Servicing Report

for

380 Motorway Link Road, Wallarah

for Darkinjung Local Aboriginal Land Council

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Executive Summary

Northrop Consulting Engineers has been engaged by Darkinjung Local Aboriginal Land Council (DLALC) to prepare a servicing report to support the proposed rezoning of 380 Motorway Link Road, Wallarah. The report assesses the sites capacity to accommodate the proposed rezoning, outlining the availability of all necessary utility infrastructure including water, sewer, gas, electrical and communication services as well as identifying the required stormwater and flooding mitigation measures.

The 89ha site is currently undeveloped bushland intersected by a 4th order tributary of Wallarah Creek. The site is predominately zoned RU6 Transitional with the exception of a narrow corridor along Wallarah Creek zoned E2 Environmental. The proposal is seeking to rezone approximately 45ha at the northern end of the site from RU6 Transitional to IN1 General Industrial to facilitate future industrial development of the site. The remaining area is to be dedicated to environmental conservation by extending the E2 Environmental zoning to the southern boundary.

The southern boundary of the proposed industrial envelope has been informed by the Wallarah Creek Flood Planning Area (FPA) provided by the Central Coast Council (CCC). Flood related development controls will apply to all development proposed within the FPA with minor encroachments along the southern and eastern boundaries.

A preliminary management strategy for the site has been considered to outline the measures required to mitigate the effects of future development on stormwater quantity and quality. Through hydrological modelling it was found that development would result in increased peak flows which would likely have an adverse impact on downstream properties. Detention measures have therefore been proposed to attenuate runoff to pre-developed flow rates. It is anticipated that detention basins will be located within dedicated drainage reserves designed to cater for each sub-stage of future development.

In addition to this, though the adoption of Water Sensitive Urban Design (WSUD) principals Council's water quality reduction targets are achievable for the future zoning. In accordance with Council's guidelines a future treatment train approach could be implemented with rainwater tanks and gross pollutant traps to provide primary treatment, vegetated swales to provide secondary treatment and constructed wetlands to provide tertiary treatment.

Whilst the site is currently remote from existing potable water infrastructure, it is understood that lead-in infrastructure into the area is to be provided by the construction of the Mardi to Warnervale Transfer Main due for completion by 2022. Following its completion, it is understood that Wyong Coal Pty Ltd intend to provide an extension of the main from Sparks Road to service its Wallarah 2 Coal Project located approximately 1.5km west of the site. For the purpose of this assessment it has been assumed that the Wallarah 2 Project will progress prior to construction of the proposed industrial development of the site.

The site is positioned within close proximity to sewer pumping stations within both Blue Haven and Charmhaven. CCC have confirmed that it is their preference for the development to pump directly to the Charmhaven Waste Water Treatment Works (WWTW). On review of the existing topography and the expected development layout, it has been determined that the entire site can drain via gravity to a single pump station.

Based on asset mapping available through Dial Before You Dig from the respective service authorities existing electrical, telecommunication and gas utilities are located near to the site. Extension of these existing networks is considered feasible to service future industrial development of the site.

Based on the assessment undertaken to date the site is recommended for rezoning on the grounds of stormwater, flooding and essential utility services.

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1. Introduction

Northrop Consulting Engineers has been engaged by Darkinjung Local Aboriginal Land Council (DLALC) to prepare a servicing report to support the rezoning of Lot 1, 2 and 3 DP1156997 located at 380 Motorway Link Road, Wallarah (the site). This report provides an overview of the flood management requirements of the site as well as the availability of water, sewer, stormwater, gas, electrical and communication infrastructure. The report aims to demonstrate that the site has capacity to accommodate the proposed rezoning and all information contained in this report has been completed to a level commensurate with that required for a Planning Proposal. It is noted that further details will be provided at Development Application and Construction Certificate Stage.

1.1 Site Description

The site is located within the Central Coast suburb of Wallarah on the south-eastern side of the Doyalson Motorway Link Road adjacent to the Toohey's Road overpass and interchange. Illustrated in **Figure 1** below, the site is bordered by the Motorway Link Road to the north, the Main Northern Railway to the south east and bushland to the south west.

