YARRABILBA

TOWN CENTRE ROL1

STORMWATER MANAGEMENT PLAN

VERSION 1

PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

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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

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1 INTRODUCTION

The Yarrabilba Priority Development (PDA) is located within the Logan City Council area and occupies a former pine plantation situated 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 of 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.

Town Centre ROL1 (subject site) covers an area of approximately 28.6 ha which includes around 24.3 ha of town centre super lots and 4.3 ha of roads with the surrounding area as balance lot.

This document presents the stormwater management strategy for the subject site to meet the requirements set out in the *Context Plan Area Strategy – Yarrabilba Town Centre and Surrounds* (RPS, 2024). These are generally consistent with the *State Planning Policy*, *Yarrabilba Total Water Cycle Management Strategy* (DesignFlow, 2024) and *Yarrabilba Stormwater Infrastructure Master Plan* (DesignFlow, 2024). This report provides details of the proposed stormwater quality and quantity management including location, conceptual sizing and functional earthworks.

This report covers the construction phase erosion/sediment control and operational phase stormwater quality and quantity management elements specific to Town Centre ROL1. Flood management has been addressed separately in the *Yarrabilba Masterplan Flood Risk Management Strategy – Version 1.2* (DesignFlow, 2024) as the flood management strategy spans numerous current and future precincts requiring site wide planning. Verification of the local catchment flood detention and diversion drainage are provided to support the subject site application.

2 SITE CHARACTERISTICS

2.1 LOCATION

Town Centre ROL1 lies in the central portion of the Stockland Yarrabilba site west of Yarrabilba Drive and south of the Powerline easement as shown in Figure 1. The subject development area covers a total area of approximately 29.2 hectares and forms part of the broader Town Centre and Surrounds Context Plan Area Strategy (CPAS) endorsed by EDQ (DEV2011/187/28, 31 October 2023)

2.2 TOPOGRAPHY, CATCHMENTS AND DRAINAGE

The existing topography across Town Centre ROL1 area is dominated by a significant area of borrow earthworks which falls away to the north and east. Prior to earthworks, the area was defined by a ridgeline that extended east through the site. Hillslope grades are in the order of 5% with the borrow earthworks zone in varying state of cut and fill stockpiles and perimeter bunding.

Quinzeh Creek lies to the north west of the development area while an unnamed tributary of Quinzeh Creek lies to the east. Both of these waterways include ecological corridor overlays. Elevation within the ROL1 area varies from around 50mAHD in the borrow zone down to 35mAHD adjacent to Yarrabilba Drive and Wetland Avenue. The site topography is shown in Figure 2.

Town Centre ROL1 sits generally within flood Catchment QC-4 of the broader Yarrabilba development site as defined in Figure 2 of the *Yarrabilba Masterplan Flood Risk Management Strategy – Version 1.2* (DesignFlow, 2024). It is not subject to flooding (being on the local ridgeline).

2.2.1 Lawful Point of Discharge

The lawful point of discharge for stormwater from Town Centre ROL1 is to the existing Quinzeh Creek waterway to the north and floodway to the east (via ultimate piped and overland flow paths) as illustrated in Figure 2. This creek (south of the Powerlink easement) is mapped as a watercourse under the Water Act (2000). Quinzeh Creek flows generally northeast before discharging north from the site (through Precinct C) near Steele Road approximately 1.7km downstream of Town Centre ROL1.

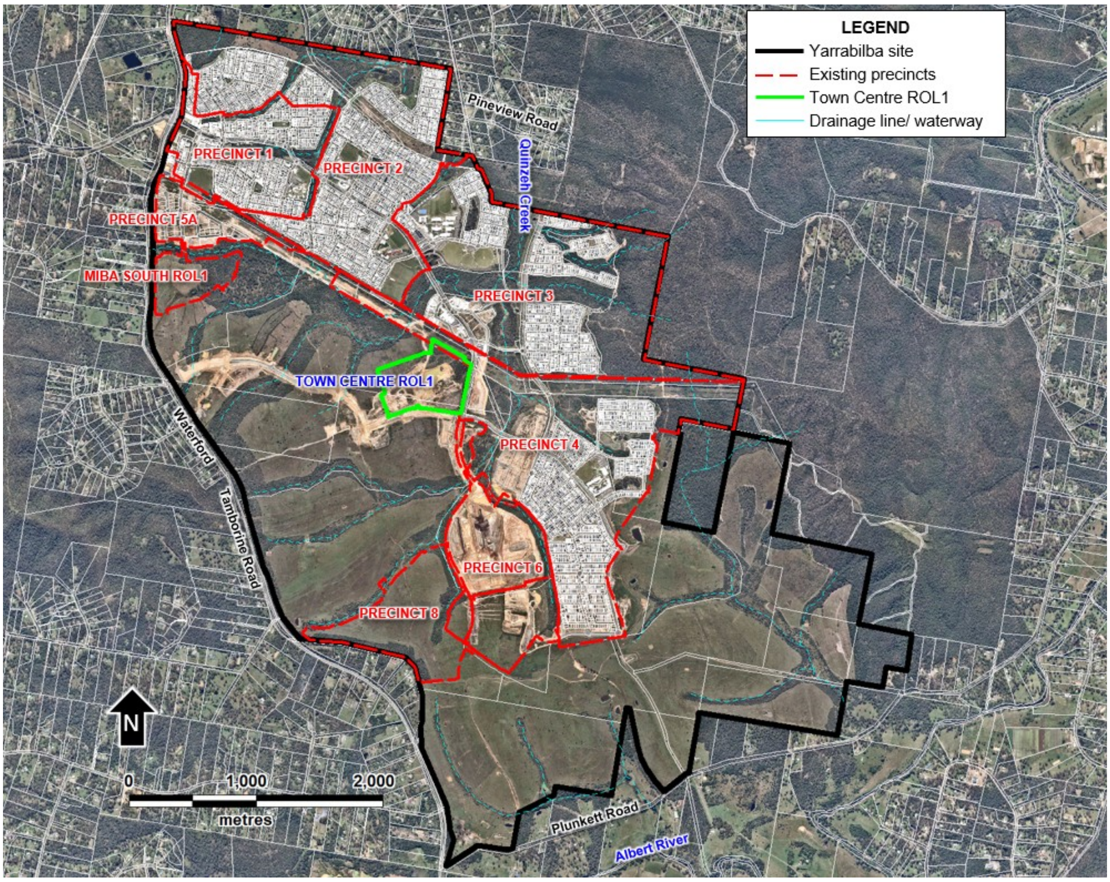


Figure 1: Yarrabilba Town Centre ROL1 locality

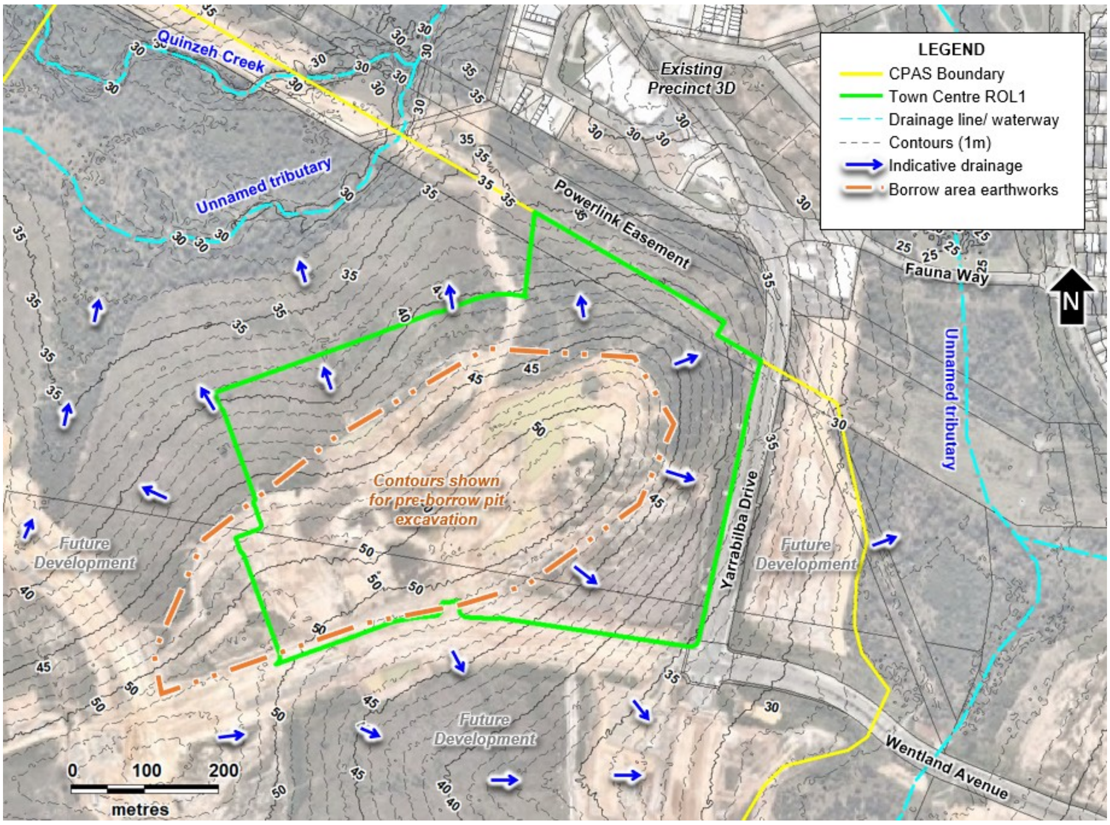


Figure 2: Existing topography, catchments and drainage

2.3 GEOLOGY AND SOILS

Geological mapping indicates Town Centre ROL1 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 Town Centre ROL1 are not expected to vary significantly from those encountered in the balance of Precinct 1 to 6 previously (i.e. those within the lower slope development zones). The alluvium zones (northern portion of Town Centre ROL1) have often displayed deep sand zones in localised areas where historic channel/creek incisions have been filled with sediment eroded from upslope catchments. Further site specific geotechnical investigations will occur within Town Centre ROL1 to confirm soil conditions for civil engineering design.

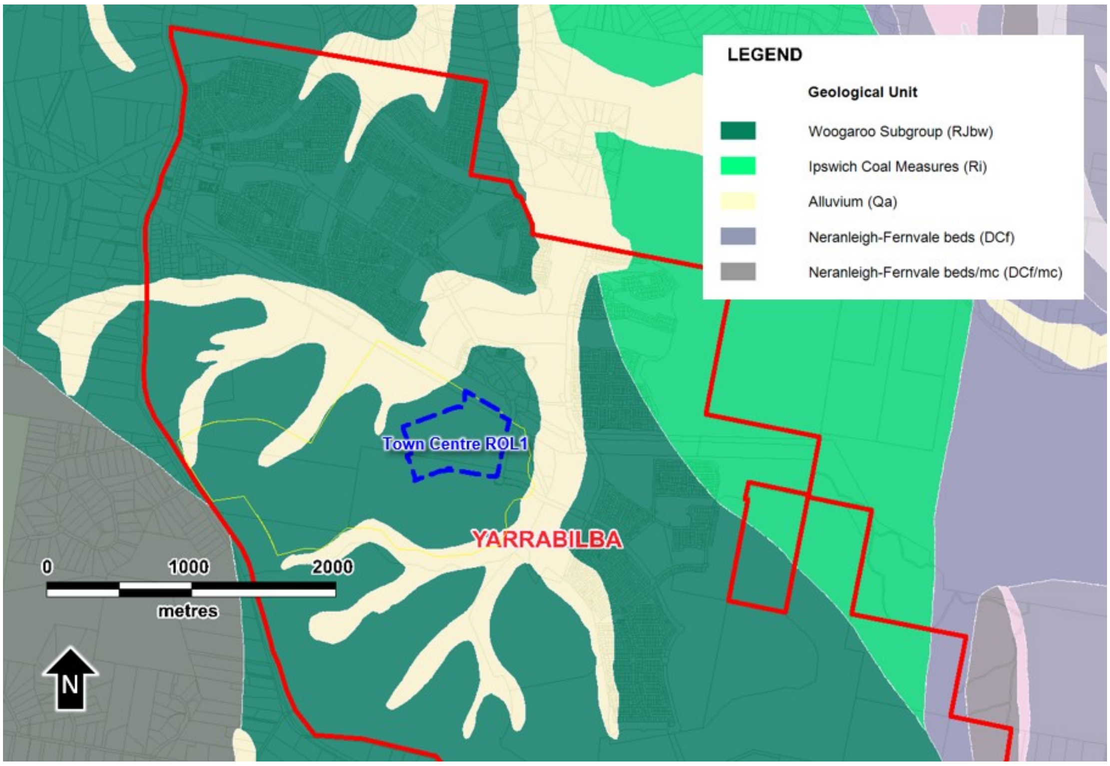


Figure 3: Geology and soils

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 around 80% of the previous land use across the Yarrabilba site, which have subsequently been cleared and are currently grazed or covered with regrowth vegetation (refer Figure 2) where development has not already occurred. Moderate to dense vegetation generally occurs along drainage lines in the Yarrabilba site.

Vegetation management will generally be undertaken in accordance with *Yarrabilba Development: Natural Environment Site Strategy* (Natura Consulting, 2024 or later) 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 Town Centre ROL1 development.

2.5 WATERWAYS

There are no mapped waterways within the Town Centre ROL1 precinct boundary. Quinzeh Creek (and tributaries) lie immediately north of the precinct and drains the MIBA development zone to the west as well as external rural residential area west of Waterford Tamborine Road. Based on the broadscale Waterway Condition Assessment (DesignFlow, 2023) carried out to support the total water cycle management strategy (DesignFlow, 2024), the section of Quinzeh Creek north of Town Centre ROL1 is in good overall condition with generally good perennial and riparian habitat (with areas of poor habitat within the cleared Powerlink easement), and good stability rating. Similarly, the unnamed waterway to the east is also in generally good condition and has been documented previously as part of Precinct 4.

Minimum waterway buffers of 30m to Quinzeh Creek (banks) and 15m to minor waterways/drainage centrelines set out in the *Stormwater Infrastructure Master Plan* (DesignFlow, 2024) have been applied to these waterways with any additional setbacks as required by the ecological and bushfire assessments also applied. All stormwater outlets from the proposed development will also be provided with scour protection to ensure stabilised concentrated flow paths.

2.6 PROPOSED DEVELOPMENT

Town Centre ROL1 (subject site) covers an area of approximately 28.6 ha which includes around 24.3 ha of town centre super lots and 4.3 ha of roads with the surrounding area as balance lot. The precinct layout is shown in Figure 4. Proposed stormwater management infrastructure (basins) are located outside the ROL1 boundary in adjacent future development areas.

