PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

Approval no: DEV2022/1306

Date: 3 February 2023

Queensland Government

YARRABILBA PRECINCT 5A MIBA NORTH

STORMWATER MANAGEMENT PLAN

VERSION 1

DesignFlow

Prepared for Lendlease

June 2022

Document Control Sheet

Report Title:	Yarrabilba Precinct 5A MIBA North Stormwater Management Plan – Version 1
Suggested Reference:	Yarrabilba Precinct 5A MIBA North Stormwater Management Plan – Version 1 (DesignFlow, 2022)
Version:	1
Client:	Lendlease
Author(s):	Nic Smith
Reviewed By:	Shaun Leinster
Approved By:	Shaun Leinster RPEQ: 15637
Date:	30 June 2022
File Location:	S:\Projects\4380
Circulation:	Electronic Copies: Lendlease, RPS, KN Group

Disclaimer

Potential implications of climate change
Unless expressly stated otherwise, historical climate data has been used in, or underpins, the analyses that are presented in this report. The historical climate is not necessarily a valid indicator of future climate, which may contain prolonged periods that are wetter or drier than the historical record used for this analysis. There is significant uncertainly surrounding how climate, and in particular, rainfall, will be impacted by various levels of greenhouse gas accumulation in the atmosphere. Rainfall has a much greater spatial variability than temperature and some areas are likely to become wetter whilst other areas become drier. Further to this there may be changes in the seasonality and intensity of rainfall. Such changes in climate could affect the conclusions and recommendations of this report.

Inherent natural variability in soils and plants
Where particular types of soils are recommended, such recommendations are based on information provided by soils suppliers, laboratories and published industry guidelines. There can be inconsistencies in the behaviour of soils under field conditions compared to laboratory conditions, and, for both natural and blended soils, many soils are non-homogenous and properties and behaviour can be variable. Where particular plant species have been recommended, such recommendations are based on botanical knowledge and observations of similar species growing in similar, but not identical conditions. Plants can be sensitive to subtle changes in climate, hydrology, soil and surrounding ecological conditions. Further to this, plant health is often closely linked to the level of maintenance provided. No warranty or guarantee, whether explicit or implied is made with respect to the suitability or performance of soils or plant species recommended in this report

Table of Contents

List of Tables

List of Figures

1 INTRODUCTION

The Yarrabilba Priority Development (PDA) is located within the Logan City Council area and occupies a former pine plantation located south of Logan Village. The Yarrabilba PDA was declared by regulation under the Economic Development Act (2012). Yarrabilba is part of a regional growth area identified in the South East Queensland Regional Plan, which identifies a need for a further 70,000 dwellings across a number a localities in the Logan City Council area by 2031. The Yarrabilba development aims to provide approximately 17,000 dwellings for a population of 45,000.

Precinct 5A MIBA North (subject site) covers an area of approximately 31.3 hectares (ha) which includes just under 14 ha of development lots, 4 ha of roads and around 13.2 ha of powerline easement and stormwater treatment areas.

This document presents the stormwater management strategy for the subject site to meet the requirements set out in the Context Planning Area Strategy. These are generally consistent with the S*tate Planning Policy*, *Yarrabilba Total Water Cycle Management Strategy* (DesignFlow, 2021) and *Yarrabilba Stormwater Infrastructure Master Plan* (DesignFlow, 2021). This report provides details of the proposed stormwater treatment measures including location, conceptual sizing and functional earthworks.

This report focusses on the construction phase erosion/sediment control, stormwater quality and waterway elements specific to Precinct 5A. Flood management has been addressed separately in *the Yarrabilba (Quinzeh Creek) Flood Study – Version 1* (DesignFlow, 2017) as the flood management strategy spans numerous current and future precincts requiring site wide planning. No flood infrastructure is required within the subject precinct.

2 SITE CHARACTERISTICS

2.1 LOCATION

Development Precinct 5A MIBA North lies in the western portion of the Lendlease site bordering the southern edge of existing Precinct 1 and Waterford Tamborine Road as shown in Figure 1. The precinct covers a total area of 31.3 ha across 5 stages which includes a significant area of existing powerline easement and buffer defining the northern extent of the precinct.

2.2 TOPOGRAPHY, CATCHMENTS AND DDRAINAGE

The existing topography across the precinct ranges from low-moderate grades (approximately 2% on ridgeline increasing to around 5% in drainage gullies and up to 7% in the south-west corner near Waterford Tamborine Road). Elevations range from approximately 45 mAHD at the eastern development edge up to 60 mAHD at the western interface with Waterford Tamborine Road.

As illustrated in Figure 2, the northern portion of the subject site drains in a southward direction from the powerline easement to a broad shallow gully running eastward through the site. This also captures a 15 ha external catchment from west of Waterford Tamborine Road. The southern portion of site is characterised by a low ridgeline separating the gully described above and the main ephemeral waterway forming the western tributary of upper Quinzeh Creek. This waterway extends west under Waterford Tamborine Road and drains the external rural residential catchment through the Yarrabilba site.

2.2.1 Lawful Point of Discharge

The lawful point of discharge for stormwater from Precinct 5A MIBA North is South into the western tributary of Quinzeh Creek as illustrated in Figure 2. This watercourse is a drainage feature under the Water Act (2000) and a moderate risk waterway under the Fisheries Act 1994. This waterway remains within the Yarrabilba site until such time as it discharges north of the site (between Precinct 3A and 3C) near Steele Road approximately 3 km downstream.

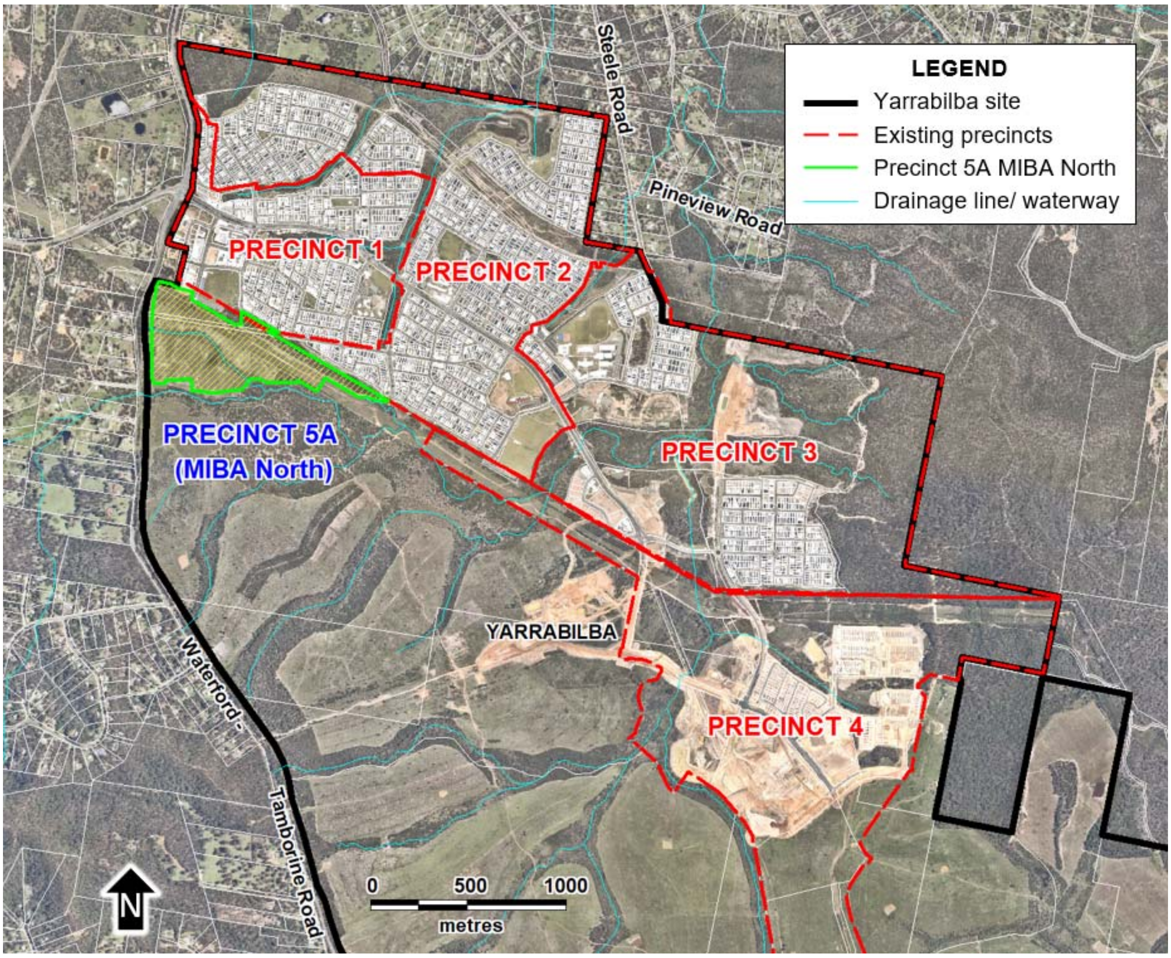


Figure 1: Yarrabilba Precinct 5A MIBA North locality

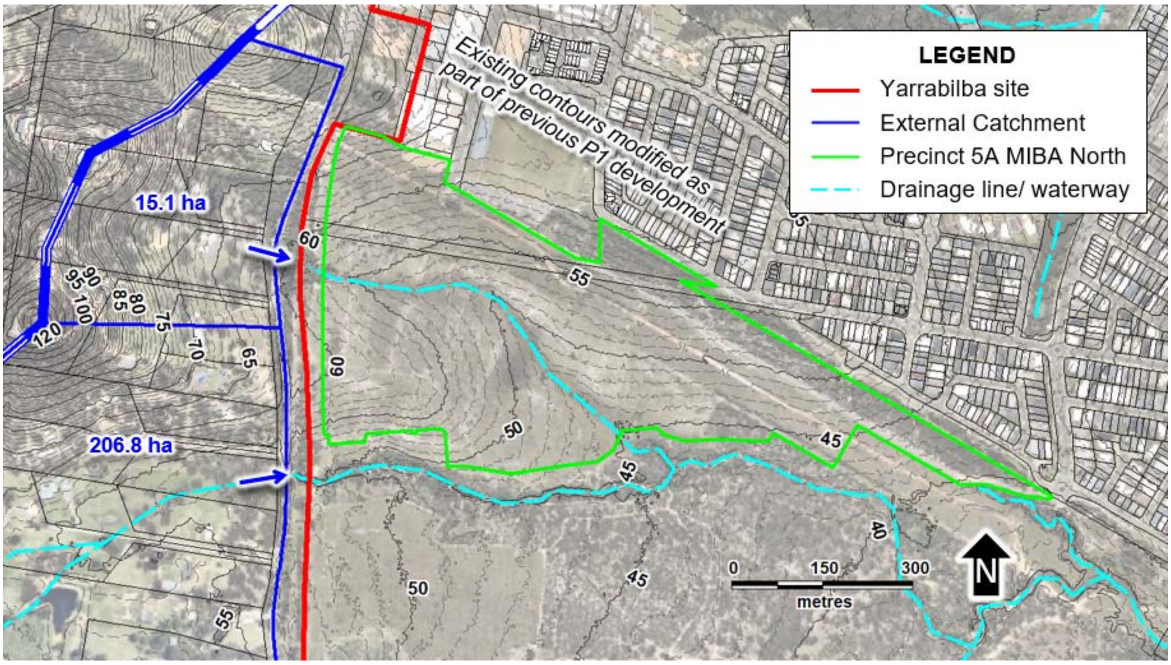


Figure 2: Existing topography, catchments and drainage

2.3 GEOLOGY AND SOILS

Geological mapping indicates Precinct 5A is located across two geological units:

- Woogaroo sub-group (RJbw)
- Alluvium (Qa)

Broad scale geotechnical investigations completed across the site (Bowler, 2004) indicate subsurface soils are typically sands overlying silty clays and weathered sandstones. The soil conditions for much of Precinct 5A MIBA are not expected to vary significantly from those encountered in the balance of Precinct 3 and 4 previously (i.e. those within the lower slope development zones). The alluvium zones (southern edge of P5 MIBA north) have often displayed deep sand zones in localised areas of previous precincts where historic channel/creek incisions have been filled with sediment eroded from upslope catchments. Further site specific geotechnical investigations will occur within Precinct 5A MIBA North to confirm soil conditions for civil engineering design.

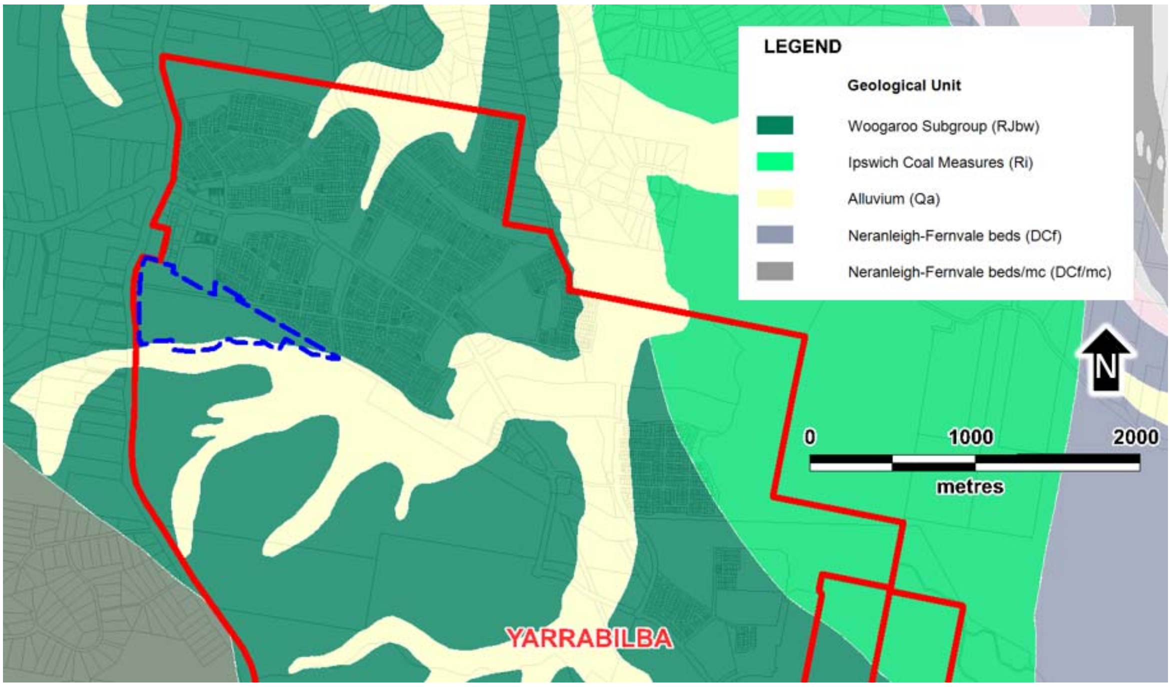


Figure 3: Geology and soils

2.4 VEGETATION

The majority of the Yarrabilba site was previously pine plantation, with most vegetation associated with grassland or pine and eucalypt/acacia regrowth of limited ecological value. Historical aerial imagery illustrates grassland and pine areas represent roughly 80% of the existing land use across the Yarrabilba site, which have subsequently been covered with regrowth. Moderate to dense vegetation generally occurs along drainage lines in the development area.

Vegetation management will generally be undertaken in accordance with *Yarrabilba Development: Natural Environment Site Strategy* (Natura Consulting, 2012) which highlights vegetation management procedures with regards to clearing approvals, revegetation, monitoring/compliance and design requirements. Strategy 14 in the CPAS provides the individual mapping for waterway, flora and fauna constraints as well as bushfire setbacks for the Precinct 5A MIBA North development.

2.5 WATERWAYS

There are no mapped waterways within Precinct 5A MIBA north boundary that are to be retained. The existing drainage line through the centre of the site (Figure 2) has been reviewed by Natura Pacific and not deemed a waterway for the purpose of ecological protection, buffering or rehabilitation as it was primarily a drainage overland path dominated by exotic pine (*Pinus elliottii*) and lantana (*Lantana camara*). These weeds were subsequently cleared as part of land management practices between 2017 and 2019. As part of development, this drainage (largely from external catchment west of Waterford Tamborine Road) is to be diverted south along the western boundary of the development via an open grassed drain towards the main waterway. Ultimately, this will be formalised further as part of the future Waterford Tamborine Road realignment and upgrade (currently in planning and design phase). This is discussed further in Section 4.

The main waterway (western tributary of upper Quinzeh Creek) lies south of and outside the Precinct 5A MIBA North boundary and while not forming part of this development application, has been included in the site planning for the purpose of waterway setbacks. A detailed survey was undertaken for this waterway and vegetation in order to assign the minimum waterway buffers set out in the *Stormwater Infrastructure Master Plan* (DesignFlow, 2021). In conjunction with existing vegetation and bushfire considerations, the development extent has been defined outside this waterway corridor.

As described in the approved CPAS, no part of MIBA North extends into the retained waterway (or buffers) to the south so no further assessment or reporting of waterway management will be mased in this report. It does, however, acknowledge the future rehabilitation works that need to be managed as part of the subsequent expansion of the MIBA area to the south. The overall condition of this waterway is generally rated as 'poor' in the *Yarrabilba General Waterway Condition Assessment* (DesignFlow, 2021) and future rehabilitation will be critical to the improvement of this waterway for long term ecological and geomorphological benefits.

2.6 PROPOSED DEVELOPMENT

The proposed development includes lots, roads and drainage reserve to support mixed industry and business land use. The precinct boundary also includes an existing major powerline easement traversing the northern extent. The total precinct covers 31.3 hectares including approximately 14 hectares of lots, 4 hectares of roads, 1.3 hectares stormwater treatment and the balance 12 hectares of powerline easement. The precinct layout is shown in Figure 4.

