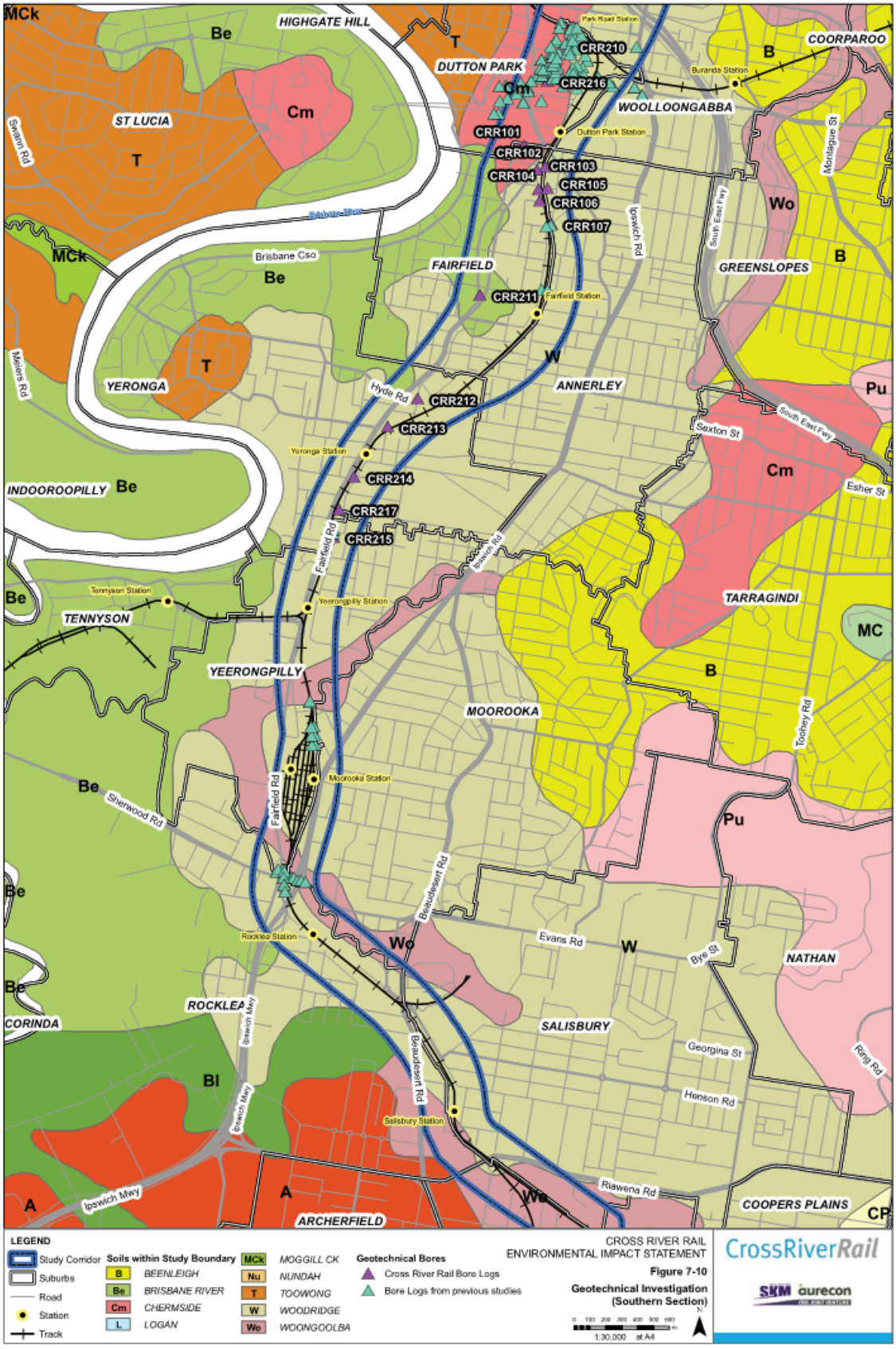



*Figure 3* *Soil Landscapes of Brisbane and South-Eastern Environs (Beckman et al 1987)*

### 3.3.2 Dispersive Soil Management

Based on the available soil mapping and geotechnical investigations, dispersive soils may be encountered within select portions of the project, most likely associated with the Beenleigh soil unit reported around Roma Street and Northern Portal works. The following section summarises the proposed management and treatment to address dispersive soils on the project.

#### Identify and Avoid

This approach is limited in terms of practical application to areas outside of project works. Consideration should be given to limiting disturbance, and excavation of soils were not required as a means to reduce the reliance on other management measures below.

#### Separation of Topsoil and Subsoil

Whilst works are typically limited to "brown-fields" areas it is expected that some topsoil will be encountered on the project, and good construction practices will dictate that topsoils be stripped and stockpiled separately to subsoils. Care should be taken during stripping works to limit mixing of profiles as much as practical. This will be particularly important in areas of potential contamination or ASS.

Topsoil stockpiles which are planned to remain unused for prolonged periods of time should be stabilised using mulch, hydromulch or a permeable, biodegradable matting or mesh to allow sunlight and moisture to penetrate and maintain biological activity.

Subsoil stockpiles containing dispersive soils should be compacted and covered using an impermeable cover such as plastic or have a layer of non sodic (and non erosive) material applied.

#### Drainage Protection

Should dispersive soils be encountered on site, all effort shall be afforded to diverting water away from such materials. Drains must not be excavated into dispersive soils without either lining with an impermeable material, lining with non-erosive, non-sodic material or gypsum treated material placed and stabilised to handle maximum flow velocities for the connected catchment up to the design event (as perTable 14).

The use of rock check dams (or similar velocity control measures) should not be used in locations with potential dispersive soils exposed within the drainage path.

The use of rock protection at inlets and outlets of culverts, chute lining or other drainage locations should account for potential dispersive soils and incorporate a layer of gypsum treatment to underlying soils.

#### Temporary Erosion Control during Earthworks

A focus on erosion control throughout the construction phase is considered the most effective approach to managing soil quality. Given the contrast between wet and dry seasons in South East Queensland, a risk-based approach should be undertaken to manage the risk of dispersion during construction works. This approach will be dictated by activities onsite and should consider rainfall forecasts, upcoming works, potential to limit extent and duration of exposure during high rainfall risk periods and contingency measures which can be employed to manage areas in the event of rainfall. Such measures would include assessment of temporary drainage to divert all runoff practical off dispersive soils, compaction of exposed areas to limit soil / water interaction, application of gypsum or ground cover treatment and maintenance of downslope sediment controls.

Reference shall be made to MRTS04 and MRTS16 for additional guidance on soil characteristics, material handling, stockpiling and reuse and treatment.

### 3.3.3 Acid Sulphate Soils

Acid Sulphate soils and acid soil are present within or directly adjacent to the project area, including:

- Albert Street precinct
- Woolloongabba precinct
- Boggo Road

There is a possibility of encountering ASS where surface works are proposed in a number of the isolated alluvial valleys along the extent of the study corridor and there is potential for the disturbance of these sediments to result in impacts to the quality of both surface water and groundwater.

While the general approach to ESC during the project considers the likelihood of encountering ASS on site, management of these soils shall be addressed elsewhere, in the ASSMP included with the CEMP.

### 3.3.4 Contaminated Land

Soil management, including the placement of temporary drainage and sediment controls within this ESCPO and SESCPs considers the likely presence of contamination along the alignment, however, the management of these soils shall be addressed elsewhere, in the CLMP included with the CEMP.

### 3.3.5 Geology

General characteristics of the various geological formations within the project alignment have been presented in Table 7. It is emphasised that these properties are generalised and the actual properties of the formations must be assessed by site-specific geotechnical investigations.

*Table 7 General characteristics of the geological formations within the project alignment*

| Map symbol | Formation name | Area present | General characteristics | | | |
|---|---|---|---|---|---|---|
| | | | Weathering | Soils | Erodibility | Slope stability |
| Qhe | Holocene Alluvium (Estuarine channels and banks) | Dominant parent material associated with the sediments of the Brisbane River channel | N/A | Sandy mud, muddy sand and minor gravel | Susceptible to erosion but severity depends on local topography, drainage, nature of clays, earthworks | Unstable, would require engineered support where excavated into. Erosion protection would be required around bridges, culverts and structures |
| Qa | Quaternary Alluvium | Dominant parent material in low elevation areas in the vicinity of the Spring Hill, the CBD and Woolloongabba | N/A | Clay, silt, sand and gravel of variable strength or density | - | - |
| Rip | Aspley Formation | Dominant parent rock within the south-eastern extent of the central section – Park Road Station to Dutton Park Station | Often very deeply weathered with marked reduction in rock strength | Clayey, occasionally sandy or gravelly sometimes high plasticity | Variable resistance to erosion depending on bedrock type and local deep weathering | Low batter angles and slope protection required for shallow cuts, full support required for deeper cuts |
| Rif | Brisbane Tuff | Dominant parent rock through the areas of elevation along the south-western extent of the central section associated with the Kangaroo to Dutton Park | Usually very shallow depth of weathering but moderately weathered tuff is strong rock | Very shallow, clayey | Welded tuff highly resistant to erosion, stratified tuff tends to fret. Fine grained basal sediments fret, breccias pluck and ravel | Steep faces with occasional rock bolting possible in fresh and slightly weathered tuff. Selective support and protection in moderately weathered tuff. Basal sediments often marginally stable |

| Map symbol | Formation name | Area present | General characteristics | | | |
|---|---|---|---|---|---|---|
| | | | Weathering | Soils | Erodibility | Slope stability |
| DCf | Neranleigh-Fernvale Beds | Dominant parent rock through areas of high elevation and exposed ridge lines in Spring Hill, the CBD and South Brisbane | Shallow to moderate depth of weathering, often with penetrative weathering along fractures with the development of clay infill | Shallow clayey gravels/gravelly clays, non-expansive | Erosion resistant | Low batter angles are necessary with shallow cuts in highly weathered rock.<br>Deeper cuts into less weathered rock usually quite stable depending on orientation of foliation and joint sets, otherwise selective support required |

## 3.4 Drainage And Hydrology

Project drainage and hydrology are characterised by the existing stormwater drainage (road and rail), including several kerb and channel drains, stormwater inlets (road and field), table/cess drains, and associated drainage channels.

Runoff from the Northern Portal to the Bowen Road Bridge the Brisbane Grammar School and Victoria Park grades west/north, discharging a considerable catchment across the alignment via a series of diversion drains, inlets and culverts to the Inner-City Bypass area.

Runoff from the Roma Street and Albert Street precincts are discharge to several roadside kerb inlets. Runoff from the Woolloongabba and Boggo Road precincts are discharged via a number of field inlets and stormwater pits.

The topography of the Southern Portal is relatively low-lying with only small areas greater than 25 m AHD in elevation. In general, the topography of the southern portion of works gradually slopes down to the south-west and west towards the Brisbane River and Oxley Creek, most of which have been heavily modified from their natural state.