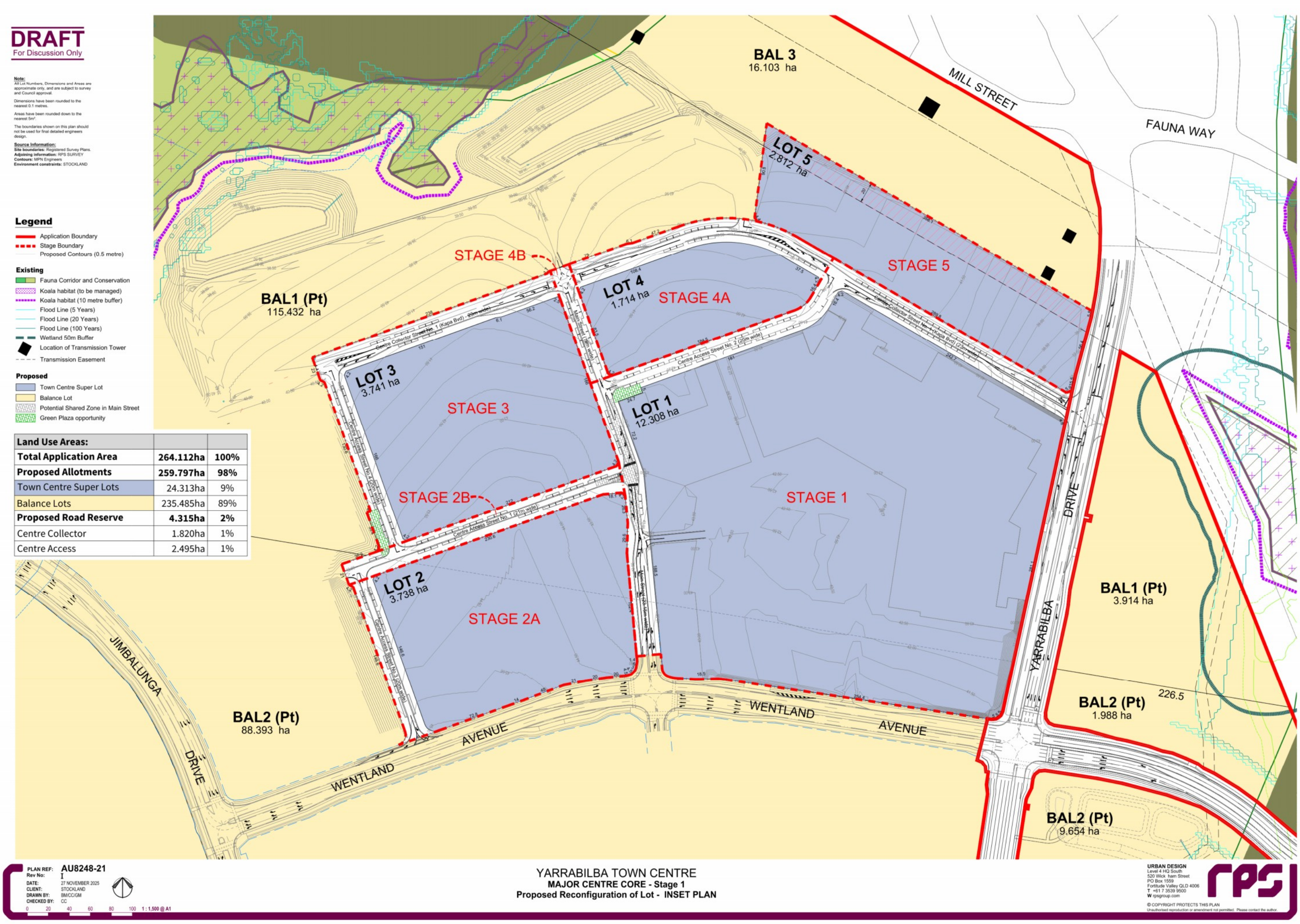


Figure 4: Town Centre ROL1 proposed layout

3 STORMWATER QUALITY

3.1 DESIGN OBJECTIVES

The stormwater quality management objectives that apply to the operational phase of Yarrabilba Town Centre ROL1 are listed in Table 1 as defined by *the Yarrabilba – Stormwater Infrastructure Master Plan* (DesignFlow, 2024), 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 quality management strategy has been developed for Town Centre ROL1 based on a review of the site characteristics, constraints and masterplan for the proposed development zones. The proposed strategy has been developed in collaboration with the design team to ensure it is well integrated with both engineering and landscape aspects of the design.

When developing the treatment strategy, several key principles were considered:

- Adopt multiple use open space principles where possible
- Adopt similar treatment philosophy to Precincts 1 to 8 development areas to maintain successful integration of treatment with development and outcomes
- Minimise the impact on existing vegetation and ecosystems
- Ensure future development/catchments are allowed for in precinct scale treatment systems.

Figure 5 shows the overall proposed treatment strategy for Town Centre ROL1 with details of treatment systems provided in Table 2. Due to the significant variability in potential commercial uses within the development, the requirement for gross pollutant traps for individual commercial lots is included to ensure that litter and coarse sediment are managed prior to discharge to the centralised treatment basins shown. The GPTs do not need to target any treatment of stormwater nutrients (phosphorus and nitrogen). GPTs are not required on residential land uses.

Design levels and the relevant flood immunity details are provided in Section 4.3, Figure 12. Further details of performance assessments of the proposed treatment strategy are presented in Section 3.3.

The strategy manages stormwater quality from the Town Centre ROL1 as well as parts of the existing Yarrabilba Drive roadway to the east and future areas surrounding the ROL1 area to the north and west. The treatment elements have therefore been conceptualised based on conservative assumptions regarding land use and impervious fractions to ensure adequate space and flexible design opportunity exists to respond to subsequent contributing development.

Table 2: Stormwater treatment elements

Treatment Type and ID	Size	Catchments	Comment
Sediment Pond 7A1 Wetland 7A2 Bioretention 7A3	450 m^2 1000 m^2 800m^2	7A	Sediment pond pre-treatment to wetland and bio basin
Sediment Pond 7B1 Bioretention 7B2	350 m^2 900 m^2	7B	Sediment pond pre-treatment to bio basin
Sediment Pond 7C1 Bioretention 7C2 & 7C3	400 m^2 1000 m^2	7C	Sediment pond pre-treatment to bio basin
Gross Pollutant Traps	varies	Each non-residential lot	Required on all non-residential lots (by others)

Note:

1. GPTs on lots are only required for litter and coarse sediment. End of line basins target fine sediment and nutrients.

The concept layout and earthworks for the proposed basins has been documented in the functional design plans by MPN (Appendix A). Key design parameters are summarised in Table 3. These are subject to detailed design as part of operational works and some flexibility in configuration exists in these basins to enable design response to ultimate catchment and landscape outcomes in these zones (e.g. sediment ponds may be replaced with sediment forebays where future drainage design dictates).

Table 3: Basin 7A concept design summary

Parameter	Sed 7A1	Wetland 7A2	Bio 7A3
Area	450 m^2	1000m^2	800 m^2
Surface level	RL30.0	RL30.0	RL30.0
Bunds	RL31.0 (min.) [1]		
1% AEP flood (in adjacent waterway)	RL29.59		

Table 4: Basin 7B concept design summary

Parameter	Sed 7B1	Bio 7B2
Area	350 m^2	900 m^2
Surface level	RL34.9	RL34.9
Bunds	RL37.0 (min.) [1]	
1% AEP flood (in adjacent waterway)	RL31.10 (max.)	

Notes:

1. External bunds relate to detention basin function over treatment areas. Internal bunds between treatment basins will be lower than the design external bund level noted above

Table 5: Basin 7C concept design summary

Parameter	Sed 7C1	Bio 7C2
Area	400 m^2	1000 m^2
Surface level	RL34.4	RL34.4
Bunds	RL36.5 (min.) [1]	
1% AEP flood (in adjacent waterway)	RL31.94 (max.)	

Notes:

2. External bunds relate to detention basin function over treatment areas. Internal bunds between treatment basins will be lower than the design external bund level noted above

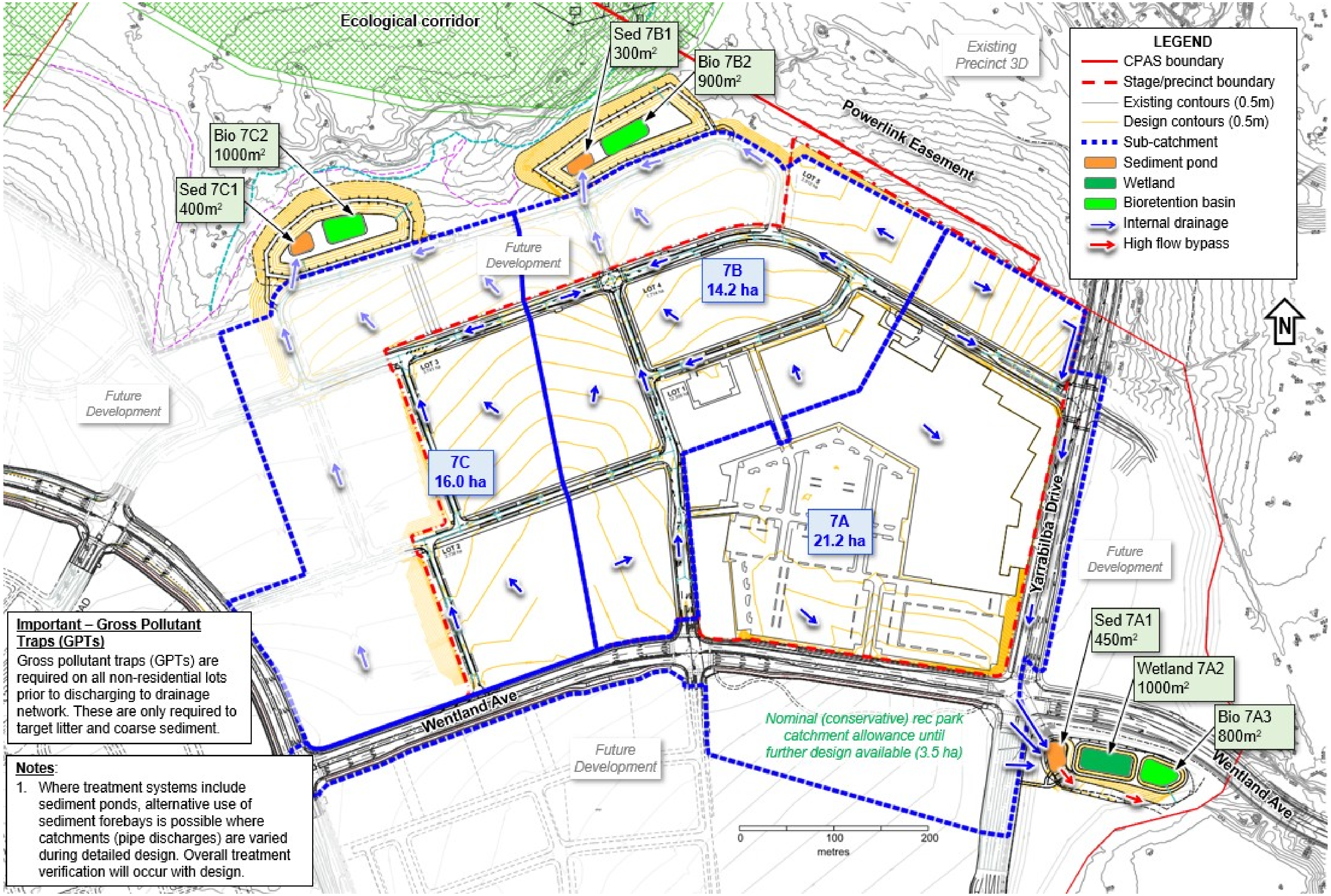


Figure 5: Town Centre ROL1 stormwater quality management strategy

3.3 STORMWATER QUALITY ASSESSMENT

MUSIC modelling was undertaken to assess the stormwater treatment performance of the proposed treatment strategy. MUSIC Version 6.4 was used for the assessment.

3.3.1 Model Structure

The structure of the MUSIC model is shown in Figure 6 with the general data provided in Table 6. MUSIC model parameters were adopted generally in accordance with the *MUSIC Modelling Guidelines* (Water by Design, 2010/2018) 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 scaled 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.

Gross pollutant traps required on al lots have been excluded from the assessment as these are only targeting litter and coarse sediment from individual non-residential lot activities (as pre-treatment to Councils ultimate stormwater quality asset).

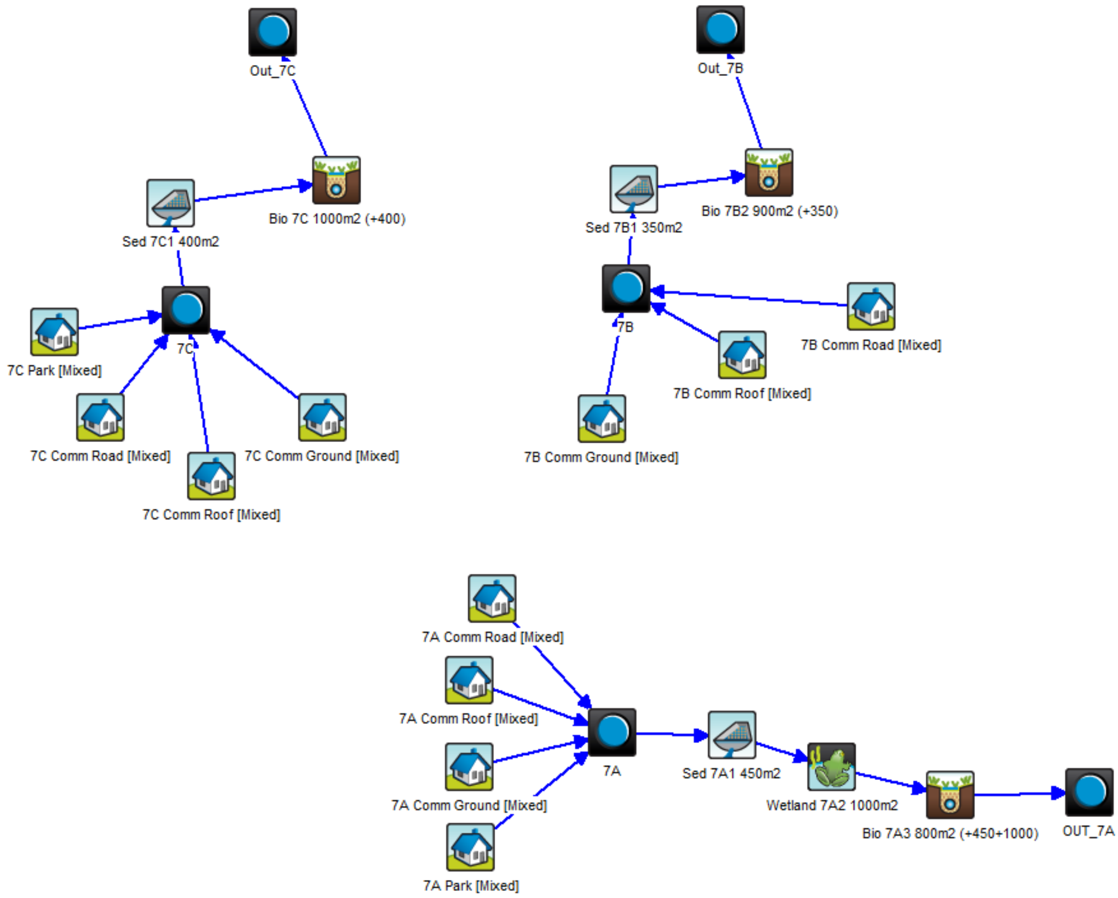


Figure 6: MUSIC model layout

Table 6: 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	
Sediment Pond	Extended detention depth (EDD) = 0.01 m (extended detention depth over 0.01m is included in bio basin where linked) Evaporative loss 75% of PET Notional detention time = <0.1hr (upstream of wetland or bioretention basin) Overflow weir width = sediment pond area/10
Wetland	Inlet pond volume = 0 (sediment ponds are upstream) Extended detention depth = 0.05m (0.1 m) (balance spills over into bio basin) Permanent pool volume - Surface area x 0.3 m (avg. depth) Notional detention time = 72 hrs Total nitrogen k = 200 m/yr Total nitrogen C* = 0.75 mg/L
Bioretention	Filter media depth = 0.6 m Extended detention depth = 0.3 m Extended detention area = Bio area (when stand-alone) or Bio + wetland + sed pond (when in combined system) Seepage = 0 mm/hr TN content 400 mg/kg Orthophosphate content 30 mg/kg Overflow weir width = bio area/10

3.3.2 Assumptions

1. A split catchment approach was adopted for modelling. Split land use percent imperviousness is generally in accordance with Table 3.5 in MUSIC Modelling Guidelines (Water by Design, 2010/2018). Minor increases in impervious fraction

to road and ground level have been applied to achieve overall imperviousness of 90%.