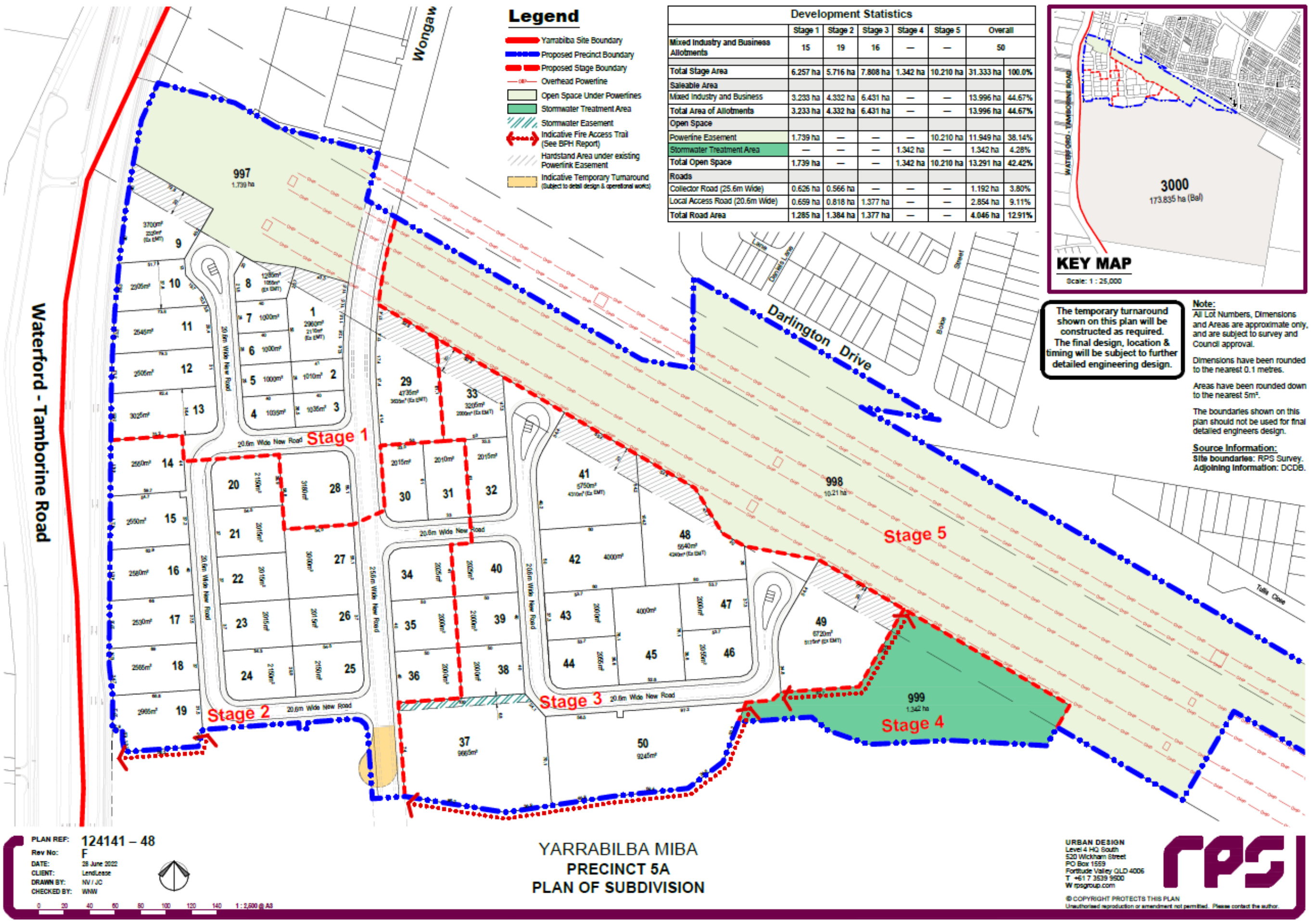


Figure 4: Precinct 5A MIBA North proposed layout (RPS)

3 STORMWATER QUALITY

3.1 DESIGN OBJECTIVES

The stormwater quality management objectives that apply to the operational phase of Yarrabilba Precinct 5A are listed in Table 5 as defined by *the Yarrabilba – Stormwater Infrastructure Master Plan* (DesignFlow, 2021), which are consistent with the State Planning Policy (DSDIP, 2017).

These objectives require the reduction of pollutant loads discharged from the development site once all construction works are complete. These load reductions are aimed at protecting the environmental values of downstream receiving waterways from the impacts of urban stormwater runoff.

Table 1: Stormwater quality objectives

Pollutant	Discharge criteria (% reduction in mean annual load)
Total suspended solids (TSS)	80%
Total phosphorous (TP)	60%
Total nitrogen (TN)	45%
Gross pollutants (GP)	90%

3.2 STORMWATER QUALITY MANAGEMENT STRATEGY

A stormwater management strategy has been developed for Precinct 5A MIBA north based on a review of the site characteristics, constraints, masterplan for the proposed development zones and discussions with Lendlease. The proposed strategy has been developed in collaboration with the design team to ensure the proposed strategy is well integrated with both engineering and landscape aspects of the design.

When developing the treatment strategy, a number of guiding principles were considered:

- Adopt multiple use open space principles where possible
- Locate treatments in waterway buffer zones, where applicable, as per *Yarrabilba – Stormwater Infrastructure Master Plan* (DesignFlow, 2021) and the *MIBA North Context Plan Area Strategy* (RPS, 2021).
- Adopt similar treatment philosophy as per Precinct 1, 2 and 3 developments to retain consistency across the development
- Integrate with landscape outcomes
- Minimise the impact on existing vegetation and adjacent aquatic ecosystems

Being a comparatively small and contained local catchment, the stormwater quality strategy relies on a single end-of-pipe treatment system capturing the majority of the developed parts of the precinct. Secondary to this is the drainage management of the northern powerline easement interface (undeveloped zone requiring clean water diversion around site) and the western interface with Waterford Tamborine Road (future road upgrade corridor by the Department of Transport and Mian Roads (DTMR). A very minor area of road at the southern boundary will discharge untreated in the short-term until future precinct expansion to the south occurs at which time this catchment will drain to future treatment areas.

Figure 5 shows the overall proposed treatment strategy for Precinct 5A with details of treatment provided in Table 2 and the relevant flood immunity provided in Table 3. Further details of performance assessments of the proposed treatment strategy are presented in Section 6.3.

Table 2: Stormwater treatment elements

Treatment Type and ID	Size	Catchments	Comment
Sediment Pond 5A1	350m²	5A1	Inlet pond to Bioretention basins 5A2 and 5A3
Bioretention Basins 5A2 - 5A3	2 x 800m²	5A1	Split inflow to each basin from sediment pond
Swale 1A	Varies	1A, E1, E2	Manages part of existing Precinct 1 plus diverts easement runoff around development

The concept design for the sediment pond and bioretention basins has been documented in the functional design plans by KN Group (Appendix A). Key design parameters are summarised in Table 3. These are subject to detailed design as part of operational works.

Table 3: Stormwater treatment basins concept design levels summary

	Design Level (mAHD)
Sediment pond (NWL)	45.6
Bioretention surface	45.5
Embankment (external)	46.5 (min.)
1% AEP Flood level (adjacent waterway)	44.0 (approx.)

Notes:
NWL = Normal water level

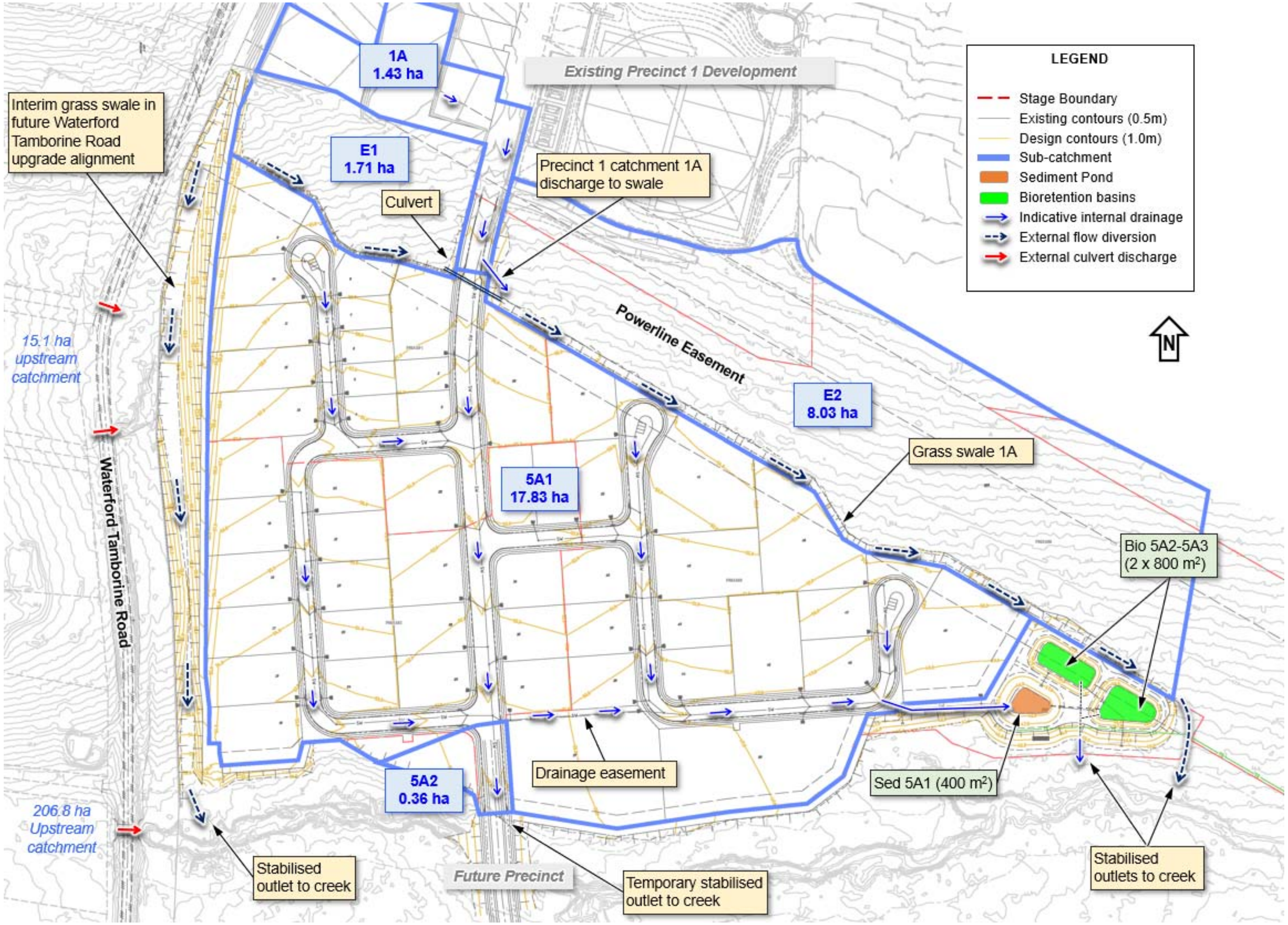


Figure 5: Precinct 5A MIBA North stormwater quality management strategy

3.3 STORMWATER QUALITY ASSESSMENT

MUSIC modelling was conducted to assess the stormwater treatment performance of the proposed treatment strategy. MUSIC Version 6.3 was used for the assessments.

3.3.1 Model Structure

The structure of the MUSIC model is shown in Figure 6 with the general data provided in Table 4.

MUSIC model parameters were adopted generally in accordance with the *MUSIC Modelling Guidelines* (Water by Design, 2010) using 10 years (1990-2000) of modified Shailer Park meteorological data. Six minute rainfall data and monthly average evapotranspiration data was used. The Shailer Park station was selected for adoption as it is the closest rainfall station to the site with 6 minute data. The rainfall data set was modified to generate a data set closer representing Logan Village rainfall. The Shailer Park 6 minute rainfall was reduced by a factor of 0.849 to produce a rainfall data set with a similar annual total to Logan Village (950mm) for the period considered. Discussion of this was provided in Section 5.1 of the *Precinct 1 Stormwater Management Plan* (DesignFlow, 2011) and has been consistently used in all subsequent applications since that time.

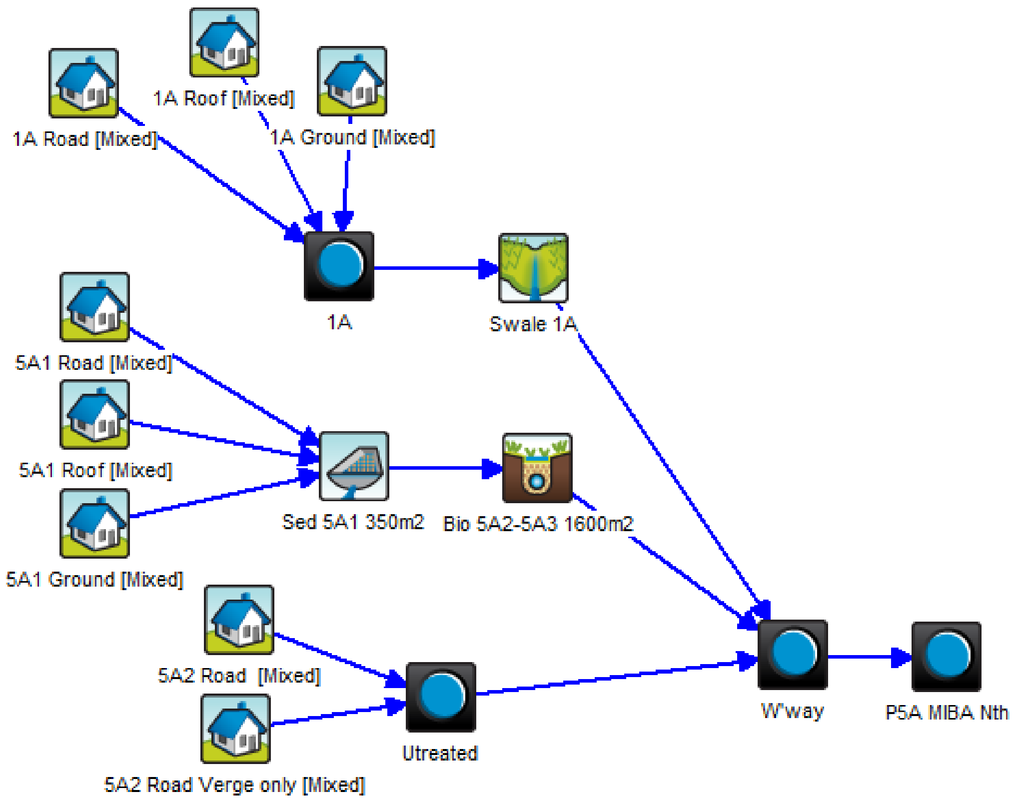


Figure 6: MUSIC model layout

Table 4: MUSIC modelling parameters

Parameter	Value
Source Data	
Rainfall data set	1990-99– Modified Shailer Park Station 040715
Modelled time step	6 minute
Mean annual rainfall 1990-2000	950 mm
Potential evapotranspiration	1,446 mm
Soil properties (runoff generation parameters)	Table 3.7 Music Modelling Guidelines (as appropriate depending on land use)
Pollutant concentrations (base flow and storm flow concentration)	Table 3.8 Music Modelling Guidelines (as appropriate depending on land use)
Percent impervious	Table 3.5 and 3.6 Music Modelling Guidelines (as appropriate depending on land use)
Treatment Devices	
Bioretention	Filter media depth = 0.6 m Extended detention depth = 0.3 m Extended detention area = Bio + sed pond Seepage = 0 mm/hr TN content 400 mg/kg Orthophosphate content 30mg/kg
Sediment Basin	Extended detention depth (EDD) = 0.01 m (extended detention area included in bio basin – see above) Evaporative loss 75% of PET Notional detention time = <0.1hr (upstream of bio)
Swale	Length = 100m [1] Slope = 2% Base width = 5m Top width = 8m Depth = 0.5m Vegetation height = 50mm (assume mowed)

Notes:

1. Actual swale length is in the order of 580m, however combined site objectives (excluding easement catchment) can be readily achieved with a swale length of 100m so this is used for conservative modelling.

3.3.2 Assumptions

1. Water quality management measures are sized only for the portion of each catchment undergoing development (i.e. excludes undeveloped/revegetated powerline easement)

2. While the combined catchments of 1A, E1 and E2 discharge via a grassed swale approximately 580m in length, a conservative modelling approach has adopted only developed catchment 1A discharging into a 100m section of swale to illustrate more than adequate swale length exists. If the full easement catchment was included (as a developed source load) discharging to the full swale length (or even 50% of swale given distributed inflow), overall pollutant load reductions would be higher than reported in Section 3.3.4 below. This approach therefore remains conservative at this concept design phase.

3. A split catchment approach was adopted for industrial areas. Split land use percent imperviousness is generally in accordance with Table 3.5 in MUSIC Modelling Guidelines (Water by Design, 2010/2019) with ground level imperviousness adopted as 80% (commercial) as the more conservative approach than industrial.

4. Lot and road reserve areas were measured from development layout with roof area proportion assigned as 65% of lot areas (which equates to approximately 50% of overall catchment area, in line with MUISC Guidelines) and balance as ground level (see item 3 above). This is conservative for the purpose of initial assessment. Where roof areas are lower (and correspondingly impervious ground areas are higher), treatment performance will improve from that reported in Section 3.3.4 below.

5. Bioretention default values for TN and OP content have been adopted as 400mg/kg and 30mg/kg respectively as per Water by Design advice (and in line with MUSIC Guideline 2019)

6. Sediment ponds have been modelled with large unrestricted outlet to bioretention (i.e. inlet zone to bioretention basins). Extended detention (ED) area for bioretention therefore includes area of sediment pond (with sediment pond ED depth set to minimum depth of 0.01m)

3.3.3 Catchment Data

The catchment areas draining to each treatment system have been derived from the urban design and drainage layouts for sub-stages where available. Table 2 previously identified catchments areas contributing to each treatment element. Table 5 below lists the catchment area, land use and percent impervious for each sub-catchment modelled with the detailed breakdown of surface types. Catchment E1 and E2 are identified below but excluded from MUSIC source catchment as these are not undergoing development. They do however discharge to Swale 1A as discussed previously in Section 3.3.2.

Table 5: MUSIC model catchment split data

Catchment ID	Total Area (ha)	Surface Type	Sub-Area (ha)	Impervious %
5A1	17.83	Road	3.84	75%
		Roof	9.09	100%
		Ground	4.90	80%
5A2	0.36	Road	0.18	75%
		Verge only	0.18	0%
1A	1.43	Road	0.34	75%
		Roof	0.71	100%
		Ground	0.38	80%
E1 [1]	*1.71*	*Open Space*	1.71	*0%*
E2 [1]	*8.03*	*Open Space*	8.03	*0%*
Total	*29.36*		*29.36*	*57%*

Notes:

1. Catchment E1 and E2 excluded from MUSIC source catchment as these are not undergoing development. They do however discharge to Swale 1A as discussed previously in Section 3.3.2.

3.3.4 Results

The results of the MUSIC modelling are presented in Table 6. All water quality objectives can be readily achieved with the proposed treatment strategy including offset for the minor catchment 5A2 which discharges untreated.

Table 6: MUSIC results

Catchments	Treatment ID	Pollutant	Inflows (kg/yr)	Outflows (kg/yr)	Reduction (%)
5A1	Sed 5A1+Bio 5A2/5A3	TSS	20500	3390	83.5
		TP	48.9	13.2	72.9
		TN	336	163	51.5
		GP	3600	0	100
1A	Swale 1A	TSS	1730	275	84.1
		TP	3.95	1.73	56.3
		TN	27	21.8	19.1
		GP	288	0	100
5A2	No treatment	TSS	956	956	0
		TP	1.55	1.55	0
		TN	4.87	4.87	0
		GP	33.4	33.4	0
Total Precinct 5A MIBA North (✓ denotes compliance with water quality objectives)		TSS	23200	4620	80.1 ✓
		TP	54.4	16.5	69.6 ✓
		TN	368	190	48.4 ✓
		GP	3920	33.4	99.1 ✓

3.4 COMPLIANCE AND CERTIFICATION

Design and construction certification of operational stormwater quality measures is to occur in accordance with the following guidelines:

- Water by Design (2104). *Bioretention Technical Design Guidelines (Version 1.1)* Healthy Waterways Ltd, Brisbane
- Water by Design (2009), Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands, SEQ Healthy Waterways Partnership. Brisbane, Queensland.
- Water by Design (2012), *Transferring Ownership of Vegetated Stormwater Assets Version 1*. Healthy Waterways Partnership. Brisbane, Queensland.

4 STORMWATER QUANTITY

In line with the CPAS prepared for P5 MIBA North, flood management will generally be undertaken in accordance with the *Yarrabilba Development: Flood Risk Management Strategy* (BMTWBM, 2012) (as referenced in the *Yarrabilba – Stormwater Infrastructure Master Plan* (DesignFlow, 2021)) which beneficially exploits the use of the natural terrain and constructed road crossings (over drainage features and watercourses) to attenuate increased runoff from development. It should be noted that flood mitigation infrastructure is not constructed solely for a single stage or precinct, but functions as part of a total site flood management strategy that addresses current and future development precinct requirements. A number of these detention zones have been constructed in Precinct 1, 2 and 3 to date in advance of the urban development within the catchment. No flood management infrastructure is required or proposed as part of the Precinct 5A MIBA North area and no further flood impact assessment is therefore required as part of this stormwater management plan.