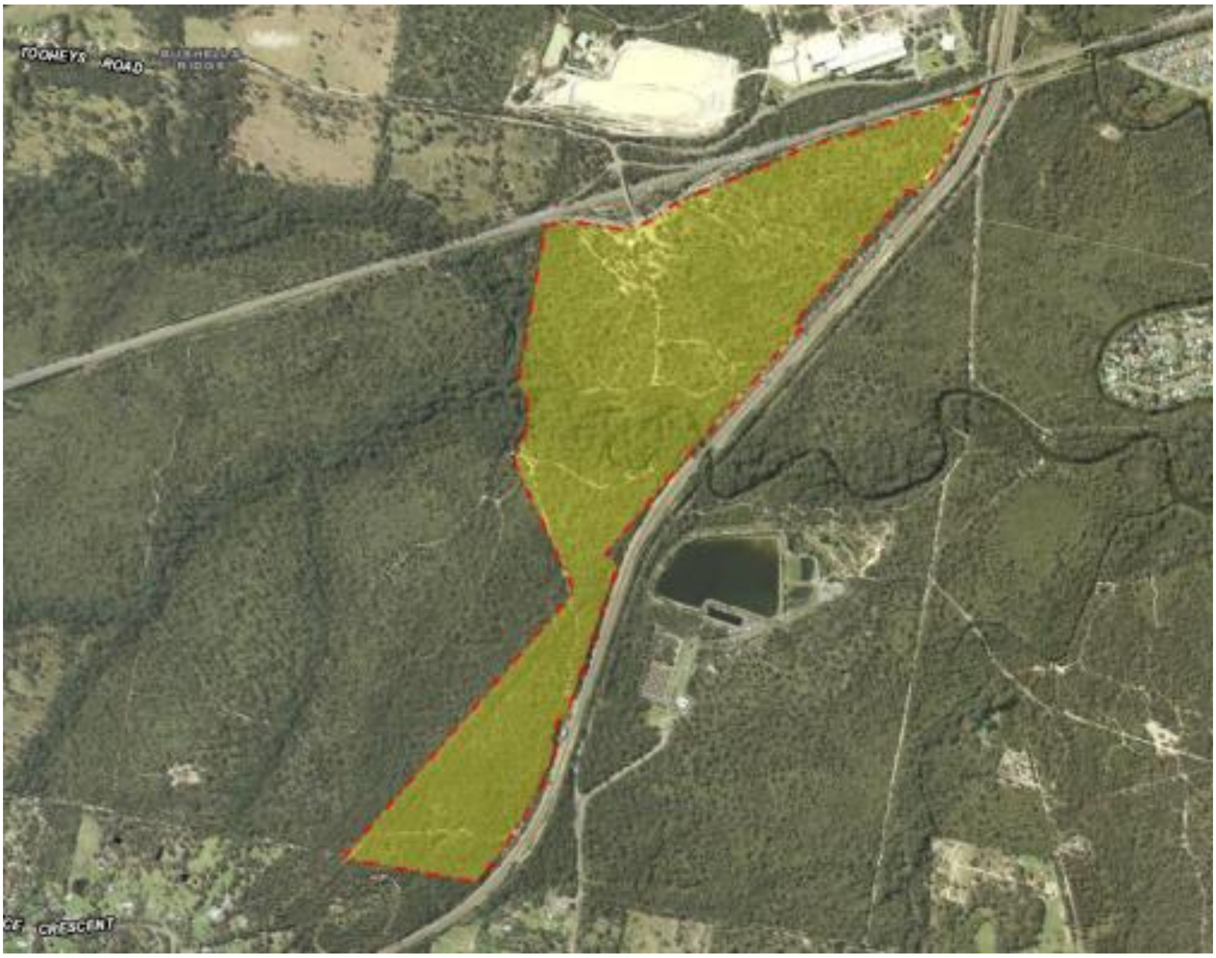

Figure 1 – Existing Site (Aerial image source https://maps.six.nsw.gov.au/)

Currently undeveloped the land is predominately vegetated with the exception of several trails which transvers the site. With a total area of approximately 89ha the land is characterised by gently undulating slopes with average longitudinal grades of 5%. Surrounding land uses include industrial and residential, with a Boral quarry and manufacturing plan to the north and the Blue Haven residential subdivision approximately 400m to the east. The site is currently zoned E2 Environmental and RU6 Transitional.

1.2 Proposed Development

The development proposes an industrial subdivision/ business park partially across lots one and three and across the majority of lot two, refer **Figure 2** below. To facilitate this proposal the application is seeking rezoning of approximately 45ha from RU6 Transitional to IN1 General Industrial. **Figure 2** below illustrates the extent of the proposed industrial rezoning. The residual site area, approximately 44ha being the southern portion of lot one, is to be maintained as bushland and dedicated to environmental conservation. To facilitate this, the remaining area zoned RU6 Transitional is to be rezoned E2 Environmental.

Figure 2 – Proposed IN1 General Industrial Extent (Aerial image source https://maps.six.nsw.gov.au/)

1.3 Wallarah Creek

Natural drainage of the site is characterised by Wallarah Creek which flows across the site and continues beneath the Main Northern Railway. The intersection of Lot one by Wallarah Creek flood levels has been one of the constraints used to inform the southern boundary of the proposed development envelope. To ensure adequate protection is provided to the existing water course a riparian corridor is to be established to buffer the creek line. In accordance with the Department of Industry Water guidelines the riparian corridor width has been determined by watercourse order as classified under the Strahler System using current 1:25 000 topographic maps.

Drawing WA1.1 - Wallarah Creek Flooding and Riparian Corridor Extents provided in Appendix B illustrates the determined creek order and corresponding corridor widths. Two 3rd order water courses join immediately upstream of the western site boundary resulting in a 4th order watercourse across the site. As illustrated by the proposal 70m and 90m riparian corridors are to buffer the 3rd and 4th order water courses respectively with no encroachment proposed by the new IN1 envelope.

The proposal for rezoning for industrial uses does encompass a mapped unnamed 1st order watercourse within sub-catchment 2. The site was investigated via aerial imagery, LiDAR aerial survey and onsite ground truth walkover. No evident localised depression, channel or permanent water body was found in the location of the mapped 1st order water course. The vegetation within the vicinity of the mapped creek line is illustrated in **Figures 3** and **Figure 4** below.

Under the NSW Department of Industry Guidelines for Controlled Activities on Waterfront Land, a riparian corridor is required to form a transition zone between the land, also known as the terrestrial environment, and the lake, river, watercourse or aquatic environment. Given that there is no evidence of an aquatic environment onsite the mapped watercourse is considered to more accurately reflect a drainage line. With no designated riparian corridor proposed the drainage line will need to be incorporated into the layout of any future onsite development.

Figure 3 – Mapped 1st Order Water Course Crossing Existing Onsite Fire Trail

Figure 4 – Existing Vegetation in Vicinity of Mapped 1st Order Watercourse

2. Flooding

2.1 Site Catchment

The Wallarah Creek catchment covers an area of approximately 33km^2. The catchment, illustrated in **Figure 5**, ultimately drains in an easterly direction into Budgewoi Lake. Flooding has been experienced across the catchment on a number of occasions with several investigations into its behaviour undertaken between 1992 and 2014. A comprehensive flood study of the entire catchment considering both mainstream and overland flow was published by Wyong Shire Council in 2016.