2. Sediment ponds connect via culverts or weirs to wetland or bioretention basins with minimal flow restriction (i.e. minimum allowable 0.01m extended detention adopted in MUSIC with large pipe connection to freely convey inflows)

3. Bioretention basins cells are modelled as combined total surface area (where actual design will split these into multiple cells to ensure flow distribution across filter).

4. Bioretention basins have 0.3m extended detention depth before overflowing to discharge pits. Extended detention area is taken as the sum of 'shared' area over bioretention <u>and</u> wetland and/or sediment pond (refer also to item 2 above) as bioretention controls rapid water level drawdown for all these systems.

5. All overflow weirs from treatment systems adopt the treatment area/10 for the weir width as per the *MUSIC Modelling Guideline* which ensures conservatively large weirs and avoids any additional treatment resulting from extended detention above weirs. No allowances have been made for the minor flood attenuation function of the basin in the water quality modelling.

The above assumptions ensure the functional design of all treatment systems is conservative and allows for sufficient earthworks, treatment and maintenance access space allowances within the current layout. All systems will be subject to detailed hydraulic and MUSIC model verification at detailed design stage to optimise the sizing for the contributing catchments and surrounding open space integration.

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 contributing to each treatment element. Table 7 below lists the catchment area and percent impervious for each sub-catchment modelled with a detailed breakdown of surface types. All land use is based on industrial land use.

Table 7: MUSIC model catchment split data

Catchment ID (refer to Figure 5)	Total Area (ha)	% Impervious	Surface Type	Sub-Area (ha)	Impervious %
7A	21.20	86%	Road	5.37	95%
			Roof	8.95	100%
			Ground	3.58	90%
			Park	3.30	30%
7B	14.20	97%	Road	4.26	95%
			Roof	7.10	100%
			Ground	2.84	90%
7C	16.00	95%	Road	4.67	95%
			Roof	7.78	100%
			Ground	3.11	90%
			Park	0.45	30%
Total	51.40	92%		51.40	92%

Notes:

1. Road and ground level impervious fractions have been scaled up from minimum guideline values to reflect town centre environment to ensure sufficient treatment for conceptual design.

3.3.4 Results

The results of the MUSIC modelling are presented in Table 8. All water quality objectives can be readily achieved with the proposed treatment strategy. This includes allowance for future development surrounding the Town Centre ROL1 zone.

Table 8: MUSIC results

Catchments	Treatment ID	Pollutant	Inflows (kg/yr)	Outflows (kg/yr)	Reduction (%)
7A	Sed 7A1, Wetland 7A2, Bio 7A3	TSS	28000	5100	81.7 ✓
		TP	64.3	18.9	70.6 ✓
		TN	502	264	47.4 ✓
		GP	4110	0	100 ✓
7B	Sed 7B1, Bio 7B2	TSS	20500	4030	80.3 ✓
		TP	47.7	14.3	70.1 ✓
		TN	374	188	49.7 ✓
		GP	2990	0	100 ✓
7C	Sed 7C1, Bio 7C2/7C3	TSS	22500	4330	80.8 ✓
		TP	52.9	16	69.7 ✓
		TN	418	212	49.2 ✓
		GP	3310	0	100 ✓

These results indicate conservative outcomes which enables the detailed design of the basins or stormwater drainage network (or earthworks updates) to divert flows to different parts of the catchment without adversely impacting overall treatment performance. It also provides flexibility in design for integration (and downsizing) of treatment systems in open space areas. This will be resolved in conjunction with civil and landscape design with verification MUSIC modelling provided with each basin.

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 (2014). *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 AND FLOODING

4.1 DESIGN OBJECTIVES

The stormwater quantity and flood management objectives that apply to the subject development as defined by the *Yarrabilba – Stormwater Infrastructure Master Plan* (DesignFlow, 2024) and summarised in the MIBA South CPAS are provided below.

- Preserve peak site discharges at the boundary of the (Yarrabilba) site at or below pre-development conditions for all events from 50% to 1% AEP
- No worsening of flooding to properties downstream of the site
- Maintain flood conveyance capacity through site
- Provide for 1% AEP flood immune development within the site with consideration of climate change

Key aspects of stormwater quantity management for Town Centre ROL1 relate to management of local site peak discharge increases as part of the site wide *Yarrabilba Flood Risk Management Strategy – Version 1.2* (DesignFlow, 2024) and ensuring the proposed development designs for flood immunity.

An updated version of the Quinzeh Creek portion of the hydrological and hydraulic models derived from the Yarrabilba Flood Risk Management Strategy described above has been used to define the Town Centre specific requirements for development including the inclusion of the preliminary earthworks design TIN for the subject site. A description of the key design areas and proposed design responses are provided below.

4.2 FLOOD DETENTION

As described in Section 5.1.1 of the *Yarrabilba Flood Risk Management Strategy – Version 1.2* (DesignFlow, 2024) (referred to herein as FRMS) the ultimate site flood mitigation strategy for the Quinzeh Creek catchment of Yarrabilba is reliant on a large regional scale flood detention basin (formerly Flood Basin 15, now referred to by Council as Expedition Road Detention Basin adjacent to Precinct 3). This major basin enables the flood hydrograph separation of the western and southern total site sub-catchments (under ultimate development conditions) within the broader Catchment QC-4 (refer to Figure 7 below), in order to avoid coincident flood peaks discharging from site to the north.

The western part of catchment QC-4 containing the northern portion of Town Centre ROL1 development zone included a preliminary detention basin upstream of Garragull Drive as part of a future road extension, which only required attenuation of frequent minor flooding (up to 50% AEP) rather than major flooding events which were offset by the Expedition Road Detention Basin. As noted in the Town Centre CPAS (RPS, 2023), an alternative approach utilising distributed local detention basins to achieve equivalent outcomes was also possible in the western catchment areas. Given the implications for fish passage on the conceptual Garragull Drive detention option, local offline detention approach has been pursued as part of this application. Local detention only applies to the catchments draining north from the Town Centre to Quinzeh Creek. South and east draining sub-catchments do not require flood detention as this is managed by the Expedition Road detention Basin to the north east of Town Centre.

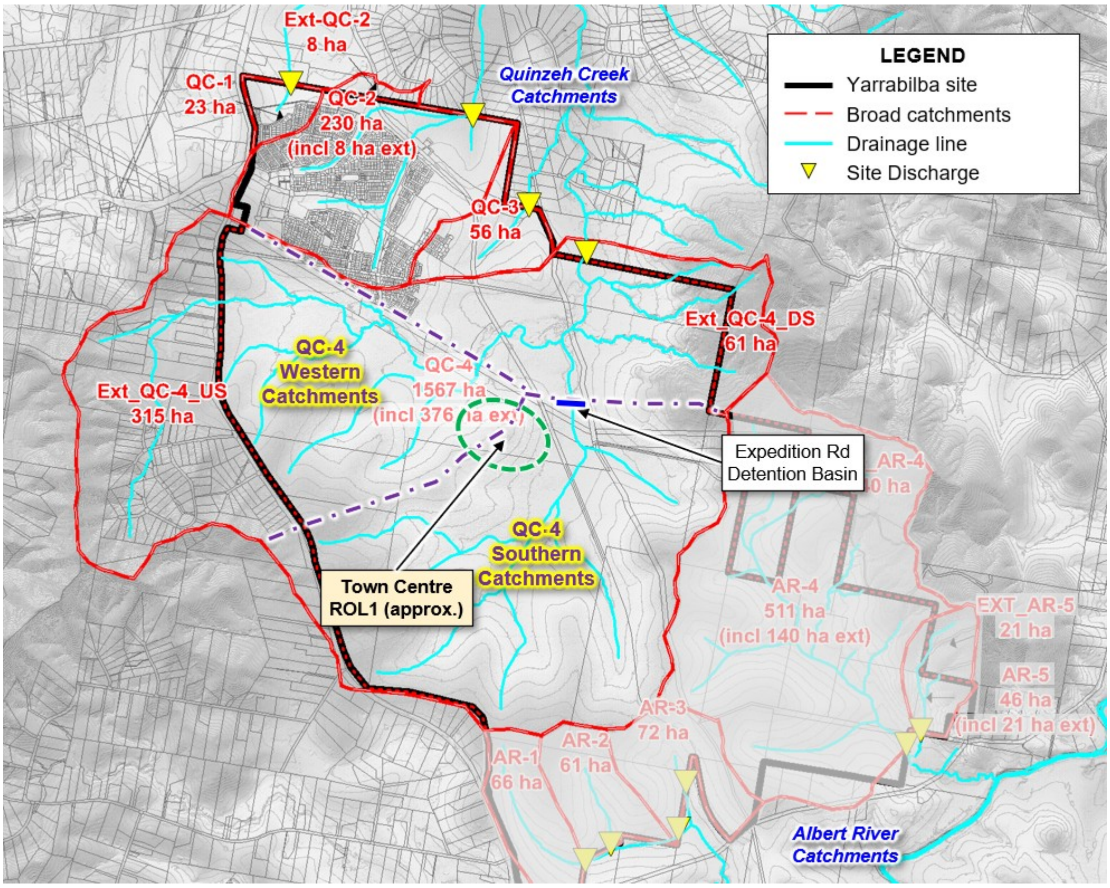


Figure 7: Broad catchment delineation (extract from Figure 2, Yarrabilba FRMS (Designflow, 2024)

Updated FRMS modelling review was undertaken to determine the equivalent sizing of offline detention required to achieve the same (or better) no worsening outcomes as the original FRMS concept (with online Garragull Drive future detention). This involved the following modifications to the FRMS model:

- Remove Garragull Drive detention function (refer Figure 11, FRMS, 2024) by enlarging culverts to minimise headwater/tailwater difference.
- Application of local detention on western QC-4 sub-catchments within hydrological model (applied as basin area and outlets scaled to catchment area).
- Iterative runs of detention area and outlets on local basins until no flood level impacts result downstream of Yarrabilba site in hydraulic model (full Quinzeh catchment).
- Derivation of a permissible unit discharge ($m^3/s/ha$) allowance from all conceptual offline detention basins (in western catchments) that can be applied progressively to local catchments in design (as they vary in size from masterplan assumptions).

The revised FRMS modelling of the MIBA South, Town centre core and frame areas (all characterised by high fraction impervious and yet to be developed) indicated attenuation of flows up to the 50% AEP is required to manage flood impacts downstream of the broader Yarrabilba site. Events larger than this can bypass detention without impacts external to the site. A permissible 50% AEP discharge from all new development within the western catchments of site was derived at 0.025-0.03 m^3/s per hectare of development (primarily commercial, industrial and high density residential) which was broadly applied to the respective catchments within the western Quinzeh Creek catchment zone of Yarrabilba.

Table 9: Permissible 50% AEP discharge

Catchment	Area (ha)	Permissible 50% AEP Discharge (m^3/s)
7A	*21.2*	*n/a*
7B	14.2	0.36 – 0.43
7C	16.0	0.40 – 0.48

Notes:

1. Catchment 7A discharges east to the existing regional flood detention basin upstream of Fauna Way (Expedition Road Detention Basin) and does not require local detention. Catchment data is included for completeness.

This contrasts with the majority of development in recent years (Precinct 4 and 6) which lie upstream of the Expedition Road Detention Basin constructed as part of Precinct 3 and therefore did not require local detention basins within those precincts.

A localised XPSWMM model was set up for the Town Centre ROL1 area (and immediate surrounds) in order to refine the local detention basin required and outlet structures associated with this development. This is discussed below.

4.2.1 Hydrological and Hydraulic Assessment

XPSWMM (1d) was used to assess post development catchment discharge and derive an appropriately sized storage (co-located with local stormwater treatment basin) to achieve the permissible 50% AEP discharge of 0.025-0.03 $m^3/s/ha$ for the northern drainage catchments. The ensemble storms approach was used in line with ARR2019 using the latest rainfall data from the Bureau of meteorology (BOM). Temporal patterns, losses and pre-burst data was sourced from the ARR Data Hub (Appendix B). Durations from 10 minutes to 6 hours were assessed with the critical duration for the basin storage and discharge being 1 hour duration for the minor 50% AEP event.

4.2.2 Catchments

Catchment data used in XPSWMM (Figure 8) is provided in Table 10 below which is derived from the current layout and grading. Preliminary allowances for catchment imperviousness have been broadly derived in line with the water quality modelling assumptions in Section 3.3 and are conservatively high at this stage of assessment to ensure basin sizing is sufficient for future detailed lot sub-division and land use. It should be noted that Catchment 7A (and basin 7A) does not require flood detention basin functionality but is included below for the purposes of preliminary hydraulic performance review.

Table 10: Catchment data

Catchment	Area	Slope %	Impervious %	Pervious Roughness	Impervious Roughness
7A	*21.2*	*2.1*	*85%*	*0.035*	*0.015*
7B	14.2	1.0	97%	0.035	0.015
7C	16.0	1.3	94%	0.035	0.015

Notes:

1. Broad impervious fractions are derived from MUSIC model split land uses are conservative for this ROL1 assessment to ensure basins are not undersized.
2. Catchment 7A includes 3.5ha major rec park with 30% impervious allowance. Basin 7A does not operate as a detention basin but is included for general hydraulic review.
3. Catchment 7C includes 0.5ha neighborhood rec park with 20% impervious allowance.

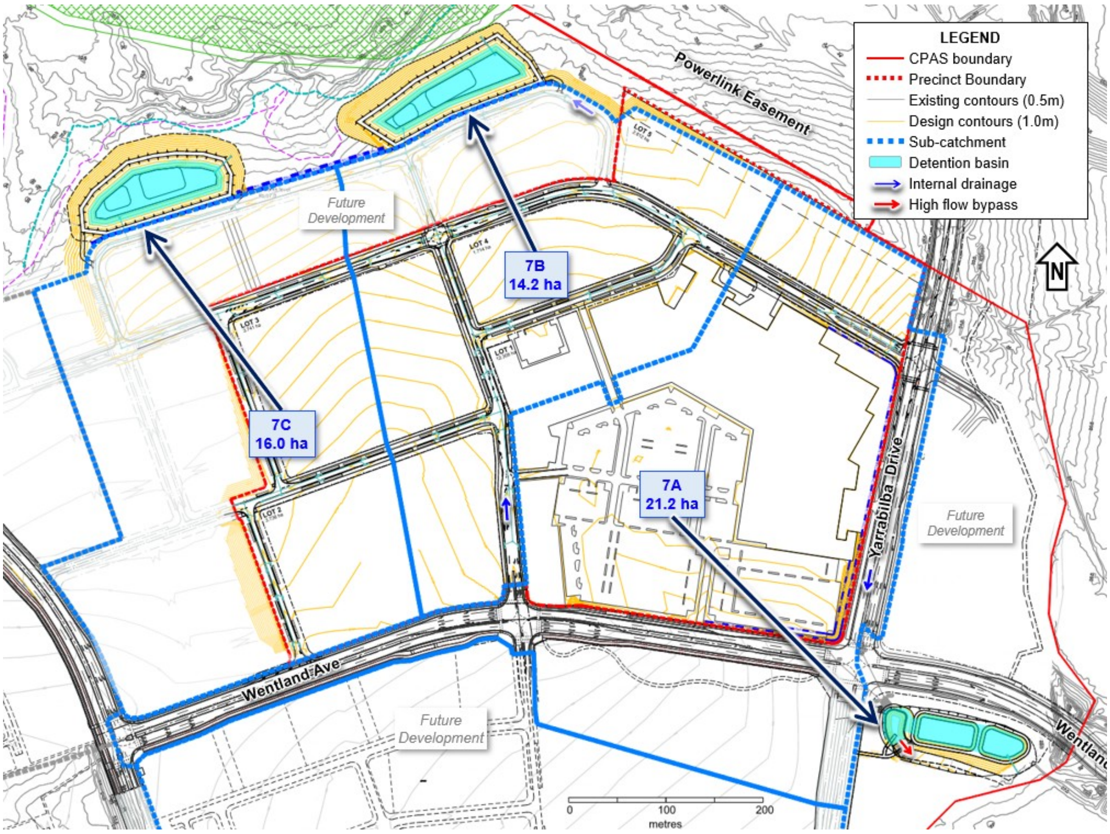


Figure 8: XPSWMM catchment layout

4.2.3 Rainfall and losses

Rainfall data has been obtained from the Bureau of Meteorology rainfall data system while losses (Table 11) and temporal patterns were extracted from the ARR Data Hub for the location co-ordinates below. Pre-burst rainfall has been included in the analysis to translate total storm loss (Table 11) into burst loss which varies with AEP and duration. The Data Hub extract is provided in Appendix B.