A review of the preliminary earthworks design of the proposed development area in relation to local flood levels is provided in Figure 7. This indicates that P5A MIBA North is well above the 1% AEP flood level being conveyed through the western tributary of upper Quinzeh Creek. This is based on the latest available flood model data (with consideration of the future ultimate Waterford Tamborine Road upgrade and drainage) and will be subject to ongoing review as part of the expansion of the master planned developed of Yarrabilba.

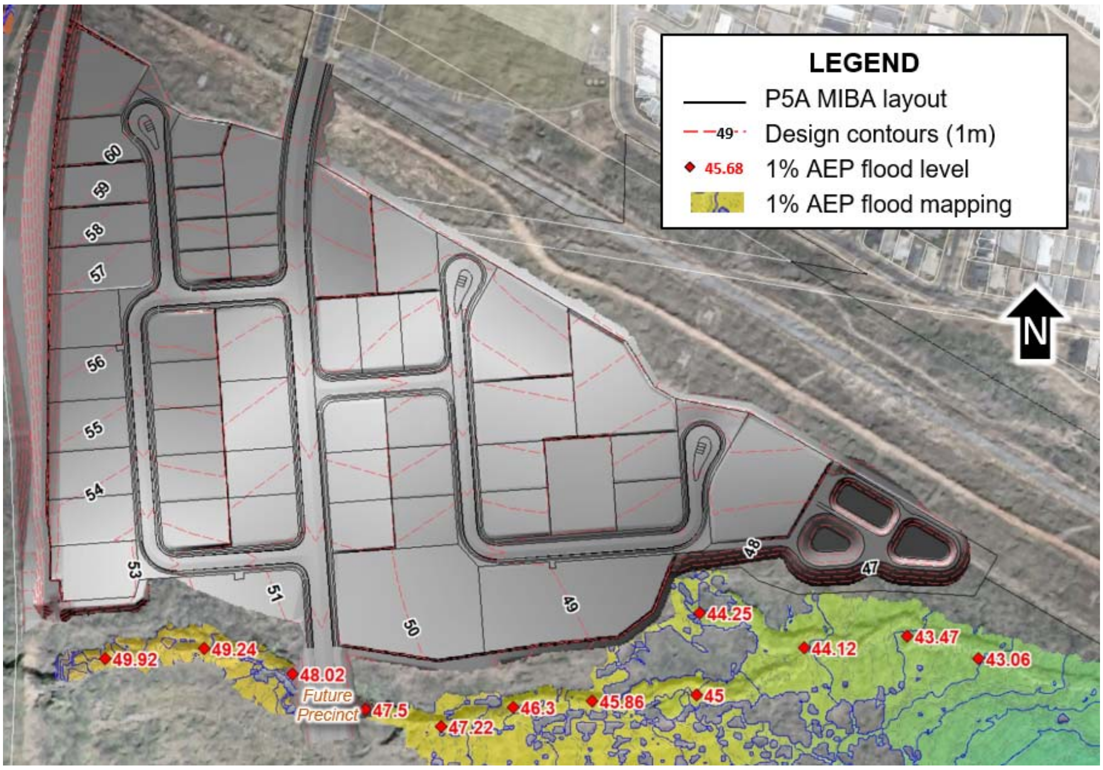


Figure 7: 1% AEP Flood levels and preliminary earthworks

As noted previously in Section 3.2, two key areas exist for drainage management from non-development areas due to the filling of the P5A MIBA north zone to create lots. These drainage diversions are the northern edge of development (power line easement) and western edge (Waterford Tamborine Road).

The northern powerline easement drain simply functions to capture clean water runoff from the vegetated easement corridor as well as a small portion of the existing precinct 1 development immediately north and divert it east around the MIBA development (and stormwater treatment basins) and discharge to the existing waterway. This diversion will comprise a grassed swale combined with stabilised outlet zone interfacing the waterway corridor). Indicative layout and sizing of this swale has been provided on the KN Group functional design drawings in Appendix A.

The western diversion drain will be provided as an interim drain until such time as the Waterford Tamborine Road upgrade/realignment occurs. This drain functions similar to the proposed ultimate road duplication design by capturing all localised crossroad culvert drainage and conveying it south towards the main creek line (western tributary of upper Quinzeh Creek). This drain will have major 1% AEP storm capacity of approximately 5.2 m^3/s to account for current external catchment discharge under Waterford Tamborine Road. This open drain be grassed with localised rock stabilised outlet zone interfacing the waterway corridor.

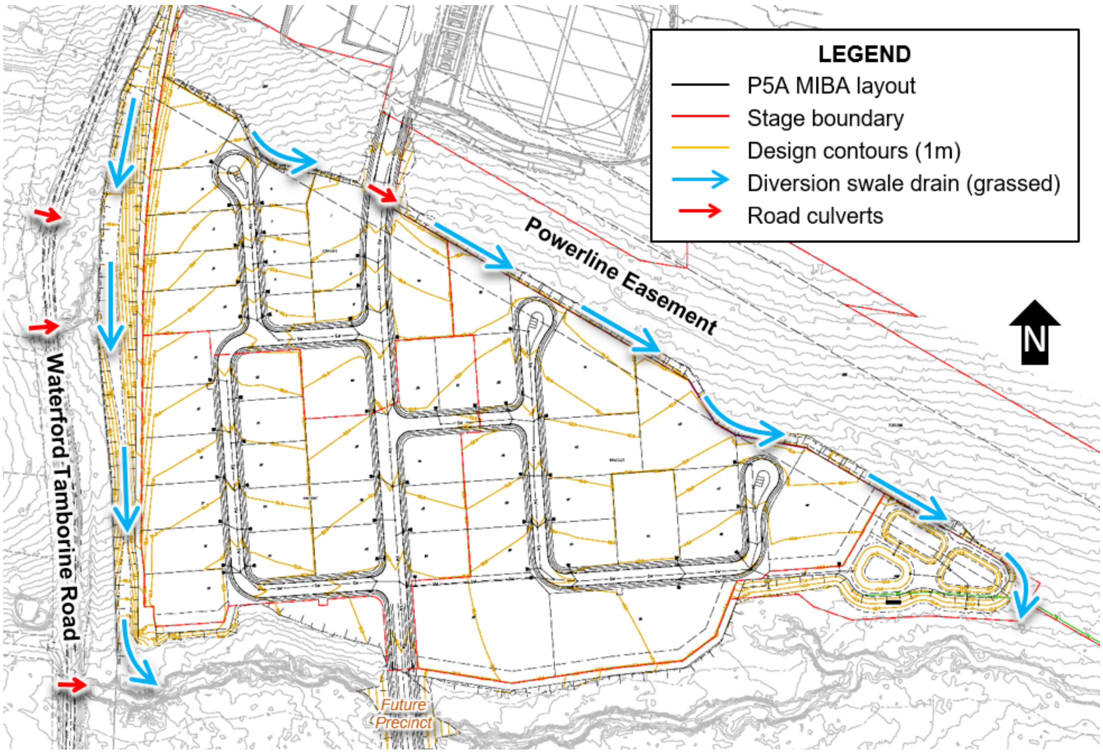


Figure 8: Drainage diversion external to development footprint

5 EROSION AND SEDIMENT CONTROL

5.1 DESIGN OBJECTIVES

The management of stormwater runoff during the construction phase is a critical part of protecting the Yarrabilba waterways and drainage lines. Construction phase design objectives for Precinct 5A are provided in Table 7 which are generally in accordance with the *Yarrabilba – Stormwater Infrastructure Master Plan* (DesignFlow, 2021) and the State Planning Policy (DSDIP, 2017).

Table 7: Construction phase stormwater quality

Issue	Desired outcomes
Drainage control	1. Manage stormwater flows around or through areas of exposed soil to avoid contamination. 2. Manage sheet flows in order to avoid or minimise the generation of rill or gully erosion. 3. Provide stable concentrated flow paths to achieve the construction phase stormwater management design objectives for temporary drainage works (part 2). 4. Provide emergency spillways for sediment basins to achieve the construction phase stormwater management design objectives for emergency spillways on temporary sediment basins (part 3).
Erosion control	1. Stage clearing and construction works to minimise the area of exposed soil at any one time. 2. Effectively cover or stabilise exposed soils prior to predicted rainfall. 3. Prior to completion of works for the development, and prior to removal of sediment controls, all site surfaces must be effectively stabilised* using methods which will achieve effective short-term stabilisation.
Sediment control	1. Direct runoff from exposed site soils to sediment controls that are appropriate to the extent of disturbance and level of erosion risk. 2. All exposed areas greater than 2500 metres2 must be provided with sediment controls which are designed, implemented and maintained to a standard which would achieve at least 80% of the average annual runoff volume of the contributing catchment treated (i.e. 80% hydrological effectiveness) to 50mg/L Total Suspended Solids (TSS) or less, and pH in the range (6.5–8.5).
Litter, hydrocarbons and other contaminants	1. Remove gross pollutants and litter. 2. Avoid the release of oil or visible sheen to released waters. 3. Dispose of waste containing contaminants at authorised facilities.
Waterway stability and flood flow management	1. Where measures are required to meet post-construction waterway stability objectives (specified in table B), these are either installed prior to land disturbance and are integrated with erosion and sediment controls, or equivalent alternative measures are implemented during construction. 2. Earthworks and the implementation of erosion and sediment controls are undertaken in ways which ensure flooding characteristics (including stormwater quantity characteristics) external to the development site are not worsened during construction for all events up to and including the 1 in 100 year ARI (1% AEP).

*Note: An effectively stabilised surface is defined as one that does not, or is not likely to result in visible evidence of soil loss caused by sheet, rill or gully erosion or lead to sedimentation water contamination.

5.2 MANAGEMENT STRATEGY

5.2.1 Local Erosion and Sediment Control

Erosion and sediment control (ESC) will occur on a development stage by stage basis in accordance with *Best Practice Erosion and Sediment Control* (IECA, 2008) to achieve the objectives listed in Table 1. This will involve a combination of:

- Erosion control - Ensuring that all exposed surfaces are stabilised as soon as possible and that erosion of un-stabilised areas of works are minimised
- Drainage control - Ensuring that provision is made to control all on site runoff to designated treatment areas and to enable appropriate bypass of external flows which do not require treatment
- Sediment capture - Ensuring that mobilised sediment is captured through a combination of source controls such as silt fences and appropriately designed sediment basins. Where possible sediment basins for construction will be located within the voids required for the future stormwater quality treatment systems (sediment basins, bioretention basins, wetlands etc.).

The details of the local erosion and sediment controls for each stage of development are not provided in this report given the high level nature of the document. However, prior to any works commencing on a particular development stage in Precinct 5A MIBA North, a site specific Erosion and Sediment Control Plan (E&SCP) will be documented for the development stage in question prior to works starting. This will occur as part of the operational works application but can be adjusted by the contractor and site supervisor prior to commencement of construction provided the E&SCP complies with Best Practice Erosion and Sediment Control (IECA, 2008) and delivers the objectives listed previously in Table 7.

A current bulk earthworks application has occurred across the subject site to enable the placement of fill from another works precinct. To support this, an existing Erosion and Sediment Control Strategy (ESCS) was prepared and is provided in Appendix B. This strategy will continue to be implemented as part of ongoing bulk earthworks works (with detailed works specific erosion and sediment control plans to be prepared and periodically updated by the principal contractor in line with works program). Extracts from the existing and ultimate levels earthworks and ESC approach are provided in Figure 9 and Figure 10 respectively.

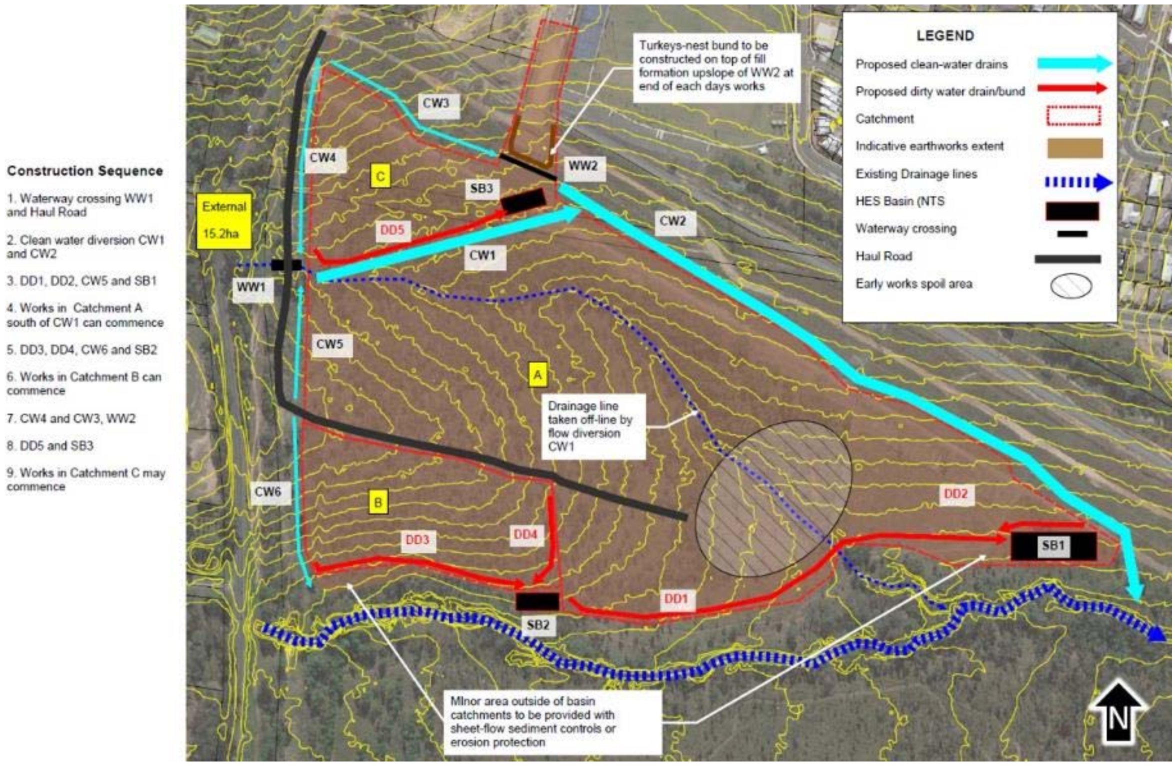


Figure 9: ESC strategy – existing levels

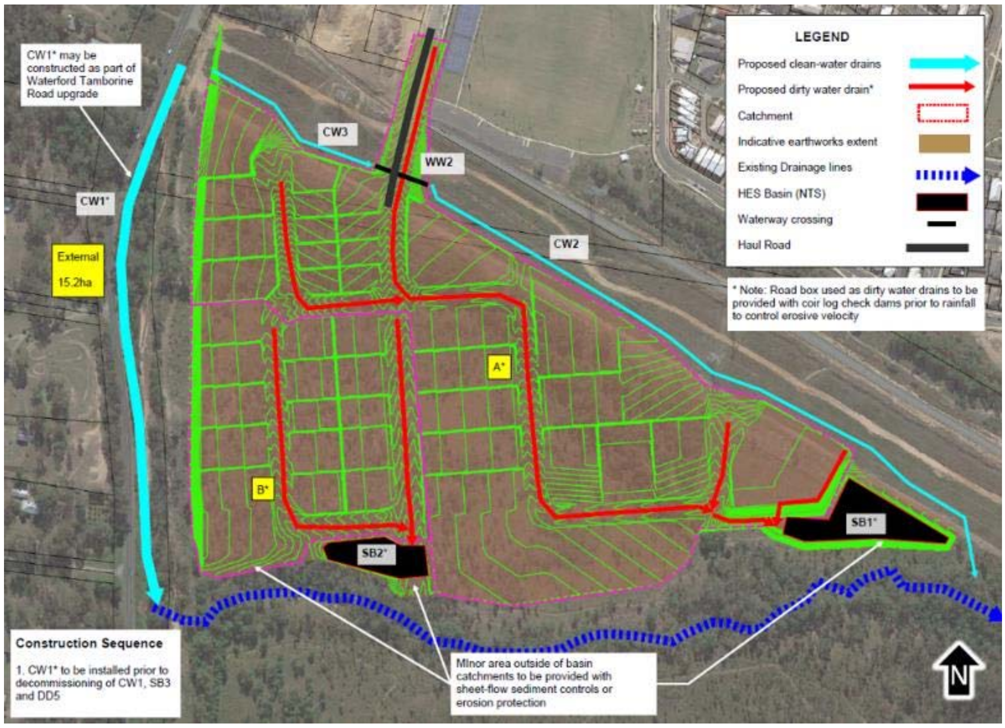


Figure 10: ESC Strategy – final levels

5.2.2 High Efficiency Sediment (HES) Basins

Given the importance of managing construction runoff into the waterways downstream of Yarrabilba and the potential impact on the ecology and residents, HES sediment basins are being strategically adopted (where practical) across Precinct 5A MIBA North. HES basins offer an improved technology for construction sediment management which essentially converts batch sediment basins into continuous flow treatment systems that respond in real time to storm events. The design sought to be achieved by HES basins that ensures at least 80% of the average annual runoff volume treated to 50mg/L TSS or less

The HES basin essentially comprises:

- Flocculent dosing system
- Inlet zone for mixing, flow distribution and efficient removal of coarse sediment
- Settling basin
- Outlet(s)

Implementation of HES basins have the potential to significantly reduce the fine and dispersive sediment load discharge from the site by a further 50% compared to traditional batch sediment basins.

5.3 MONITORING AND AUDITING

5.3.1 Principal Contractor

Site inspections and monitoring are to be undertaken by the principal contractor in accordance with Sections 6.17 and 7.4 of *the Best Practice Erosion and Sediment Control Document* (IECA, 2008) as detailed below. Best practice site management requires all ESC measures to be inspected at the following frequencies and include the following checks as a minimum:

Daily site inspections (during rainfall):

- All drainage, erosion and sediment control measures
- Occurrences of excessive sediment deposition (whether on-site or off-site)
- All site discharge points (including dewatering activities as appropriate)

Weekly site inspections (even if work is not occurring on-site)

- All drainage, erosion and sediment control measures
- Occurrences of excessive sediment deposition (whether on-site or off-site)
- Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements
- Litter and waste receptors
- Oil, fuel and chemical storage facilities

Prior to anticipated runoff producing rainfall (within 24 hours of expected rainfall)

- All drainage, erosion and sediment control measures
- All temporary flow diversion and drainage works

Following runoff producing rainfall (within 18 hours of rainfall event)

- All drainage, erosion and sediment control measures
- Occurrences of excessive sediment deposition (whether on-site or off-site)
- Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements

5.3.2 CPESC Compliance Audits

The ESC measures implemented at the site are proposed to be inspected on a bi-monthly to quarterly basis by a CPESC (Certified Professional in Erosion and Sediment Control) who is independent of the principal contractor and an audit report kept on file. The purpose of the audits to is to ensure the developer and the contractors are meeting their obligations for ESC under the Environmental Protection Act (EP Act). The site will be assessed against these requirements in accordance with *Procedural Guideline: Standard work method for the assessment of the lawfulness of releases to waters from construction sites in South East Queensland EM1135* (DEHP, 2011).