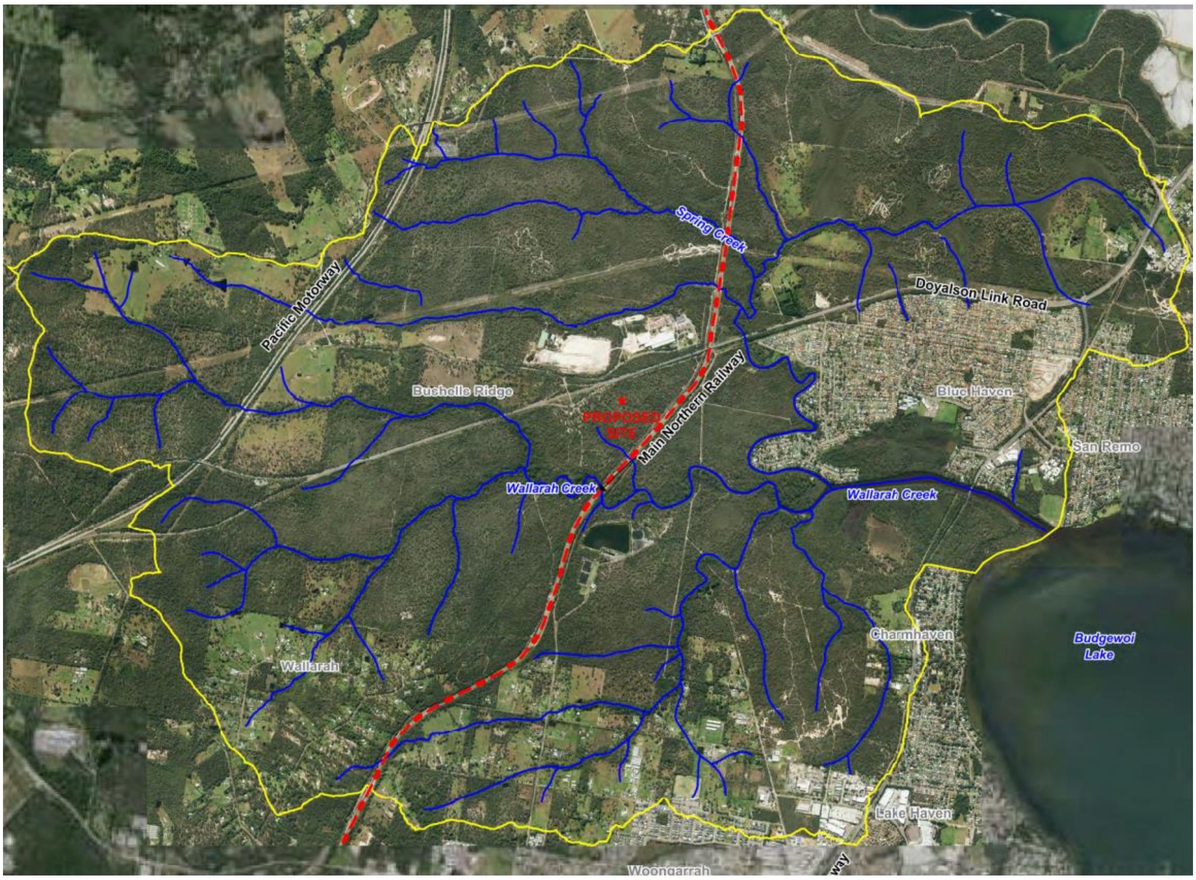

Figure 5 – Wallarah Creek Catchment
Source: Wallarah Creek Catchment Flood Study (Wyong Shire Council, 2016)

2.2 Wallarah Creek Catchment Flood Study (Wyong Shire Council, 2016)

The *Wallarah Creek Catchment Flood Study* (Wyong Shire Council, 2016) provides a technical assessment of flood behaviour across the catchment for a range of design floods using existing topographic data and current state development conditions. The study was used to identify areas at greatest risk to flood damage to inform a targeted assessment of where flood mitigation measures would be best implemented as part of the subsequent Floodplain Risk Management Study and Plan. The below outlines the methodology and results of the study.

2.2.1 Methodology

An XP-RAFTS hydrologic model was developed to simulate all areas of the catchment except for the Blue Haven urban catchment where a TUFLOW model was used. The models were used to simulate design flood behaviour for the 20%, 5% and 1% Annual Exceedance Probability (AEP) floods as well as the Probable Maximum Flood (PMF). A range of storm durations were simulated for each design flood to ensure the highest peak flood level was defined across all sections of the catchment.

2.2.2 Results

The primary findings from the study were as follows:

- Flooding across the Wallarah Creek catchment results from:
  - Major watercourses overtopping banks.
  - Overland flooding due to insufficient capacity within the piped stormwater network.
  - Inundation from elevated water levels within Budgewoi Lake.
- Flooding downstream of the Wallarah Creek/ Spring Creek confluence is typically dominated by Budgewoi Lake levels while flooding upstream of the confluence is typically dominated by runoff from the Wallarah Creek catchment.
- Flooding can occur from a variety of different storm/ rainfall durations. In urban areas worst case flooding would typically occur during short duration storm events (less than two hours). Whereas along major watercourses, longer rainfall duration events (greater than six hours) would typically produce the worst flooding. As a result, flooding across the catchment may be produced by relatively short, high intensity thunderstorms through to longer rainfall events that may be generated by east coast lows.

As a result of the study a Flood Planning Area (FPA) was deduced for Council to identify areas where flood related development controls should be applied. The FPA was determined using the 1% AEP flood extend plus a 500mm freeboard. In some flatter areas of the catchment a 500mm freeboard would extend beyond the PMF which was not considered realistic. In these areas the FPA was clipped to match the PMF inundation extent.

The study was also used to determine flood hazard across the site based on the hydraulic categories of flood fringe, flood storage and floodway. In accordance with the NSW Government Floodplain Development Manual, flood fringe is an area with inundation less than 0.15m, flood storage an area of greater than 0.15m and floodway an area where 80% of the total flow is conveyed.

2.3 Site Flooding

Extracts from the 2016 study illustrating the estimated flood inundation extents for the 1% AEP and PMF storm events in the vicinity of the site have been provided below in **Figures 6** and **7**. As shown, the 1% AEP flood inundation from Wallarah Creek is anticipated to reach levels up to 7.5m AHD. During the PMF inundation extents increase with levels from Wallarah Creek expected up to 8m AHD. Minor localised catchment flooding to the northwest of the site, adjacent to the Motorway Link road is also expected to affect the site in both the 1% AEP and PMF events.

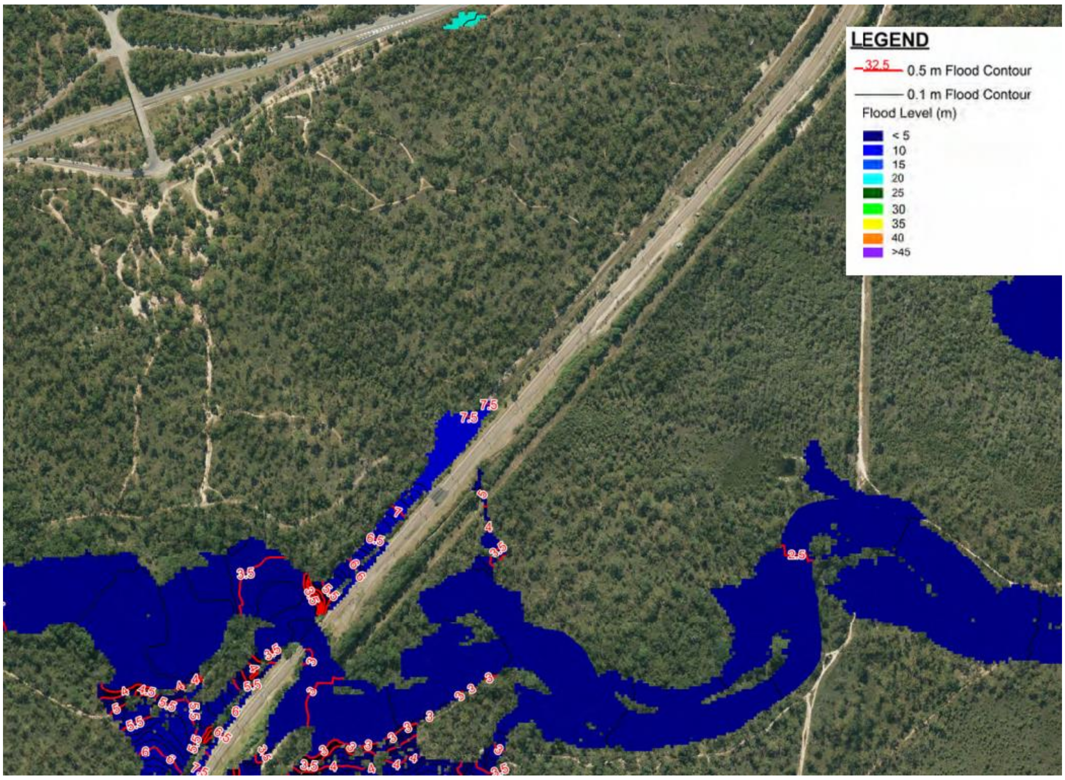

Figure 6 – Peak Flow Level Contours 1% AEP - Wallarah Creek Catchment Flood Study (WSC, 2016)