- Longitude 153.120°
- Latitude -27.819°
- ARR division: East Coast North

Table 11: Rainfall losses

	Pervious	Impervious
Initial Loss (mm)	26	1
Continuing Loss (mm/hr)	1.9	0

4.2.4 Minor and major drainage

Preliminary grading and drainage layout by MPN as been used to derive indicative minor and major flows into the three basin locations and potential bypass flows directly to waterway corridors (where road sag locations are not adjacent to basin). These bypass locations are shown in Figure 8 and are represented in XPSWMM as surcharge from drainage in events larger than the nominal pipe capacity (nominally 10% AEP).

4.2.5 Detention storage volumes

The preliminary assumptions for the stage-storage relationship for the minor detention basins are represented by the volume over the sediment pond, wetland and/or bioretention basins, with the depth above this being dedicated to minor flood storage. Refined modelling of the detailed earthworks will occur as part of design with hydraulic model verification. Note that Basin 7A is included in the data below but does not function as a detention basin. All flood detention for the east discharging basins is provided by the regional Expedition Road detention basin to the north east of the town centre. Basin 7A is retained here to provide preliminary design details consistent with Basins 7B and 7C.

An initial water level has been applied to each basin to represent the first 0.3m of depth being full (stormwater quality volume) prior to the storm burst.

Table 12: Preliminary stage storage data

Depth (m)	Elevation (mAHD)	Stage Area (m^2) [1,2]	Volume (m^3)
Basin 7A			
0	30.0	2697	0
1	31.0	4621	3523
Basin 7B			
0	34.9	1250	0
1	35.9	2763	1957
1.01	35.91	4160	1991
2.1	37.0	6512	7760
Basin 7B			
0	34.4	1300	0
1	35.4	2989	2086
1.01	35.41	4353	2123
2.1	36.5	6621	8047

Notes:

1. XPSWMM utilises stage-area relationship to calculate the incremental volume internal to the model.
2. Stage area tabulated above are combined for area over sediment pond and/or bio basins. Model has assigned sub areas to each of sediment pond and bio basin(s).
3. Step change in area at 1m to 1.01m is the top of internal bunds between water quality basins expanding out to detention area beyond.
4. A 0.3m initial depth has been applied to the basins for stormwater treatment volume being full prior to storm burst.

4.2.6 Basin concept design

Preliminary design details for each basin are provided in Table 13 to Table 15 with corresponding concept layouts shown in Figure 9 to Figure 11.

Table 13: Basin 7A preliminary design

Parameter	Basin 7A
Basin floor (bio filter surface)	RL30.0
Bund	RL31.0 (min. external bunds) RL30.5 (internal bunds)
Stormwater quality	450m² sediment pond, 1000m² wetland, 800m² bioretention basin (with culvert or weir connection between). Batters/storage areas typically 1:4 or flatter.
Basin Outlet Structures	
Low level outlet [1]	1/ 1.5m pit at RL30.3, 750mm dia pipe from pit at IL28.95, 1% grade.
High flow weir	20m at RL30.5

Notes:

1. Low level outlets set bioretention basin extended detention depth required for treatment.
2. High flow bypass weir conveys major 1% AEP flows around treatment basins from sediment pond.

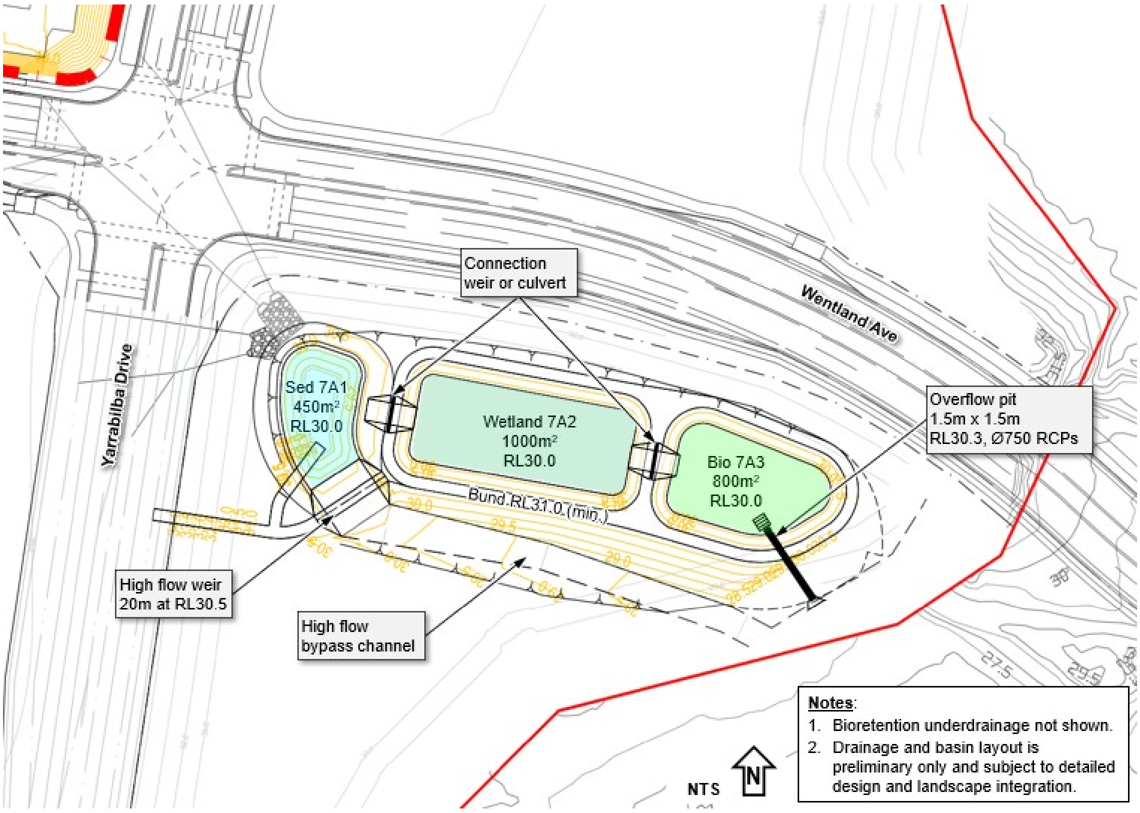


Figure 9: Basin 7A concept design

Table 14: Basin 7B preliminary design

Parameter	Basin 7B
Basin floor (bio filter surface)	RL34.9
Bund	RL37.0 (min. external bunds) RL35.9 (internal bunds)
Stormwater quality	350m² sediment pond, 900m² bioretention basin (with culvert or weir connection between). Batters/storage areas typically 1:6 or flatter.
Basin Outlet Structures *Low level outlet* [1]	 2/ 1.5m x 1.5m pits at RL35.2, 375mm dia pipe from pit at IL33.85, 1% grade (with orifice plate in pit to reduce outlet area to equiv. 250mm dia pipe).
High flow weir	10m at RL36.2

Notes:

1. Low level outlets set bioretention basin extended detention depth required for treatment

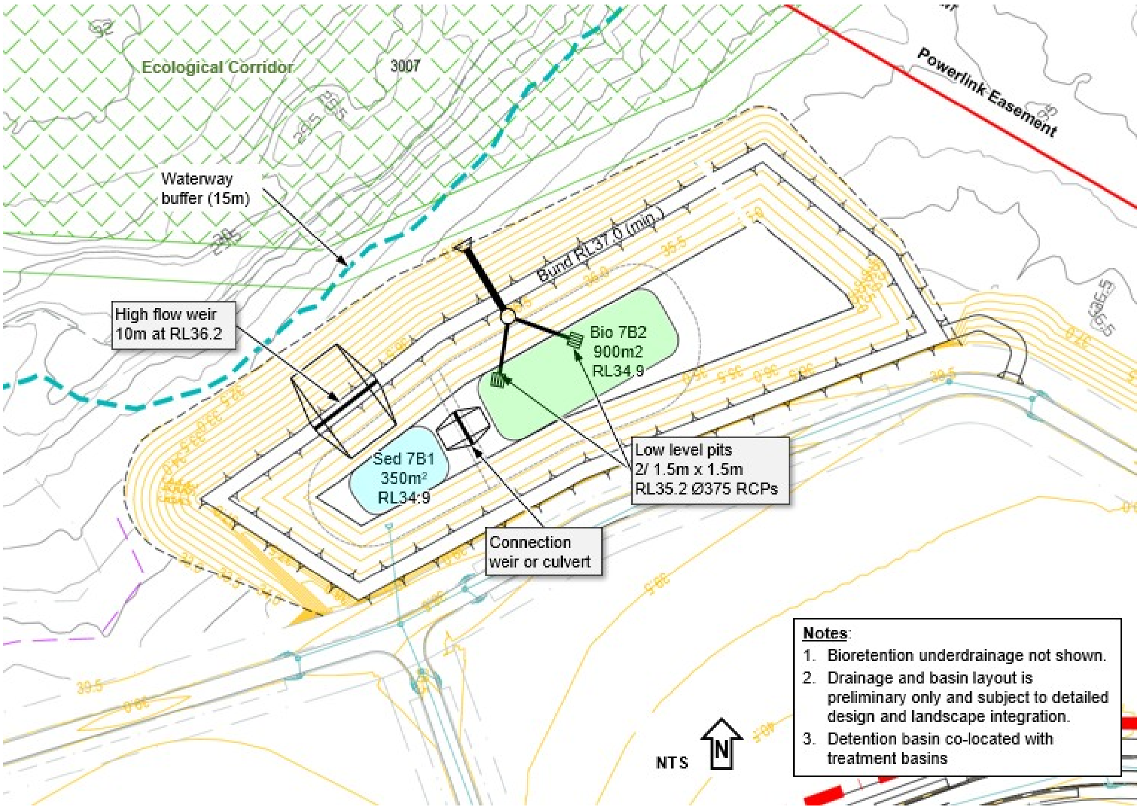


Figure 10: Basin 7B concept design

Table 15: Basin 7C preliminary design

Parameter	Basin 7C
Basin floor (bio filter surface)	RL34.4
Bund	RL36.5 (min. external bunds) RL35.4 (internal bunds)
Stormwater quality	400m² sediment pond, 900m² bioretention basin (with culvert or weir connection between). Batters/storage areas typically 1:6 or flatter.
Basin Outlet Structures *Low level outlet* [1]	2/ 1.5m x 1.5m pits at RL34.7, 375mm dia pipe from pit at IL33.35, 1% grade (with orifice plate in pit to reduce outlet area to equiv. 250mm dia pipe).
High flow weir	15m at RL35.7

Notes:

1. Low level outlets set bioretention basin extended detention depth required for treatment

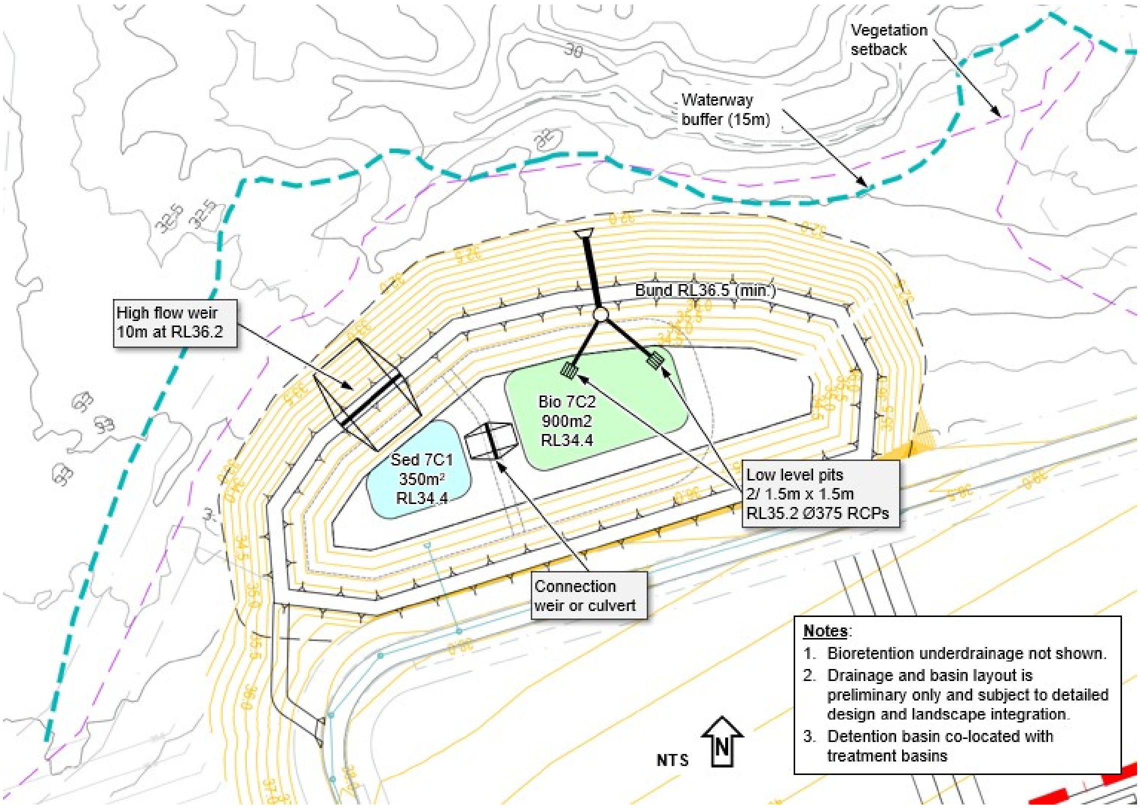


Figure 11: Basin 7C concept design

4.2.7 Results

Table 16 provides results for the minor detention basins 7B and 7C which provides adequate discharge control of the target 50% AEP event. Results are reported as the median peak results for the full range of ensemble storms and durations.

Table 16: Detention basin median peak discharge (50% AEP)

Catchment	Area (ha)	50% AEP Permissible Discharge (m^3/s)	50% AEP Discharge (m^3/s)
7A	21.2	n/a	n/a
7B	14.2	0.36 – 0.43	0.39 ✓
7C	16.0	0.40 – 0.48	0.43 ✓

Notes:

2. Catchment 7A discharges east to the regional flood detention basin upstream of Fauna Way (expedition Road Detention Basin) and does not require local detention.

Additional hydraulic results for each basin are provided in Table 17. Results are provided up to 1% AEP for inflows from the pipe drainage network and overland flow to ensure adequate freeboard and bypass flow management occurs within the basin.

Table 17: Basin hydraulic results (median) with zero outlet blockage

AEP	Peak Discharge (m^3/s)	Water Level (mAHD)	Depth (m)	Volume (m^3)
Basin 7A				
63.2%	3.29	30.69	0.73	n/a
50%	3.77	30.72	0.76	n/a
10%	6.98	30.84	0.9	n/a
1%	10.85	30.95	1.03	n/a
Basin 7B				
63.2%	0.38	36.02	1.12	2451
50%	0.39	36.12	1.22	2912
10%	2.19	36.42	1.52	4385
1%	4.55	36.59	1.69	5283
Basin 7C				
63.2%	0.42	35.55	1.05	2766
50%	0.43	35.67	1.17	3284
10%	2.61	35.95	1.45	4691
1%	5.34	36.14	1.64	5651

Table 17 Notes:

1. Discharge results based on zero blockage to outlets structures (i.e. no reliance of blockage to achieve discharge control for permissible targets).
2. Detention depth includes 0.3m initial water level in water quality basins.