The compliance audits will involve:

- Site inspection with the contractors to assess ESC actions on the site against the ESC plans and the requirements of EP Act and DEHP Procedural Guideline.
- Identifying non-compliances on the site, photographing and recording these for reporting.
- Where the rectification action is simple, these will be recorded and verbally communicated to the contractor for action.
- Review of any water quality and rainfall information for the site
- Compilation of a ESC Audit report which:
    - Identifies the ESC obligations
    - ESC issue and non-compliances
    - Actions (simple) to be taken to rectify the issues and non-compliances.

The triggers for inspections and reporting by the CPESC are as follows:

- Prior to the commencement of clearing works in each catchment
- Prior to the commencement of bulk earthworks;
- Prior to the commencement of civil works; and
- At regular monthly intervals during works.

6 CONCLUSION

A stormwater management strategy for Yarrabilba Precinct 5A MIBA North development has been prepared to meet the requirements of the Yarrabilba Stormwater Infrastructure Master Plan (DesignFlow, 2021) and Precinct 5A Context Plan Area Strategy.

The strategy includes a range of treatment measures including sediment ponds, bioretention systems and swales that integrate with the local urban and natural environment to ensure the stormwater quality objectives are achieved for the overall precinct while providing protection or enhancement to the local waterways and amenity. Sufficient space has been allowed for in the development layout for the stormwater treatment measures which have been verified via preliminary earthworks plans. Site design has also ensured all development lots are above the local 1% AEP flood level and provided with adequate flow conveyance drains for external catchment discharge.

Setback to local waterway and vegetation corridors have guided the development layout with due consideration for future development expansion and waterway rehabilitation to the south of the subject site.

Construction phase stormwater management objectives have been established for the site, in accordance with State Planning Policy (DSDIP, 2017). The preliminary locations of sediment basins have been provided with an Erosion and Sediment Control strategy to be developed as part of detailed design for operational works. Audits will be completed during construction to ensure compliance with State Planning Policy and Environment Protection Act.

7 REFERENCES

DesignFlow (2021) *Yarrabilba Total Water Cycle Management Strategy*

DesignFlow (2021) *Yarrabilba Stormwater Infrastructure Master Plan*

DesignFlow (2021) *Yarrabilba General Waterway Condition Assessment*

DesignFlow (2017) *Yarrabilba (Quinzeh Creek) Flood Study - Version 1*

DSDIP (2017) *State Planning Policy*

Lendlease (2021) *Yarrabilba MIBA North Context Planning Area Strategy – Precinct 2A & Part of Precinct 5*

Natura Consulting (2012) *Yarrabilba Development: Natural Environment Site Strategy*

Natura Consulting (2012) *Natural Environment Site Strategy (NESS)*

Water by Design (2010). *MUSIC Modelling Guidelines. SEQ Healthy Waterways Partnership.*

APPENDIX A FUNCTIONAL DESIGN PLANS

LEGEND

- STAGE BOUNDARY
- PROPOSED KERB FACE
- EASEMENT
- PROPOSED ROAD CENTRELINE
- PROPOSED FOOTPATH
- EXISTING ELECTRICAL OVERHEAD
- FAUNA OFFSET
- ENVIRONMENTAL DRIPLINE
- FIRE ACCESS TRACK (GRAVEL)

ROADWORKS PLAN

SCALE 1:1000

SCALE 10 5 0 10 20 30 40 50 60 70 80 90 100m

1 : 1000 (A1 UNREDUCED)

DO NOT SCALE THIS DRAWING
IF IN DOUBT - ASK!

NORTH

LOCALITY PLAN

YARRABILBA PRECINCT 5-MIBA
CAMP CABLE ROAD
POWERLINK ESMT
WATERFORD TAMBORINE ROAD
YARRABILBA

REVISIONS

No	Description	Date	By
A	FOR APPROVAL	30.06.22	JS

Associated Consultants: rps

Client: lendlease

Project: YARRABILBA
PRECINCT 5 - MIBA
PRELIMINARY PLANNING
FUNCTIONAL DRAWINGS

kn group
ABN 35 112 53 611
L1, 62 Astor Tce
Spring Hill Q 4000
07 3017 1900
www.kngroup.com.au

Approved

Drawing Title
P05A FUNCTIONAL LAYOUT
ROADWORKS PLAN
SHEET 1

Drawn	Designed	Checked	Date
JS	JS	RM	JUN 22

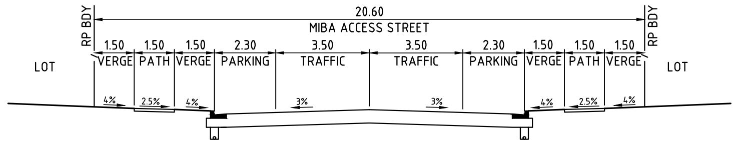
Scale	Sheet
AS SHOWN	01 of 07

	Drawing No	Revision
A1	18-102-SK001	A

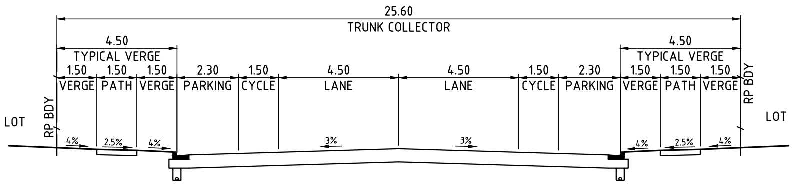
LEGEND

- STAGE BOUNDARY
- PROPOSED KERB FACE
- EASEMENT
- PROPOSED ROAD CENTRELINE
- PROPOSED FOOTPATH
- EXISTING ELECTRICAL OVERHEAD
- FAUNA OFFSET
- ENVIRONMENTAL DRIPLINE
- FIRE ACCESS TRACK (GRAVEL)

ROADWORKS PLAN
SCALE 1:1000



A SECTION
001 SCALE 1:100



B SECTION
001 SCALE 1:100

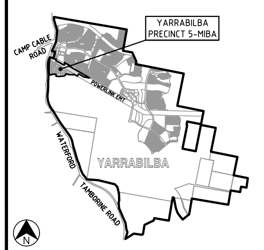
SCALE
1 0.5 0 1 2 3 4 5 6 7 8 9 10m
1 : 100 (A1 UNREDUCED)

SCALE
10 5 0 10 20 30 40 50 60 70 80 90 100m
1 : 1000 (A1 UNREDUCED)

DO NOT SCALE THIS DRAWING
IF IN DOUBT - ASK!

NORTH

LOCALITY PLAN



REVISIONS

No	Description	Date	By
A	FOR APPROVAL	30.06.22	JS

Associated Consultants
rps

Client
lendlease

Project
YARRABILBA
PRECINCT 5 - MIBA
PRELIMINARY PLANNING
FUNCTIONAL DRAWINGS

kn group
ABN 35 112 53 611
L1, 62 Astor Tce
Spring Hill Q 4000
07 3017 1900
www.kngroup.com.au

Approved

Drawing Title
P05A FUNCTIONAL LAYOUT
ROADWORKS PLAN
SHEET 2

Drawn	Designed	Checked	Date
JS	JS	RM	JUN 22

Scale	Sheet
AS SHOWN	02 of 07

	Drawing No	Revision
A1	18-102-SK002	A

LEGEND

- PROPOSED KERB FACE
- PROPOSED SEWER
- PROPOSED TRUNK SEWER
- PROPOSED STORMWATER
- PROPOSED WATER
- PROPOSED TRUNK WATER
- EXISTING SEWER
- EXISTING STORMWATER
- EXISTING WATER
- ** BIO BASIN/SEDIMENT POND REFER DESIGNFLOW'S REPORT: SMP - PRECINCT 5
- EXISTING ELECTRICAL OVERHEAD
- FAUNA OFFSET
- ENVIRONMENTAL DRIPLINE
- FIRE ACCESS TRACK (GRAVEL)
- SCOUR PROTECTION

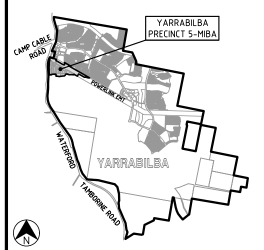
SERVICES PLAN
SCALE 1:1000

SCALE 1 : 1000 (A1 UNREDUCED)

DO NOT SCALE THIS DRAWING
IF IN DOUBT - ASK!

NORTH

LOCALITY PLAN



REVISIONS

No	Description	Date	By
A	FOR APPROVAL	30.06.22	JS

Associated Consultants: rps

Client: lendlease

Project: YARRABILBA

PRECINCT 5 - MIBA
PRELIMINARY PLANNING
FUNCTIONAL DRAWINGS

kn group
ABN 35 112 53 611
L1, 62 Astor Tce
Spring Hill Q 4000
07 3017 1900
www.kngroup.com.au

Approved

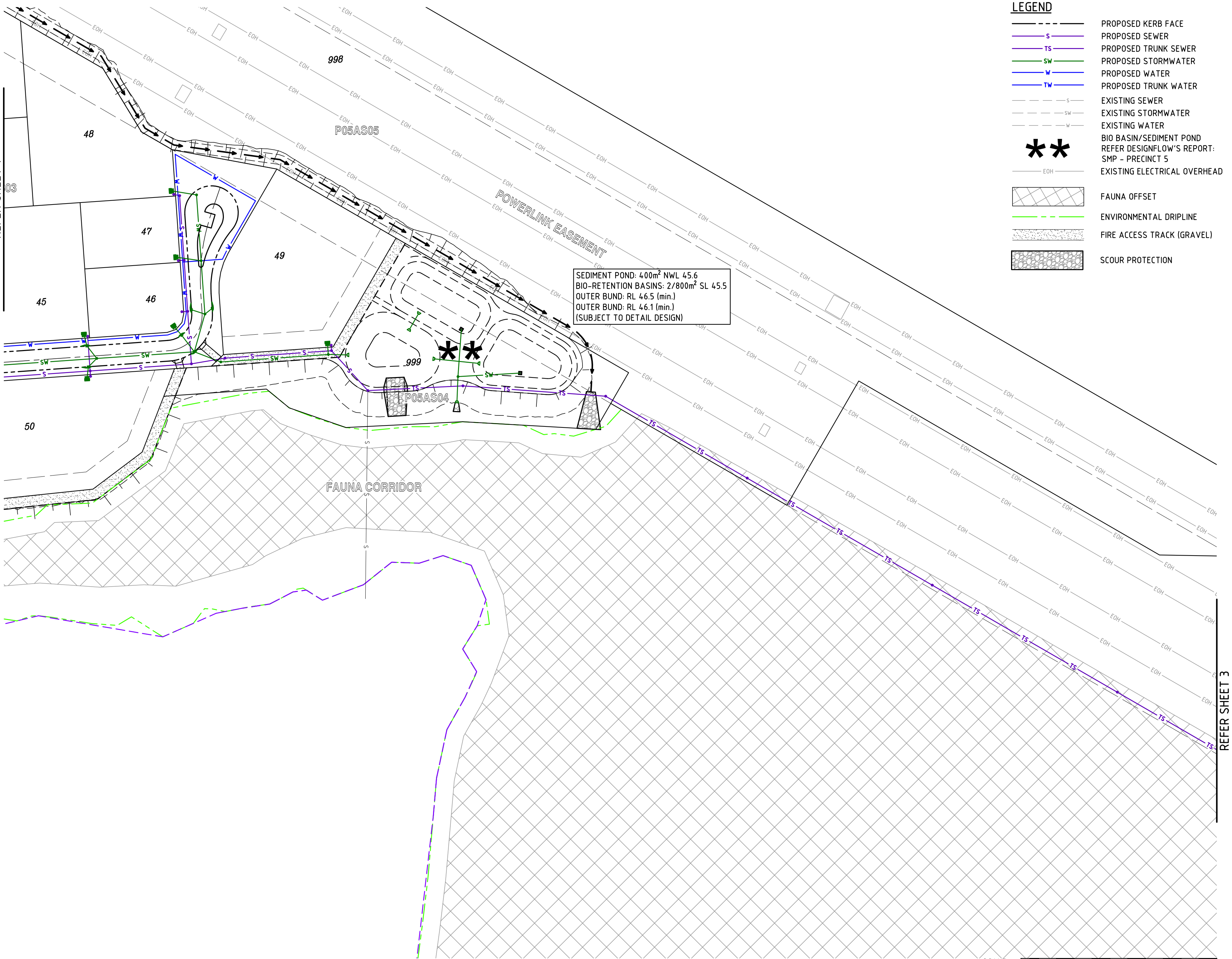
Drawing Title
P05A FUNCTIONAL LAYOUT
SERVICES PLAN
SHEET 1

Drawn	Designed	Checked	Date
JS	JS	RM	JUN 22

Scale	Sheet
AS SHOWN	03 of 07

	Drawing No	Revision
A1	18-102-SK003	A

M:\2018\18102 Yarrabilba Precinct 4 Preliminary Support\Engineering\Acad\18-102-SK003-005-P05A-FUNC-SERVICES.dwg Plotted by: JS on 30/06/2022 3:56:52 PM



SERVICES PLAN

SCALE 1:1000

DO NOT SCALE THIS DRAWING
IF IN DOUBT - ASK!

NORTH

LOCALITY PLAN

YARRABILBA PRECINCT 5-MIBA

REVISIONS

No	Description	Date	By
A	FOR APPROVAL	30.06.22	JS

Associated Consultants: rps

Client: lendlease

Project: YARRABILBA

PRECINCT 5 - MIBA
PRELIMINARY PLANNING
FUNCTIONAL DRAWINGS

kn group
ABN 35 112 53 611
L1, 62 Astor Tce
Spring Hill Q 4000
07 3017 1900
www.kngroup.com.au

Approved

Drawing Title

P05A FUNCTIONAL LAYOUT
SERVICES PLAN
SHEET 2

Drawn	Designed	Checked	Date
JS	JS	RM	JUN 22

Scale	Sheet
AS SHOWN	04 of 07

	Drawing No	Revision
A1	18-102-SK004	A

M:\2018\18102 Yarrabilba Precinct 4 Preliminary Support\Engineering\Acad\18-102-SK003-005-P05A-FUNC-SERVICES.dwg Plotted by: JS on 30/06/2022 3:56:53 PM

SERVICES PLAN

SCALE 1:1000

SCALE 1 : 1000 (A1 UNREDUCED)

DO NOT SCALE THIS DRAWING
IF IN DOUBT - ASK!

NORTH

LOCALITY PLAN

REVISIONS

No	Description	Date	By
A	FOR APPROVAL	30.06.22	JS

Associated Consultants

rps

Client

lendlease

Project

YARRABILBA

PRECINCT 5 - MIBA
PRELIMINARY PLANNING
FUNCTIONAL DRAWINGS

kn group
ABN 35 112 53 611
L1, 62 Astor Tce
Spring Hill Q 4000
07 3017 1900
www.kngroup.com.au

Approved

Drawing Title
P05A FUNCTIONAL LAYOUT
SERVICES PLAN
SHEET 3

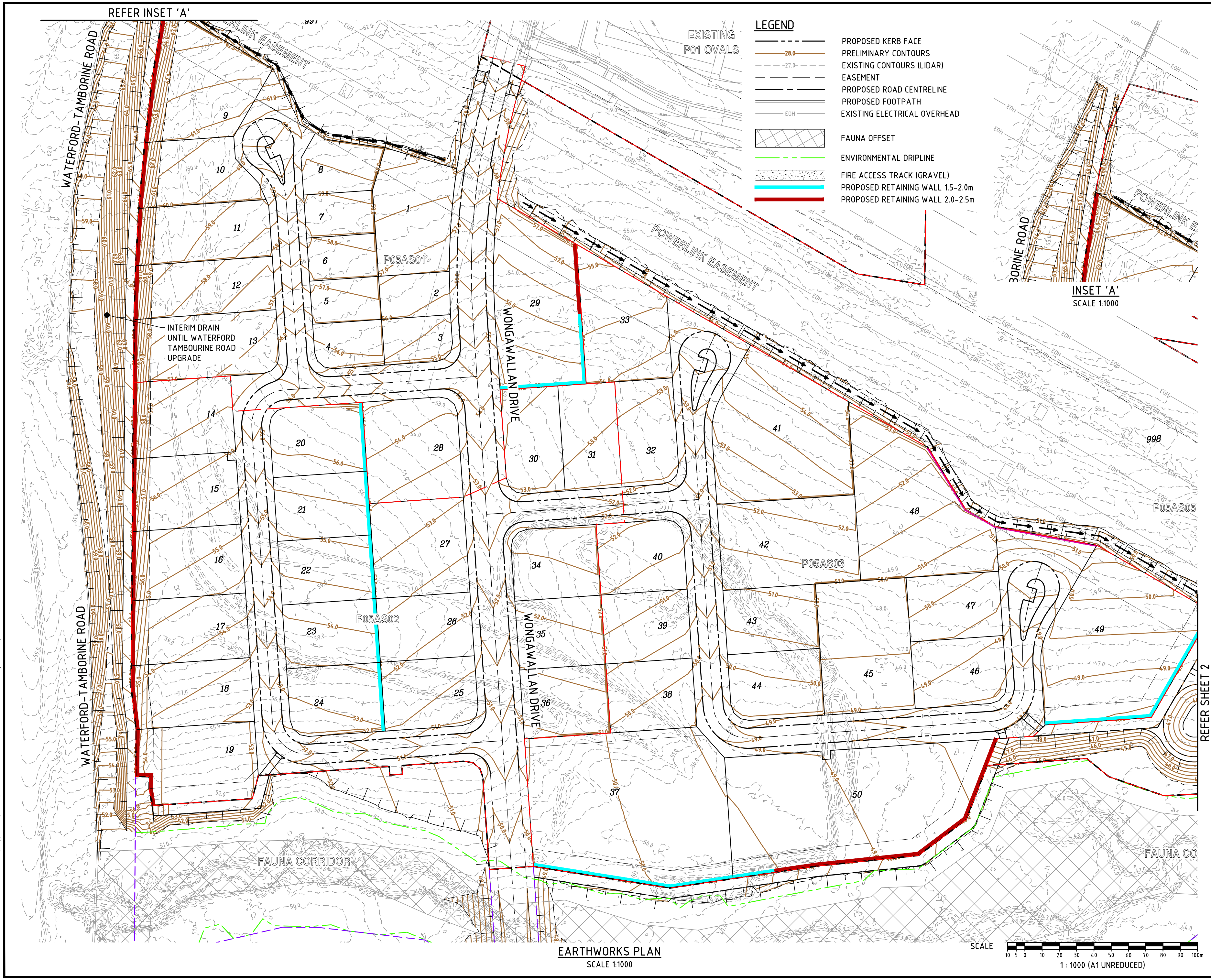
Drawn	Designed	Checked	Date
JS	JS	RM	JUN 22

Scale	Sheet
AS SHOWN	05 of 07

	Drawing No	Revision
A1	18-102-SK005	A

M:\2018\18102 Yarrabilba Precinct 4 Preliminary Support\Engineering\Acad\18-102-SK003-005-P05A-FUNC-SERVICES.dwg Plotted by: JS on 30/06/2022 3:56:55 PM

DO NOT SCALE THIS DRAWING
IF IN DOUBT - ASK!