SESCPs include detailed information on external catchments reporting to the site, internal catchments and runoff characteristics as well as assessments of peak discharge and allowable flow velocities. In accordance with Coordinator-General conditions, all care has been taken to ensure temporary drainage and sediment controls are designed to avoid afflux or cause the redirection of uncontrolled surface water flows, including stormwater flows, outside of worksites.

### 3.4.1 Deviation To Coordinator-General Conditions

In accordance with Condition 17 of the Coordinator-General Conditions it is noted that “project works, and worksites, must be designed and implemented to avoid inundation from stormwater due to a 2 year (6hr) ARI rainfall event and floodwaters due to a 5-year ARI rainfall event”.

For the purpose of temporary ESC, it is however considered more reasonable, and effective to design drainage for flow events based on drainage design life and Intensity-Frequency-Duration (IFD) data available for the given catchment and critical duration. This principle complies with both Best Practice guidelines (namely IECA (2008), the BCC City Plan, and MRTS52 and is adopted for temporary drainage throughout the project.

*Table 8 Project ESC planning framework – Design standards for temporary drainage features*

| Reference | Drainage Feature | Anticipated Design Life (Months) | | | |
|---|---|---|---|---|---|
| | | <3 | 3 - 12 | 12 - 24 | >24 |
| IECA 2008 | Temporary Drainage Structures | 2yr ARI | | 5yr ARI | 10yr ARI |
| | Emergency Spillways | 10yr ARI | 20yr ARI | 50yr ARI | |
| | Temporary Culverts | 1yr ARI | | | |
| MRTS52 | Temporary Drainage Structures | 39% AEP (2yr ARI) | | 18% AEP (5yr ARI) | 10% AEP (10yr ARI) |

| Reference | Drainage Feature | Anticipated Design Life (Months) | | | |
|---|---|---|---|---|---|
| | | <3 | 3 - 12 | 12 - 24 | >24 |
| | Emergency Spillways | 5% AEP (20yr ARI) | | | 2% AEP (50yr ARI) |

1) *Includes catch drains, diversion bunds and chutes. Excludes minimum 150mm freeboard. If drainage structure located immediately upslope of occupied property that would be adversely affected a minimum 10 yr ARI design standard applies.*

2) *Emergency spillways on temporary sediment basins. Excludes Referable Dams.*

*Table 9 – CBGU IFD Design Rainfall Intensity (mm/h)*

| Duration | 1 year | 2 year | 5 year | 10 year | 20 year | 50 year | 100 year |
|---|---|---|---|---|---|---|---|
| 5 min | 112 | 141 | 176 | 204 | 234 | 274 | 305 |
| 10 min | 92.2 | 116 | 145 | 167 | 191 | 222 | 246 |
| 20 min | 68 | 85.5 | 107 | 123 | 141 | 165 | 182 |
| 30 min | 54.3 | 68.2 | 85.5 | 98.9 | 113 | 133 | 147 |
| 1 hour | 34.8 | 43.7 | 55.1 | 64 | 73.8 | 86.9 | 97 |
| 2 hour | 21.4 | 26.9 | 34 | 39.8 | 46.2 | 54.9 | 61.7 |
| 3 hour | 16 | 20.2 | 25.6 | 30 | 35 | 41.8 | 47.1 |
| 6 hour | 9.88 | 12.5 | 15.9 | 18.8 | 22 | 26.5 | 30.1 |
| 9 hour | 7.52 | 9.51 | 12.3 | 14.5 | 17.1 | 20.6 | 23.5 |
| 12 hour | 6.22 | 7.89 | 10.2 | 12.2 | 14.3 | 17.4 | 19.9 |
| 24 hour | 3.97 | 5.08 | 6.72 | 8.06 | 9.58 | 11.7 | 13.5 |
| 48 hour | 2.5 | 3.23 | 4.39 | 5.32 | 6.38 | 7.9 | 9.15 |
| 72 hour | 1.87 | 2.43 | 3.34 | 4.07 | 4.9 | 6.1 | 7.1 |

# 4 Erosion Risk Assessment

An erosion risk assessment provides an indicator tool to determine the sediment control and erosion control standards that should be applied to a project. Application of the risk assessment has considered construction activities relevant to all major stages of the Project.

## 4.1 RUSLE Methodology

A quantitative erosion risk assessment for each disturbed catchment along the alignment has been conducted using the Revised Universal Soil Loss Equation (RUSLE), see **Equation 1**. RUSLE aims to predict the potential long term average soil loss rate from a given site based on the following parameters:

$$A = R \times K \times LS \times C \times P$$ Equation 1 (IECA, 2008)

Where:

A is the predicted soil loss per hectare per year
R is the rainfall erosivity factor (3,705 – Refer to Section 3.1.1)
K is the soil erodibility factor (0.017 - 0.025 – Refer to Section 3.1.2)
LS is the slope length/gradient factor (varies – Refer to Section 3.1.3)
C is the ground cover and management factor (1.0 – Refer to Section 3.1.4)
P is the erosion control practice factor (1.3 – Refer to Section 3.1.4)

### 4.1.1 R Factor – Rainfall

The rainfall erosivity factor (R factor), is a measure of the ability of rainfall to cause erosion. The rainfall erosivity factor (R factor), is a measure of the ability of rainfall to cause erosion. It is the product of two components (1) total energy and (2) intensity for each rainfall event.

R factors are published for a range of locations throughout Queensland, including Brisbane, which is considered reflective of the Project. Reference to Table E1 of IECA (2008) indicates an annual R factor value of **3,705**.

*Table 10 Monthly % and Annual Rainfall Erosivity (R-factor) values*

| Monthly % and Annual Rainfall Erosivity (R-factor) values | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
| % | 18.1 | 18.5 | 13.8 | 7.7 | 4.8 | 4.3 | 3.0 | 2.1 | 2.1 | 5.2 | 8.1 | 12.2 | 100% |
| R - values | 671 | 686 | 512 | 286 | 178 | 159 | 111 | 77.9 | 77.9 | 193 | 300 | 452 | 3,705 |

*Note: adopted from E1, p. E.4 & E2, p. E.5 IECA 2008.*

Based on this R factor of **3,705**, any slope greater than 7% represents a high erosion hazard.

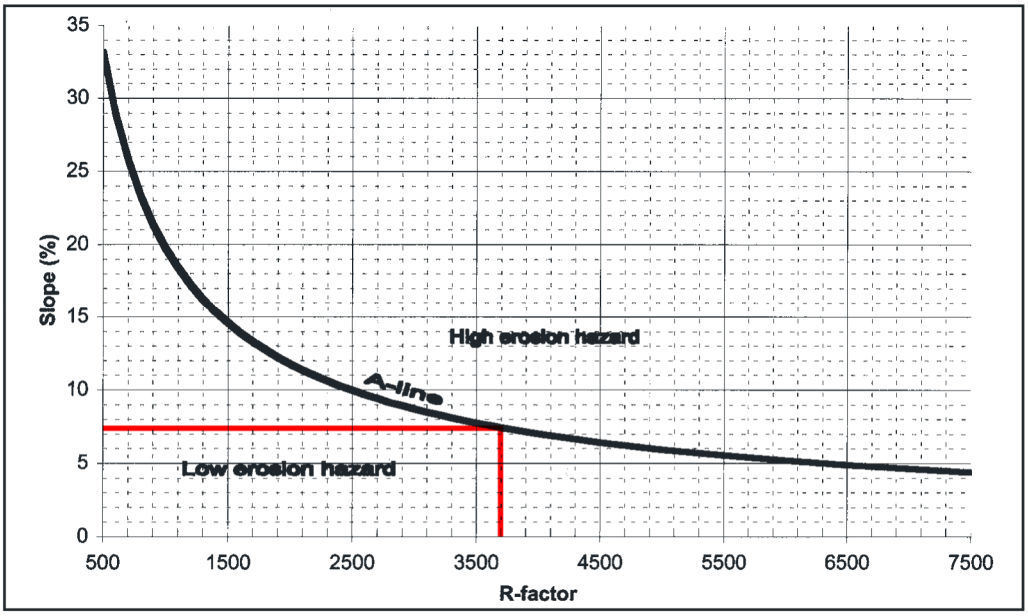



*Figure 4* *Assessment of potential erosion hazard (adopted from Figure 4.6 Managing Urban Stormwater: Soils and Construction - march 2004)*

### 4.1.2 K-Factor - Soil Erodibility

The soil erodibility factor (K-factor) is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff. Soil texture is the principle component affecting the K-factor, but soil structure, organic matter and profile permeability also contribute.

Soil descriptions for the site are provided above in section 4.3. Based on available soil information, substantial variation exists along the alignment, in term of texture and soil properties. For this reason, a site-specific soil loss assessment shall be conducted as part of the preparation of the SESCPs using K-factors suitable for that work area. These K-factors typically range from 0.017 for gravelly soils and sandy clays, to 0.025 for silty clays and the alluvium and clay fills, corresponding to Table E4 of IECA (2008).

It is unlikely that dispersive soil properties will be encountered in most soils along the alignment, however, should they occur a 20% adjustment factor will be incorporated into soil loss calculations for SESCPs, and soils will be managed in accordance with 4.3.2 of this ESCPO.

### 4.1.3 LS-Factor - Slope and Length

Slope length and slope gradient have substantial effects on soil erosion by water. The two (2) effects are represented by the slope length factor (L) and the slope steepness factor (S). In the application of RUSLE, the two are evaluated together as a numerical representation of the length-slope combination (LS factor).

In order to assign an LS factor for each disturbed catchment, an equal area slope gradient has been calculated. LS factors have been assigned based on Table E3 of IECA (2008).

LS factors are significantly influenced by the stage of works, including existing and design slopes within specific catchments. For this reason, site-specific LS factors corresponding to Table E3 of IECA (2008) and stage/area specific ground conditions are utilised in the soil loss calculations completed as part of the SESCPs.

### 4.1.4 Cover (C) And Practice (P) Factors

Within RUSLE, the C and P factors are used to describe management of the site with respect to reducing soil loss. The C factor measures the combined effect of all the interrelated cover and management variables adopted over the site. It also represents non-structural methods for controlling erosion (i.e. covering exposed areas with various erosion control products to minimise raindrop impact or stabilisation by temporary or permanent vegetation).

The P factor measures the combined effect of all support practices and management variables. P factor is reduced by practices that reduce both the velocity of runoff and the tendency of runoff to flow directly downhill. It also represents structural methods for controlling erosion.

Industry accepted default values of 1 and 1.3 have been adopted as C and P factors respectively in soil loss estimations where stripping results in a typical, cleared construction area (per table E11 of IECA, 2008). In some areas existing ground cover may be retained to some extent, and in later stages of the project ground stabilising works may reduce these factors. These will be investigated and presented in the SESCPs.

### 4.1.5 4.5. Soil Loss Results

The estimated soil loss (in tonnes per hectare per year) have been calculated in SESCPs and used to inform the erosion and sediment control requirements in those areas.