Table 18 provides a check of flood levels and freeboard in the basin under blocked outlet conditions (100% pit blockage). Outflows occur via the bypass weir only. Basin 7A is not affected by pit blockage as the culvert connection to the wetland (and subsequently into bio basin) restricts flow transfer in this system to protect the wetland macrophyte zone.

Table 18: Basin flood levels with blockage (100% pit blocked, weir flow only)

AEP	Water Level (mAHD)	Increase (from zero blockage) (m)	Freeboard (m)
Basin 7A			
63.2%	30.70	+0.01	0.30
50%	30.72	0	0.28
10%	30.84	0	0.16
1%	30.95	0	0.05
Basin 7B			
63.2%	36.35	+0.33	0.65
50%	36.38	+0.26	0.62
10%	36.51	+0.09	0.49
1%	36.65	+0.06	0.35
Basin 7C			
63.2%	35.87	+0.32	0.63
50%	35.89	+0.22	0.61
10%	36.04	+0.09	0.46
1%	36.20	+0.06	0.30

4.2.8 Discussion

The preliminary design of the minor flood detention basins provides adequate attenuation of local development runoff to mitigate flows up to the 50% AEP down to the required target of 0.025-0.03 $m^3/s/ha$ of development. This contributes to the broader flood strategy for the western development zones within the Quinzeh Creek catchment of Yarrabilba site.

Analysis of adverse blockage conditions within the basin (all pits 100% blocked) indicates that all events up to the 1% AEP remain below the top of bund with controlled discharge to adjacent open space via the high flow bypass weirs. With all basin pits designed with raised dome grates, this level of blockage is considered conservative and unlikely to occur in practice.

Detailed design of the basins will involve further review of the water quality basin design within the floor of the system, outlet structures and considerations of the ultimate pipe drainage network design (and catchment) to this location. This current assessment provides adequate support for the current functional design of this basin area for both water quality management and minor flow attenuation.

4.3 FLOOD LEVELS AND IMMUNITY

A review of the preliminary earthworks design of the proposed development area in relation to local flood levels is provided in Figure 12. This indicates that Town Centre ROL1 area is above the 1% AEP climate change flood level (year 2090 RCP4.5 in line with Logan City Council) being conveyed within both Quinzeh Creek to the north west and upstream of the Expedition Road detention Basin to the east under ultimate development conditions. This is based on the latest available flood model data assuming ultimate upstream development conditions.

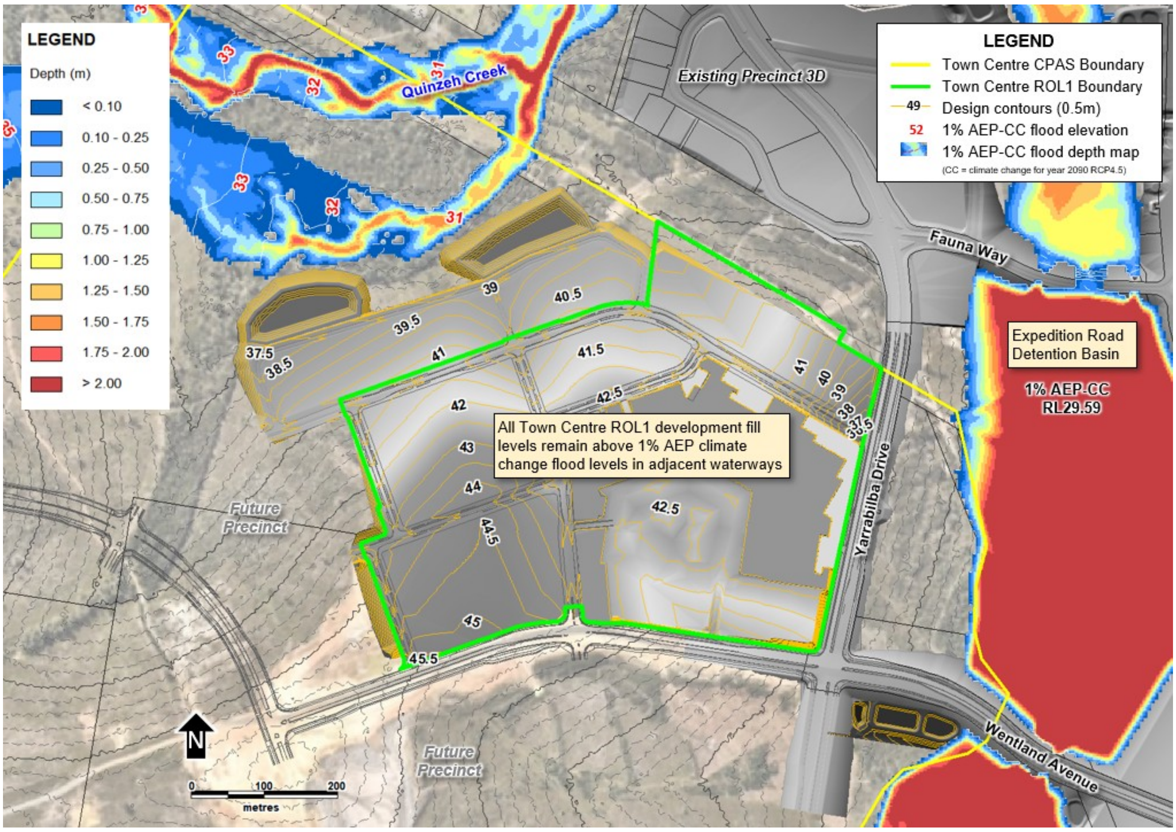


Figure 12: 1% AEP climate change flood levels and preliminary earthworks

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 Town Centre ROL1 are provided in Table 19 which are generally in accordance with the *Yarrabilba – Stormwater Infrastructure Master Plan* (DesignFlow, 2024) and the State Planning Policy (DSDIP, 2017).

Table 19: 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 bulk earthworks and 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 Town Centre ROL1, 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 19.

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 Town Centre ROL1. 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

6 CONCLUSION

A stormwater management strategy for Yarrabilba Town Centre ROL1 development has been prepared to meet the requirements of the *Yarrabilba Stormwater Infrastructure Master Plan* (DesignFlow, 2024) and Context Plan Area Strategy.

The strategy adopts stormwater quality treatment measures including sediment ponds, wetland and bioretention basins that manage the stormwater runoff pollutant generation from Town Centre ROL1 development area (Basins 7A to 7C). These treatment systems integrate with the local urban and natural environment to ensure the stormwater quality objectives are achieved for the 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 layout plans. Individual lot owners within the catchment will be required to install gross pollutant trap(s) (GPT) upstream of their connection to the drainage network as part of development of lots. These GPTs are only required to serve as littler and coarse sediment pre-treatment to the end of line basins (ultimate Council stormwater asset)

Site design has also ensured all development lots are above the local 1% AEP flood level and provided with adequate flow conveyance for external catchment discharge. Local flood detention Basins 7B and 7C (co-located with stormwater quality basins) provide attenuation of developed catchment flows up to the required 50% AEP as part of the broader western catchment flood management strategy within Quinzeh Creek portions of Yarrabilba.

Future management or rehabilitation of waterways adjoining the subject site will occur as part of future development expansion of the broader Town Centre zone.

Construction phase stormwater management objectives have been established for the site, in accordance with State Planning Policy (DSDIP, 2017). Preparation of detailed erosion and sediment control plan(s) are required prior to works commencing plus ongoing staging and updates to these plans to ensure the ESC strategy responds to the changing site conditions. Audits will be completed during construction to ensure compliance with State Planning Policy and Environment Protection Act.

7 REFERENCES

DesignFlow (2024) *Yarrabilba Stormwater Infrastructure Master Plan*

DesignFlow (2023) *Yarrabilba Waterway Condition Assessment*

DesignFlow (2024) *Yarrabilba Masterplan Flood Risk Management Strategy*

DSDIP (2017) *State Planning Policy*

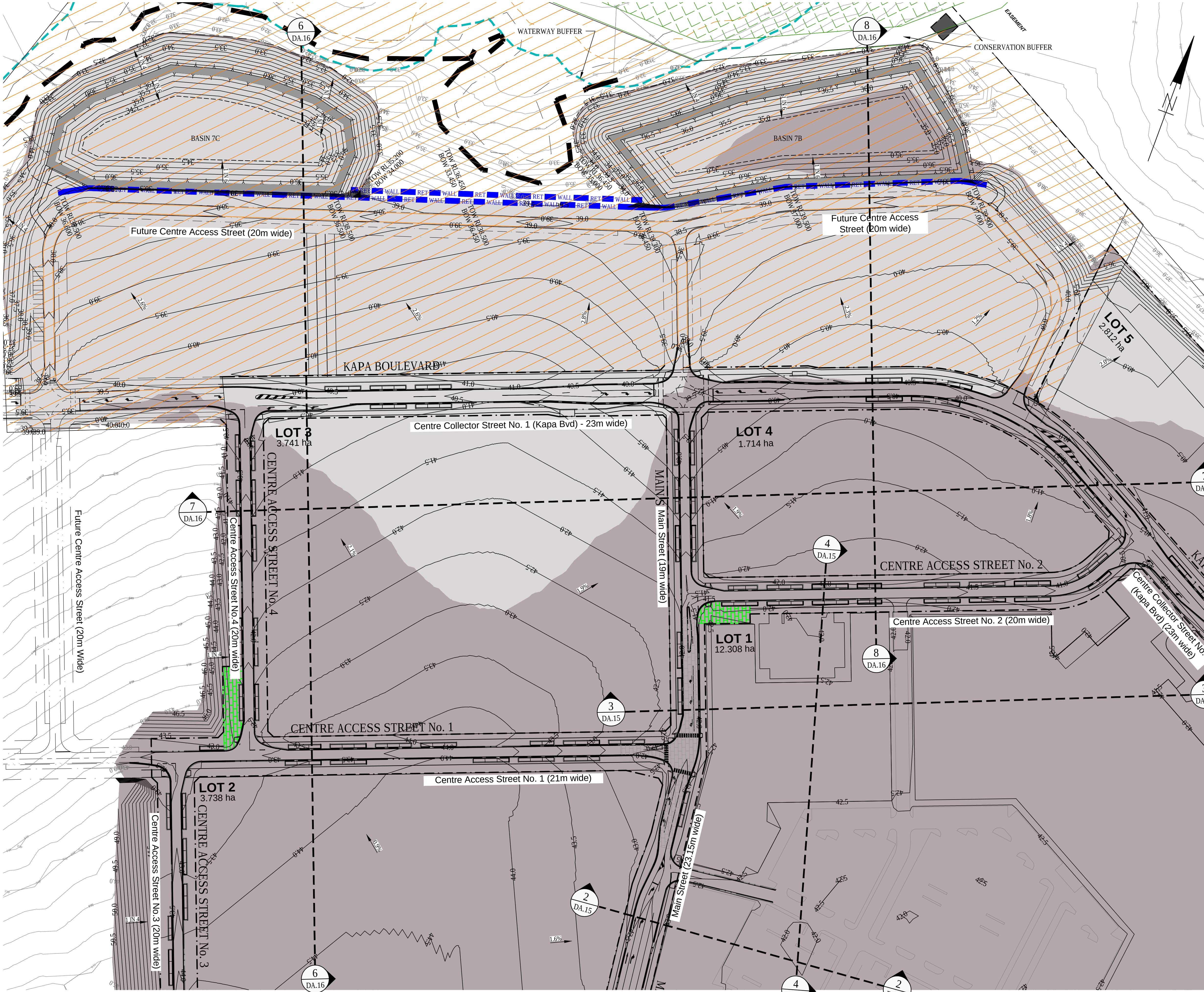
IECA (2008) *Best Practice Erosion and Sediment Control*

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

Water by Design (2018) *MUSIC Modelling Guidelines.* Water by Design, Healthy Land and Water Limited, Brisbane, Queensland. (https://waterbydesign.com.au/download/music-guideline-2018)

IPWEAQ (2016) *Queensland Urban Drainage Manual*

APPENDIX A FUNCTIONAL DESIGN PLANS



FOR CONTINUATION REFER DWG No. DA.02

FOR CONTINUATION REFER DWG No. DA.03

LEGEND

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	STAGE BOUNDARY	
5.00	CONTOUR	5.00
	BUILDING	
	CONCRETE	
	EDGE OF BITUMEN	
	KERB	
	KERB AND CHANNEL	
SW	STORM WATER MAIN	
W	WATER MAIN	
S	SEWER MAIN	
T	TELECOMMUNICATIONS	
	O/H ELECTRICITY	
	FENCE	
RET WALL	BOULDER WALL	RET WALL
RET WALL	RETAINING WALL	RET WALL
	TOP OF BATTER	
	TOE OF BATTER	
	SWALE DRAIN	
	KOALA HABITAT 10m BUFFER	
	15m WATERWAY BUFFER	
	CONSERVATION BUFFER	
	EDGE KOALA HABITAT	
	BOREHOLE	BH1
	CUT AREA	
	FILL AREA	

NOTE: CONTOURS ARE 0.5m INTERVALS

CONCEPT ASSESSMENT ONLY FOR LAYOUT REVIEW. TO BE COMPLETED UNDER FUTURE APPLICATION

0 10 20 30 40 50

SCALE 1:1000 (A1) 1:2000 (A3)

ISSUE	DATE	AMENDMENT	BY	APP
B	26.11.25	FOR APPROVAL	DG	LS
A	14.11.25	PRELIMINARY	DG	LS

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CLIENT: Stockland

YARRABILBA TOWN CENTRE
MAJOR CENTRE CORE
STAGE 1 RAL PLAN
YARRABILBA DRIVE

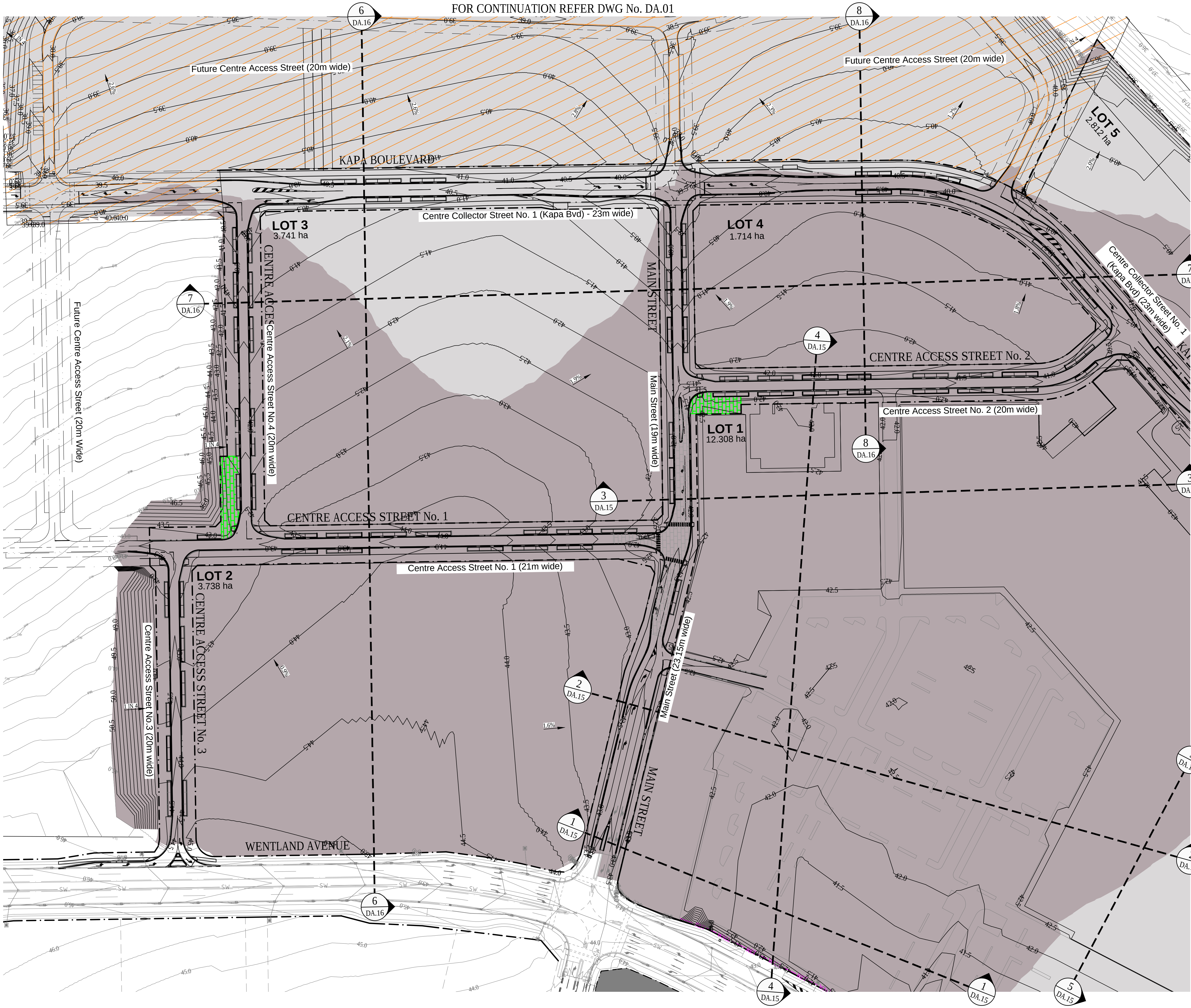
BULK EARTHWORKS PLAN
SHEET 1

DESIGN: DG	DRAWN: DG	SCALES: AS SHOWN
CHKD:	APPRD:	DATE:

mpn JOB	DRAWING No.	REV
10467	DA.01	B

NOT FOR CONSTRUCTION

FOR APPROVAL



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EXISTING		PROPOSED
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	STAGE BOUNDARY	
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	BUILDING	
	CONCRETE	
	EDGE OF BITUMEN	
	KERB	
	KERB AND CHANNEL	
SW	STORM WATER MAIN	
W	WATER MAIN	
S	SEWER MAIN	
T	TELECOMMUNICATIONS	
	O/H ELECTRICITY	
	FENCE	
RET WALL	BOULDER WALL	RET WALL
RET WALL	RETAINING WALL	RET WALL
	TOP OF BATTER	
	TOE OF BATTER	
	SWALE DRAIN	
	KOALA HABITAT 10m BUFFER	
	15m WATERWAY BUFFER	
	CONSERVATION BUFFER	
	EDGE KOALA HABITAT	
	BOREHOLE	BH1
	CUT AREA	
	FILL AREA	

FOR CONTINUATION REFER DWG No. DA.03

NOTE: CONTOURS ARE 0.5m INTERVALS

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YARRABILBA TOWN CENTRE
MAJOR CENTRE CORE
STAGE 1 RAL PLAN
YARRABILBA DRIVE

BULK EARTHWORKS PLAN SHEET 2

DESIGN: DG	DRAWN: DG	SCALES: AS SHOWN
CHKD:	APPRD:	DATE:

mpn JOB	DRAWING No.	REV
10467	DA.02	B

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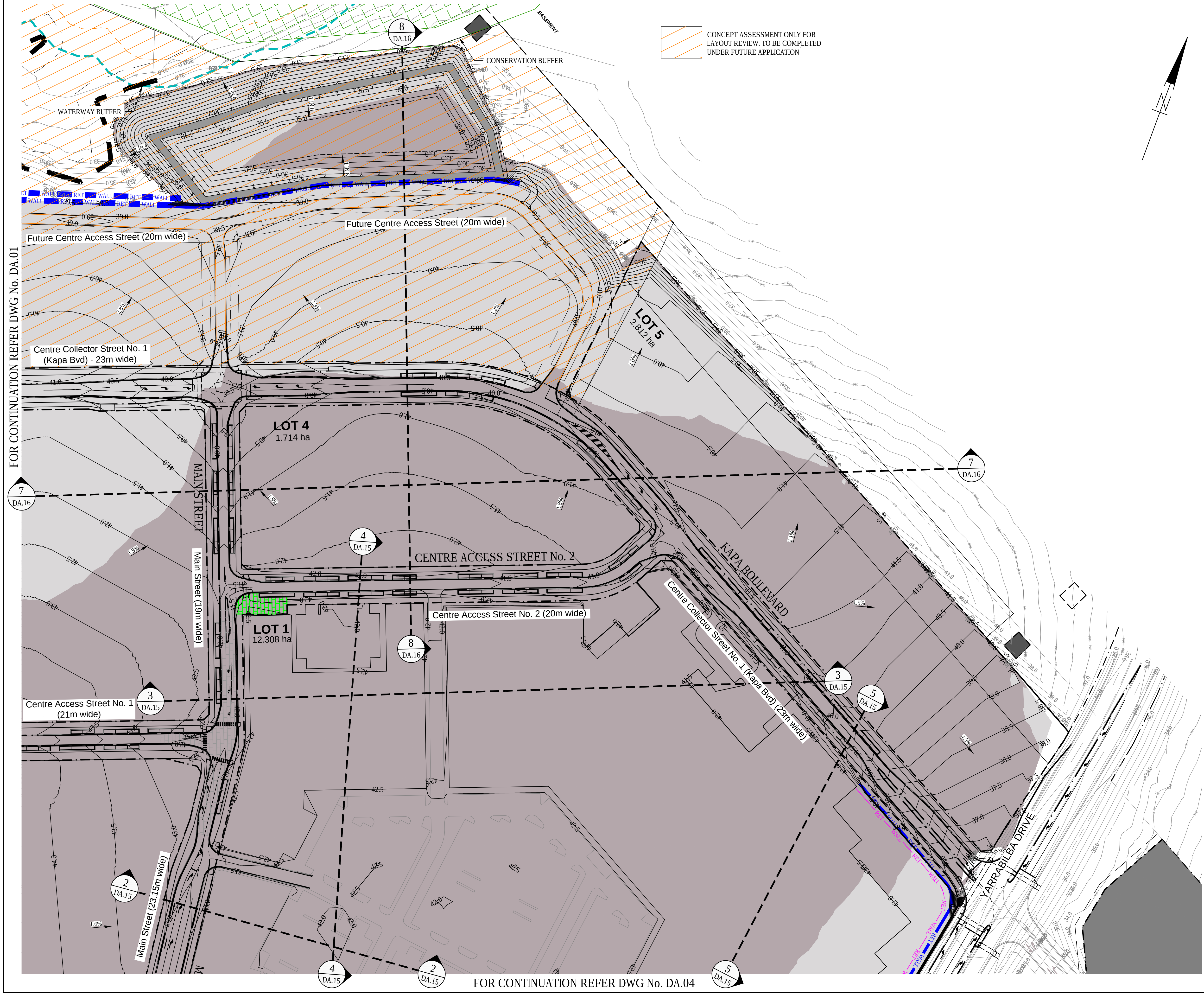

LEGEND

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	STAGE BOUNDARY	
5.00	CONTOUR	5.00
	BUILDING	
	CONCRETE	
	EDGE OF BITUMEN	
	KERB	
	KERB AND CHANNEL	
SW	STORM WATER MAIN	
W	WATER MAIN	
S	SEWER MAIN	
T	TELECOMMUNICATIONS	
	O/H ELECTRICITY	
	FENCE	
RET WALL	BOULDER WALL	RET WALL
RET WALL	RETAINING WALL	RET WALL
	TOP OF BATTER	
	TOE OF BATTER	
	SWALE DRAIN	
	KOALA HABITAT 10m BUFFER	
	15m WATERWAY BUFFER	
	CONSERVATION BUFFER	
	EDGE KOALA HABITAT	
	BOREHOLE	BH1
	CUT AREA	
	FILL AREA	

NOTE: CONTOURS ARE 0.5m INTERVALS

0 10 20 30 40 50

SCALE 1:1000 (A1) 1:2000 (A3)

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A	14.11.25	PRELIMINARY	DG	LS

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YARRABILBA TOWN CENTRE
MAJOR CENTRE CORE
STAGE 1 RAL PLAN
YARRABILBA DRIVE

BULK EARTHWORKS PLAN
SHEET3

DESIGN: DG	DRAWN: DG	SCALES: AS SHOWN
CHKD:	APPRD:	DATE:

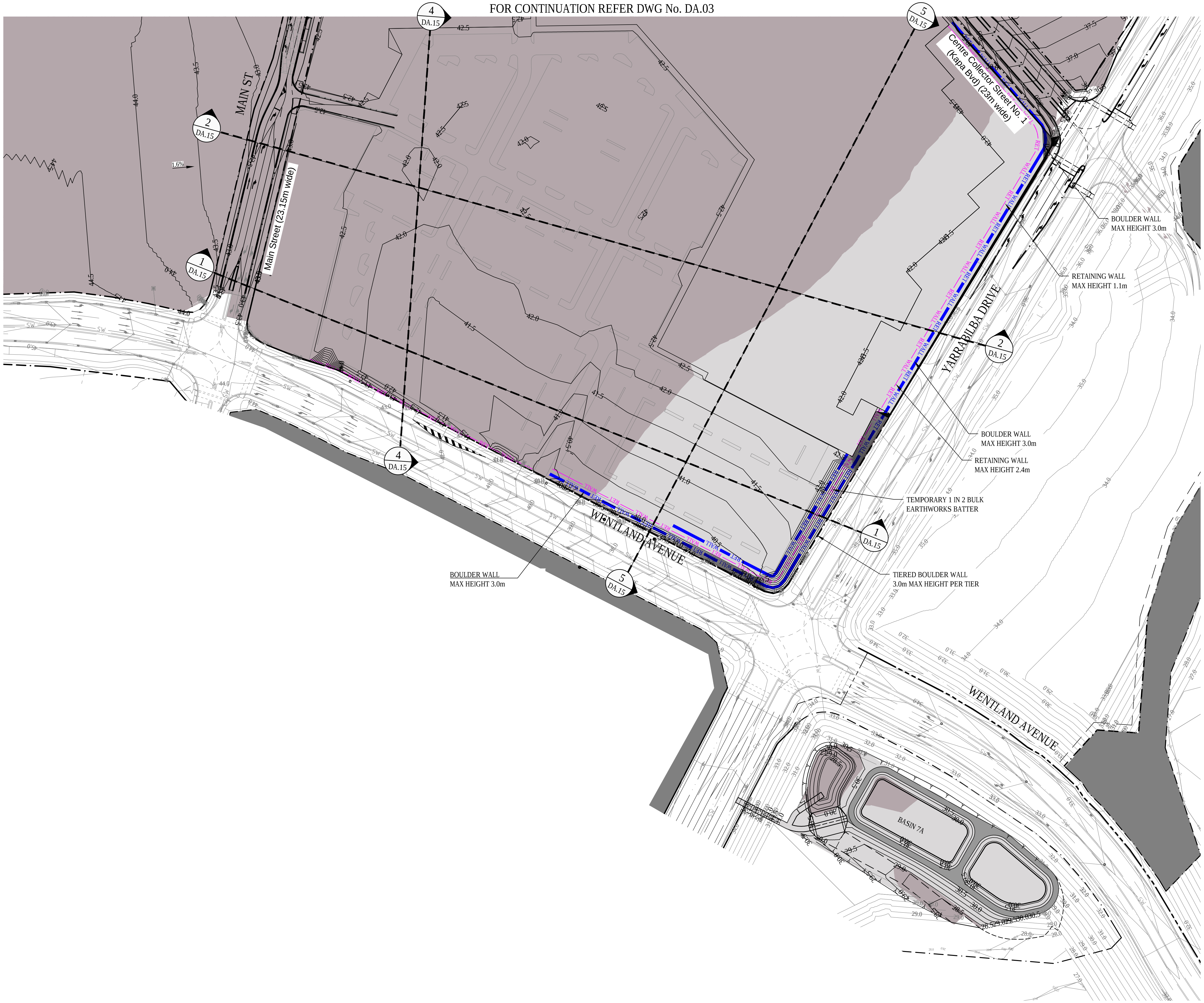
mpn JOB	DRAWING No.	REV
10467	DA.03	B

NOT FOR CONSTRUCTION

FOR APPROVAL

FOR CONTINUATION REFER DWG No. DA.03

FOR CONTINUATION REFER DWG No. DA.02



LEGEND

EXISTING		PROPOSED
	PROPERTY BOUNDARY	
	STAGE BOUNDARY	
5.00	CONTOUR	5.00
	BUILDING	
	CONCRETE	
	EDGE OF BITUMEN	
	KERB	
	KERB AND CHANNEL	
SW	STORM WATER MAIN	
W	WATER MAIN	
S	SEWER MAIN	
T	TELECOMMUNICATIONS	
	O/H ELECTRICITY	
	FENCE	
RET WALL	BOULDER WALL	RET WALL
RET WALL	RETAINING WALL	RET WALL
	TOP OF BATTER	
	TOE OF BATTER	
	SWALE DRAIN	
	KOALA HABITAT 10m BUFFER	
	15m WATERWAY BUFFER	
	CONSERVATION BUFFER	
	EDGE KOALA HABITAT	
	BOREHOLE	BH1
	CUT AREA	
	FILL AREA	

NOTE: CONTOURS ARE 0.5m INTERVALS

0 10 20 30 40 50

SCALE 1:1000 (A1) 1:2000 (A3)

ISSUE	DATE	AMENDMENT	BY	APP
B	26.11.25	FOR APPROVAL	DG	LS
A	14.11.25	PRELIMINARY	DG	LS

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CLIENT: Stockland

YARRABILBA TOWN CENTRE
MAJOR CENTRE CORE

STAGE 1 RAL PLAN
YARRABILBA DRIVE

BULK EARTHWORKS PLAN
SHEET4

DESIGN: DG	DRAWN: DG	SCALES: AS SHOWN
CHKD:	APPRD:	DATE:

mpn JOB	DRAWING No.	REV
10467	DA.04	B

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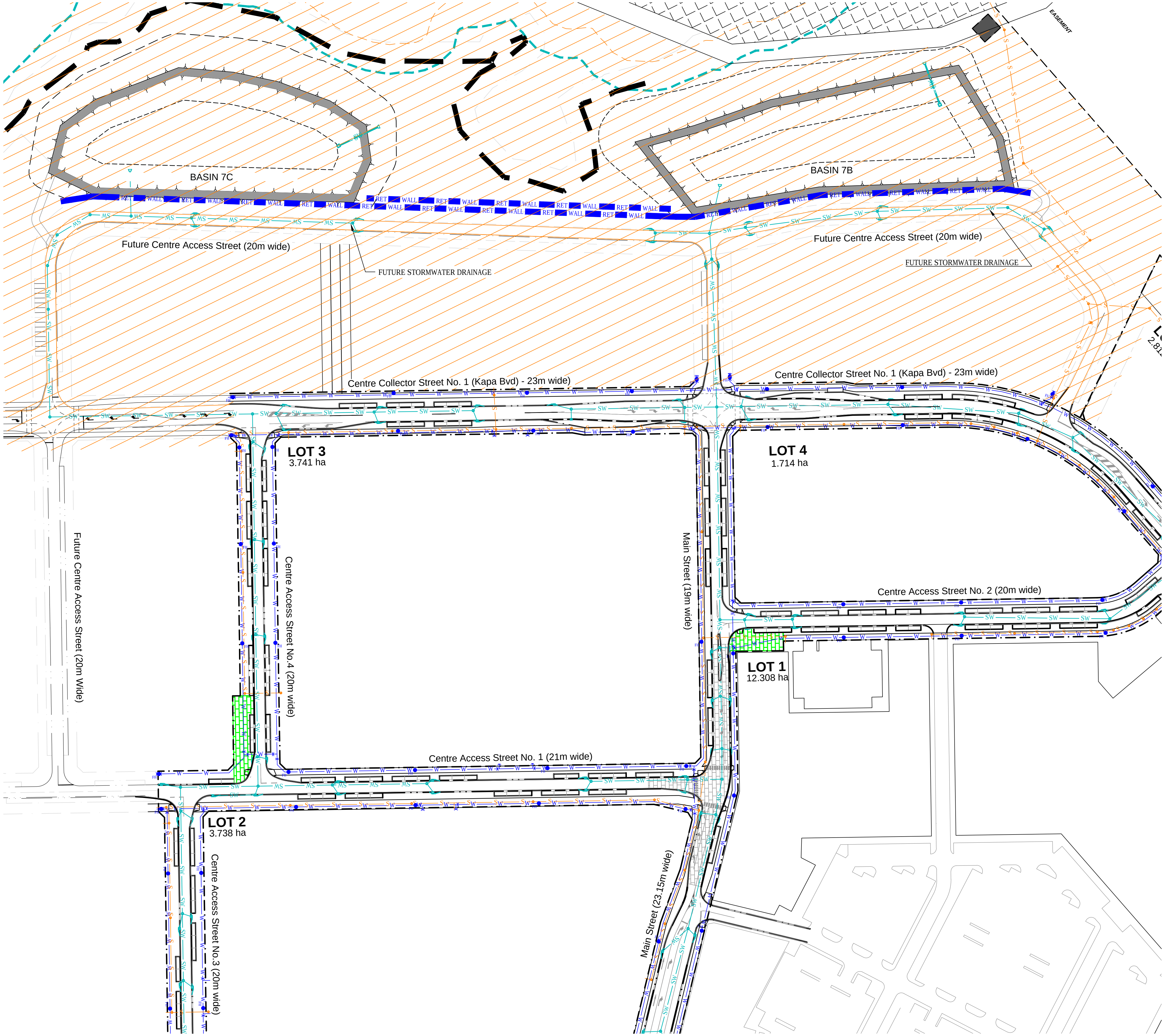