M:\2018\18102 Yarrabilba Precinct 4 Preliminary Support\Engineering\Acad\18-102-SK006-007-P05A-FUNC-EWKS.dwg Plotted by: JS on 30/06/2022 3:57:02 PM

NORTH

LOCALITY PLAN

YARRABILBA PRECINCT 5-MIBA
CAMP CABLE ROAD
YARRABILBA
WATERFORD TAMBORINE ROAD

REVISIONS

No	Description	Date	By
A	FOR APPROVAL	30.06.22	JS

Associated Consultants

rps

Client

lendlease

Project

YARRABILBA

PRECINCT 5 - MIBA
PRELIMINARY PLANNING
FUNCTIONAL DRAWINGS

kn group
ABN 35 112 53 611
L1, 62 Astor Tce
Spring Hill Q 4000
07 3017 1900
www.kngroup.com.au

Approved

Drawing Title

P05A FUNCTIONAL LAYOUT
EARTHWORKS PLAN
SHEET 1

Drawn	Designed	Checked	Date
JS	JS	RM	JUN 22

Scale	Sheet
AS SHOWN	06 of 07

	Drawing No	Revision
A1	18-102-SK006	A

DO NOT SCALE THIS DRAWING
IF IN DOUBT - ASK!

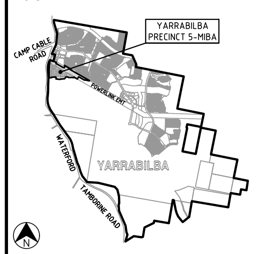
NORTH

EARTHWORKS PLAN
SCALE 1:1000

LEGEND

- PROPOSED KERB FACE
- PRELIMINARY CONTOURS
- EXISTING CONTOURS (LIDAR)
- EASEMENT
- PROPOSED ROAD CENTRELINE
- PROPOSED FOOTPATH
- EXISTING ELECTRICAL OVERHEAD
- FAUNA OFFSET
- ENVIRONMENTAL DRIPLINE
- FIRE ACCESS TRACK (GRAVEL)
- PROPOSED RETAINING WALL 1.5-2.0m
- PROPOSED RETAINING WALL 2.0-2.5m

LOCALITY PLAN



REVISIONS

No	Description	Date	By
A	FOR APPROVAL	30.06.22	JS

Associated Consultants: rps

Client: lendlease

Project: YARRABILBA
PRECINCT 5 - MIBA
PRELIMINARY PLANNING
FUNCTIONAL DRAWINGS

kn group
ABN 35 112 53 611
L1, 62 Astor Tce
Spring Hill Q 4000
07 3017 1900
www.kngroup.com.au

Approved

Drawing Title
P05A FUNCTIONAL LAYOUT
EARTHWORKS PLAN
SHEET 2

Drawn	Designed	Checked	Date
JS	JS	RM	JUN 22

Scale	Sheet
AS SHOWN	07 of 07

	Drawing No	Revision
A1	18-102-SK007	A

SCALE 10 5 0 10 20 30 40 50 60 70 80 90 100m
1 : 1000 (A1 UNREDUCED)

APPENDIX B EROSION AND SEDIMENT CONTROL STRATEGY (BEW)

YARRABILBA

PRECINCT 5 MIBA NORTH

EROSION AND SEDIMENT CONTROL STRATEGY

VERSION 1

DesignFlow

Prepared for Lendlease

October 2021

Document Control Sheet

Report Title:	Yarrabilba – Precinct 5 MIBA North Erosion and Sediment Control Strategy – Version 1
Suggested Reference:	Yarrabilba – Precinct 5 MIBA North Erosion and Sediment Control Strategy – Version 1 (DesignFlow, 2021)
Version:	1
Client:	Lendlease
Author(s):	Leon Rowlands, Nic Smith
Reviewed By:	Shaun Leinster
Approved By:	Leon Rowlands CPESC 4364
Date:	09/11/2021
File Location:	S:\Projects\4380
Circulation:	Electronic Copies: KN Group, Lendlease

Disclaimer

Potential implications of climate change

Unless expressly stated otherwise, historical climate data has been used in, or underpins, the analyses that are presented in this report. The historical climate is not necessarily a valid indicator of future climate, which may contain prolonged periods that are wetter or drier than the historical record used for this analysis. There is significant uncertainly surrounding how climate, and in particular, rainfall, will be impacted by various levels of greenhouse gas accumulation in the atmosphere. Rainfall has a much greater spatial variability than temperature and some areas are likely to become wetter whilst other areas become drier. Further to this there may be changes in the seasonality and intensity of rainfall. Such changes in climate could affect the conclusions and recommendations of this report.

DesignFlow

Table of Contents

List of Tables

List of Figures

1 INTRODUCTION

1.1 SCOPE AND FRAMEWORK

MIBA North is located immediately south of the existing powerline easement and immediately west of Waterford Tamborine Road within the Yarrabilba PDA. The location of the works is shown in Figure 1.

This Erosion and Sediment Control Strategy (ESCS) has been prepared to support a bulk earthworks application over the area and demonstrates how best practice erosion and sediment control will be delivered over the area. Sizing is provided for major controls such as sediment basins and major drainage features. The ESCS will be supported by detailed Erosion and Sediment Control Plans (ESCP's) which will be prepared by the Contractor for individual works areas before works commence and will contain detailed sizing for all components.

This ESCS therefore documents the following:

- Site characteristics and constraints relevant to ESC management
- Design objectives to be achieved by the ESCS and individual ESCPs
- ESC strategy elements for major site catchments, including:
    - location and size of major sediment controls (i.e. basins),
    - key phasing considerations,
    - strategies for riparian works and
    - approaches to revegetation

1.2 PROPOSED DEVELOPMENT

The development layout and ultimate stormwater drainage and treatment strategy is still under development. The earthworks are required at this time in order to commence removal of material from other areas of the Yarrabilba development. Ultimately the MIBA North works will provide a mix of business and industry uses and link to the existing MIBA South development through the extension of Wongawallen Drive.

The works include the filling of an existing drainage line which flows diagonally through the works area and has a catchment which extends west of Waterford Tamborine Road. Temporary diversion of this external catchment is required to facilitate the proposed earthworks, with the ultimate diversion to occur in conjunction with the duplication of Waterford Tamborine Rad.

The extent of earthworks encompassed by this ESCS is shown in Figure 2.

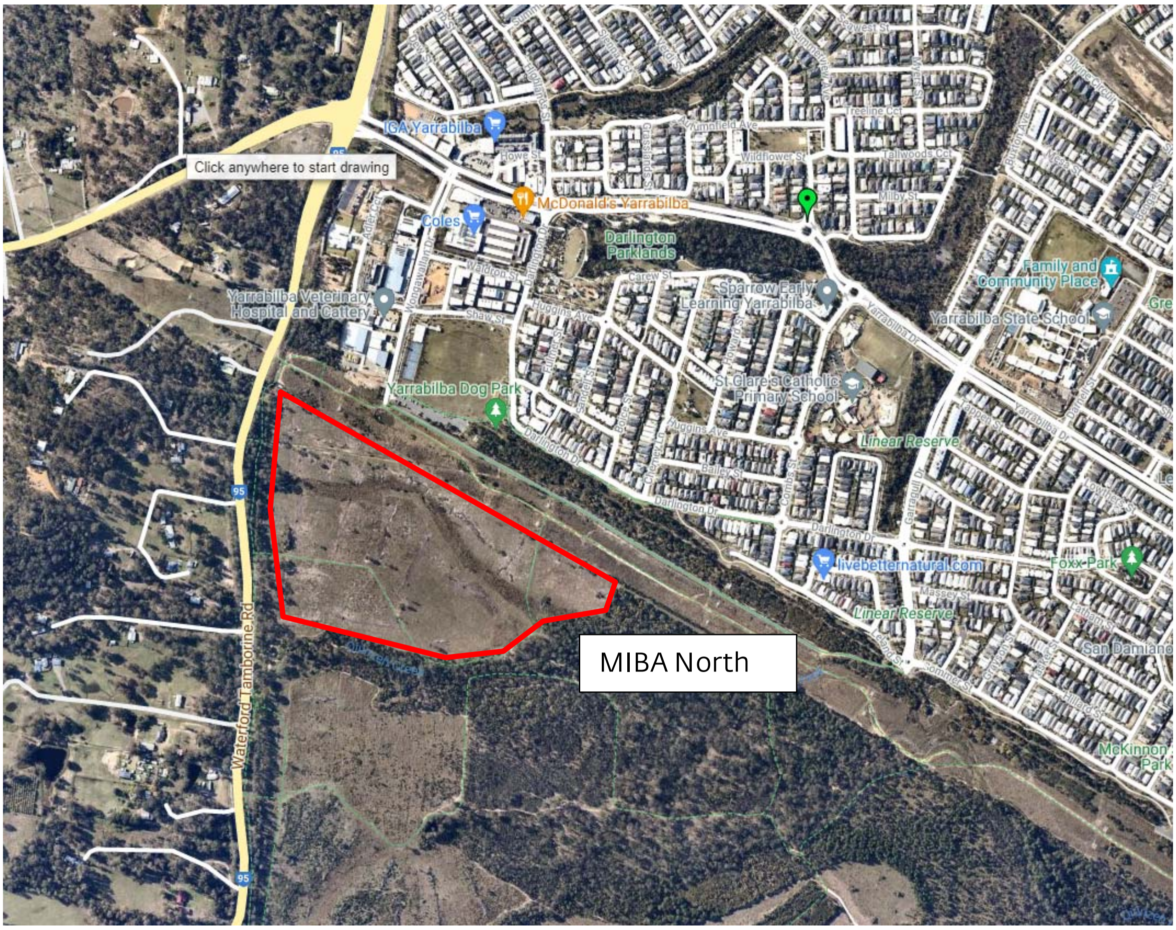


Figure 1: Site locality

Figure 2: Bulk earthworks extent

2 SITE CHARACTERISTICS

2.1 TOPOGRAPHY, CATCHMENTS AND DRAINAGE

The bulk earthworks catchments based on existing and final earthworks levels and provided in Figure 3 and Figure 4 respectively. Major existing and proposed drainage features are included in these figures to aid interpretation. The sub-catchment areas are similar between earthworks phases, with the most significant change occurring when sub-catchment C becomes part of sub-catchment A* when the ~15ha external catchment which originates West of Waterford Tamborine Road is diverted around the works area. This diversion is expected to occur as part of the duplication of Waterford Tamborine Road.

For this ESCS a conservative approach has been adopted and sediment controls have been sized for each sub-catchment based on the largest of either the existing or final sub-catchment areas. The footprint provided by the end-of-line ultimate bioretention basin system provides an excellent opportunity for locating sediment basins to control water quality during the construction phase of the development for sub-catchments A/A* and B/B* and are a crucial part of the ESCS documented in Section 4.

For sub-catchment C, there is no space provided for an ultimate bioretention system within this sub-catchment, so a sediment basin will necessarily impede the works to some extent.

2.2 SOILS

No specific sampling and laboratory testing of soils has been undertaken for the ESCS. It is recommended that prior to works commencing in a specific area, the Contractor should undertake soil sampling and laboratory analysis to inform the detailed ESCP's. Soil testing should be undertaken in accordance with IECA (2008) Chapter 3 and Appendix C9, and should include as a minimum 2 boreholes for each works area and testing of a representative topsoil and sub-soil sample for the following:

- Topsoil:
    - Soil pH
    - EC
    - Organic carbon
    - TN, nitrate
    - Exchangeable basic and acidic cations (Ca, Mg, K, Na, Al)
    - Plant available phosphorus and potassium
- Subsoil
    - PSD
    - pH and EC
    - Emerson Class number
    - Dispersion percentage

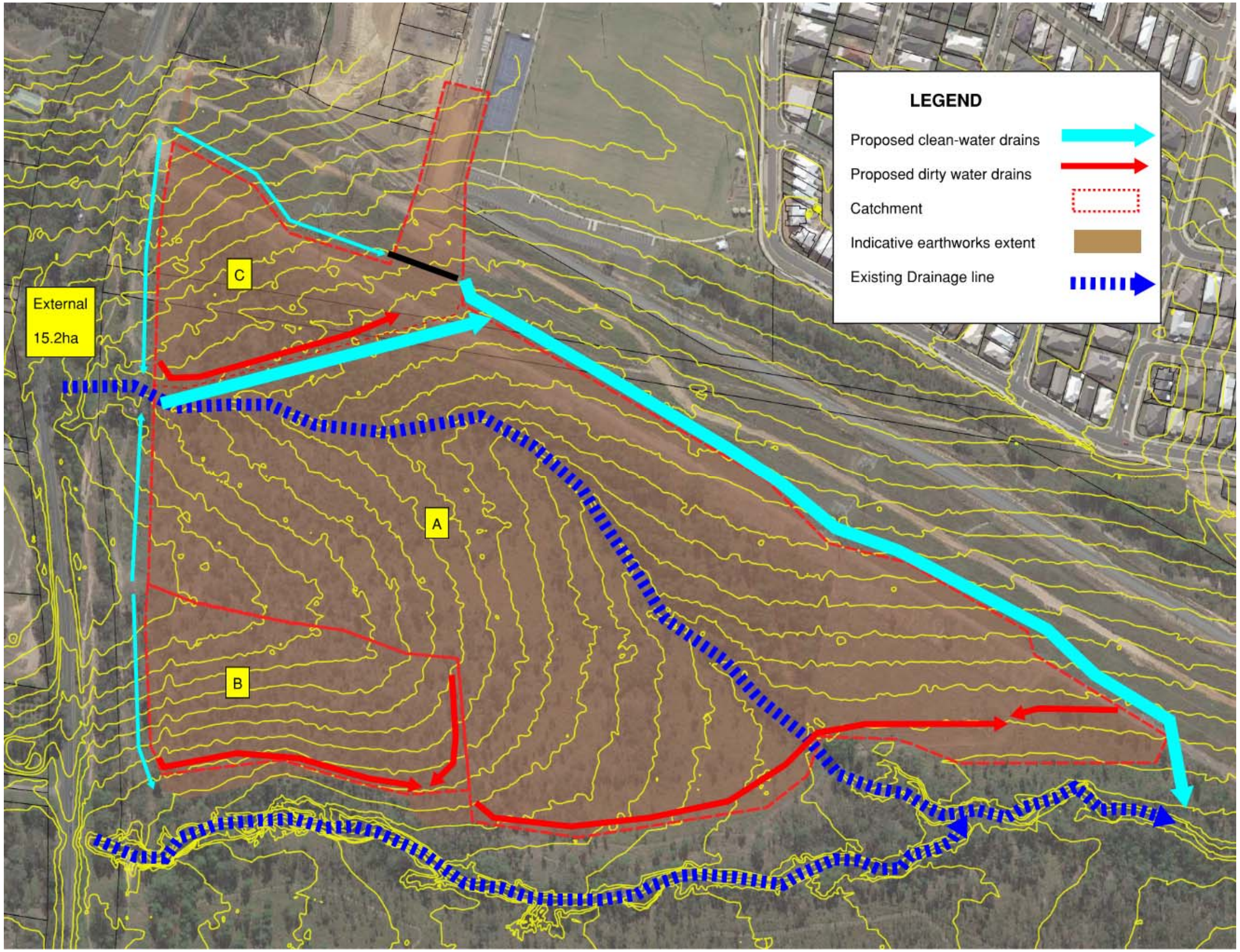


Figure 3: Bulk earthworks sub-catchments – existing levels

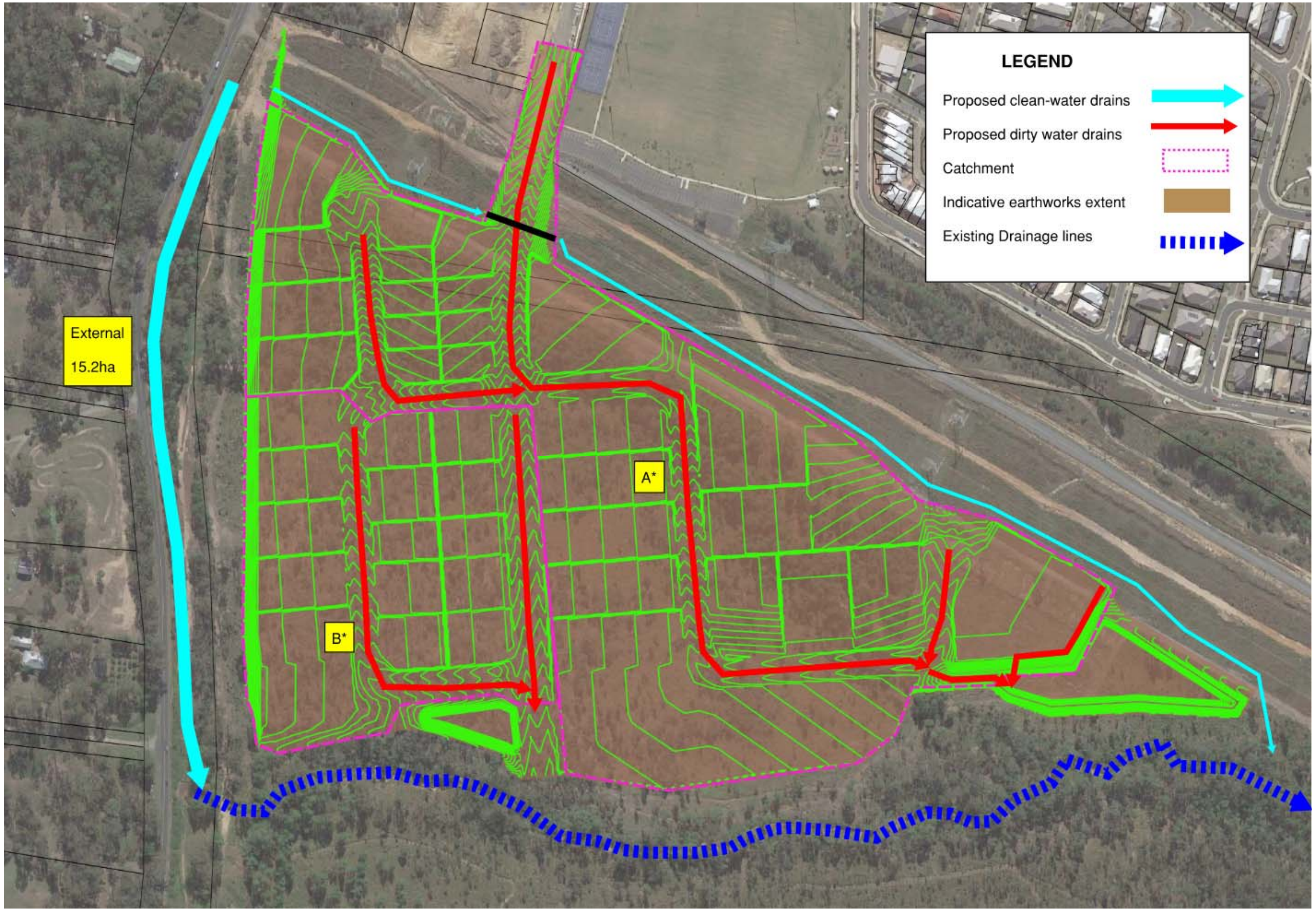


Figure 4: Bulk earthworks sub-catchments – final levels

Topsoil testing is particularly important in order to ensure successful revegetation and the contractor is to apply ameliorants to topsoil as required based on the results of testing.

In the absence of other information, it has been assumed for this ESCS that site soils will be dispersive and construction runoff will require treatment with a chemical flocculent/coagulant to remove fine and dispersive sediment prior to discharge.

Visually, there are clear signs of dispersive soils within the site, with severe gully erosion present in places. This has specific implications for drainage controls and the construction of sediment basin embankments from in-situ material. These structures can suffer from failure if dispersive soils are not managed appropriately and specific geotechnical advice, based on soil testing, should be sought.

2.3 CLIMATE

Average rainfall data is plotted in Figure 5. It can be seen that the lowest rainfall months based on the long-term average are July – September, and high risk works such as riparian activities should be programmed to occur during this part of the year.