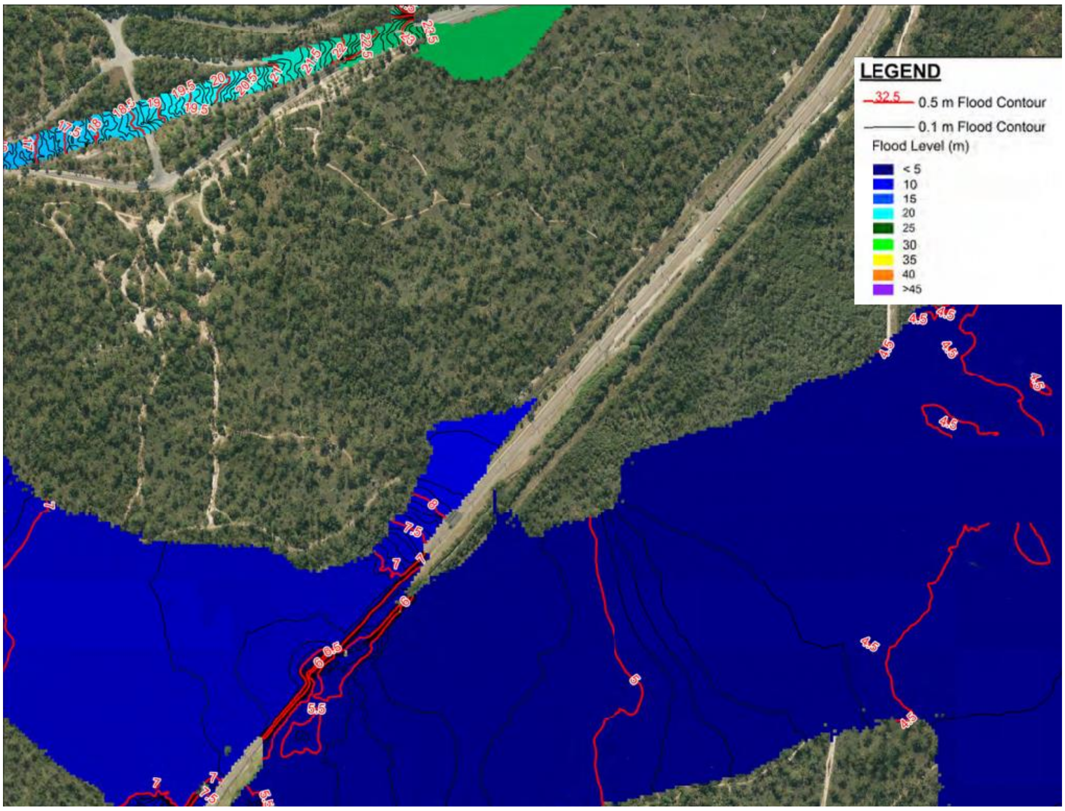

Figure 7 – Peak Flow Level Contours PMF - Wallarah Creek Catchment Flood Study (WSC, 2016)

2.3.1 Flood Planning Area (FPA)

To assess potential flood impacts on the proposed development, flood inundation extents produced by the *Wallarah Creek Catchment Flood Study* were obtained from Council and overlaid across the site. The resultant figure has been provided within Appendix B, refer WA-10 Wallarah Creek Riparian Corridor and Flood Extents. As illustrated the proposed development envelope is marginally affected by flood inundation waters during the 1% AEP storm event and subsequently the FPA along the southern and eastern boundaries. As a result, flood related development controls will apply to all development proposed within these areas.

2.3.2 Flood Hazard Category

Extract from the 2016 study illustrating the PMF Provisional Flood Hazard Category across the site is provided in **Figure 8.** As depicted Wallarah Creek presents a Category six Hazard to the south however continually rising land to the northeast provides access to onsite flood free land.