FOR CONTINUATION REFER DWG No. DA.12

FOR CONTINUATION REFER DWG No. DA.13

LEGEND

EXISTING		PROPOSED
	PROPERTY BOUNDARY	
	EASEMENT BOUNDARY	
	CONTOUR	
	BUILDING	
	CONCRETE	
	EDGE OF BITUMEN	
	KERB	
	KERB AND CHANNEL	
	FLUSH KERB	
	KERB RAMP	
	BOLLARD	
SW	STORM WATER MAIN	SW
W W	WATER MAIN	W W
S S	SEWER MAIN	S S
RM	RISING MAIN	
G G	GAS MAIN	
T T	TELECOMMUNICATIONS	
	TOP OF BATTER	
	FACE OF BATTER	
	TOE OF BATTER	
	BOULDER WALL	RET WALL
	RETAINING WALL	RET WALL
	KOALA HABITAT 10m OFFSET	
	15m WATERWAY BUFFER	
	CONSERVATION BUFFER	
	EDGE KOALA HABITAT	

CONCEPT ASSESSMENT ONLY FOR LAYOUT REVIEW. TO BE COMPLETED UNDER FUTURE APPLICATION

ISSUE	DATE	AMENDMENT	BY	APP
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YARRABILBA TOWN CENTRE
MAJOR CENTRE CORE
STAGE 1 RAL PLAN
YARRABILBA DRIVE

SERVICES LAYOUT
SHEET 1

DESIGN: DG | DRAWN: DG | SCALES: AS SHOWN
CHKD: | APPRD: | DATE:

mpn JOB: 10467 | DRAWING No.: DA.11 | REV: B

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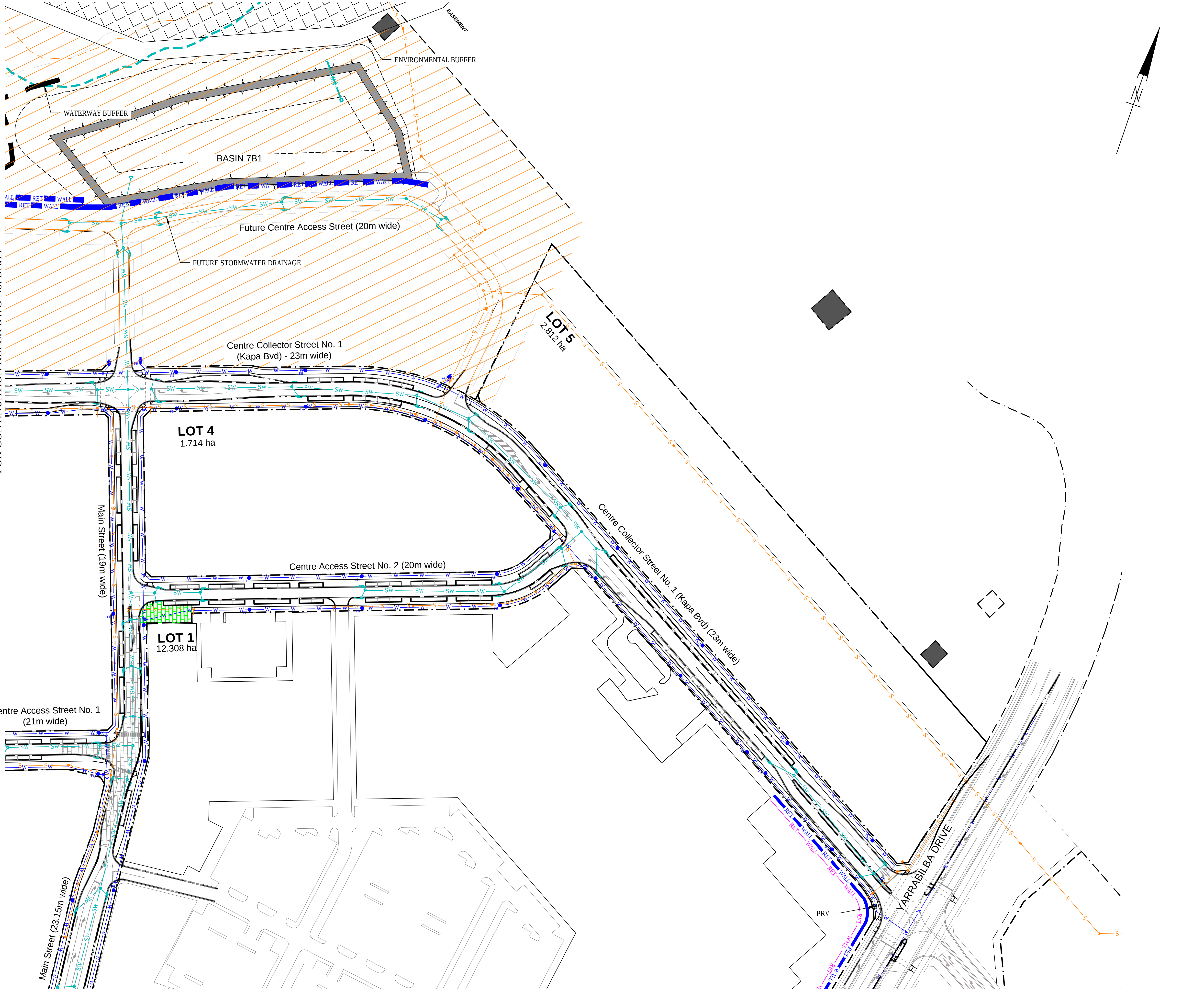

FOR CONTINUATION REFER DWG No. DA.11

FOR CONTINUATION REFER DWG No. DA.13

LEGEND

EXISTING		PROPOSED
	PROPERTY BOUNDARY	
	EASEMENT BOUNDARY	
	CONTOUR	
	BUILDING	
	CONCRETE	
	EDGE OF BITUMEN	
	KERB	
	KERB AND CHANNEL	
	FLUSH KERB	
	KERB RAMP	
	BOLLARD	
SW	STORM WATER MAIN	SW
W W	WATER MAIN	W W
S S	SEWER MAIN	S S
RM	RISING MAIN	
G G	GAS MAIN	
T T	TELECOMMUNICATIONS	
	TOP OF BATTER	
	FACE OF BATTER	
	TOE OF BATTER	
	BOULDER WALL	RET WALL
	RETAINING WALL	RET WALL
	KOALA HABITAT 10m OFFSET	
	15m WATERWAY BUFFER	
	CONSERVATION BUFFER	
	EDGE KOALA HABITAT	

CONCEPT ASSESSMENT ONLY FOR LAYOUT REVIEW. TO BE COMPLETED UNDER FUTURE APPLICATION

ISSUE	DATE	AMENDMENT	BY	APP
B	26.11.25	FOR APPROVAL	DG	LS
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CLIENT: Stockland

YARRABILBA TOWN CENTRE
MAJOR CENTRE CORE

STAGE 1 RAL PLAN
YARRABILBA DRIVE

SERVICES LAYOUT
SHEET 2

DESIGN: DG | DRAWN: DG | SCALES: AS SHOWN
CHKD: | APPRD: | DATE:

mpn JOB: 10467 | DRAWING No.: DA.12 | REV: B

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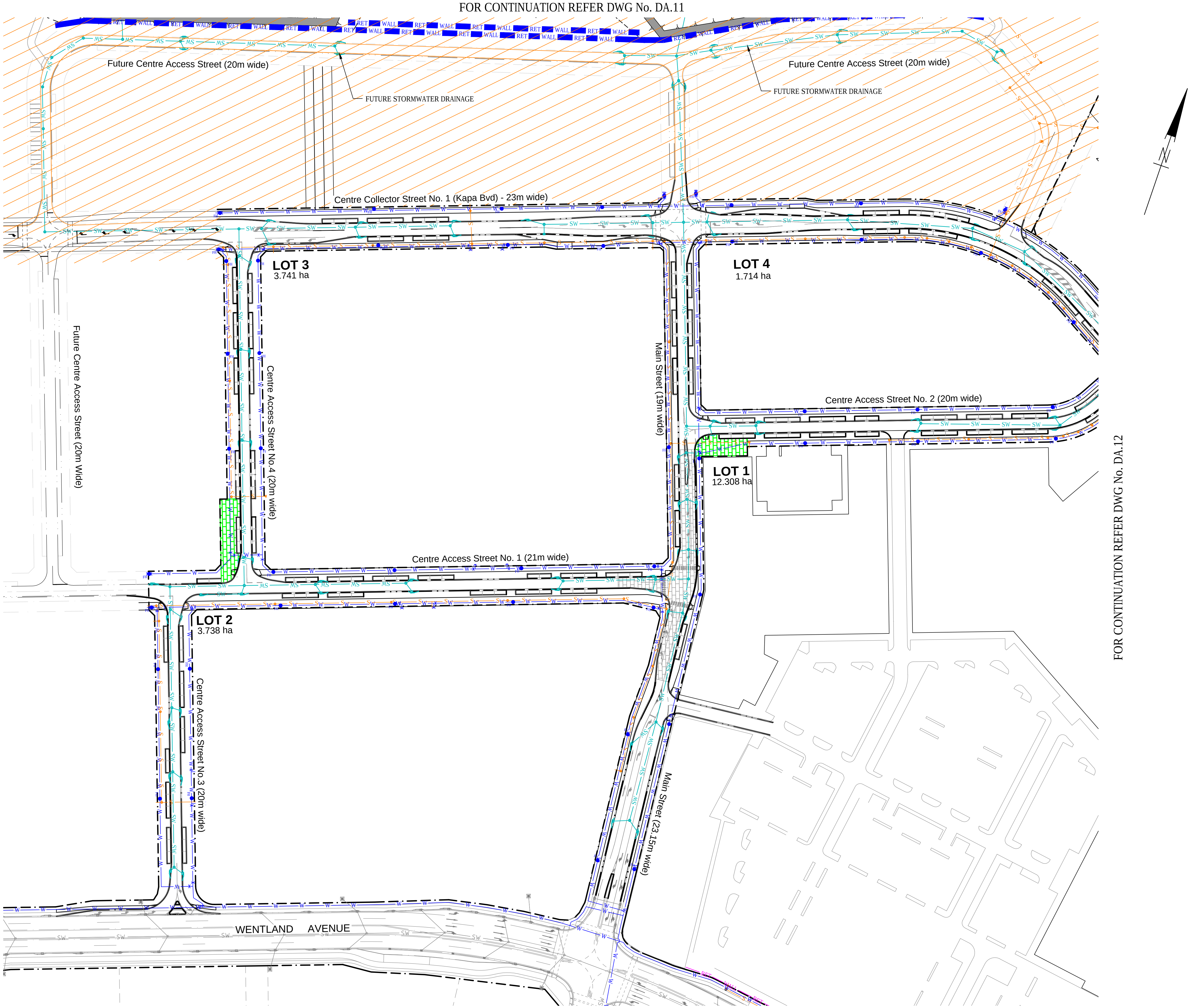

LEGEND

EXISTING		PROPOSED
	PROPERTY BOUNDARY	
	EASEMENT BOUNDARY	
	CONTOUR	
	BUILDING	
	CONCRETE	
	EDGE OF BITUMEN	
	KERB	
	KERB AND CHANNEL	
	FLUSH KERB	
	KERB RAMP	
	BOLLARD	
SW	STORM WATER MAIN	SW
W W	WATER MAIN	W W
S S	SEWER MAIN	S S
RM	RISING MAIN	
G G	GAS MAIN	
T T	TELECOMMUNICATIONS	
	TOP OF BATTER	
	FACE OF BATTER	
	TOE OF BATTER	
	BOULDER WALL	RET WALL
	RETAINING WALL	RET WALL

KOALA HABITAT 10m OFFSET

15m WATERWAY BUFFER

CONSERVATION BUFFER

EDGE KOALA HABITAT

CONCEPT ASSESSMENT ONLY FOR LAYOUT REVIEW. TO BE COMPLETED UNDER FUTURE APPLICATION

ISSUE	DATE	AMENDMENT	BY	APP
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CLIENT: Stockland

YARRABILBA TOWN CENTRE
MAJOR CENTRE CORE

STAGE 1 RAL PLAN
YARRABILBA DRIVE

SERVICES LAYOUT
SHEET 3

DESIGN: DG	DRAWN: DG	SCALES: AS SHOWN
CHKD:	APPRD:	DATE:

mpn JOB	DRAWING No.	REV
10467	DA.13	B

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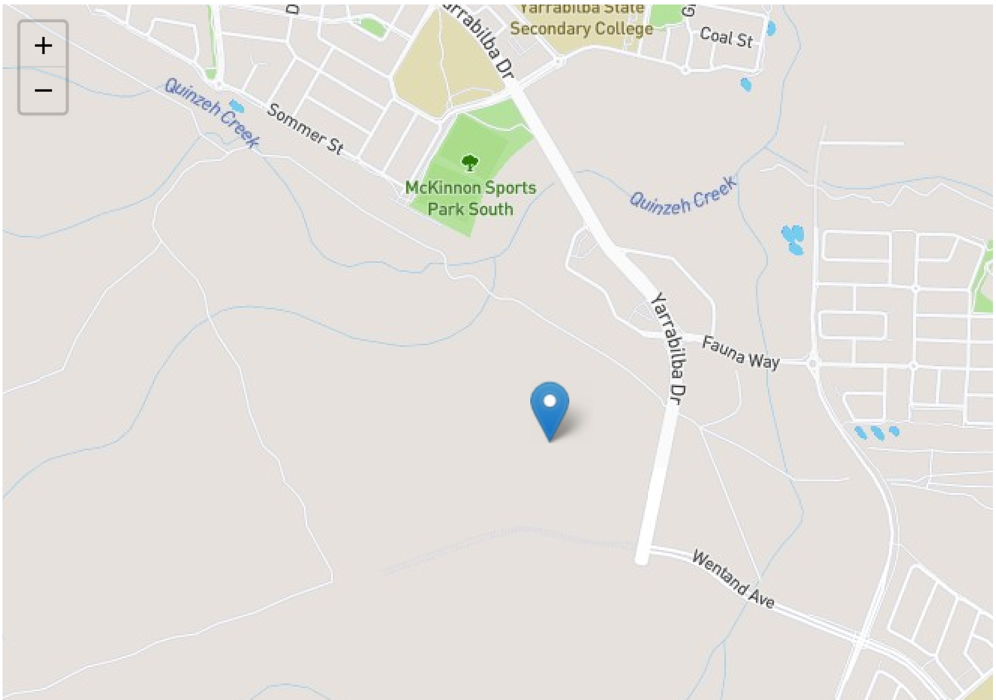
FOR APPROVAL