# 5 Erosion Control

Erosion control refers to the management of the working area to prevent or reduce soil particles being mobilised or entrained in water. The soil loss and resulting erosion risk determined in Section 4 and the SESCPs specifies the extent of erosion control required on site.

Given the seasonal variation in rainfall, as described in Section 3.1, and in accordance with BCC City Plan (2014) erosion control practices are to be in accordance with Table 4.4.1 & 4.4.4 of IECA (2008), represented below in Table 11.

*Table 11 Monthly erosion risk rating based on monthly rainfall erosivity*

| LOCATION | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brisbane | H | H | H | H | M | M | M | M | L | M | H | H |

*E = Extreme, H = High, M = Moderate, L = Low, VL = Very Low erosion risk.*

A summary of best practice erosion management requirements (as per IECA, 2008) based on the erosion risk output is presented in *Table 12*.

*Table 12 Erosion Risk Rating Based on Soil Loss Required Management*

| Erosion Risk Rating | Soil Loss (T/ha/year) | Advance Land Clearing Allowed (wks. work) | Max days to stabilisation | Staged Construction and Stabilisation of Earth Batters >6H:1V | Stockpiles stabilized | Stockpile height (m) |
|---|---|---|---|---|---|---|
| Very Low | 0 -150 | 8 | 30 (60%) | NA | NA | 4 |
| Low | 150 – 225 | 8 | 30 (70%) | NA | NA | 3 |
| Moderate | 225 - 500 | 6 | 20 (70%) | Yes | NA | 3 |
| High | 500 – 1500 | 4 | 10 (75%) | Yes | Yes | 2 |
| Extreme | >1500 | 2 | 10 (80%) | Yes | Yes | 2 |

*Note: adopted from Table 4.4.3 IECA Nov 2008.*
*Note whilst the above erosion control requirements are consistent with best practice (IECA, 2008) they do not consider the sensitive nature of the receiving environment, nor waterways.*

Any works within or adjacent to watercourses (including construction of temporary drains, permanent drain or culvert installation, creek diversions and temporary access tracks) must be delayed for as long as possible, completed with consideration of forecast rainfall, completed in as rapid fashion as possible and stabilised rapidly following works.

The minimum sediment control standards based on the erosion risk rating, corresponding soil loss rate and requirements of IECA (2008) is shown in Table 13.

*Table 13 Minimum Sediment Control Standard Based On Soil Loss*

| Catchment Area ($m^2$) | Soil Loss (t/ha/yr) | | | Description |
|---|---|---|---|---|
| | Type 1 | Type 2 | Type 3 | |
| 250 | NA | NA | As required | Filter fence |
| 1000 | NA | NA | All Cases | Filter fence or Type 2 |
| 2500 | NA | >75 | 75 | Decanting Earth Bund, mulch bund, rock filter dam, undersized basin/sump |
| >2500 | >150 | 150 | 75 | Sediment basin (sized in accordance with design standard), Decanting Earth Bund, mulch bund, rock filter dam, undersized basin/sump |
| >10,000 | >75 | NA | 75 | Sediment basin (sized in accordance with design standard) |

*Note: adopted from Table 4.4.7 IECA Nov 2008.*

*Note: whilst the above erosion control requirements are consistent with best practice (IECA, 2008) they do not consider the sensitive nature of receiving environments, nor waterways.*

## 5.1 Erosion Control During Works Stages

Erosion control has been separated to identify controls relevant to each stage of construction, from clear and grub to landscaping.

### 5.1.1 Clear And Grub

- Educate and inform site personnel about site soil quality and required management, including during stripping of topsoil
- Establish exclusion zones to prevent over-disturbance, and restrict stripping to approved areas only
- Stabilise diversion bunds and temporary drainage features with nominated measures
- Stage topsoil stripping to coincide with areas of active earthworks only
- Establish stabilised site access points
- Stabilise any high traffic areas, such as haul routes or site facilities

### 5.1.2 Cut And Fill Earthworks

- Minimise occurrence and duration of stockpiling
- Maintain stabilised site access points, haul routes and facilities areas
- Carry out dust suppression and monitor air quality during high winds, noting that some works may be discontinued if excessive dust is observed
- Roughen earthworks areas, including batters
- Progressively stabilise steep batters if practical, using temporary erosion control (binders and blankets) or by expediting final treatment
- Should they be encountered, ameliorate or bury dispersive soils beneath non-dispersive material

### 5.1.3 Drainage Structures

- Retain existing ground cover in drainage lines as long as possible, restricting disturbance to immediately before active works
- Expedite construction works in drainage lines, monitoring weather forecasts and maximising production during dry weather
- Implement temporary erosion control (erosion control mat) prior to rainfall if permanent treatments are not complete (clean water diversions only)

# 6 Drainage Control

Drainage control considers three main principles; diverting external flow before it enters site, directing site runoff to an appropriate sediment control, and ensuring runoff is conveyed in a non-erosive manner.

Wither reference to the deviation to Coordinator-General conditions detailed in Section 3.3.1 the following criteria have been adopted for the project, conservatively addressing both IECA (2008) and MRTS52 specification.

*Table 14 Drainage Design Standards*

| Drainage Feature | Anticipated Design Life (Months) | | | |
|---|---|---|---|---|
| | <3 | 3 - 12 | 12 - 24 | >24 |
| Temporary Drainage Structures | 39% AEP (2yr ARI) | | 18% AEP (5yr ARI) | 10% AEP (10yr ARI) |
| Emergency Spillways | 5% AEP (20yr ARI) | | 2% AEP (50yr ARI) | |
| Temporary Culverts | 1yr ARI | | | |

Given the likely presence of contaminated and acid sulphate soils, as well as local topography, being mostly flat, it is considered that the most effective means of achieving both clean and dirty water diversion is through the following:

1. using existing drainage controls and
2. installation of temporary drainage controls on the extent of clear and grub.

Temporary drainage controls will effectively divert any external catchments around the site and assist drainage of site runoff where flat ground and local undulation makes drainage difficult to achieve. Temporary drainage controls have been designed to prevent scour and convey runoff up to the rainfall event for which they are designed.

Temporary chutes, culverts and spillways have also been sized in accordance with the criteria identified in Table 14 to prevent scour.

Hydrologic data used in hydraulic design has been sourced from the Bureau of Meteorology (each precinct was selected -27.466, 153.021; -27.472, 153.027; -27.485, 153.034; -27.495, 153.031 ) and is presented in Table 15.

Disturbance to existing drainage features is to be avoided where possible or for as long as possible. Works within these areas are to be undertaken immediately prior to requiring access and completed within a dry forecast unless contingency measures are applied. Where access crosses existing drains, a temporary crossing incorporating a sized pipe may be required.

Details regarding temporary drainage arrangement, staging and stabilisation of measures are presented within SESCPs.

### 6.1.1 Drain Treatment

Treatment of temporary drains is required where flow velocities will result in soil mobilisation and drain scour. Due to the moderate to steep topography and resulting peak flows which temporary clean water drains must

convey all will be required to be lined to maintain non-erosive flows. Treatment of temporary drains includes hydraulically applied ditch liners, soil binder, roll-on blankets and turf. Treatment is based on an assessment of suitability, life of drain and whole of life costs (installation and maintenance).

### 6.1.2 Rock Check Dams

Drains exceeding 5% gradient or where peak flows exceed approx. 1 $m^3/s$ will require installation of rock check dams to reduce velocities to that suitable for temporary drain lining. The spacing of rock check dams is defined by the gradient of the drain, such that the top of the downslope rock check is level with the toe of the upslope rock check.

### 6.1.3 Culvert Installation

For the installation of permanent culverts, detailed construction sequencing will be provided in the relevant Workpack. The Workpack will include a staged methodology to manage clean water diversion and divert sediment-laden runoff to treatment measures.

A critical component of these works is the completion of works within a rapid timeframe and the consideration of any forecast rainfall such that works only commence when conditions are favourable, i.e. a five (5) day dry weather forecast period. Should a rainfall event occur during works, contingency measures are specified within the methodology and should be enacted immediately.

The below key management principles will be implemented for culvert installations:

1. Appropriately plan and organise the work activities.
2. Minimise channel disturbance.
3. Control the movement of water.
4. Minimise soil erosion.
5. Minimise the release of sediment and sediment-laden water.
6. Promptly rehabilitate disturbed areas.

.

*Table 15 IFD ranfill intensities*

| Duration | 1 year | 2 year | 5 year | 10 year | 20 year | 50 year | 100 year |
|---|---|---|---|---|---|---|---|
| 1 min | 157 | 198 | 247 | 286 | 328 | 383 | 424 |
| 2 min | 130 | 164 | 207 | 241 | 278 | 328 | 366 |
| 3 min | 122 | 154 | 194 | 225 | 259 | 305 | 340 |
| 4 min | 117 | 147 | 184 | 214 | 246 | 288 | 321 |
| 5 min | 112 | 141 | 176 | 204 | 234 | 274 | 305 |
| 10 min | 92.2 | 116 | 145 | 167 | 191 | 222 | 246 |
| 15 min | 78.2 | 98.2 | 123 | 142 | 162 | 189 | 209 |
| 20 min | 68 | 85.5 | 107 | 123 | 141 | 165 | 182 |
| 25 min | 60.3 | 75.8 | 94.9 | 110 | 126 | 147 | 163 |
| 30 min | 54.3 | 68.2 | 85.5 | 98.9 | 113 | 133 | 147 |
| 45 min | 42.2 | 53 | 66.6 | 77.2 | 88.8 | 104 | 116 |
| 1 hour | 34.8 | 43.7 | 55.1 | 64 | 73.8 | 86.9 | 97 |
| 1.5 hour | 26.2 | 33 | 41.7 | 48.6 | 56.2 | 66.6 | 74.6 |
| 2 hour | 21.4 | 26.9 | 34 | 39.8 | 46.2 | 54.9 | 61.7 |
| 3 hour | 16 | 20.2 | 25.6 | 30 | 35 | 41.8 | 47.1 |
| 4.5 hour | 12 | 15.2 | 19.4 | 22.8 | 26.6 | 31.9 | 36.2 |
| 6 hour | 9.88 | 12.5 | 15.9 | 18.8 | 22 | 26.5 | 30.1 |
| 9 hour | 7.52 | 9.51 | 12.3 | 14.5 | 17.1 | 20.6 | 23.5 |
| 12 hour | 6.22 | 7.89 | 10.2 | 12.2 | 14.3 | 17.4 | 19.9 |

*(Sourced from BOM)*

# 7 Sediment Control

Details regarding sediment basin design calculation, staging and installation are presented within SESCPs. Sediment basins are located and designed to trap/collect sediment - laden runoff from disturbed areas of the construction site. Sediment basins will be located to maximize the trapping of pollutants close to drainage lines.