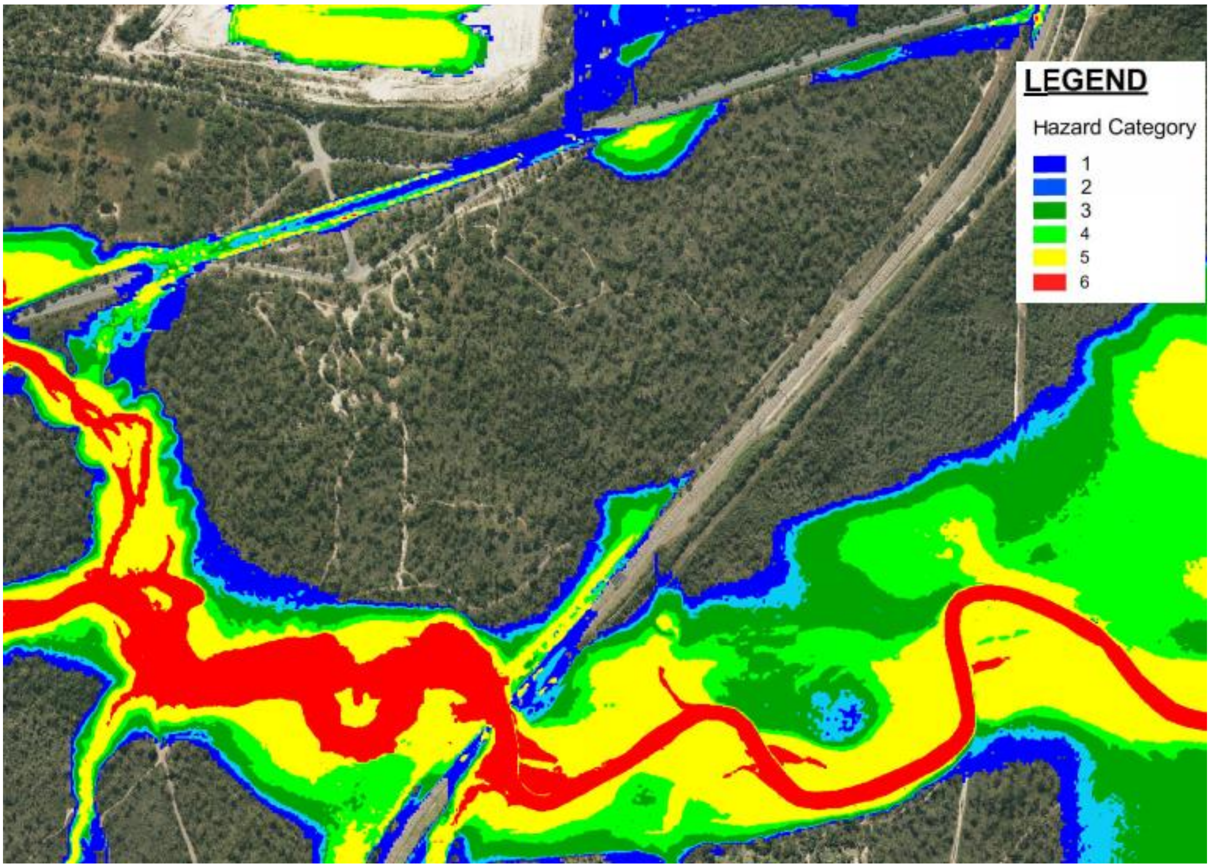

Figure 8 – Flood Hazard Category 1% AEP- Wallarah Creek Catchment Flood Study (WSC, 2016)

3. Stormwater Drainage

Urbanised development often results in significant modification to soils, topography, impervious percentages and vegetation. Surface water runoff volumes and pollutant concentrations from urban catchments are typically above pre-developed states and without management have the potential to convey increased runoff volumes and pollutant loads to downstream receiving waters. To mitigate the potentially detrimental effects of urbanisation upon the environment stormwater runoff is to be managed.

3.1 Stormwater Management Objectives

The Central Coast Council (CCC) currently has two operational Development Control Plans (DCPs). Situated within the old Wyong Local Government Area (LGA) the proposed rezoning will need to comply with the 2013 Wyong DCP. In accordance with the DCP a stormwater management strategy is to be prepared for all subdivision development which will generally comply with the following:

- All land is to be adequately drained so as not to impact on adjacent sites.
- Development will not contribute to drainage or flooding problems elsewhere.
- Prevent erosion and sedimentation through incorporation of adequate soil stability measures.
- Promote water sensitive urban development and provide a more integrated approach to urban water cycle management.
- Ensure conservation of water and reduction in mains water consumption by utilising stormwater as a natural water resource for larger subdivisions.
- Protect sensitive ecosystems and to maintain hydrological regimes to downstream environments.

The specific design requirements for stormwater quantity and quality management are outlined in Section 10 of the CCC’s 2018 Civil Works Specification. Under this guideline the following design objectives are applicable:

- Post-development peak flow from the outlet point(s) of the site to the downstream public drainage system or receiving water shall not exceed the pre-development peak flow for both the minor and major system design storm AEP.
- Development shall mitigate the impacts of urban development on stormwater quality through adoption of Water Sensitive Urban Design Principles to reach the nominated pollutant load reduction targets.

3.2 Stormwater Management Strategy

A concept stormwater management strategy illustrating compliance with the design objectives outlined in Section 3.1 above will need to be prepared to support any subsequent development applications following rezoning.

Considered pertinent to assessing the feasibility of the rezoning application, the sections below outline a preliminary strategy for the onsite detention and water quality measures required to mitigate the effects of future development. It is anticipated that details of the minor and major conveyance infrastructure will be provided once subdivision layouts have been determined during the Development Application and Detailed Design phase.

3.3 Catchment Parameters

In accordance with Table 10.2 of CCC's Civil Works Specification and the proposed industrial land use, a gross impervious fraction of 90% has been assumed for the preliminary strategy.

Based on the existing drainage regime, natural topography and site configuration, the proposed development extent has been broken into three sub-catchments as shown in **Figure 9.** For the purpose of the preliminary management strategy the stormwater sub-catchments have been considered to independently address the outlined objectives.

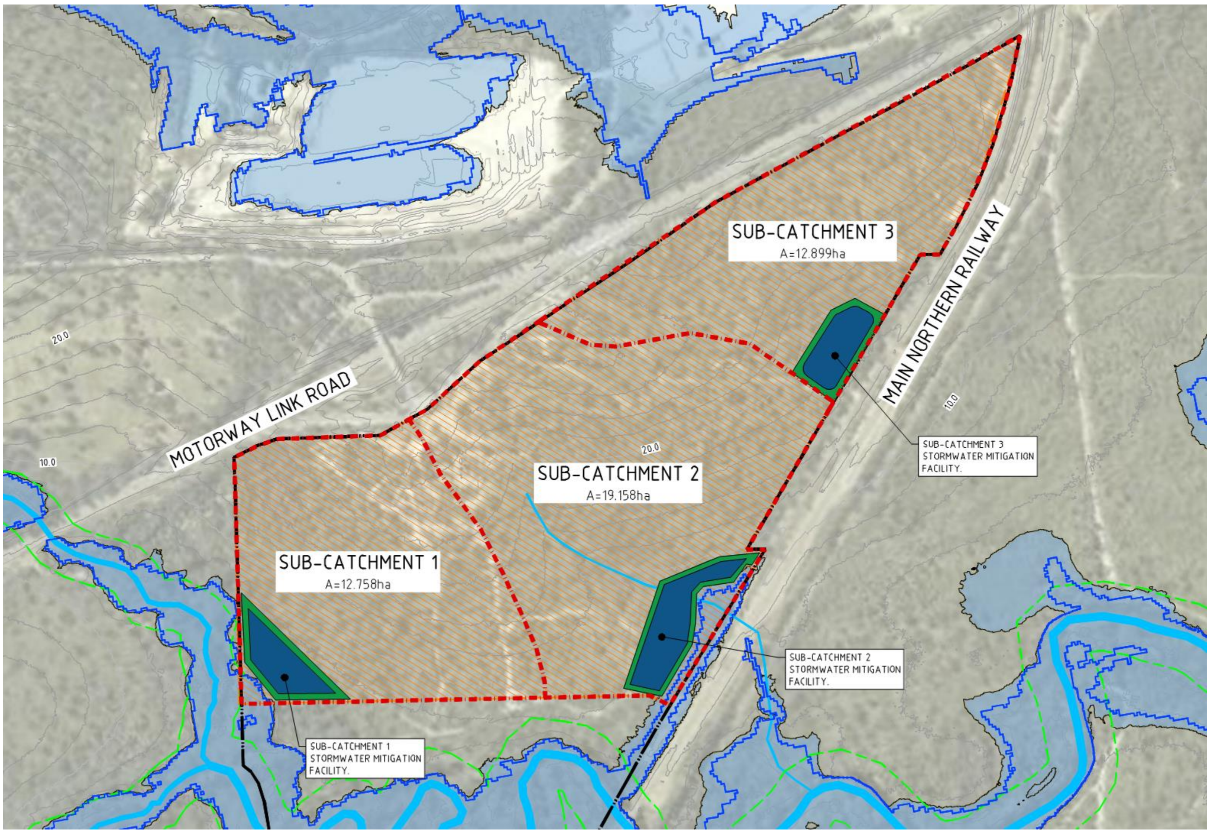

Figure 9 – Stormwater Drainage Sub-catchments

3.4 Stormwater Detention

Preliminary hydrological modelling has been undertaken to assess the contributing catchment in both the pre and post developed scenarios. The model was then used to develop mitigation measures which have been designed to ensure no net increase in peak flows for a range of events from the 20% AEP to the 1% AEP over a range of durations from the 10 minutes to 72 hours. This range of events was considered appropriate for the site with water quality treatment devices expected to effectively attenuate more frequent flows.