It should however be noted that high rainfall can occur at any time of year in South-East Queensland and controls are still required for works regardless of the month in which they occur.

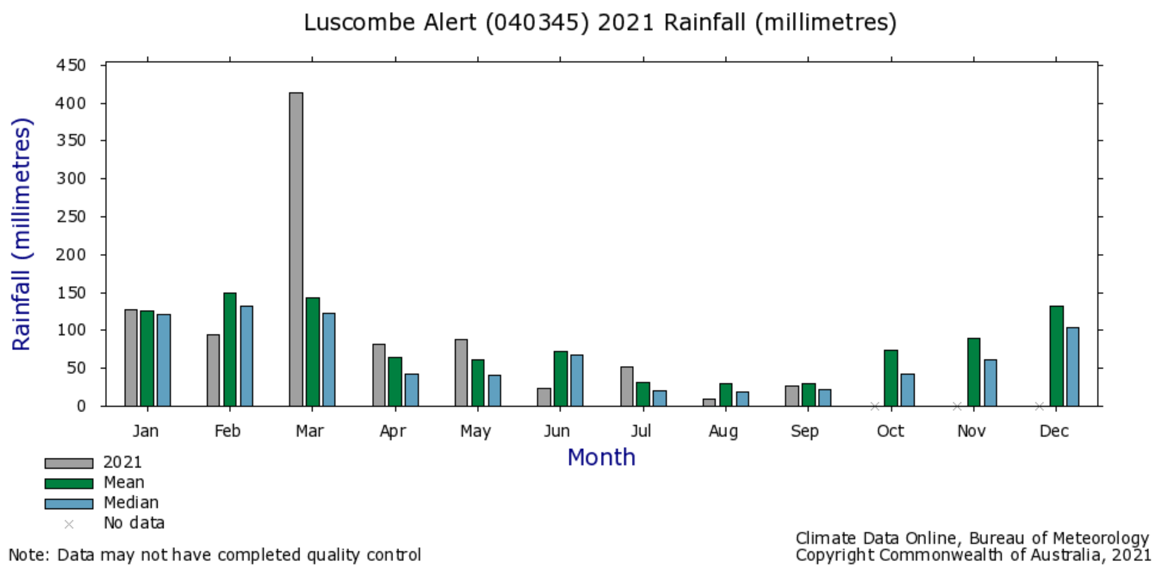


Figure 5: Rainfall Statistics

2.4 FLOODING

Flooding characteristics at the site have been established by modelling undertaken by DesignFlow (2020). The ultimate 1%AEP flood event inundation plan is shown below in Figure 6. It can be seen that the majority of the bulk earthworks areas are outside of the 1%AEP flood extent. Quinzeh Creek, located immediately South of the works, is a heavily incised channel and there is little overbank flows to the North.

The local drainage line which flows through the works has an estimated Q2 (39% AEP) flowrate of 1.9m3/s which will need to be diverted around the active works area. This flowrate is significant, and care will need to be taken where this flow diversion re-enters Quinzeh Creek to avoid scour and erosion of the creek channel. Entering at an oblique angle and providing adequate energy dissipation and scour protection will be key to minimising this risk.

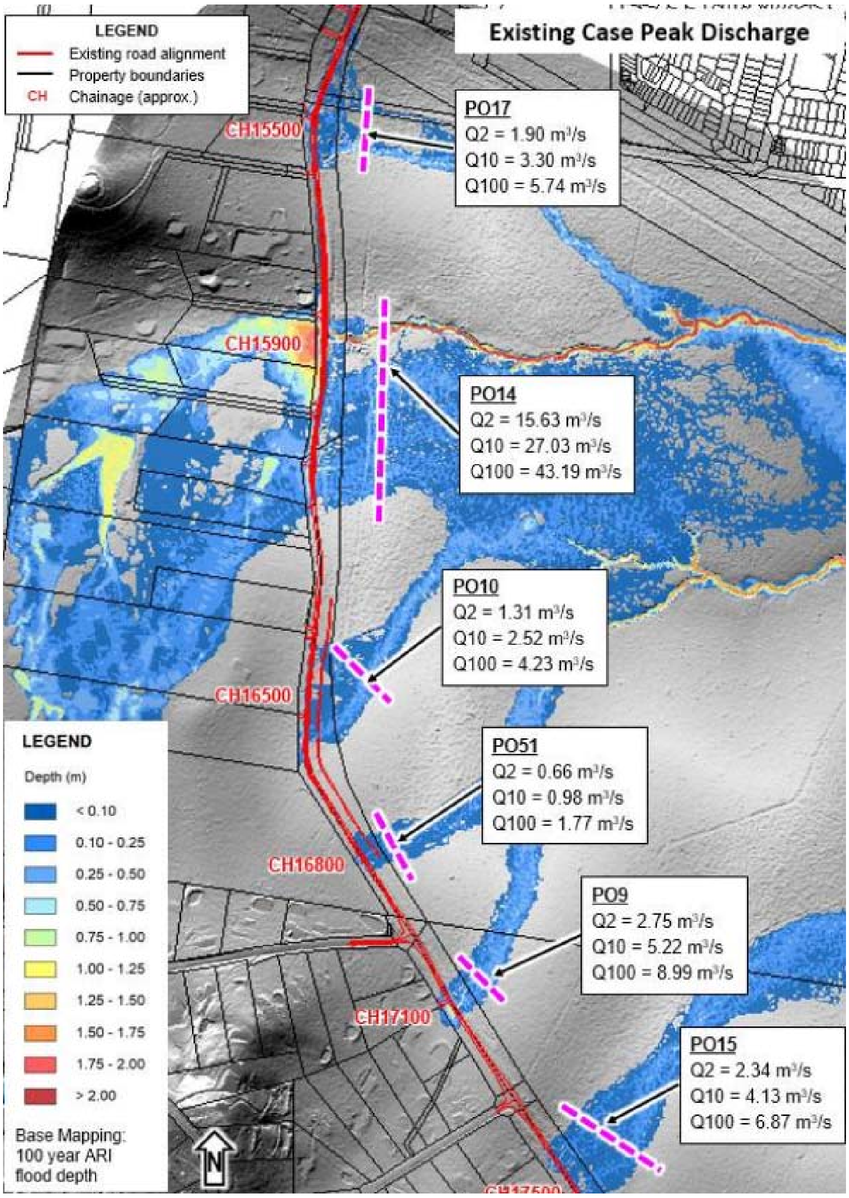


Figure 6: 1% AEP flood extent (DesignFlow, 2020)

3 DESIGN OBJECTIVES

The design objectives relevant to the construction phase of development works are specified in Appendix 2 of the State Planning Policy 2017 (SPP2017). These are reproduced in Table 1, Table 2 and Table 3 below.

Table 1: Construction Phase Stormwater Design Objectives

Issue	Desired outcomes
Drainage control	1. Manage stormwater flows around or through areas of exposed soil to avoid contamination. 2. Manage sheet flows in order to avoid or minimise the generation of rill or gully erosion. 3. Provide stable concentrated flow paths to achieve the construction phase stormwater management design objectives for temporary drainage works (part 2). 4. Provide emergency spillways for sediment basins to achieve the construction phase stormwater management design objectives for emergency spillways on temporary sediment basins (part 3).
Erosion control	1. Stage clearing and construction works to minimise the area of exposed soil at any one time. 2. Effectively cover or stabilise exposed soils prior to predicted rainfall. 3. Prior to completion of works for the development, and prior to removal of sediment controls, all site surfaces must be effectively stabilised[13] using methods which will achieve effective short-term stabilisation.
Sediment control	1. Direct runoff from exposed site soils to sediment controls that are appropriate to the extent of disturbance and level of erosion risk. 2. All exposed areas greater than 2500 metres^2 must be provided with sediment controls which are designed, implemented and maintained to a standard which would achieve at least 80% of the average annual runoff volume of the contributing catchment treated (i.e. 80% hydrological effectiveness) to 50mg/L Total Suspended Solids (TSS) or less, and pH in the range (6.5–8.5).
Litter, hydrocarbons and other contaminants	1. Remove gross pollutants and litter. 2. Avoid the release of oil or visible sheen to released waters. 3. Dispose of waste containing contaminants at authorised facilities.
Waterway stability and flood flow management	1. Where measures are required to meet post-construction waterway stability objectives (specified in table B), these are either installed prior to land disturbance and are integrated with erosion and sediment controls, or equivalent alternative measures are implemented during construction. 2. Earthworks and the implementation of erosion and sediment controls are undertaken in ways which ensure flooding characteristics (including stormwater quantity characteristics) external to the development site are not worsened during construction for all events up to and including the 1 in 100 year ARI (1% AEP).

Table 2: Construction Phase Stormwater Design Objectives for temporary drainage works

Temporary drainage works	Anticipated operation design life and minimum design storm event		
	‹ 12 months	12–24 months	› 24 months
Drainage structure	1 in 2 year ARI/39% AEP	1 in 5 year ARI/18% AEP	1 in 10 year ARI/10% AEP
Where located immediately up-slope of an occupied property that would be adversely affected by the failure or overtopping of the structure	1 in 10 year ARI/10% AEP		
Culvert crossing	1 in 1 year ARI/63% AEP		

Table 3: Construction Phase Stormwater Design Objectives for emergency spillways on temporary sediment basins

Drainage structure	Anticipated operation design life and minimum design storm event		
	‹ 3 months	3–12 months	› 12 months
Emergency spillways on temporary sediment basins	1 in 10 year ARI/10% AEP	1 in 20 year ARI/5% AEP	1 in 50 year ARI/2% AEP

The design objectives specified in the SPP2017 generally reflect accepted best practice in Australia, however the Sediment Control (2) objective is a higher standard than required in other states and is reflective of both the pronounced wet season and degree of development activity which occur in Queensland.

Healthy Land and Water (2017) provide a range of strategies for achieving the requirements of the sediment control design objective which are summarised below:

1. High Efficiency Sediment (HES) Basins:

   Install and operate Type-A or Type-B sediment basins designed in accordance with IECA Appendix B (2019), described as High-Efficiency Sediment (HES) basins. These are sediment basins which have automated dosing of chemicals which assist flocculation/coagulation of fine and dispersive sediment and which operate on a continuous-flow basis. Type-A basins incorporate a floating decant as the primary outlet while Type-B basins can remain full between events and have only a spillway outlet. A conceptual layout for a Type-B HES basin is provided in Figure 7.

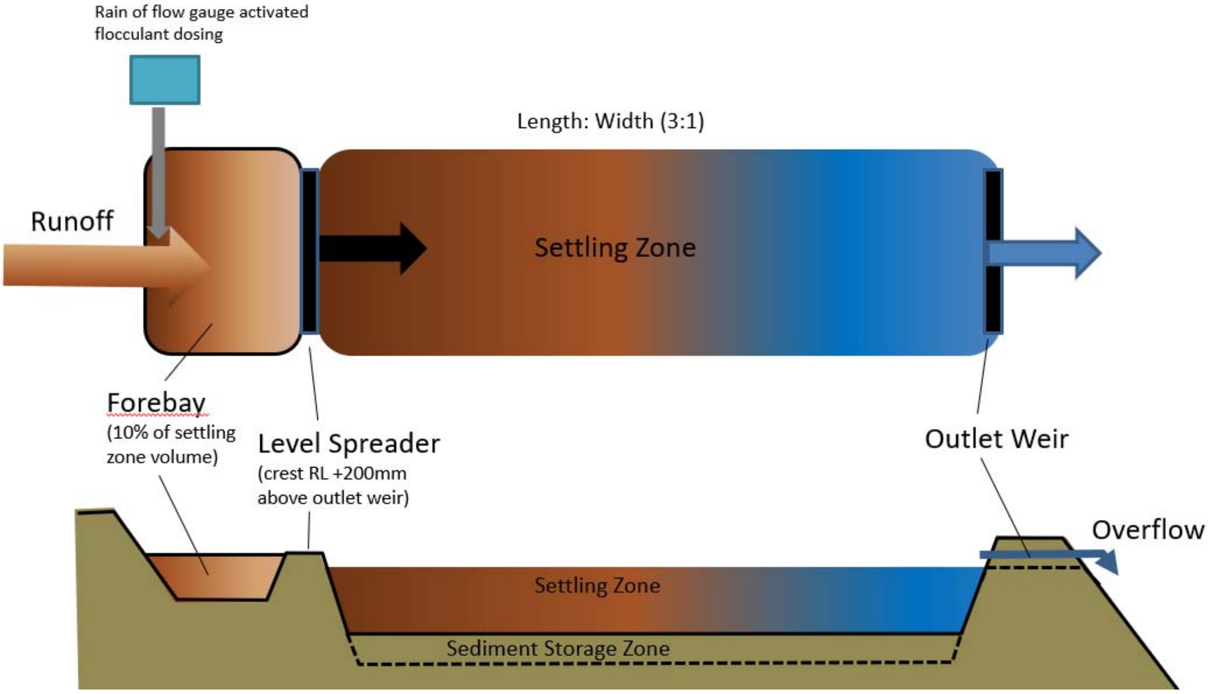


Figure 7: Conceptual High-Efficiency Sediment (HES) Basin Type-B Functional Layout

2. **Large Batch Basins:**

Batch sediment basins (Type D) designed in accordance with IECA (2008) will not comply with the SPP2017 design objective. Modified batch basin designs may be possible for some sites, however for most sites the batch basins would need to be impractically large or require impractical treatment and dewatering strategies to meet the design objective. If the batch basin is proposed to be treated and emptied within 2 days of rainfall ceasing, then the required basin settling volume is 650m^3/ha for SkyRidge Estate. Sediment storage volumes need to be provided in addition to the above volumes, consistent with IECA Appendix B (2019).

3. **Total Capture:**

For flat sites, with no external catchment, perimeter bunding may be appropriate where it can be shown that the bund height is sufficient to capture the anticipated (average) wet season rainfall completely (i.e. total capture). A simple water-balance calculation and earthworks sections showing the bund arrangements and capture volumes will be sufficient to show that this strategy can be implemented. However careful consideration will be required for how this strategy can continue to operate beyond earthworks stage to when civil construction is being undertaken or nearing completion.

4. **Alternative Innovative Measures:**

Alternative measures may be implemented where it can be shown through long-term water-balance modelling that the measures will achieve the release criteria of

50mg/L TSS for at least 80% of the average annual runoff volume. This would need to be documented and justified in the detailed ESC Plan(s).

5. Erosion Control:

Effective erosion control can be implemented in lieu of requiring sediment control specified above. For small areas, which are unable to drain to a basin, this could be achieved by implementing contingency measures prior to rainfall, such as covering exposed soil with blankets (mulch or synthetic) or spray-on soil binders. In these circumstances the erosion controls must result in an effectively stabilised surface prior to rainfall to justify the exclusion of sediment controls.

Each of the above approaches has been considered and specific recommendations provided for the site catchments in Section 4.1.

4 EROSION AND SEDIMENT CONTROL STRATEGY

4.1 STRATEGIES FOR SPECIFIC SITE SUB-CATCHMENTS

The overall strategy during construction for each of the site sub-catchments and discharge locations are discussed below and shown in Figure 8 and Figure 9. Considerations for the detailed design of erosion, drainage and sediment controls are provided in Sections 4.4 to 4.6.

The overall strategy is provided based on two phases – existing levels and final levels. Transition between these two phases is a gradual process and the detailed construction ESCP's may need to show a number of interim plans to cover this transition.

4.2 EXISTING LEVELS

A key feature of this strategy is the diversion of the existing drainage line which currently bisects the works area. This diversion (CW1 and CW2) needs to occur prior to any other works within sub-catchment A.

Within each of the site sub-catchments (A, B and C), the strategy is simple, with Type-B HES basins provided at the low-point of each sub-catchment. The basins are fed through the provision of dirty-water diversion drains, while external 'clean' catchments are diverted around the works by clean water diversion drains. Small areas which fall outside of the sediment basin catchments can be managed with sheet-flow sediment controls such as sediment fencing.

Sediment basin SB1 (sub-catchment A and SB2 (Sub-catchment B) are located in the ultimate footprint of WSUD treatment systems. The basin locations can remain static throughout construction and should be constructed based on the maximum catchment size which will occur at any point during construction. For SB1, this will be the catchment based on existing levels, while for SB2 this is the catchment based on final levels.

Both SB1 and SB2 are located in areas which will ultimately be filled. It is important to note that this basin (as for all controls listed in this section) needs to be functional before topsoil stripping occurs throughout the contributing sub-catchments. The basin are likely to be constructed as a combination of cut and filling in order to command the identified sub-catchments based on existing levels. Filling for the bioretention footprint would therefore need to be delayed until the last phase of earthworks, once the contributing catchments have been stabilised and the sediment basin can be decommissioned.

Sediment basin SB3 (sub-catchment C) is not located within any future WSUD footprint and is a temporary basin which will ultimately need to eb removed to facilitate filling. The removal of SB3 is dependent on the decommissioning of CW1 and the commissioning of CW1*.

Construction Sequence

1. Waterway crossing WW1 and Haul Road
2. Clean water diversion CW1 and CW2
3. DD1, DD2, CW5 and SB1
4. Works in Catchment A south of CW1 can commence
5. DD3, DD4, CW6 and SB2
6. Works in Catchment B can commence
7. CW4 and CW3, WW2
8. DD5 and SB3
9. Works in Catchment C may commence

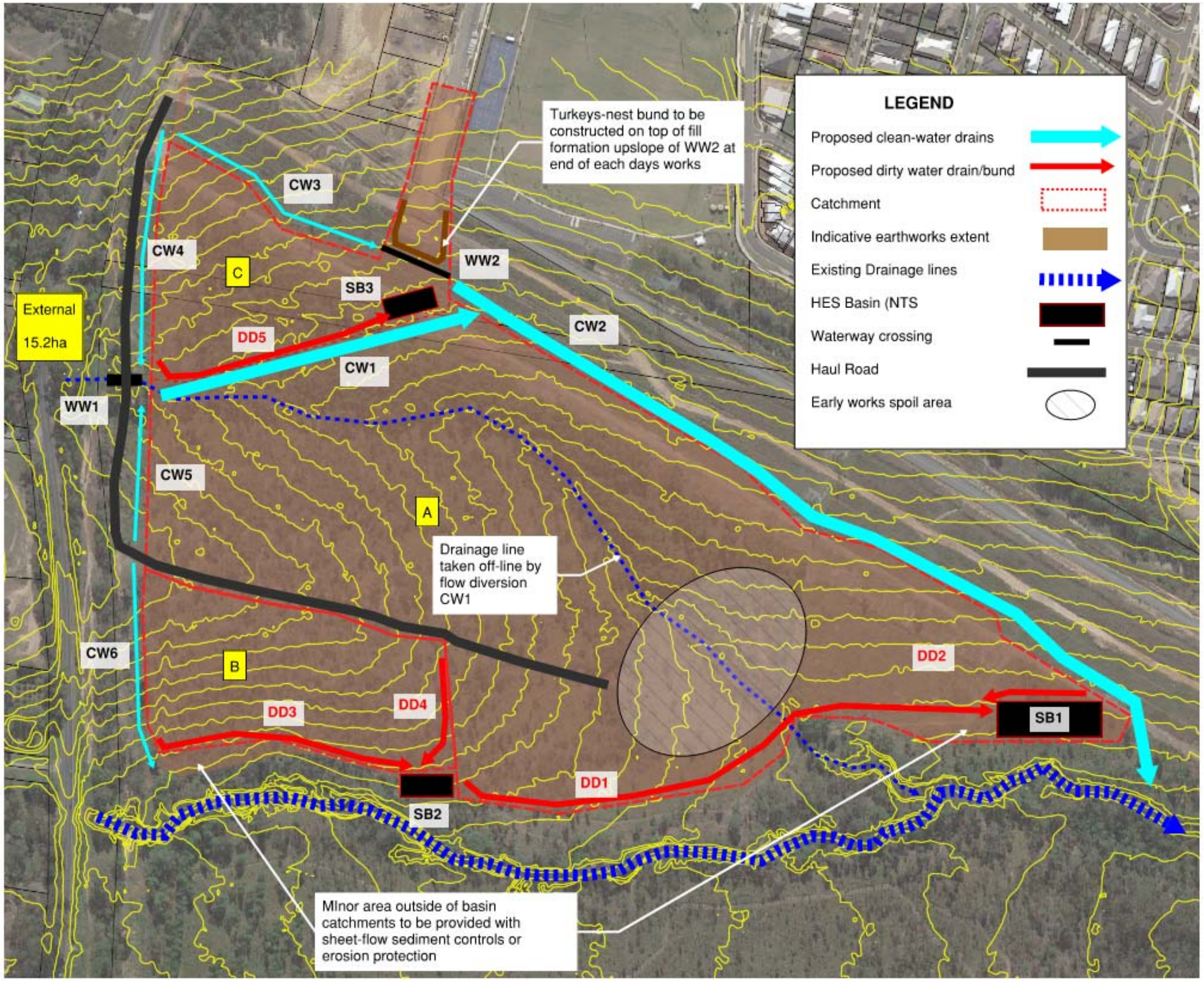


Figure 8: Strategy Elements (Existing Levels)

4.3 FINAL LEVELS

The key difference between the 'existing levels' and 'final levels' strategy is the management of the external catchment west of Waterford Tamborine Road. The final levels strategy relies on this external catchment being diverted through clean water channel CW1* which remains west of the works area and diverts the catchment to Quinzeh Creek.