Where sediment basins have not been triggered, Type 2 or 3 sediment control devices have been nominated based on estimated soil loss rates. Specified Type 2 and 3 sediment control measures to be utilised are nominated within SESCP. It must be noted that Type 2 and 3 sediment control measures whilst potentially appropriate under IECA (2008) for selected disturbed catchments, may not achieve project conditions, specifically related to water quality, hence have only been specified in highly constrained areas. Within localised areas draining to nominated Type 2 or 3 sediment controls an emphasis shall also be placed on utilising temporary erosion control measures. Temporary erosion control measures to be applied to such areas shall be either soil binder, mulch application or approved other.

## 7.1 Sediment Basin Dewatering and Monitoring

Where practicable, water from sediment basins is to be reused on-site within existing erosion and sediment controls for dust suppression without any treatment. Otherwise, all dewater must be conducted in strict compliance with the project 'Permit To Dewater' process.

### Testing of Retained Water

CBGU's Environmental team or trained delegate will conduct the necessary testing and provide advice on management of all surface water on site. If the below criteria is achieved, the Environmental Team or approved delegate will approve the discharge of the water by completing and signing the' Water Release Approval' form.

CPB will utilize manual and automated flocculation to treat non-compliant water. CPB will follow recommended dosing rates from supplier and will develop specific soil type rates based on testing results. The flocculent will be broad cast sprayed over the entire sediment basin. If the below criteria listed in table 12, is not achieved the Environmental team or delegate will advise the Supervisor or delegate that further treatment and testing is necessary.

The capacity of sediment basins and retention basins must be returned / maintained within five (5) days of a rainfall event.

## 7.2 Discharge Criteria

The Imposed Conditions relating to Erosion and Sediment Control for the Project can be found on the Coordinator-General's website (http://www.dsdmip.qld.gov.au/coordinator-general/assessments-and-approvals/coordinated-projects/completed-projects/cross-river-rail-project.html).

## 7.3 Type 2 And 3 Controls

The nominated type and location of Type 2 and 3 sediment control measures are presented in SESCPs. Minimum sizing for Type 2 sediment controls is also provided within SESCPs and are based on best practice design standards.

Note as detailed where site constraints do not permit the installation of Type 1 sediment control, Type 2 control will be adopted. The specific location of these areas has been indicated in accompanying plans with the required compensatory measures detailed.

In locations where excavation is not desirable a rock filter bund (Type 2) will be incorporated into the diversion bunds at the intended release point. Other Type 2 sediment control measures may include excavated sediment traps (acknowledging potential contaminated and acid sulphate soils) or utilisation of table drains as linear storage measures. Sediment fence is nominated as the appropriate Type 3 control measure in all instances.

laboratory assessment, increasing the risk of uncontrolled overtops during further rainfall events.

### 7.3.1 Installation and Timing of Controls

Unless otherwise authorised all controls shall be installed wholly within the Licensed Construction Area (LCA), with drainage that does not impact neighbouring properties.

Timing may be inconsistent with typical construction staging (i.e. Clear and Grub, Earthworks, Final Level s etc.) given the specific programme of works suitable for rail closures. For this reason, an adaptable, progressive approach to planning has been considered that accounts for both construction staging (earthworks) and the programme of works.

Further detail on the installation and timing of controls appropriate to each work area are included with the SESCPs.

# 8 Maintenance & Monitoring of ESC Measures

Weekly inspections of all installed erosion and sediment control devices will be conducted by the Environmental Team to check compliance with the approved ESCP, and rectify any non-conformances within agreed timeframes or prior to rainfall occurring.

In addition to the above and where required additional inspection will be conducted, as listed below:

- Erosion control structures must be routinely inspected to ensure they remain effective particularly after high intensity rainfall or run-off events.
- Erosion and sediment control devices must be cleared, repaired or replaced whenever inspections show signs of non-compliance or ineffective capability or capacity. As a minimum all ESCs must be maintained/returned back to the design capacity/intendant within three (3) days of a rainfall event.
- Sediment and erosion control measures and areas receiving concentrated flows should be inspected on a regular basis, replaced where damaged and emptied following rainfall events, if required.
- Drainage lines and areas of concentrated water flow must be inspected regularly for erosion and to determine whether remedial action is required.

Where deficiencies in controls or systems are identified, the issue and required action will be documented and managed according to project requirements (as per the EMP) and a record maintained to demonstrate timely action and close out.

Maintenance will be required of ESC measures throughout the project, particularly after rain. Table 16 Minimum Standard for Maintenance of ESC defines the Action Criteria and corrective actions to be implemented.

*Table 16 Minimum Standard for Maintenance of ESC*

| ESC Type | Control Measure | Action Criteria | Maintenance Action | Responsibility |
|---|---|---|---|---|
| Erosion Control | Erosion control matting (e.g. geotextile) | Matting undermined or folded up | Reinstate matting, ensure secured as per specifications. Drainage to be controlled across matted area. | Supervisor |
| | Hydromulching | Signs of erosion. Loss of protection on surface | Reapply hydromulch as required. Drainage to be controlled across hydromulched area. | Supervisor |
| | Soil binding solutions (e.g. polymers) | Signs of erosion. Loss of protection on surface | Reapply soil binder as required. Drainage to be controlled across the bound area. | Supervisor Site Engineer |

| ESC Type | Control Measure | Action Criteria | Maintenance Action | Responsibility |
|---|---|---|---|---|
| | Outlet Protection | Erosion or scour at the outlet | Increase surface roughness of outlet (e.g. using different size rock) and length of scour protection.<br>Geofabric lining underneath to be replaced if damaged and place black plastic underneath geofabric. | Supervisor<br>Environmental Manager (construction) |
| Sediment Control | Sediment/filer fence | Evidence of ineffectiveness (sagging, undermining or bypassing) | Reinstate to rectify sagging or undermining.<br>Place sand bags to stop or install new section if bypassing | Supervisor<br>Site Engineer |
| | | >30% of retention capacity is blocked by sediment | Remove sediment from fence.<br>Replace or back flush any portion that has become blocked. | Supervisor<br>Site Engineer |
| | Access and Egress Points | Sediment or mud being tracked onto the public road | Sweeper truck to clean road.<br>Increase the length and/or roughness of the exit control | Supervisor<br>Site Engineer |
| | Sediment Traps | Accumulated sediment taking up > 30% of capacity | Accumulated sediment to be removed | Supervisor<br>Site Engineer |
| | Sediment Basins | Accumulated sediment taking up >30% of capacity | Accumulated sediment to be removed | Supervisor<br>Environmental Manager (construction) |
| | | Damage to any components of the sediment basin | Damaged components to be repaired and reinstated. | Supervisor<br>Environmental Manager (construction) |
| Drainage Control | Clean water diversions | Evidence of scour significant or erosion | Repair scour or erosion.<br>Review existing control measures and enhance or investigate installing additional controls that are more effective. | Supervisor<br>Environmental Manager (construction) |
| | Dirty water diversion | | | Supervisor<br>Environmental Manager (construction) |
| | Batter chutes | | | Supervisor<br>Environmental Manager (construction) |
| Velocity Controls | Check Dams (rock or sandbag) | Damage to check dam or blow outs | Review existing controls and scour pattern, reduce spacing between controls and size of controls. Control construction traffic that may also be affecting controls. | Supervisor<br>Site Engineer |
| | Geo - Logs | Damage to Geo - Logs or blow outs | Review existing controls and scour pattern, reduce spacing between controls and ensure adequately secured / pinned. | Supervisor<br>Site Engineer |

| ESC Type | Control Measure | Action Criteria | Maintenance Action | Responsibility |
|---|---|---|---|---|
| | Sediment sumps / knockout pits on grade | Accumulated sediment taking up >30% of capacity | Remove accumulated sediment and reinstate control. | Supervisor<br>Site Engineer |
| | Cut off drains or whoa boys | Evidence of scour, overtopping or erosion | Repair scour or erosion. Review existing control investigate installing additional controls that are more effective. If it has overtopped increase size of control to make it more robust. Measures and scour pattern. Enhance or investigate installing additional controls<br>That are more effective. If it has overtopped increase size of control to make it more robust. | Supervisor<br>Site Engineer |

*Note: Additional controls may be used on the Project.*

# 9 Progressive Rehabilitation

Areas will be stabilised following completion, suspension and/or extended exposure with no construction activity (i.e. Christmas shutdown). Stabilisation of inactive works areas will be identified in the PESCPs. If the Project is to have an extended shutdown period all areas are to be stabilised with appropriate erosion control (i.e. soil binder, geo-textile fabric and/or jute mesh).

- Progressively complete landscaping throughout the alignment wherever possible, ensuring landscaping is completed as soon after earthworks as possible
- Combine temporary control with long term revegetation measures, such as binders, mulch or hydromulch to provide immediate stabilisation while landscaping establishes
- Prior to high risk periods (i.e. wet season) seek to reduce exposed areas as much as practical and stabilise inactive work areas, considering the duration of inactivity and likelihood of significant rainfall
- Rehabilitate all areas outside the main alignment, including haul routes, laydowns, stockpile areas and other facilities.

# 10 Impacts and Mitigation Measures

A range of potential impacts to the environment and potential environmental mitigation measures are outlined below.

## 10.1 Impacts

The construction phase of the Project will require earth works in the form of cut and fill, as well as tunnelling, resulting in localised changes to landform contours and topography. Additionally, activities associated with construction of the Project has the potential to alter or impede overland surface flow and drainage patterns.

The potential general impacts of the Project on existing soil values within the Project footprint are likely to be associated with accelerated erosion and sediment movement due to disturbance of soils, onsite spoil placement locations, access points and construction work. Uncontrolled impacts to soils values that have been identified include:

- Loss of valuable topsoil material
- Accelerated erosion of vulnerable soils
- Contaminant mobilisation within surface water or groundwater
- Loss of sediment offsite into waterways, including the Brisbane River
- Changes to flows of surface water
- Mortality of aquatic and riparian flora
- Mortality of aquatic fauna.

The severity of the potential impacts on the values of the surrounding environment depend on a number of factors, including:

- The nature of the affected soil (e.g. acid generating, sodic, saline or dispersive soils)
- The period and frequency of disturbance and exposure
- The buffering capacity of the receiving surface water bodies or the groundwater system.

Potential erosion and sediment movement impacts within for the Project have been considered for:

- Construction worksites
- Onsite spoil management and removal
- Surface works associated with track work and road network changes/upgrades, tunnel portal locations, ancillary surface works and structures, such as service relocation/installation
- Construction of structures such as bridges, rail and pedestrian access structures.

Within the context of the Project, impacts to the following soil landscapes identified as a result of surface works are:

- Soils of the Beenleigh soil landscape are likely to be disturbed by surface works associated with the Albert Street Station worksite, this soil type typically comprised a disturbed surface/near surface layer incorporating fill material followed by a deep clay layer that contains fragments of siltstone and a mix of

fresh and decomposing organic material. Erosion hazard for this soil type is typically considered to be low.