3.4.1 Methodology

The model was developed using the Runoff Analysis and Flow Training Simulation (RAFTS) software package. RAFTS is a deterministic runoff routing model that simulates catchment runoff processes. The model was developed using the following inputs:

- For the existing scenario the catchment was categorised as pervious with bushland characteristics observed to establish roughness coefficients. For the post developed scenario, a 90% impervious faction was adopted with pavement characteristics observed to establish roughness coefficients, refer **Table 1** below.
- Average catchment slopes were digitised using LiDAR contour data.
- Rainfall data for the model was obtained from the Bureau of Meteorology using AR&R2016 intensity data and temporal patterns.
- Initial and continuing loses have been based on the values published by AR&R2016 of 49mm and 3mm respectively. As stated on the ARR Data Hub, at this stage the advice provided in NSW on losses and pre-burst rainfall are considered to be over-estimated and should be derived considering a hierarchy of approaches. With no recorded losses from actual events within or surrounding the catchment, pre-developed pervious surface losses were estimated as 40% of the published values in accordance with ARR's hierarchy approach. For the post-developed scenario, pervious surface losses were then estimated at 80% of the pre-developed losses.

  Modelling undertaken by the 2016 Wyong Shire Council Flood Study adopted initial and continuing losses of 10mm and 2.5mm respectively. Sensitivity analysis found that the catchment was relatively insensitive to changes in initial loss. After calibration to historic flood data it was found that adoption of an initial loss between 10-30mm provided an accurate representation of the catchment. Further to this sensitivity analysis of continuing losses found that results were not significantly impacted by changes in continuing loss between 0-3.5mm.

  To be conservative with detention estimation a higher initial loss and lower continuing loss to those adopted by the flood study have been adopted by this assessment, **Table 1** below summarises the modelled values. Further investigation to confirm appropriate losses is recommended at DA stage to inform detailed detention design.

Table 1: Adopted Hydrologic Parameters used in XP-RAFTS

	Predeveloped Scenario Bushland Catchment	Developed Scenario Urban Catchment	
	Pervious Surfaces	Pervious Surfaces	Impervious Surfaces
Initial loss (mm)	19.6	15.7	1.5
Continuing Loss rate (mm/hr)	1.2	1.0	0
Catchment Roughness	0.050	0.040	0.012

3.4.2 Results

The results from the peak storm events have been summarised below in **Table 2**.

As summarised in **Table 2** it is evident that the proposed development will increase peak flows within each sub-catchment over a range of rainfall events. This net increase in peak flows is likely to have adverse effects on downstream properties and the regional hydrology. Detention measures have therefore been proposed to mitigate the negative impacts on the catchment regime at the site boundaries.

Table 2: Median Peak Storm Event Site Discharge Flow Rates

Sub-catchment	Area (ha)	Storm Event AEP %	Pre-developed Scenario Peak Discharge Flowrate (m^3/s)	Critical Duration	Post-developed Scenario Peak Discharge Flowrate (m^3/s)	Critical Duration
1	12.758	20	1.3700	1hr	4.3450	15mins
		5	2.4885	1hr	6.4610	15mins
		1	3.7875	45min	9.5275	10mins
2	19.158	20	1.8260	2hr	6.4985	15mins
		5	3.2515	1hr	9.5730	15mins
		1	4.9565	45min	14.3995	10mins
3	12.899	20	1.4405	1hr	4.3760	15mins
		5	2.6035	1hr	6.5625	15mins
		1	3.9345	45min	9.5845	10mins

3.4.3 Detention Storage Volume

The results from the peak storm events with the integrated detention basins have been summarised below in **Table 3**. It is noted that these values are approximate only and based on predeveloped catchments. Further detailed modelling will be required at Development Application and Construction Certificate stage to fully determine the development characteristics (road layout, percentage impervious, latest guidelines etc.). The below values have therefore been provided as a guide to display how detention may be located and incorporated within future development.

Table 3: Median Peak Storm Event Site Discharge Flow Rates with Detention

Sub-catchment	Detention Basin Storage Volume (m^3)	Storm Event AEP %	Pre-developed Scenario Peak Discharge Flowrate (m^3/s)	Critical Duration	Post-developed Detention Basin Discharge Flowrate (m^3/s)	Critical Duration
1	5850	20	1.3700	1hr	1.2050	1hr
		5	2.4885	1hr	2.0855	1hr
		1	3.7875	45min	3.7115	45min
2	9800	20	1.8260	2hr	1.6350	1hr
		5	3.2515	1hr	2.9345	1hr
		1	4.9565	45min	4.8605	45min
3	5900	20	1.4405	1hr	1.2050	1hr
		5	2.6035	1hr	2.2080	1hr
		1	3.9345	45min	3.8420	45min

As summarised the proposed storage volumes will effectively attenuate runoff up to the 1% AEP peak flow and are therefore considered to effectively mitigate the effects of the development on stormwater quantity in accordance with the intent of the DCP. Detailed design to confirm the basin volumes and outlet configurations is to be undertaken at subsequent Development Application and Construction Certificate stages. It is anticipated that each basin will be located within a dedicated drainage reserve within each sub-stage of the development.

3.5 Stormwater Quality Treatment

In accordance with the DCP the development is to incorporate the principles of Water Sensitive Urban Design (WSUD). WSUD is a philosophy that incorporates urban water cycle management into the urban design process. The philosophy considers options to integrate urban water management infrastructure within the natural environment. It aims to protect the health of aquatic ecosystems and minimise negative impacts on the natural water cycle.