APPENDIX B ARR DATA HUB

Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	153.12
Latitude	-27.819
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Climate Change Factors	show



Leaflet (http://leafletjs.com) | Map data © OpenStreetMap (https://www.openstreetmap.org/) contributors, CC-BY-SA (https://creativecommons.org/licenses/by-sa/2.0/), Imagery © Mapbox (https://www.mapbox.com/)

Data

River Region

Division	North East Coast
River Number	45
River Name	Logan-Albert Rivers

Layer Info

Time Accessed	21 November 2025 04:50PM
Version	2016_v1

ARF Parameters

$$ARF = Min\left\{1, \left[1 - a\left(Area^b - c\log_{10}Duration\right)Duration^{-d} + eArea^f Duration^g\left(0.3 + \log_{10}AEP\right) + h10^{iArea\frac{Duration}{1440}}\left(0.3 + \log_{10}AEP\right)\right]\right\}$$

Zone	a	b	c	d	e	f	g	h	i
East Coast North	0.327	0.241	0.448	0.36	0.00096	0.48	-0.21	0.012	-0.0013

Short Duration ARF

$$ARF = Min\left[1, 1 - 0.287\left(Area^{0.265} - 0.439\log_{10}(Duration)\right).Duration^{-0.36} + 2.26 \text{ x } 10^{-3} \text{ x } Area^{0.226}.Duration^{0.125}\left(0.3 + \log_{10}(AEP)\right) + 0.0141 \text{ x } Area^{0.213} \text{ x } 10^{-0.021\frac{(Duration-180)^2}{1440}}\left(0.3 + \log_{10}(AEP)\right)\right]$$

Layer Info

Time Accessed	21 November 2025 04:50PM
Version	2016_v1

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

ID	5092.0
Storm Initial Losses (mm)	26.0
Storm Continuing Losses (mm/h)	1.9

Layer Info

Time Accessed	21 November 2025 04:50PM
Version	2016_v1

Temporal Patterns | Download (.zip) (static/temporal_patterns/TP/ECnorth.zip)

code	ECnorth
Label	East Coast North

Layer Info

Time Accessed	21 November 2025 04:50PM
Version	2016_v2

Areal Temporal Patterns | Download (.zip) (./static/temporal_patterns/Areal/Areal_ECnorth.zip)

code	ECnorth
arealabel	East Coast North

Layer Info

Time Accessed	21 November 2025 04:50PM
Version	2016_v2

BOM IFDs

Click here (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-27.819&longitude=153.12&sdmin=true&sdhr=true&sdday=true&user_label=) to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

Time Accessed	21 November 2025 04:50PM

Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.9 (0.027)	3.0 (0.062)	4.4 (0.076)	5.7 (0.085)	8.4 (0.105)	10.4 (0.116)
90 (1.5)	0.5 (0.014)	2.7 (0.049)	4.2 (0.063)	5.5 (0.072)	11.9 (0.129)	16.7 (0.159)
120 (2.0)	0.4 (0.009)	7.0 (0.116)	11.4 (0.156)	15.6 (0.182)	17.6 (0.171)	19.2 (0.164)
180 (3.0)	0.8 (0.017)	8.4 (0.123)	13.5 (0.162)	18.3 (0.187)	23.3 (0.196)	27.0 (0.198)
360 (6.0)	2.1 (0.034)	12.6 (0.143)	19.5 (0.182)	26.2 (0.206)	44.5 (0.286)	58.2 (0.325)
720 (12.0)	2.7 (0.034)	11.0 (0.094)	16.4 (0.115)	21.7 (0.127)	41.3 (0.198)	56.0 (0.234)
1080 (18.0)	2.3 (0.024)	11.9 (0.086)	18.3 (0.107)	24.4 (0.120)	36.4 (0.146)	45.4 (0.159)
1440 (24.0)	3.6 (0.033)	7.7 (0.049)	10.3 (0.053)	12.9 (0.056)	29.2 (0.103)	41.4 (0.128)
2160 (36.0)	0.0 (0.000)	4.6 (0.025)	7.6 (0.033)	10.5 (0.038)	22.7 (0.068)	31.8 (0.083)
2880 (48.0)	0.0 (0.000)	1.2 (0.006)	2.0 (0.008)	2.8 (0.009)	13.1 (0.035)	20.8 (0.048)
4320 (72.0)	0.0 (0.000)	0.1 (0.000)	0.2 (0.001)	0.3 (0.001)	4.7 (0.011)	8.1 (0.016)

Layer Info

Time Accessed	21 November 2025 04:50PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	21 November 2025 04:50PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.2 (0.004)	0.4 (0.006)	0.5 (0.007)	0.5 (0.006)	0.5 (0.006)
90 (1.5)	0.0 (0.000)	0.2 (0.003)	0.3 (0.004)	0.4 (0.005)	1.0 (0.011)	1.5 (0.014)
120 (2.0)	0.0 (0.000)	0.8 (0.013)	1.3 (0.017)	1.7 (0.020)	1.3 (0.013)	1.0 (0.009)
180 (3.0)	0.0 (0.000)	0.2 (0.003)	0.4 (0.005)	0.5 (0.005)	0.8 (0.007)	1.0 (0.007)
360 (6.0)	0.0 (0.000)	0.6 (0.007)	1.0 (0.009)	1.4 (0.011)	4.0 (0.026)	6.0 (0.034)
720 (12.0)	0.0 (0.000)	2.1 (0.018)	3.6 (0.025)	4.9 (0.029)	8.6 (0.041)	11.4 (0.048)
1080 (18.0)	0.0 (0.000)	1.9 (0.014)	3.1 (0.018)	4.3 (0.021)	6.2 (0.025)	7.6 (0.027)
1440 (24.0)	0.0 (0.000)	0.1 (0.000)	0.1 (0.001)	0.2 (0.001)	4.2 (0.015)	7.2 (0.022)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.4 (0.001)	0.7 (0.002)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	21 November 2025 04:50PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	16.8 (0.477)	28.4 (0.584)	36.2 (0.622)	43.6 (0.646)	39.8 (0.497)	37.0 (0.411)
90 (1.5)	14.6 (0.367)	23.0 (0.416)	28.6 (0.431)	33.9 (0.438)	65.5 (0.706)	89.2 (0.848)
120 (2.0)	10.6 (0.245)	29.6 (0.491)	42.3 (0.581)	54.4 (0.637)	93.7 (0.910)	123.1 (1.050)
180 (3.0)	30.2 (0.619)	49.4 (0.719)	62.1 (0.746)	74.2 (0.756)	112.9 (0.947)	141.9 (1.040)
360 (6.0)	32.4 (0.526)	51.6 (0.588)	64.3 (0.600)	76.4 (0.601)	117.9 (0.757)	149.0 (0.833)
720 (12.0)	37.7 (0.466)	59.1 (0.508)	73.2 (0.513)	86.8 (0.511)	112.1 (0.538)	131.1 (0.548)
1080 (18.0)	21.8 (0.227)	51.6 (0.372)	71.4 (0.419)	90.3 (0.444)	109.2 (0.439)	123.3 (0.432)
1440 (24.0)	28.9 (0.268)	47.5 (0.302)	59.7 (0.309)	71.5 (0.310)	84.8 (0.300)	94.7 (0.292)
2160 (36.0)	12.6 (0.099)	24.8 (0.133)	32.8 (0.143)	40.5 (0.148)	60.3 (0.180)	75.0 (0.195)
2880 (48.0)	12.9 (0.091)	27.2 (0.131)	36.7 (0.143)	45.8 (0.149)	62.4 (0.167)	74.9 (0.174)
4320 (72.0)	0.2 (0.001)	10.6 (0.045)	17.5 (0.060)	24.1 (0.069)	45.7 (0.107)	62.0 (0.126)

Layer Info

Time Accessed	21 November 2025 04:50PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	62.6 (1.777)	98.4 (2.019)	122.1 (2.102)	144.8 (2.148)	135.1 (1.686)	127.7 (1.418)
90 (1.5)	51.1 (1.287)	76.1 (1.376)	92.7 (1.398)	108.5 (1.401)	190.8 (2.054)	252.5 (2.399)
120 (2.0)	37.0 (0.856)	76.9 (1.273)	103.4 (1.421)	128.7 (1.508)	190.3 (1.848)	236.4 (2.016)
180 (3.0)	70.6 (1.447)	108.2 (1.574)	133.0 (1.599)	156.9 (1.598)	241.6 (2.026)	305.2 (2.236)
360 (6.0)	59.6 (0.967)	106.5 (1.213)	137.6 (1.284)	167.3 (1.315)	245.1 (1.575)	303.4 (1.696)
720 (12.0)	88.8 (1.098)	125.2 (1.076)	149.3 (1.046)	172.4 (1.014)	220.3 (1.058)	256.2 (1.071)
1080 (18.0)	57.8 (0.603)	95.5 (0.688)	120.4 (0.706)	144.4 (0.710)	179.0 (0.719)	205.0 (0.718)
1440 (24.0)	77.7 (0.718)	103.3 (0.657)	120.3 (0.622)	136.6 (0.591)	166.3 (0.589)	188.6 (0.582)
2160 (36.0)	37.6 (0.295)	76.9 (0.412)	102.9 (0.448)	127.8 (0.466)	149.7 (0.447)	166.0 (0.432)
2880 (48.0)	44.2 (0.312)	75.2 (0.362)	95.7 (0.374)	115.4 (0.376)	147.8 (0.395)	172.1 (0.400)
4320 (72.0)	14.4 (0.090)	40.5 (0.171)	57.7 (0.198)	74.3 (0.213)	94.1 (0.220)	109.0 (0.222)

Layer Info

Time Accessed	21 November 2025 04:50PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

Climate Change Factors

Rainfall Factors

SSP1-2.6

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	**1.18**	**1.17**	**1.16**	**1.14**	**1.13**	**1.12**	**1.12**	**1.11**	**1.1**	**1.1**
2040	1.21	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.11	1.11
2050	**1.22**	**1.2**	**1.18**	**1.17**	**1.15**	**1.15**	**1.14**	**1.13**	**1.12**	**1.11**
2060	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2070	1.24	1.22	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2080	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2090	**1.23**	**1.21**	**1.2**	**1.18**	**1.17**	**1.16**	**1.15**	**1.14**	**1.13**	**1.12**
2100	1.22	1.2	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.12

SSP2-4.5

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	**1.18**	**1.17**	**1.16**	**1.14**	**1.13**	**1.12**	**1.12**	**1.11**	**1.1**	**1.1**
2040	1.22	1.2	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.12
2050	**1.27**	**1.24**	**1.23**	**1.21**	**1.19**	**1.18**	**1.17**	**1.16**	**1.15**	**1.14**
2060	1.3	1.27	1.25	1.23	1.21	1.2	1.19	1.18	1.16	1.16
2070	1.33	1.3	1.28	1.26	1.24	1.22	1.21	1.19	1.18	1.17
2080	1.37	1.33	1.31	1.28	1.26	1.24	1.22	1.21	1.2	1.19
2090	**1.4**	**1.36**	**1.34**	**1.31**	**1.28**	**1.26**	**1.24**	**1.23**	**1.21**	**1.2**
2100	1.41	1.37	1.35	1.32	1.29	1.27	1.25	1.24	1.22	1.21

SSP3-7.0

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	**1.18**	**1.17**	**1.16**	**1.14**	**1.13**	**1.12**	**1.12**	**1.11**	**1.1**	**1.1**
2040	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2050	**1.29**	**1.26**	**1.24**	**1.22**	**1.2**	**1.19**	**1.18**	**1.17**	**1.16**	**1.15**
2060	1.35	1.32	1.3	1.27	1.25	1.23	1.22	1.2	1.19	1.18
2070	1.42	1.38	1.35	1.32	1.29	1.28	1.26	1.24	1.22	1.21
2080	1.5	1.45	1.42	1.38	1.35	1.33	1.3	1.28	1.26	1.25
2090	**1.59**	**1.53**	**1.49**	**1.44**	**1.4**	**1.38**	**1.35**	**1.33**	**1.3**	**1.29**
2100	1.66	1.59	1.55	1.5	1.45	1.42	1.39	1.37	1.34	1.32

SSP5-8.5

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	**1.2**	**1.18**	**1.17**	**1.16**	**1.14**	**1.13**	**1.13**	**1.12**	**1.11**	**1.11**

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2040	1.26	1.24	1.22	1.2	1.18	1.17	1.16	1.15	1.14	1.14
2050	**1.34**	**1.31**	**1.29**	**1.26**	**1.24**	**1.23**	**1.21**	**1.2**	**1.18**	**1.18**
2060	1.42	1.38	1.35	1.32	1.29	1.28	1.26	1.24	1.22	1.21
2070	1.52	1.47	1.43	1.4	1.36	1.34	1.31	1.29	1.27	1.26
2080	1.63	1.57	1.52	1.48	1.43	1.4	1.37	1.35	1.33	1.31
2090	**1.77**	**1.69**	**1.64**	**1.58**	**1.52**	**1.49**	**1.45**	**1.42**	**1.39**	**1.37**
2100	1.86	1.77	1.71	1.64	1.58	1.54	1.5	1.47	1.43	1.41

Loss Factors

Initial Loss (Adjustment Factors)

	Losses SSP1-2.6	Losses SSP2-4.5	Losses SSP3-7.0	Losses SSP5-8.5
2030	**1.02**	**1.02**	**1.02**	**1.03**
2040	1.03	1.03	1.03	1.03
2050	**1.03**	**1.03**	**1.04**	**1.04**
2060	1.03	1.04	1.04	1.05
2070	1.03	1.04	1.05	1.06
2080	1.03	1.05	1.06	1.07
2090	**1.03**	**1.05**	**1.07**	**1.08**
2100	1.03	1.05	1.07	1.09

Continuing Loss (Adjustment Factors)

	Losses SSP1-2.6	Losses SSP2-4.5	Losses SSP3-7.0	Losses SSP5-8.5
2030	**1.04**	**1.05**	**1.05**	**1.05**
2040	1.05	1.05	1.06	1.06
2050	**1.06**	**1.06**	**1.07**	**1.08**
2060	1.06	1.07	1.08	1.1
2070	1.06	1.08	1.1	1.12
2080	1.06	1.09	1.11	1.14
2090	**1.06**	**1.09**	**1.13**	**1.16**
2100	1.06	1.1	1.14	1.18

Temperature Changes (Degrees, Relative to 1961-1990 Baseline)

Year	SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
2030	**1.2**	**1.2**	**1.2**	**1.3**
2040	1.3	1.4	1.5	1.6
2050	**1.4**	**1.7**	**1.8**	**2.1**
2060	1.5	1.9	2.2	2.5
2070	1.5	2.1	2.5	3

Year	SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
2080	1.5	2.2	2.9	3.5
2090	**1.5**	**2.4**	**3.3**	**4.1**
2100	1.4	2.5	3.6	4.5

Layer Info

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Note	Updated climate change factors for IFD Initial loss and continuing loss based on IPCC AR6 temperature increases from the updated Climate Change Considerations (Book 1: Chapter 6) in ARR (Version 4.2). ARR recomends the use of Current and near-term (2030 midpoint). Medium-term (2050 midpoint) and Long-term (2090 midpoint)

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