- Soils of the Brisbane River soil landscape are likely to be disturbed by surface works associated with the Albert Street Station worksites, this soil type was typically noted as containing a deep profile of silty clay with narrow bands of silty sand and a layer of gravelly clayey sand overlying meta siltstone. This soil type is susceptible to wind erosions and overall erosion hazard is moderate to high.
- Soils of the Chermside soil landscape are likely to be disturbed by surface works associated with the Woolloongabba Station worksite and Boggo Road Station, the observations from bore logs indicate this soil type comprised a disturbed surface to near surface layer consisting of fill material which overlies a silty clay with small amounts of fine to medium grained sand. These soils types typically have a low to moderate erosion hazard.
- Soils of the Toowong soil landscape are unlikely to be disturbed by surface works, as such no geotechnical investigations in this soil type have been undertaken.
- Soils of the Woodridge soil landscape likely to be disturbed as a result of surface works associated with the Boggo Road Station, this soil type was typically noted as comprising a disturbed surface layer of fill material followed by a silty clay with some fine to medium grained sand. Residual soils at 1.4 m below ground level comprise sandy clay overlying medium to coarse sandstone with some conglomerate at 2.5 m below ground level. Erosion hazard for this soil type is typically considered to be moderate to high.

The general impacts for erosion and sediment applies to all locations, with additional site-specific impacts identified in the subsections below.

### 10.1.1 Southern Portal and Boggo Road

Construction activities with the potential to impact erosion and sediment include creation, storage and movement of spoil associated with southern portal dives and general construction activities.

Areas of high erosion risk and slopes exceeding 10% gradient, have been identified in the vicinity of Dutton Park (Appendix A). Unmitigated impacts are possible to the surface soil and landform stability during surface works in this area, which may also increase the risk of impacts to surface water quality within the receiving environment of Brisbane River, as a result of sediment movement.

### 10.1.2 Woolloongabba, Albert Street and Roma Street Stations

Sites within the central section of the Project that would be directly impacted by surface works include:

- Demolition of existing buildings
- Construction of the Roma Street Station, including pedestrian access to Roma Street, reconfiguration of vehicle access to Roma Street Parklands and pedestrian connections to the Roma Street Station concourse
- Construction of the Albert Street Station, including the northern construction worksite at Mary Street, the southern construction worksite at Alice Street, pedestrian access beneath Alice Street, and associated surface road works
- Construction of the Woolloongabba Station including the construction worksite, and associated surface road works

- Construction of the Boggo Road Station, including the station construction worksite and pedestrian connections with Park Road Station
- Construction of bridges and ramps for pedestrian access.
- Minimal vegetation clearing would be undertaken as part of the surface works due to most of the works occurring within tunnel and surface works being limited to underground station construction locations
- Preparation of laydown, material storage, handling, preparation and spoil stockpile/treatment areas within the Albert Street Station and Woolloongabba Station worksites
- Installation/construction of storm water/drainage control and sediment control measures including bunding for material storage areas within the Albert Street Station and Woolloongabba Station worksites
- Construction of haul routes, carparks and vehicular access tracks for the Albert Street Station and Woolloongabba Station worksites
- Installation of services for site offices and workshops within the Albert Street Station and Woolloongabba Station worksites
- Construction activities for the underground station caverns and changes to the surface road network.

Areas of higher erosion risk with slopes greater than 10% gradient, are likely to be intercepted at Woolloongabba (Appendix A). Certain works have an increased potential to mobilise surface soil and reduce landform stability during construction at these locations. There may also be an increased risk of impacts to surface water quality, within the receiving environment of the Brisbane River, resulting from sediment movement at such locations.

### 10.1.3 Northern Portal

Sites within the northern section of the Project that would be directly impacted by surface works include:

- Preparation of laydown, material storage, handling, preparation and spoil stockpile/treatment areas within the construction worksites
- Installation/construction of storm water/drainage control and sediment control measures including bunding for material storage areas within the construction worksites
- Construction of haul routes, carparks and vehicular access tracks for the construction worksites
- Installation of services for site offices and workshops within the construction worksites
- Construction activities for the northern portal
- Formation works would be required in most track work locations, which includes bringing in and stockpiling material and ballast for placement during these works and would also include topsoil stripping with and adjacent to the surface work areas.

Within the northern section of the Project soils within the Logan soil landscape are likely to be disturbed by surface works associated with the construction phase.

There is also a risk of impacts to surface water quality within the receiving environment of Breakfast Creek due to sediment movement.

## 10.2 Mitigation Measures

Mitigation measures for erosion and sediment control have been developed in accordance with the Best Practice Erosion and Sediment Control (IECA Australasia 2008), Soil Erosion and Sediment Control – Engineering Guidelines for Queensland Construction Sites (Institute of Engineers Australia (Qld Division) 1996) and Draft Urban Stormwater – Queensland Best Practice Environmental Management Guidelines 2009 (DERM 2009a). Site-specific mitigation measures are provided in Section 3.2.2 to Section 3.2.7.

The erosion and sediment control strategies / plans took the following into consideration:

- Seasonal conditions
- Soil types, particularly dispersive, sodic and saline soils
- Local hydrology affecting the worksite
- Local drainage, including temporary and overland flow paths.

Disturbing surface and shallow soils and sediments on steep slopes during construction present a potential risk to the soil values within the tunnelling works area. This is of particular concern for surface works that would be scheduled during the wet season (November to April). Specific soil management and erosion mitigation measures are required to be implemented to enable adequate sediment control for each of the sites within the tunnelling works area. This will be important at sites identified as having high erosion risk. These risks will be addressed by the progressive development of stage-specific ESCP's for the site that has been identified as potentially at risk of accelerated erosion due to slopes, such as Woolloongabba and Dutton Park.

The following advisory mitigation measures may be implemented to achieve the nominated environmental outcomes and performance criteria. Additional or different mitigation measures may be applied to achieve the environmental outcomes and performance criteria:

- To inform detailed design and construction planning, soil sampling is occurring at worksites as part of further geotechnical investigations, to identify and characterise soils in areas of proposed surface works. The results from the investigations will be considered as progressive ESCP's are developed, and construction advances. Characteristics of interest include confirmation of soil landscapes, soil depth, presence of fill and soil chemical properties.
- Manage ESC's in accordance with the guidelines for Best Practice Erosion and Sediment Control (International Erosion Control Association, 2008) and TMR's Technical Standard MRTS52 Erosion and Sediment Control (ESCP p 4).

### 10.2.1 General

To reduce the risk of erosion during construction, the following potential mitigation measures will be utilised where appropriate:

- Where possible, avoid disturbance of vulnerable surface and subsurface soils
- Minimise construction worksite clearing and the extent and duration of soil exposure
- Install spoil enclosure sheds at construction worksites, where required, to maintain clean stormwater runoff and minimise disturbed surface areas

- Haul routes and construction vehicle access roads are to be paved in accordance with the requirements outlined in the Air Quality Management Plan (AQMP), Construction Worksite Management (CWMP) and Construction Traffic Management Plan (CTMP)
- Identification of “no-go” zones to minimise the extent of unnecessary soil disturbance, including any disturbances outside the worksites
- Divert clean waters around disturbed surfaces and spoil storage locations (ESCP p 5)
- Monitor the effectiveness of installed control measures in accordance with Section 5 of this ESCP (OESCP p 5)
- Any damaged erosion and sediment control measures will be repaired or replaced following rainfall events (OESCP p 5)
- Sediment control devices with accumulated sediment volumes in excess of design capacity should be cleaned out to reinstate the settling and storage zone volumes
- Stockpiles located away from drainage areas and flood-affected areas. Provide adequate bunding to prevent sediment run-off into waterways or stormwater drains (OESCP p 6).
- Erosion and sediment control measures must be maintained in good working order, with any damaged or ineffective measures repaired or replaced following rainfall events or otherwise as required
- Plan construction works to provide for progressive and timely stabilisation and rehabilitation of disturbed areas using stored topsoil where practicable
- Undertake finishing and landscaping works for ongoing sediment and erosion control around the worksites following construction as per the Coordinator General’s conditions
- Measures for the management of spoil, include:
  - Installation of spoil enclosure sheds
  - Managing the stripping and stockpiling of surface spoil material from surface works areas with regard to potential contamination
  - Spoil being taken offsite must be placed at an approved and suitably managed spoil disposal location
  - Refer to Haulage Management Plan (HMP) for haulage routes to licensed landfill facility (OESCP p 6).

### 10.2.2 Southern Portal

The Southern Portal is expected to be within the Chermside soil landscape. This soil type is considered to be low to moderate risk for erosion, with erosion risk increasing with increasing slope.

Mitigation measures would be implemented for the Project to control and reduce the risk of erosion due to construction activities. Erosion control measures would be based upon the objective of reducing the risk of erosion during construction by:

- Managing the stripping and stockpiling of surface spoil material from surface works areas with regard to potential contamination at the worksites
- Sediment traps will be excavated to collected overflow water with catch drains used to direct the water

- Managing the extent of soil disturbance and vegetation clearing as well as reducing the exposure of vulnerable soils and soils on steep slopes to accelerated erosion by wind and water action, particularly where site access works are required for the southern portal worksite
- Implement ESCP stormwater management systems during construction to control the velocity of runoff from exposed areas and capture sediment entrained in runoff prior to release/discharge from worksites
- Sediment fence to be installed on the downgradient side of the construction area and along internal drainways as a combined control encompassing any exposed areas of work. Sediment fencing will comply with the IECA Guideline.
- Rock check dams to be installed along the alignment of the sediment fence in order to reduce the amount of sediment runoff
- Vehicle entry and exit points, including the locations of construction grids and wash-down points have been detailed on the plans as required. Where necessary the location of entry/exit points and associated grids will be updated on subsequent PESCP's.

### 10.2.3 Boggo Road

The Boggo Road Station is expected to be within the Chermside soil landscape. This soil type is considered to be low to moderate risk for erosion.

Mitigation measures would be implemented for the Project to control and reduce the risk of erosion due to construction activities. Erosion control measures would be based upon the objective of reducing the risk of erosion during construction by:

- Managing the stripping and stockpiling of surface spoil material from surface works areas with regard to potential contamination at the worksites
- Designing stormwater management systems during detailed design and implemented during construction to control velocity of runoff from exposed areas and capture sediment entrained in runoff prior to release/discharge from worksites
- Vehicle entry and exit points, including the locations of construction grids and wash-down points have been detailed on the plans as required. Where necessary the location of entry/exit points and associated grids will be updated on subsequent PESCP's.

### 10.2.4 Woolloongabba Station

The Woolloongabba Station worksite is expected to be within the Chermside soil landscape. This soil type is considered to be low to moderate risk for erosion, depending on the steepness of the slope at the point of disturbance. Sediment control measures proposed for the Woolloongabba Station worksite would need to address the potential for contaminated sediment mobilised at the site.