Councils DCP outlines a number of acceptable strategies for achieving principles of WSUD including:

- Establishment of urban lakes, primarily as biological treatment systems.
- Utilisation of water quality control ponds (WQCP) or constructed wetlands, as physical and biological treatment systems, upstream of urban lakes.
- Incorporation of gross pollutant traps (GPTs) on inlets to urban lakes and WQCPs to intercept trash and debris and the coarser fractions of sediment.
- Incorporation of 'off-stream' sediment interception ponds (SIP) in land development works to intercept and treat runoff prior to its discharge to the stormwater system.

At a pre a pre-lodgement meeting held between the proponent and CCC on the 18th April 2019 Council advised the biofiltration basins will not be acceptable on this site with their preference being constructed wetlands.

3.5.1 Pollution Load Reduction Targets

Water quality is proposed to be managed through a treatment train approach to meet pollutant removal efficiency targets specified within Council's DCP. The relevant targets have been reproduced in **Table 4** below.

Table 4: Pollutant Removal Efficiency Targets

Pollutant	Treatment Efficiency Target
Total Suspended Solids (TSS)	80% reduction in mean annual load
Total Nitrogen (TN)	45% reduction in mean annual load
Total Phosphorous (TP)	45% reduction in mean annual load
Gross Pollutant (GP)	90% reduction in mean annual load (for pollutants greater than 5mm in diameter)

3.5.2 MUSIC Modelling

The performance of the proposed stormwater management strategy has been assessed using the conceptual computer software MUSIC (Version 6.3). MUSIC serves as a planning and decision support system that is used to estimate the efficiency of Stormwater Quality Improvement Devices (SQIDs) at capturing common stormwater pollutants including Total Suspended Solids, Total Nitrogen, Total Phosphorous and Gross Pollutants from stormwater runoff. Modelling involves the use of historical or synthesized long-term rainfall data and algorithms that can simulate the performance of stormwater treatment measures to determine stormwater pollution control.

CCC's MUSIC-Link for low land development has been utilised for all rainfall and source node pollutant data inputs. Source nodes were classified as one of two land use categories being roof or industrial areas. For the purpose of the water quality study the roof area was estimated as 40% of the site.

3.5.3 Proposed Treatment Train

Treatment trains consisting of the following devices have been proposed for each sub-catchment:

- Reuse Tanks – Individual rainwater harvesting tanks have been proposed for future lots. Lot yield has been estimated at approximately 0.45ha based on 70% coverage of the site. Given the planned industrial land use, reuse demand rates and subsequent minimum volumes are difficult to establish and therefore have been conservatively estimated at 20kL. Depending on the specific industry it is expected that larger volumes could be accommodated onsite. All tanks are to be fitted with proprietary first flush devices as minimum treatment prior to onsite reuse. By capturing the first portion of runoff from the roof areas the first flush devices will effectively remove course sediment and attached nutrients from the system.

- GPTS – End of line proprietary gross pollutant traps have been proposed to provide primary treatment. The devices are designed to remove litter, debris and course sediment from runoff to protect downstream treatment measures. Humegard GPT units have been modelled using the manufactures published pollutant reduction values.

- Swales – Vegetated swales have been proposed as conveyance measures between the piped outlets and constructed wetlands. The swales will provide secondary treatment via infiltration into the soil and filtration of low flows through the vegetation.

- Wetlands – Constructed wetlands have been proposed as end of line tertiary treatment measures. Constructed wetland systems are shallow, extensively vegetated water bodies that use enhanced sedimentation, fine filtration and biological uptake processes to remove pollutants from stormwater. The proposed wetlands will generally consist of an inlet zone, macrophyte zone and a high flow bypass channel. Detail design of the wetland will need to show consideration to the landscape, plant species section, nominal detention time and hydrodynamic basin function. At this stage the wetlands have been conservatively estimated to have a surface area of approximately 5% of the contributing catchment area.

3.5.4 Results

The estimated pollutant load reductions modelled in Music are presented in **Table 5.** The resultant MUSIC-Link report has been provided in Appendix C.

Table 5: Stormwater Quality Results

Sub-Catchment	Parameter (kg/yr)	Source Load	Residual Load	% Reduction
1	TSS	13600	2330	83
	TP	29.3	11.5	60
	TN	281	154	45
	GP	3280	0	100
2	TSS	20500	3530	83
	TP	43.9	17.2	61
	TN	422	233	45
	GP	4930	0	100
3	TSS	13800	2390	83
	TP	29.5	11.5	61
	TN	285	156	45
	GP	3320	0	100

As summarised in **Table 5**, the proposed treatment train will effectively meet all residual pollutant load reduction targets as recommended by the DCP. Detailed design to confirm the device sizes and inlet configurations is to be undertaken at subsequent Development Application and Construction Certificate stages. It is anticipated that the constructed wetlands will be located within dedicated drainage reserves within each sub-stage of the development.

Drawing WA1.2 – *Preliminary Stormwater Strategy* provided in **Appendix B** illustrates the proposed stormwater mitigation facilities across each sub-catchment.

3.6 Erosion and Sediment Control

In addition to the long-term impacts of urbanisation, significant impacts on stormwater quality can result during construction. Construction activities involve the removal of vegetation and exposure of large areas of bare soil which increases the risk of erosion. Sediment runoff during construction is considered a significant contributor to high nutrient levels in wet weather conditions.

Whilst detailed erosion and sediment control plans are not considered pertinent to the rezoning application, concept plans will be required to support any subsequent development applications. There are various best practice guidelines which assist in preparing management plans with Landcom's Managing Urban Stormwater: Soils and Construction (the 'Blue Book') considered the most relevant and comprehensive guideline in NSW. In accordance with Council's DCP the Blue Book' is expected to form the basis for the preparation of the stage specific erosion and sediment control designs. Consideration should also be given to CCC's Civil Work and Construction Specifications when preparing detailed design plans.

4. Potable Water

4.1 Points of Connection and Available Capacity

The subject site is currently remote from existing water infrastructure. The nearest water supply area is the Blue Haven residential area located approximately 500m to the east. CCC have advised that the Blue Haven supply area does not have the capacity to service the development and alternative servicing arrangements will be required.

4.2 Estimated Water Demand

Water demands for the proposed development have been estimated in accordance with the Water Supply Code of Australia, Hunter Water Edition, incorporating CCC's modified water demands. As the future development layout is currently unknown, area-based loading calculations have been used. Estimated water demands are provided in **Table 6**.