This channel (CW1*) may be constructed as part of the Waterford Tamborine Road upgrade. However, if the earthworks needs to eb completed ahead of this upgrade, then an equivalent of CW1* will need to be constructed within the site as part of the earthworks.

Once CW1* (or equivalent) is delivered, then SB3 and the previous diversion channel (CW1) may be decommissioned and earthworks can progress in the area previously occupied by these features.

Sediment controls within sub-catchments A* and B* remain as Type-B HES basins, with small areas which fall outside of the sediment basin catchments managed by sheet-flow sediment controls such as sediment fencing. Dirty-water drains will be provided by the road box (as it is formed), with coir-log check dams provided within the road box prior to rainfall, in order to minimise erosion within the road box itself.

4.4 EROSION CONTROL

The following discussion relates to general earthworks areas. Specific discussion on riparian works are provided in Section 4.7.

IECA (2008) identifies erosion risk based on average monthly rainfall and provides best practice rehabilitation requirements for different times of the year based on this risk. The erosion risk for the subject site for different times of the year is shown in Table 4.

Table 4: Erosion risk by time of year

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	High	High	High	High	Moderate	Very Low	Very Low	Very Low	Moderate	Moderate	High

The requirements for land clearing and rehabilitation vary depending on the time of year (i.e. level of risk). The performance targets, based broadly on IECA (2008) and example methods of achieving those targets are provided in Table 5. The detailed ESCPs for each works area are to provide specific details on how the performance targets are to be achieved.

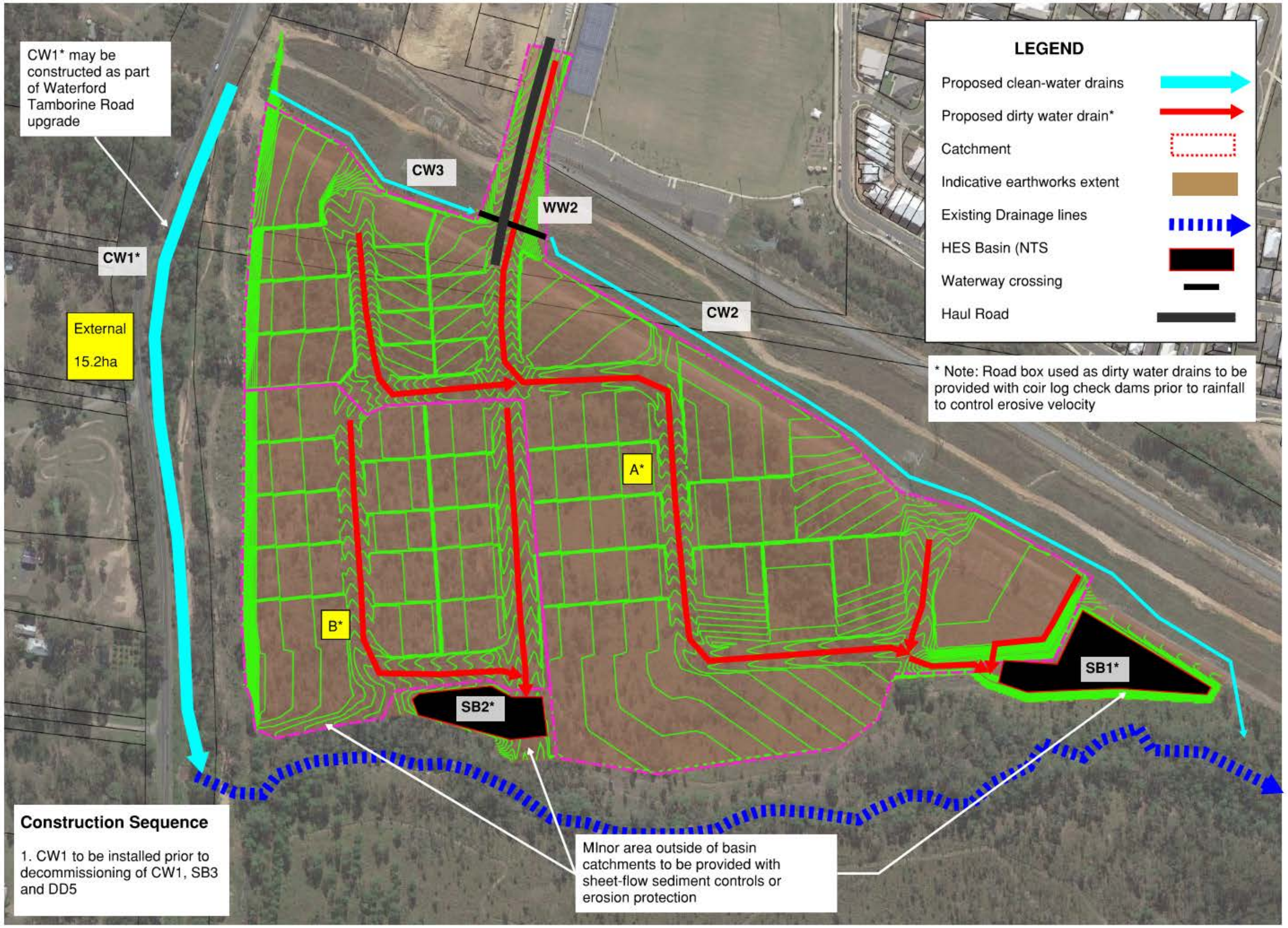


Figure 9: Strategy Elements (Final Levels)

Table 5: Erosion performance targets and example methods

Erosion Risk	Performance Target	Example Method
Very Low	• Land clearing limited to 8 weeks worth of construction work. • Disturbed areas stabilised with 60% cover within 30 days of finished levels being reached or works delayed for more than 30 days	• Future lots stabilised with drill seeding of annual and perennial grass species, with soil amelioration based on soil tests. • Steep areas where drill seeding not possible stabilised with hydromulch
Moderate	• Land clearing limited to 6 weeks worth of construction work. • Disturbed areas stabilised with 70% cover within 20 days of finished levels being reached or works delayed for more than 20 days	• Future lots stabilised with drill seeding of annual and perennial grass species, with soil amelioration based on soil tests. Soil binder provided for short-term stabilisation over seeded areas. • Steep areas where drill seeding not possible stabilised with bonded-fibre matrix. • Provided within 20 days of final levels being reached.
High	• Land clearing limited to 4 weeks worth of construction work. • Disturbed areas stabilised with 75% cover within 10 days of finished levels being reached or works delayed for more than 10 days	• Future lots stabilised with drill seeding of annual and perennial grass species, with soil amelioration based on soil tests. Soil binder provided for short-term stabilisation over seeded areas. • Steep areas where drill seeding not possible stabilised with bonded-fibre matrix. • Provided within 10 days of final levels being reached.

Table 5 refers to short-term stabilisation requirements. As the earthworks areas may remain undeveloped for an extended period of time, the sediment controls will need to remain in place and continue to be actively managed until effective long-term erosion control (i.e. vegetative cover) is achieved based on the cover requirements for the highest monthly erosion risk (i.e. 75% cover).

4.5 DRAINAGE CONTROL

Drainage controls are required to limit flow path lengths in order to prevent or minimise rill erosion and to ensure clean external catchments are diverted around the works and disturbed catchments are directed to appropriate sediment controls such as HES basins.

Table 2 and Table 3 provide design standards for drainage controls. As the site exhibits visual signs of the presence of dispersive soils, specific measures will need to be applied to drainage controls to prevent severe erosion, such as topsoil capping or addition of gypsum to diversion drains prior to lining.

Details of drainage controls will be provided with the detailed ESCP's. Preliminary sizing is however provided for two key aspects which can be used as a comparison for the sizing in the detailed ESCPs:

1. Culvert crossing WW1 of the Haul Road, which is necessary for the early works to commence; and
2. Diversion channel CW1/CW2.

4.5.1 Culvert Crossing WW1

Table 3 specifies a design standard of 1:1yr ARI for the conveyance of the waterway crossing. However, the crossing should also be constructed to remain stable durign overtopping flows between the 1:1yr to 1:10yr ARI (IECA, 2008). For this reason, the standard drawing for waterway crossings (TCC-01 – refer Appendix B) identifies the culverts to be placed in rock fill rather than earth or fine aggregate.

The 1:1yr ARI peak flow has been estimated usign the modified rational method and based on an external catchment area of 15.2ha and a time of concentration of ?? minutes. This provided a peak flow estimate of 1.6m3/s.

Inidicate culvert sizing can be determined based on inlet control design nomographs and assuming a nominal cover of 500mm above the culvert obvert. This results in a culvert size of 2/675RCP.

This sizing is preliminary and survey of the crossing location will be required to refine the sizing based on actual available head (cover). Sizing of culverts may also need to be increased dependent on the waterway corssing cross-section, in order to ensure that the 1:10yr flow is contained to over-top only in the area of rock fill.

4.5.2 Diversion Channel CW1

Table 3 specifies a design standard of 1:2yr ARI for draiange controls which are required to operate for 12 months or less. DesignFlow (2020) provie an estimate of Q2 at this location of 1.90m3/s.

Based on existing contours, the available fall for CW1 is 2m, resulting in an average logitudinal grade for CW1 of 0.4%. Preliminary channel properties to convey this flow would be base width 3m, side slopes 1:3, channel depth min 0.52m and geofabric lining.

It is however recommended that a lager channel is installed where possible in roder to provide for the conveyance of larger events and greater construction flexibility. For example, if the channel is to remain in palce for greater than 24 months, then a 1:10yr ARI design standard is required. This would increase the channel base width by 2m (to 5m) and the depth by 20mm (to 0.54m)

4.6 SEDIMENT CONTROL

4.6.1 High Efficiency Sediment Basins

Type-B Basins

Appendix A contains full calculations for each of the HES basins identified in Figure 8 and Figure 9. The HES basins are Type-B, with sizing determined from the procedures documented in IECA (2019). The basin and catchment properties are summarised below in Table 6.

The scour velocity checks provided in Appendix A indicate that for some basins the velocity may be an issue. It is recommended that permeable baffles be implemented in all HES basins in order to improve the distribution of velocities across the basin section and minimise the risk of resuspension.

Table 6: Preliminary Type-B HES Basin Properties

Basin ID	Sub-Catchments	Catchment Area (ha)	Existing or Final Contours?	Basin Volume (m^3)	Basin Area (m^2)
SB1	A	15.2	Existing	4,425	2,883
SB1*	A*	14.4	Final	4,278	2,801
SB2	B	2.6	Existing	876	796
SB2*	B*	5.7	Final	2,040	1,518
SB3	C	2.6	Existing	858	784

Each Type-B basin should be provided with an automatic dosing unit. Flow-based dosing would be preferrable for Basins SB1/1* and SB2/2* compared to rainfall-activated dosing due to the extent of earthworks and changes to the contributing catchment which will occur. For basin SB3 a rainfall activated doser would be appropriate.

A suitable flocculant and dosing rate will need to be determined based on jar testing. Suitable candidate products would be chitosan and aluminium-chloro-hydrate (ACH).

Standard drawings for HES basins are provided in Appendix B.

Sheet flow controls

Small areas which cannot drain to sediment basins (for example, fill batters) should be provided with sheet-flow sediment controls such as sediment fencing. These areas are expected to be small based on the current earthworks design.

Wongawallan Drive Controls

The northern section of the Wongawollan Drive extension consists of a fill embankment which will be cut-off from the sediment basins SB3 or SB1 by the clean-water diversion channel until the final formation levels are achieved.

As the embankment levels come up, a turkeys nest bund should be created at the top of the formation to fully contain any runoff generated by the formation. Captured runoff can either be treated in-situ prior to discharge or pumped to SB3 for treatment.

The batters of the formation which cannot flow to a sediment basin should be provided with sheet-flow sediment controls such as sediment fencing. These areas should also be progressively stabilised as final levels are achieved.

4.7 RIPARIAN WORKS

Riparian works are required for the construction of CW1 and WW1.

For WW1, it is proposed that this area is isolated using a cofferdam (earth bund – geofabric covered) on the upslope side of works and either a gravity or pumped flow diversion is provided to convey minor flows around the works area. A contingency should be kept on site consisting of geofabric/erosion control blankets and if rain is forecast then the channel invert in the works area should be stabilised using these blankets in order to prevent erosion caused by overtopping of the upslope bund.

Diversion channel CW1 should be constructed offline, with the existing drainage line kept in place and conveying all flows until CW1 is complete.

In terms of rehabilitation once WW1 and the haul road is removed, IECA (2008) provides minimum requirements for land clearing and rehabilitation associated with riparian works. These requirements provide generous timeframes for rehabilitation which are inconsistent with the significant water quality risk posed by these types of works.

It is proposed that the following land clearing and rehabilitation performance requirements are adopted instead:

1. Waterway works are scheduled to occur during periods of very low erosion risk (July-September), or at other times of the year only where the exposed area which may be exposed to flows can be limited to an area which can be stabilised prior to forecast rainfall
2. Flow diversions are to remain in place until the area of work has been stabilised (90% cover) using methods suitable for the expected velocity

Where possible, stabilisation should utilise the ultimate landscape outcome proposed for the riparian area. Where this is not specified, then methods which are suitable for the expected velocities and degree of inundation should be implemented, such as erosion control blankets.

4.8 CONSTRUCTION SEQUENCE

Specific construction and ESC sequencing requirements identified as part of this strategy are summarised below.

- Construction of the riparian works (WW1 and CW1) are high risk and need to be given priority and should be scheduled to occur in the driest time of the year (June-September).
- Before works (apart from ESC) in Catchment A commence, the following is required (in order):
    - Waterway crossing WW1 and Haul Road
    - Clean water diversion CW1 and CW2
    - DD1, DD2, CW5 and SB1
    - Works in Catchment A south of CW1 can commence
- Before works (apart from ESC) in Catchment B commence, the following is required (in order):
    - DD3, DD4, CW6 and SB2
    - Works in Catchment B can commence
- Before works (apart from ESC) in Catchment C commence, the following is required (in order):
    - CW4 and CW3, WW2
    - DD5 and SB3
    - Works in Catchment C may commence
- Clean water drain CW1* is required to be installed prior to decommissioning and filling in the area of CW1, SB3 and DD5. For all other areas, controls are required to remain in place until 75% vegetative surface cover is achieved in each sub-catchment.

5 MONITORING

Automatic monitoring of water quality (turbidity and pH) should be implemented at the discharge of each Type-B sediment basin and an alert generated if the water quality targets specified in Table 1 are exceeded.

It is recommended that monthly audits are undertaken of the works by a CPESC independent of the Principal Contractor. Monthly auditing should be undertaken following the procedures which would be followed should a compliance inspection be undertaken by Department of Environment and Science (DES) officers.

These procedures are documented in *Procedural guide – Releases to waters from land development sites and construction sites 2500m2 and greater* (DES, 2021).