Mitigation measures would be implemented of the Project to control and reduce the risk of erosion due to construction activities. Erosion control measures would be based upon the objective of reducing the risk of erosion during construction by:

- Reducing impacts from sediment and contaminants upon surface water through a spoil shed at the Woolloongabba Station worksite for the activities associated with spoil management, handling and removal from site

  - Excavated material will be removed from site for disposal. The stockpile of materials and backfill materials will be maintained into encapsulated and removable waste skip/bins within the spoil shed. As a contingency the stockpile area with the spoil shed must have a sediment fence installed on the downgradient site to capture any runoff. Stockpile waste bins must not be located within 30m of any waterway and sediment fence must be placed 0.5m from the toe of the stockpile – stockpile material must not be touching the sediment fence at any time.

- Managing the stripping and stockpiling of surface spoil material from surface works areas with regard to potential contamination at the Woolloongabba Station worksites
- Implement stormwater management devices during construction to control velocity of runoff from exposed areas and capture sediment, entrained in runoff at the Woolloongabba Station worksite, prior to release/discharge from site in compliance with site stormwater discharge limits
  - Several methods of inlet sediment traps will be employed, including the use of sand bags/filter socks within overlap kerb, filter socks surrounding stormwater drain inlet and filter bags covering stormwater drains.
- Sediment traps will be excavated to collect overflow water with catch drains used to direct the water
- Designing stormwater management systems during detailed design and implemented during construction to control velocity of runoff from exposed areas and capture sediment entrained in runoff prior to release/discharge from worksites
- Sediment fence to be installed on the downgradient side of the construction area and along internal drainways as a combined control encompassing any exposed areas of work. Sediment fencing will comply with the IECA Guideline.
- Rock check dams to be installed along the alignment of the sediment fence in order to reduced the amount of sediment runoff
- Vehicle entry and exit points, including the locations of construction grids and wash-down points have been detailed on the plans as required. Where necessary the location of entry/exit points and associated grids will be updated on subsequent PESCP's.

### 10.2.5 Albert Street Station

The southern construction worksite for the Albert Street Station is expected to be either in Beenleigh or Brisbane River soil landscapes. These soils are considered to be of a moderate to high erosion risk, depending on steepness of the slope at the point of disturbance. This site is relatively low-lying and does not have any steep slopes within or directly adjacent to the site, therefore, standard sediment control measures for the Albert Street Station worksites are proposed.

Mitigation measures would be implemented for the Project to control and reduce the risk of erosion due to construction activities. Erosion control measures would be based upon the objective of reducing the risk of erosion during construction by:

- Reducing impacts from sediment and contaminants upon surface water through a spoil shed at the Albert Street Station worksite for the activities associated with spoil management, handling and removal from site

  - Excavated material will be removed from site for disposal. The stockpile of materials and backfill materials will be maintained into encapsulated and removable waste skip/bins within the spoil shed. As a contingency the stockpile area with the spoil shed must have a sediment fence installed on the downgradient site to capture any runoff. Stockpile waste bins must not be located within 30m of any waterway and sediment fence must be placed 0.5m from the toe of the stockpile – stockpile material must not be touching the sediment fence at any time.

- Managing the stripping and stockpiling of surface spoil material from surface works areas with regard to potential contamination at the Albert Street Station worksites
- Stormwater management devices will be designed during detailed design and implemented during construction to control velocity of runoff from exposed areas and capture sediment, entrained in runoff at the Albert Street Station worksite, prior to release/discharge from site in compliance with site stormwater discharge limits
  - Several methods of inlet sediment traps will be employed, including the use of sand bags/filter socks within overlap kerb, filter socks surrounding stormwater drain inlet and filter bags covering stormwater drains.
- Sediment traps will be excavated to collected overflow water with catch drains used to direct the water
- Sediment fence to be installed on the downgradient side of the construction area and along internal drainways as a combined control encompassing any exposed areas of work. Sediment fencing will comply with the IECA Guideline.
- Rock check dams to be installed along the alignment of the sediment fence in order to reduce the amount of sediment runoff
- Vehicle entry and exit points, including the locations of construction grids and wash-down points have been detailed on the plans as required. Where necessary the location of entry/exit points and associated grids will be updated on subsequent PESCP's.

### 10.2.6 Roma Street Stations

The Boggo Road Station is expected to be within the Chermside soil landscape. This soil type is considered to be low to moderate risk for erosion, depending on the steepness of the slope at the point of disturbance. Standard sediment control measures for construction worksites are proposed for the Boggo Road Station.

Mitigation measures would be implemented for the Project to control and reduce the risk of erosion due to construction activities. Erosion control measures would be based upon the objective of reducing the risk of erosion during construction by:

- Managing the stripping and stockpiling of surface spoil material from surface works areas with regard to potential contamination at Roma Street Station worksites
- Stormwater management devices will be designed during detailed design and implemented during construction to control velocity of runoff from exposed areas and capture sediment, entrained in runoff at the Roma Street Station worksite, prior to release/discharge from site in compliance with site stormwater discharge limits

  - Several methods of inlet sediment traps will be employed, including the use of sand bags/filter socks within overlap kerb, filter socks surrounding stormwater drain inlet and filter bags covering stormwater drains.

- Sediment traps will be excavated to collected overflow water with catch drains used to direct the water
- Sediment fence to be installed on the downgradient side of the construction area and along internal drainways as a combined control encompassing any exposed areas of work. Sediment fencing will comply with the IECA Guideline.
- Rock check dams to be installed along the alignment of the sediment fence in order to reduced the amount of sediment runoff
- Vehicle entry and exit points, including the locations of construction grids and wash-down points have been detailed on the plans as required. Where necessary the location of entry/exit points and associated grids will be updated on subsequent PESCP's.

### 10.2.7 Northern Portal

Between the Bowen Bridge Road overpass and the northern portal worksite the proposed alignment follows the ICB alignment closely and is likely to be located within the Logan soil landscape within a relatively flat, low-lying historical drainage line. The erosion risk associated with surface works within the worksite is anticipated to be low, but consideration of potential erosion and sediment movement risks associated with excavation and surface works for gaining access to the northern portal worksite will be required due to the steep slopes of the adjacent and surrounding area between the Bowen Bridge Road overpass and the northern portal worksite. Standard sediment control measures for construction worksites are proposed for surface works within this area.

Mitigation measures would be implemented throughout various stages of the Project to control and reduce the risk of erosion due to construction activities. Erosion control measures would be based upon reducing the risk of erosion during construction by:

- Managing the stripping and stockpiling of topsoil material from construction worksites and surface works areas and segregation of potentially contaminated material
- Managing the extent of soil disturbance and vegetation clearing as well as reducing the exposure of vulnerable soils and soils on steep slopes to accelerated erosion by wind and water action, particularly where site access works are required for the northern portal worksite
- Designing stormwater management systems during detailed design and implemented during construction to control velocity of runoff from exposed areas and capture sediment entrained in runoff prior to release/discharge from worksites within the northern section of the study corridor
- Sediment fence to be installed on the downgradient side of the construction area and along internal drainways as a combined control encompassing any exposed areas of work. Sediment fencing will comply with the IECA Guideline.
- Vehicle entry and exit points, including the locations of construction grids and wash-down points have been detailed on the plans as required. Where necessary the location of entry/exit points and associated grids will be updated on subsequent PESCP's.

### 10.2.8 Site Reinstatement

The following site reinstatement procedures for all worksites involved in the tunnelling works, should be put in place after completion of works:

- Restore, rehabilitate and where appropriate, enhance open space and public areas disturbed or damaged by construction, progressively and as soon as practicable following construction
- No stockpiles of excavated material or topsoil should be left within the vicinity of the worksites, with any excess spoil material relocated to the nominated stockpile area and subject to the appropriate erosion and sediment control measures.
- Where practicable, replacement of cleared mature trees with plantings of advanced individuals
- Regrading of the surface to facilitate surface runoff without erosion, and to create a landform suitable for use consistent with City Plan designations
- Reinstatement of paths, including the bicycle path, street or park furniture, signage equipment and lighting
- Reinstatement of grassed areas and paved surfaces where practicable.

Site reinstatement should be done in general accordance with relevant sub-plans including the CWMP and Social Amenity Management Plan (SAMP).

# 11 Compliance Management

## 11.1 Roles and Responsibilities

The organisational responsibilities and accountabilities in relation to environmental management throughout Project construction works are outlined in the overarching CEMP.

## 11.2 Induction and Training

### 11.2.1 Environmental Induction

All CBGU staff, subcontractors and visitors to worksites must attend general induction training that covers general environmental management requirements, site-wide controls and site-specific and work specific risks and mitigation measures. Further details regarding environmental induction requirements have been outlined in the overarching CEMP.

### 11.2.2 Environmental Training

Details regarding environmental training requirements have been outlined in the overarching CEMP.

## 11.3 Communication

Communication strategies including internal communication, external and Government Authority consultation, and stakeholder and community liaison must be undertaken in accordance with the CEMP and the Community and Stakeholder Engagement Plan (CSEP).

## 11.4 Incidents and Emergencies

### 11.4.1 Incident Notification

The immediate response to all incidents is to make the area safe and undertake measures to prevent further environmental harm. The Environment and Sustainability Manager, Shared Services Director and Project Director should be notified immediately in the event of an environmental incident.

Further details regarding Incident Notification, have been outlined in the overarching CEMP.

### 11.4.2 Incident Types

Incidents may include, but are not limited to:

- Any breach of the legislation or an approval condition or the Co-ordinator General Conditions (NCE)
- Unauthorised harm or desecration to Aboriginal objects or Aboriginal places
- Unauthorised damage or destruction to any State or locally significant relic or Heritage item

### 11.4.3 Incident Prevention Management

Incident Prevention management has been identified within the overarching CEMP

### 11.4.4 Incident Investigation

The Incident Investigation process has been specified in the overarching CEMP.

### 11.4.5 Complaint Management

All complaints are to be dealt with in accordance with the complaints management procedure outlined in the CEMP.

# 12 Inspections, Monitoring, Auditing and Reporting

This section outlines the compliance processes that have been adopted by CBGU to ensure compliance with the Coordinator-General Conditions and any other legislative requirements. The section below details specific requirements relating to Inspections, monitoring, auditing requirements have not been outlined in the overarching CEMP.

## 12.1 Environmental Monitoring

### 12.1.1 Performance Monitoring

Monitoring will be undertaken at various sensitive receptors to validate the impacts predicted for the Project to measure the effectiveness of environmental controls and implementation of this ESCPO. The monitoring also helps in addressing any potential Community Complaints that may be made. The monitoring requirements for ESC are outlined below:

- As part of routine daily site inspections, conduct visual assessment of erosion and sediment control measures to verify their condition and effectiveness and identify the need for maintenance, including material being tracked onto the road network. Any maintenance works required to rectify defects are to be undertaken as soon as practicable after detection
- Review ESCPs at least monthly or when there is a change in work activities at a particular site, and update as necessary to ensure the continued effectiveness of management measures
- Immediately following a defined rainfall event (45mm in 6 Hours), inspect and conduct necessary maintenance on all erosion and sediment control measures, including bunding and water treatment facilities, and inspect drainage discharge points from each worksite for evidence of sediment transport, if any
- During the post-construction maintenance phase, conduct monthly visual inspections of surface soil stabilisation measures and undertaken rectification measures as required, to ensure successful establishment
- Regular surface water monitoring, as specified within the Water Quality Monitoring Plan (WQMoP), will be undertaken at predetermined locations as detailed in the Dewatering and Discharge Procedure. This data will also be used to validate the effectiveness of the ESC measures implemented for the Project.

### 12.1.2 Auditing

Audits will be undertaken to assess the effectiveness of environmental controls, compliance with the CEMP, compliance with Environmental Design Requirements, and other relevant permits, approvals, and guidelines. There will be a monthly internal audit undertaken by CBGU as per the CEMP, who is to report findings to the Environmental Monitor and the Authority. This includes reporting on compliance with the CEMP and the Imposed Conditions.

Audits will be undertaken in accordance with the overarching CEMP.

### 12.1.3 Corrective Action

Corrective actions must be undertaken where monitoring or validated complaints indicate the environmental outcomes or Imposed Conditions are not achieved in relation to particular works, either because the performance criteria have not been met, or mitigation measures have not been implemented. Where corrective actions become necessary, the specific works that do not achieve the environmental outcomes or meet the Imposed Conditions must cease until the corrective actions have been developed and implemented.

The process for developing and implementing Correction Actions has been specified within the overarching CEMP.

## 12.2 Reporting

### 12.2.1 Monthly Reporting

To ensure compliance with Coordinator-General Condition 6, CBGU will prepare and submit a monthly report within 6 weeks from the end of the month to the Delivery Authority

The specific requirements of the Monthly Report have been identified in the CEMP.

### 12.2.2 Incidents and Non-Compliance Event Reporting

Environmental incidents meeting the criteria of an NCE shall be notified verbally as soon as practical and in writing within 48 hours of becoming aware of an incident occurring to the Development Authority. Notification will generally be undertaken by the Environment and Sustainability Manager or a member of the CBGU environment team. Additional notification of the incident to the relevant authorities, EM and parent companies will also be undertaken as required.

Further details regarding reporting, including provision of interim and detail reports have been provided in the CEMP.

## 12.3 Documentation and Communication

### 12.3.1 Environmental Records

The process for managing and collecting environmental records is detailed in the overarching CEMP. All relevant records in relation to water quality must be maintained in accordance with these requirements.

### 12.3.2 Document Control

Document control requirements have been specifically addressed within the overarching CEMP.

### 12.3.3 Review

In accordance with the General Requirements of the CEMP this ESCPO must also be updated and revised on the basis of:

- Detailed designs for Erosion and Sediment Control Plans by the Contractor
- Detailed construction planning
- Meteorological data relevant to each worksite.

Revisions shall be reviewed and approved prior to issue. Updates to this ESCPO are numbered consecutively and issued to holders of controlled copies

Revisions to this ESCPO may also be required during the Project to reflect changing circumstances or identified deficiencies. Revisions may result from:

- Management Review
- Audit (either internal or by external parties)
- Complaints or non-conformance reports
- Changes to the Company's standard system.

### 12.3.4 Communication

All internal and external communication with all stakeholders including the public, Coordinator-General, government agencies and the Delivery Authority must be done in accordance with the requirements of the CEMP.

# 13 Severe Weather

The controls indicated in this plan have been designed in accordance with criteria specified in MRTS52 and IECA (2008) document. These specifications have been adopted based on the project duration and sensitivity of the receiving environment/community, with consideration given to the constraints of the project locality (i.e. low-lying areas with flood susceptibility) and practical implementation of best practice ESC. The controls, and any other sediment, drainage or erosion control installed on site may fail in rain events greater than those specified.

To reduce the impacts arising from a greater than design event, or other severe weather, a brief risk assessment has been completed.

*Table 17 Severe Weather Risk Assessment*

| Hazard | Likelihood | Impact | Control |
|---|---|---|---|
| Type 2 or Type 3 sediment controls fail | Medium to high | Releases turbid water to the environment | Undertake monitoring and investigation per requirements of MRTS51 and this ESCPO. Notify the regulatory authority if release warrants. Remove deposited sediment from within and downslope of work area (without causing further disturbance) and reinstate control measures. Review measures and consider if changes required to meet the intent of this ESCPO and demonstrate all reasonable measures have been undertaken to prevent the release |
| Temporary drainage fails | Medium | Clean and dirty water combine, releases turbid water to the environment. | Stabilise drainage bunds in accordance with the specification. Inspect and maintain bunds regularly. |
| Surface treatment does not effectively stabilise surfaces | Low to medium | Surfaces will be exposed and subject to ongoing erosion. | Temporary or permanent surface treatments to be installed per specifications. Where flow velocities may exceed the maximum allowable install additional measures to either reduce flow velocity or secure treatment (i.e. pinning of turf). Rock treatments to be recessed and suitably installed to limit displacement. Stabilisation by placement of temporary erosion control or permanent landscaping to be progressively undertaken to allow greater establishment. Appropriate QA/QC of treatment application must be undertaken (even including temporary binder or hydromulching). Monitor surfaces and flow paths for signs of failure. If flow velocities appear to exceed surface treatments, consider installation of temporary velocity controls to reduce shearing effects whilst vegetation establishes and/or consider alternative treatments. |

| Hazard | Likelihood | Impact | Control |
|---|---|---|---|
| Dust generation | Low to high | Release to the environment and surrounding users | Increase dust suppression during high winds. Reduce traffic and machinery movement. Stabilise exposed areas. |

It should be noted that the most effective control measure in the event of severe weather is to secure and stabilise as much exposed area as possible. This can also be achieved by scheduling high risk activities (such as stripping, or drainage work) to low-risk periods of time (with limited rain forecast). Prior to forecasted severe weather (or any rainfall) all efforts should be made to secure the work area by temporary or permanent means.

## 13.1 RESPONSE TO SIGNIFICANT WEATHER

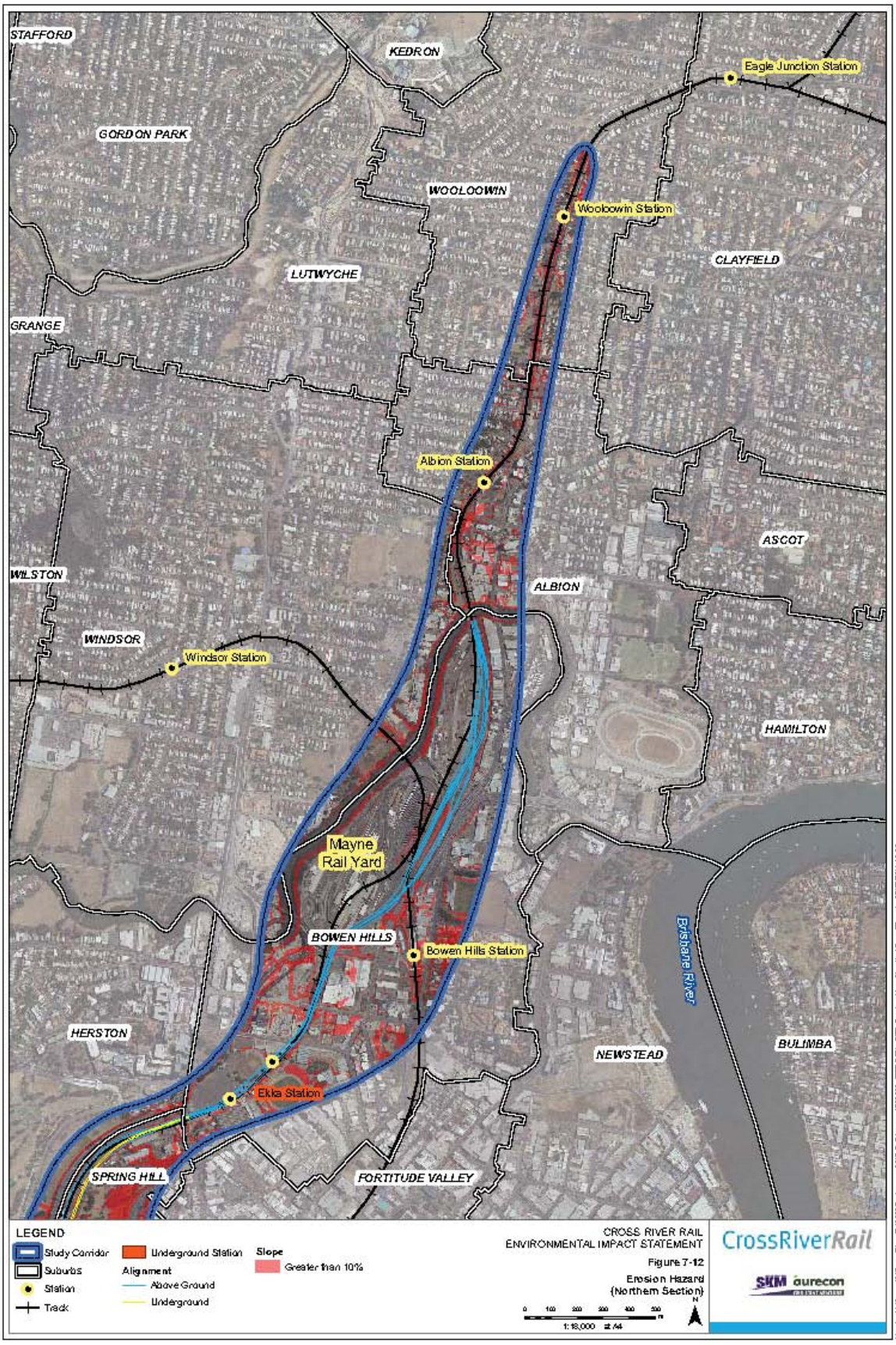
Following significant weather, the CBGU will conduct a site wide inspection of erosion, sediment and drainage controls and implement the following response strategy:

1. Identify maintenance items, including;
    a. damaged or scoured drains
    b. ripped or broken liners and erosion controls
    c. excessive sediment deposition (whether on-site or off-site)
    d. construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements
    e. water levels and sediment captured in sediment controls
2. Schedule corrective actions by order of priority, noting that the safety of project personnel and the public shall always take precedence
3. Dewater sediment controls and work areas in accordance with the nominated discharge criteria.
4. Carry out water quality monitoring in accordance with MRTS51, MRTS51.1, MRTS52, MRTS52.1 and MRTS16 as detailed in the CEMP.
5. Track closed out and outstanding items in a corrective action register
6. Present the corrective action register with water quality monitoring results as part of project records
7. Amend erosion and sediment control plans if necessary to account for any changes that may be required.