6 REFERENCES

Department of Environment and Science (2021) *Procedural guide – Releases to waters from land development sites and construction sites 2500m2 and greater* https://environment.des.qld.gov.au/__data/assets/pdf_file/0021/215418/procedural-guide-water-release-large-sites.pdf

DesignFlow (2020) *Waterford Tamborine Road Upgrade – Hydraulic Assessment version 2*

International Erosion Control Association (2008) *Best Practice Erosion and Sediment Control*

International Erosion Control Association (2019) *Appendix B – Sediment Basin Design and Construction*

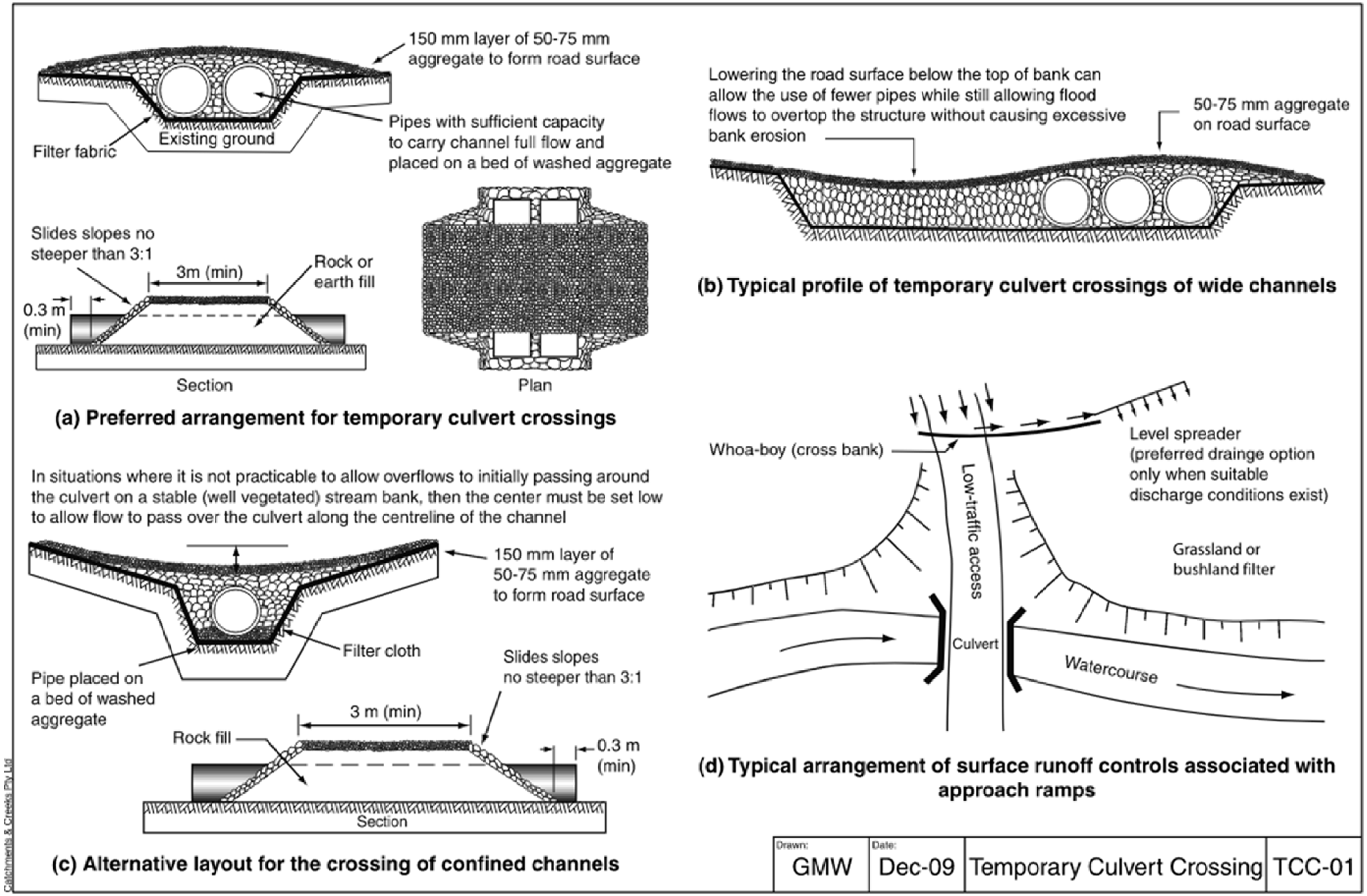
The State of Queensland (2017) *State Planning Policy*

APPENDIX A HES BASIN SIZING CALCULATIONS

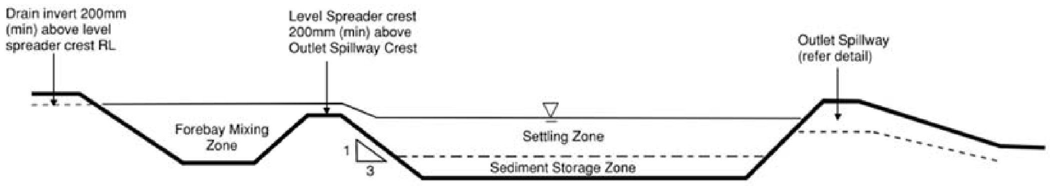
Table A1: HES Basin sizing calculations

		Q3mth Design Flowrate Calc.						Settling Zone						Forebay		Sediment Storage Zone			Overall Dimensions relative to spillway crest (excl. Forebay)						Spillway Calculations								
Basin ID	Catchment Area (Ha)	C_{10}	C_1	tc	$I_{1yr,tc}$ (mm/hr)	Q1yr (m^3/s)	Q3mth (m^3/s)	Residence Time (hr)	Settling Zone Depth (m)	Ave. settling zone area (m2)	Settling Volume (m3)	W:L (1:X)	Scour Velocity (m/s)	Forebay Min. Depth (m)	Forebay Vol (m3)	Sed Storage Vol (m3)	Sed Storage depth (approx.) (m3)	Batter (1:X)	Width (m)	Length (m)	Depth (m)	Area (m2)	Vol Total (m3)	Vol Total (m3/ha)	Basin Design Life	Design ARI	C	I (mm/hr)	Q (m^3/s)	Head over spillway (m)	Spillway crest length (m)	Spillway Crest RL (m)	Min Embankment RL (m)
SB-1	15.21	0.7	0.56	24	55.8	1.32	0.66	1.33	1.5	2107	3161	3	0.042	1	316	948	0.5	3	31.0	93.0	2.0	2883	4425	291	3-12 months	1:20yr	0.74	117	3.63	0.2	23.9	0	0.65
SB-2	2.58	0.7	0.56	18	65.1	0.26	0.13	1.33	1.5	417	625	3	0.018	1	63	188	0.6	3	16.3	48.9	2.1	796	876	339	3-12 months	1:20yr	0.74	136	0.72	0.2	4.7	0	0.65
SB-3	2.6	0.7	0.56	19	63.3	0.26	0.13	1.33	1.5	409	613	3	0.018	1	61	184	0.6	3	16.2	48.5	2.1	784	858	330	3-12 months	1:20yr	0.74	133	0.71	0.2	4.6	0	0.65
SB-1*	14.37	0.7	0.56	23	57.1	1.28	0.64	1.33	1.5	2037	3056	3	0.041	1	306	917	0.5	3	30.6	91.7	2.0	2801	4278	298	3-12 months	1:20yr	0.74	120	3.52	0.2	23.2	0	0.65
SB-2*	5.67	0.7	0.56	16	69	0.61	0.30	1.33	1.5	971	1457	3	0.028	1	146	437	0.6	3	22.5	67.5	2.1	1518	2040	360	3-12 months	1:20yr	0.74	144	1.67	0.2	11.0	0	0.65

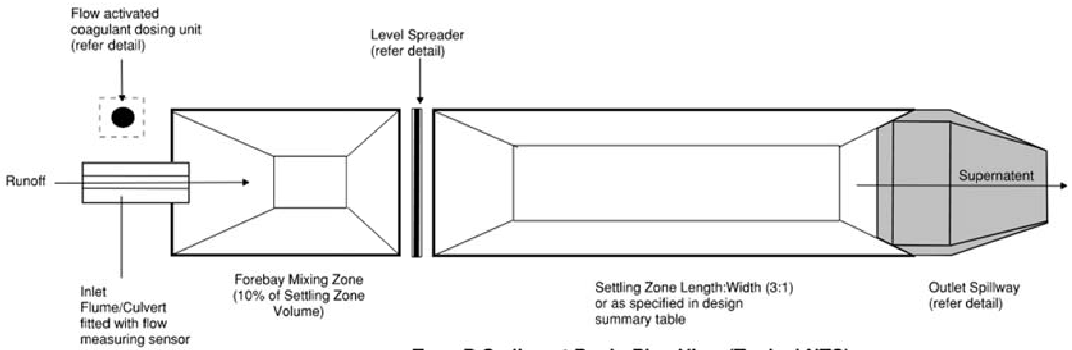
APPENDIX B STANDARD DRAWINGS



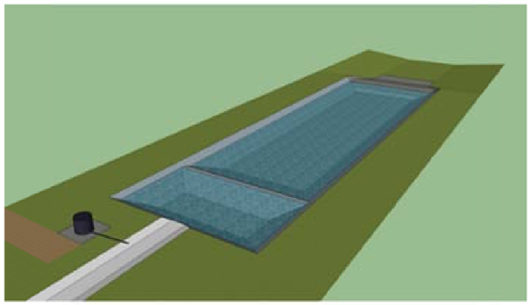
150 mm layer of 50-75 mm aggregate to form road surface
Pipes with sufficient capacity to carry channel full flow and placed on a bed of washed aggregate
Filter fabric
Existing ground
Slides slopes no steeper than 3:1
3m (min)
Rock or earth fill
0.3 m (min)
Section
Plan
(a) Preferred arrangement for temporary culvert crossings
Lowering the road surface below the top of bank can allow the use of fewer pipes while still allowing flood flows to overtop the structure without causing excessive bank erosion
50-75 mm aggregate on road surface
(b) Typical profile of temporary culvert crossings of wide channels
In situations where it is not practicable to allow overflows to initially passing around the culvert on a stable (well vegetated) stream bank, then the center must be set low to allow flow to pass over the culvert along the centreline of the channel
150 mm layer of 50-75 mm aggregate to form road surface
Filter cloth
Pipe placed on a bed of washed aggregate
Slides slopes no steeper than 3:1
3 m (min)
Rock fill
0.3 m (min)
Section
(c) Alternative layout for the crossing of confined channels
Whoa-boy (cross bank)
Level spreader (preferred drainge option only when suitable discharge conditions exist)
Low-traffic access
Grassland or bushland filter
Culvert
Watercourse
(d) Typical arrangement of surface runoff controls associated with approach ramps
Catchments & Creeks Pty Ltd
Drawn: GMW
Date: Dec-09
Temporary Culvert Crossing
TCC-01



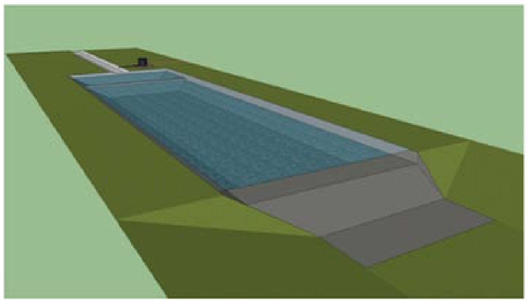
Type B Sediment Basin Long Section (Typical NTS)



Type B Sediment Basin Plan View (Typical NTS)

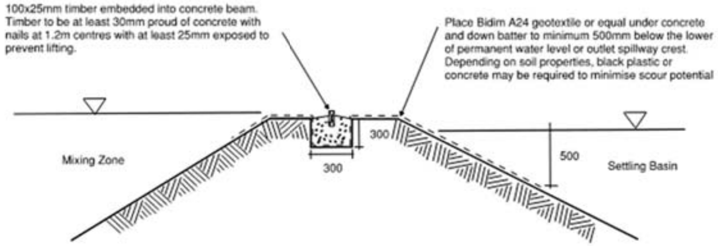


Basin Perspective (looking downstream)

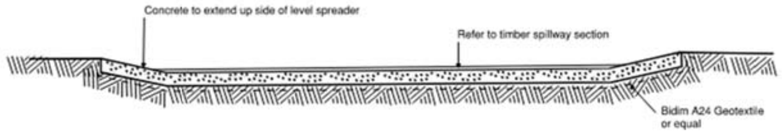


Basin Perspective (looking upstream)

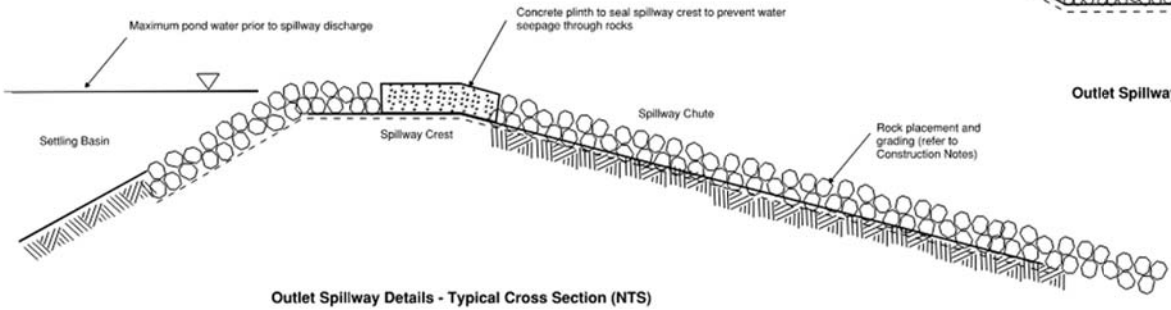
iFOD Flow Dosing Unit (custom built)



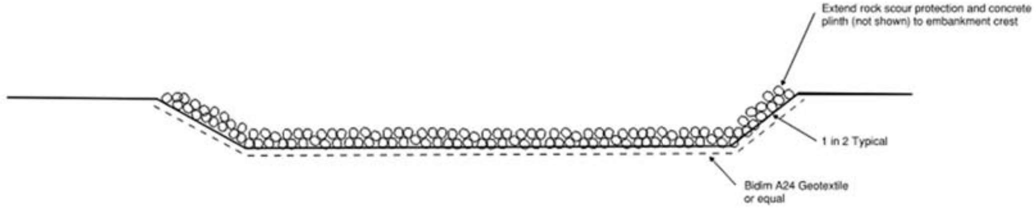
Level Spreader Details - Typical Cross Section (NTS)



Level Spreader Details - Typical Long Section (NTS)



Outlet Spillway Details - Typical Cross Section (NTS)



Outlet Spillway Details - Typical Long Section (NTS)

Notes:

Auto Doser

1. Provided as iFOD-Flow to manufacturers specification.
2. Doser and supply of flocculant to be provided on level pad 4mx4m within 10m of dosing point.
3. All-weather access track to be provided to doser.
4. Flocculant provided as Turbiclear (ACH). If alternative flocculant used then the basin size is to be increased according to jar settlement test (refer to table below.

Jar Settlement after 15 mins (mm)	Multiplication Factor to Settling Zone Volume
50	x3
75	x2
100	x1.5
150	x1

Basin construction:

Materials-

5. Earth Fill: clean soil with Emerson Class 2(1), 3, 4 or 5 and free of roots, woody vegetation, rocks and other unsuitable material. Soil with Emerson Class 4 and 5 may not be suitable depending on particle size distribution and degree of dispersion. Class 2(1) should only be used upon recommendation from geotechnical specialist.
6. Spillway rock: hard, angular, durable, weather resistant and evenly graded rock with 50% by weight larger than the specified nominal (d50) rock size. Large rock should dominate, with sufficient small rock to fill the voids between larger rock. the diameter of the largest rock should be no larger than 1.5 times the nominal rock size. The specific gravity should be at least 2.5.
7. Geotextile fabric: heavy duty, needle-punched, non-woven cloth, minimum 'bidim' A24 or equivalent.

Construction-

8. Notwithstanding any description contained with approved plans or specifications, the Contractor shall be responsible for satisfying themselves as to the nature and extent of the specified works and the physical and legal conditions under which the works will be carried out. This shall include means of access, extent of clearing, nature of the materials to be excavated, type and size of mechanical plant required, location and suitability of water supply for construction and testing purposes, and any other likely matters affecting the construction of the works.
9. Refer to approved plans for location, dimensions, and construction details. If there are questions or problems with the location, dimensions, or method of installation, contact the engineer or responsible on-site officer for assistance.
10. Before starting any clearing or construction, ensure all the necessary materials and components are on the site to avoid delays in completing the sediment basin once works begin.
11. Install requires short term sediment control measures downstream of the proposed earthworks to control sediment runoff during construction of the basin.
12. The area to be covered by the embankment, borrow pits and incidental works, together with an area extending beyond the limits of each for a distance not exceeding five (5) metres all around must be cleared of all trees, scrub, stumps, roots, dead timber and rubbish and disposed of in a suitable manner. Delay clearing the main basin area until the embankment is complete.
13. Ensure all holes made by grubbing within the embankment footprint are filled with sound material, adequately compacted, and finished flush with the natural surface.

Cut-off Trench-

14. Before construction of the cut-off trench or any ancillary works within the embankment footprint, all grass growth and topsoil must be removed from the area to be occupied by the embankment and must be deposited clear of this area and reserved for topdressing the completed embankment.
15. Excavate a cut-off trench along the centre line of the earth fill embankment. Cut the trench to stable soil material, but in no case make it less than 600mm deep. the cut-off trench must extend into both abutments to at least the elevation of the outlet spillway crest. Make the minimum bottom width wide enough to permit operation of the excavation and compaction equipment, but in no case less than 600mm. Make the side slopes of the trench no steeper than 1:1 (H:V).
16. Ensure all water, loose soil, and rock are removed from the trench before backfilling commences. The cut-off trench must be backfilled with select earth-fill of the type specified for the embankment, and this soil must have a moisture content and degree of compaction the same as specified for the core zone.
17. Material excavated from the cut-off trench may be used in the construction of the embankment provided it is suitable and it is placed in the correct zone according to its classification.

Embankment-

18. Scarify areas on which fill is to be placed before placing the fill.
19. Ensure al fill material used to form the embankment meets the specifications certified by a soil scientist of geotechnical specialist.
20. The fill material must contain sufficient moisture so it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction. Place fill material in 150 to 200mm continuous layers over the entire length of the fill area and then compact before placement of further fill.
21. Unless specified on the approved plans, compact the soil at about 1% to 2% wet optimum and to 95% modified or 100% standard compaction.embankment to an elevation 10% higher than the design height to allow for settling
22. Where both dispersive and non-dispersive classified earth-fill materials are available, non-dispersive earth-fill must be used in the core zone. the remaining classified earth-fill materials must only be used as directed by the site superintendent.

23. Where specified, construct the embankment to an elevation 10% higher than the design height to allow for settling; otherwise finished dimensions of the embankment after spreading of topsoil must conform to the drawing with a tolerance of 75mm from specified dimensions.
24. Ensure debris and other unsuitable building waste is not placed within the earth embankment.
25. After completion of the embankment all loose uncompacted earth-fill material on the upstream and downstream batter must be removed prior to spreading topsoil.
26. Topsoil and re-vegetate/stabilise all exposed earth as directed within the approved plans.

Spillway construction-
27. The spillway must be excavated as shown on the plans, and the excavated material if classified as suitable, must be used in the embankment, and if not suitable it must be disposed of into spoil heaps.
28. Ensure excavated dimensions allow adequate boxing-out such that the specified elevations, grades, chute width, and entrance and exit slopes for the emergency spillway will be achieved after placement of the rock or other scour protection measures as specified in the plans.
29. Place specified scour protection measures on the emergency spillway. Ensure the finished grade blends with the surrounding area to allow a smooth flow transition from spillway to downstream channel.
30. If a synthetic filter fabric underlay is specified, place the fabric directly on the prepared foundation. if more than 1 sheet of filter fabric is required, overlap the edges by at least 300mm and place anchor pins at minimum 1m spacing along the overlap. bury the upstream end of the filter fabric a minimum 300mm below ground and where necessary, bury the lower end of the fabric or overlap a minimum 300mm over the next downstream section as required. Ensure the filter fabric extends at least 1000mm upstream of the spillway crest.
31. Take care not to damage the fabric during or after placement. If damage occurs, remove the rock and repair the sheet by adding another layer of fabric with a minimum overlap of 300mm around the damaged area.3If extensive damage is suspected, remove and replace the entire sheet.
32. where large rock is used, or machine placement is difficult, a minimum 100mm layer of fine gravel, aggregate, or sand may be needed to protect the fabric.
33. Placement of rock should follow immediately after placement of the filter fabric. Place rock so that it forms a dense, well graded mass of rock with a minimum of voids. the desired distribution of rock throughout the mass may be obtained by selective loading at the quarry and controlled dumping during final placement.
34. The finished slope should be free of pockets of small rock or clusters of large rocks. Hand placing may be necessary to achieve the proper distribution of rock sizes to produce a relatively smooth, uniform surface. the finished grade of the rock should blend with the surrounding are. No overfall or protrusion of rock should be apparent.
35. Ensure that the final arrangement of the spillway crest will not promote excessive flow through the rock such that the water can be retained within the settling basin at the elevation no less than 50mm above of below the nominated spillway crest elevation.

Establishing the settling pond-
36. The area to be covered by the stored water outside of the limits of the borrow pits must be cleared rubbish. Trees must be cut down stump high and removed from the immediate vicinity of the work.
37. Establish all required inflow chutes and inlet baffles, if specified, to enable water to discharge into the basin in a manner that will not cause soil erosion or the re-suspension of settled sediment.
38. Install a sediment storage level marker post with a cross member set just below the top of the sediment storage zone (as specified on the approved plans). Use at least a 75mm wide post firmly set into the basin floor.
39. If specified, install internal settling pond baffles. Ensure the crest of these baffles is set level with, or just below, the elevation of the emergency spillway.
40. Install all appropriate measures to minimise safety risk to on-site personnel and the public caused by the presence of the settling pond. Avoid steep, smooth internal slopes. Appropriately fence the settling pond and post warning signs if unsupervised public access is likely or there is considered to be an unacceptable risk to the public.