A severe weather management plan (SWMP) may be developed for the project, identifying additional response measures to significant rainfall. Note that the SWMP is typically prepared to provide guidance in terms of insurance claims following severe weather. The SWMP would present measures relevant to erosion and sediment control only and would not be specific to protection of permanent infrastructure, plant or safety of personnel.

# Appendix A

## Slope Figures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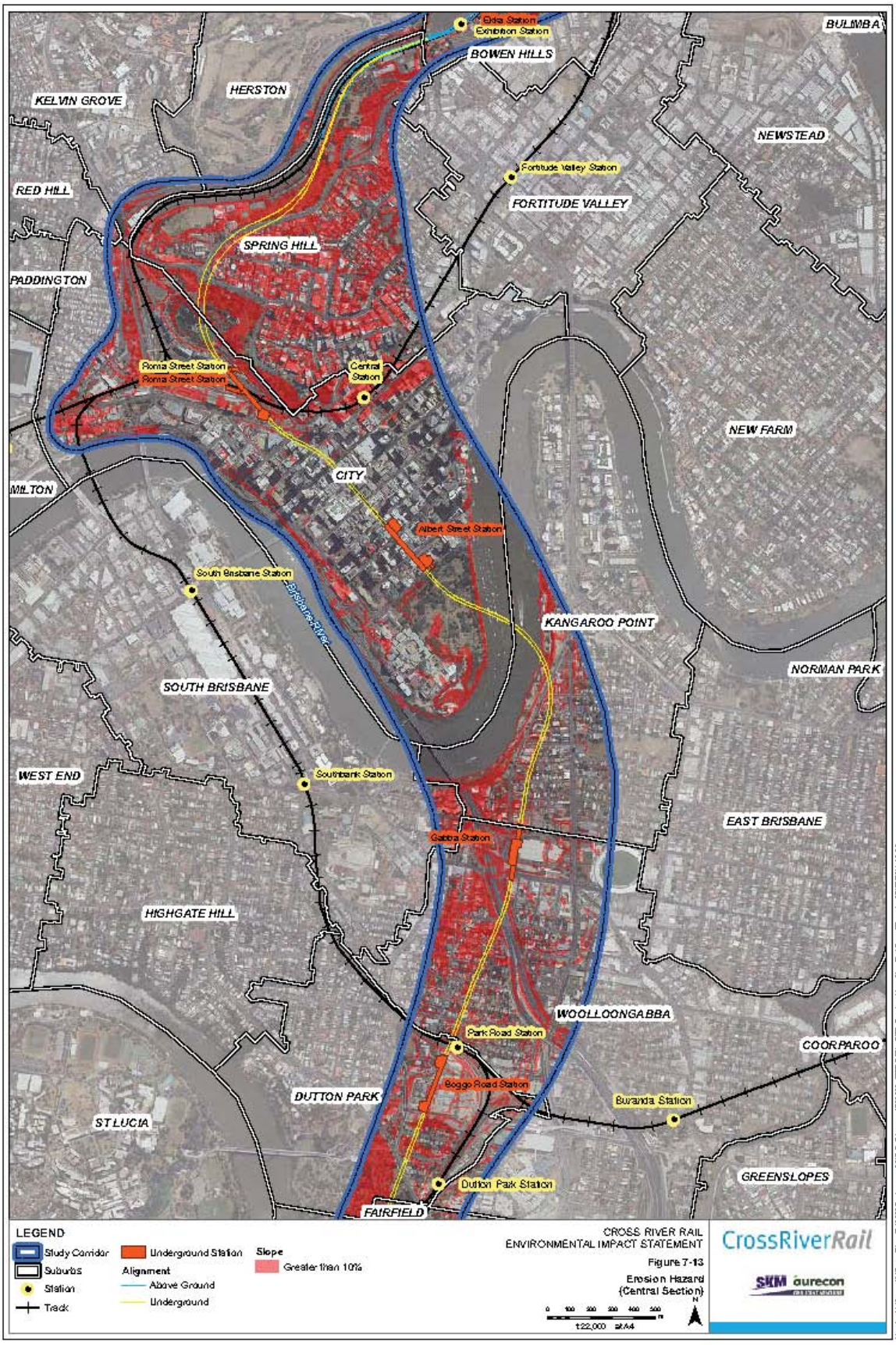
GORDON PARK
WOOLOOWIN
Wooloowin Station
CLAYFIELD
LUTWYCHE
GRANGE
Albion Station
ASCOT
WILSTON
ALBION
WINDSOR
Windsor Station
HAMILTON
Mayne
Rail Yard
BOWEN HILLS
Bowen Hills Station
Brisbane River
HERSTON
NEWSTEAD
BULIMBA
Ekka Station
SPRING HILL
FORTITUDE VALLEY
LEGEND
Study Corridor
Suburbs
Station
Track
Underground Station
Alignment
Above Ground
Underground
Slope
Greater than 10%
CROSS RIVER RAIL
ENVIRONMENTAL IMPACT STATEMENT
Figure 7-12
Erosion Hazard
(Northern Section)
CrossRiverRail
SKM aurecon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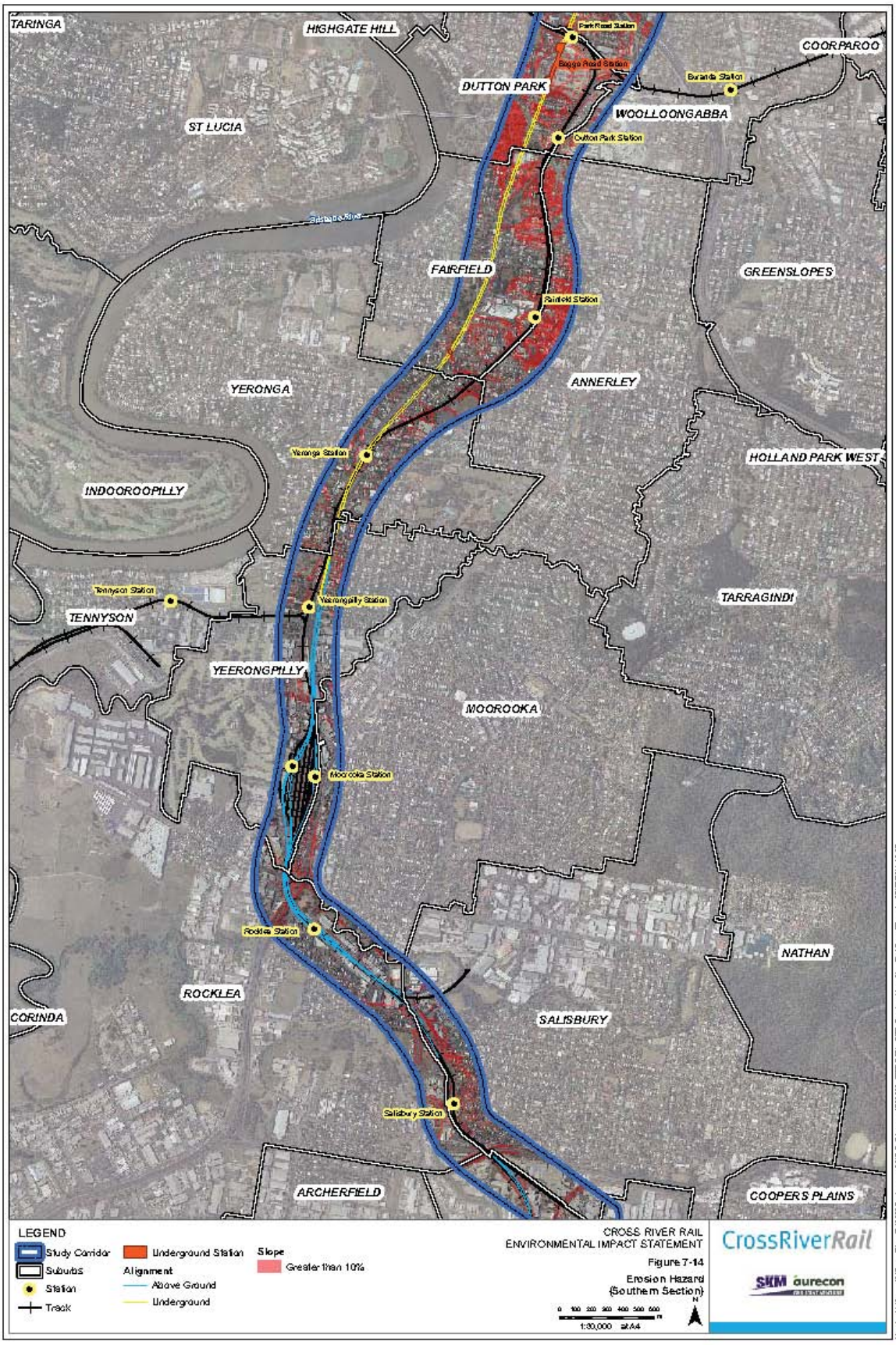
BULIMBA
KELVIN GROVE
HERSTON
NEWSTEAD
Fortitude Valley Station
RED HILL
FORTITUDE VALLEY
SPRING HILL
PADDINGTON
Roma Street Station
Roma Street Station
Central Station
NEW FARM
CITY
MILTON
Albert Street Station
South Brisbane Station
Brisbane River
KANGAROO POINT
NORMAN PARK
SOUTH BRISBANE
WEST END
Southbank Station
EAST BRISBANE
Gabba Station
HIGHGATE HILL
WOOLLOONGABBA
Park Road Station
COORPAROO
Boggo Road Station
DUTTON PARK
Buranda Station
ST LUCIA
GREENSLOPES
Dutton Park Station
FAIRFIELD
LEGEND
Study Corridor
Suburbs
Station
Track
Underground Station
Alignment
Above Ground
Underground
Slope
Greater than 10%
CROSS RIVER RAIL
ENVIRONMENTAL IMPACT STATEMENT
Figure 7-13
Erosion Hazard
(Central Section)
1:22,000 @ A4
CrossRiverRail
SKM aurecon


TARINGA
HIGHGATE HILL
Park Road Station
COORPAROO
Boggo Road Station
Buranda Station
DUTTON PARK
WOOLLOONGABBA
ST LUCIA
Dutton Park Station
FAIRFIELD
GREENSLOPES
Fairfield Station
YERONGA
ANNERLEY
Yeronga Station
HOLLAND PARK WEST
INDOOROOPILLY
Tennyson Station
Yeerongpilly Station
TARRAGINDI
TENNYSON
YEERONGPILLY
MOOROOKA
Moorooka Station
Rocklea Station
NATHAN
ROCKLEA
CORINDA
SALISBURY
Salisbury Station
ARCHERFIELD
COOPERS PLAINS
LEGEND
Study Corridor
Suburbs
Station
Track
Underground Station
Alignment
Above Ground
Underground
Slope
Greater than 10%
CROSS RIVER RAIL
ENVIRONMENTAL IMPACT STATEMENT
Figure 7-14
Erosion Hazard
(Southern Section)
1:30,000 @A4
CrossRiverRail
SKM aurecon