Table 6: Design Water Demands

Land Use Category	Industrial
Average Annual Demand Basis	3,980 kL/year/ha
Development Footprint	46.0 ha
Average Day Demand	5.8 L/s
Peak Day Demand	7.0 L/s
Peak Hour Demand	9.1 L/s
Extreme Day Demand	8.0 L/s
Peak Hour on Extreme Day Demand	10.4 L/s
95th Percentile Peak Hour Demand	8.6 L/s
Firefighting Allowance	20.0 L/s
95th Percentile Peak Hour Demand + Firefighting Allowance	28.6 L/s

4.3 Proposed Servicing

Provision of water infrastructure to the development area is currently dependent on future lead in works to service the Wallarah area. Further to discussions with CCC and preliminary assessment of infrastructure required, these works can be summarised as follows:

Phase 1: Construction of the DN750 Mardi to Warnervale Transfer Main. It is understood that detailed design of this main is complete, with construction due to commence in 2020 and completion in 2021/22;

Phase 2: Extension of a DN200 main from Sparks Road, Warnervale to the Wallarah 2 Coal Project site, located approximately 1.5 km west of the site. It is understood that this main will be constructed by Wyong Coal Pty Ltd and will be dependent on the timing of the commencement of Wallarah 2. CCC have advised that this main will be fed from the Kanwal supply area via a PRV located along Sparks Road. For the purpose of this assessment it has been assumed that the Wallarah 2 Project will progress prior to construction of the future development on site.

CCC have advised that following the completion of Phase 2 works, water supply to the Wallarah area will be transferred to a new reservoir at Kiar Ridge, which will be constructed to meet increasing water demands in the area. It is understood that this reservoir will not be required until Kanwal Reservoir can no longer meet 12-hour Peak Day Demand storage. This is currently forecast to occur in 2026.

The future lead in works are illustrated on Drawing WA.20 in Appendix B. Comments received from Central Coast Council are included in Appendix A.

Upon successful rezoning of the subject site, the developer will be required to complete a water servicing strategy for the development areas, which will need to address the following:

- Staging of the development.
- Future development in the proposed supply area.
- Proposed water demands.
- Minimum pressure requirement.
- Security of supply.

5. Sewer

5.1 Points of Connection and Available Capacity

The subject site is currently not serviced by a sewer connection and the site is not currently drainable to any existing sewer pump station (SPS). The nearest SPS to the site is located within the Blue Haven residential area to the east. The site is also located approximately 0.5 km north of the Charmhaven Wastewater Treatment Works (WWTW).

5.2 Estimated Sewer Loading

The subject site can be divided into two sewer catchments along a ridgeline running north-south through the site. Sewer loadings for each catchment have been estimated in accordance with the Gravity Sewerage Code of Australia Hunter Water Edition (WSA02) incorporating CCC's adopted average dry weather flow of 0.0067 L/s/ET. As the future development layout is currently unknown, area-based loading calculations have been used.

WSA02 currently recommends a sewerage loading range of 30 – 50 ET per gross hectare be applied for industrial developments where the future use is unknown. It is understood the subject site is proposed to accommodate light industrial land uses, consistent with the Wyong 2013 Local Environment Plan, hence the lower rate of 30 ET per gross hectare has been adopted. The estimated sewer loadings are summarised in Table 7.

Table 7: Sewer Loading

Catchment	Loading Basis	Total Units	ET	ADWF (L/s)	PDWF (L/s)	PWWF (L/s)
West	30 ET/gross hectare	14.5 ha	435	2.9	7.5	15.9
East	30 ET/gross hectare	31.5 ha	945	6.3	14.7	32.9
Total		46.0 ha	1380	9.2	22.2	48.8

5.3 Proposed Servicing

CCC have confirmed that it is their preference for the development to pump directly to Charmhaven WWTW. On review of the existing topography and the expected development layout, it has been determined that both catchment areas can drain via gravity to a single pump station. Preliminary pump station sizing parameters are provided in **Table 8.**

Table 8: Sewer Pump Station Sizing.

Pump Duty Flow	49 L/s
Pump Head at Duty Flow (m)	14.00 m
Wet Well Diameter (m)	3.00 m
Wet Well Internal Depth	6.40 m
Volume of Wet Well	4.90 m^3

The proposed servicing infrastructure is illustrated on Drawing WA.30 in Appendix B. Comments received from Central Coast Council are included in Appendix A.

Upon successful rezoning of the site, the developer will be required to prepare a sewer servicing strategy for approval by CCC. This will address the following items:

- Lot layout.
- Confirmation of expected sewer loading.
- Sewer pump station details, including emergency storage.
- Connection of sewer pump station to treatment works.
- Timing of the connection works.

6. Service Infrastructure

6.1 Electricity

High voltage in service electrical infrastructure currently exists within the north eastern corner of the site. Given the number and nature of the proposed future development it is expected that this system will have capacity to service the site. Further detailed investigations and liaison will be undertaken at Development Application Phase of the development.

6.2 Telecommunications

Based on information obtained from the Dial Before You Dig (DBYD) service, the site is located in proximity to existing communications infrastructure which services the nearby Boral Quarry, as well as emergency telephones on the Motorway Link. It is anticipated that the subject site can be serviced with telecommunications by extending and upgrading this existing network.

6.3 Gas

Based on information obtained from DBYD, a high-pressure gas main runs along the eastern boundary of the site, adjacent to the railway corridor. It is anticipated that a gas service connection could be provided from the existing gas infrastructure in the area.

7. Conclusion

Based on the assessment undertaken to date the site is recommended for planning proposal on the grounds of stormwater flooding and essential services. As outlined above the site is considered to have sufficient capacity to accommodate the proposed rezoning with further investigations required to support the detailed design of the subdivision application.

The outcomes of the preliminary stormwater management strategy indicate that detention measures can be adopted to attenuate post developed flows to pre-developed rates. In addition to this, though the adoption of WSUD principals water quality reduction targets can be achieved.

Future servicing Determination of the actual servicing requirements for each site would be subject to an application to each authority at the time of development application. Augmentation to existing infrastructure would be undertaken by the developer in conjunction with local servicing authorities and neighbouring developments.

Appendix A

Authority Correspondence

Andrew Killen

From: Leon Dawes <Leon.Dawes@centralcoast.nsw.gov.au>
Sent: Tuesday, 16 July 2019 2:57 PM
To: Andrew Killen
Cc: Lachlan McRae; Luke Drury
Subject: RE: Darkinjung Rezoning - Wallarah & Lake Munmorah - Minutes

Hi Andrew,
Thanks for pulling these minutes together. Only one comment regarding depth of construction in red below. Everything else is consistent with my understanding.

Regards

Leon Dawes
Senior Planning Engineer
Water Services and Design
Central Coast Council
P.O. Box 20 Wyong, NSW 2259
t: 02 4350 5323
m: 0447 382 249
e: Leon.Dawes@centralcoast.nsw.gov.au

From: Andrew Killen [mailto:AKillen@northrop.com.au]
Sent: Tuesday, 16 July 2019 2:43 PM
To: Leon Dawes
Cc: Lachlan McRae; Luke Drury
Subject: Darkinjung Rezoning - Wallarah & Lake Munmorah - Minutes

Hi Leon,

Thanks again for your time yesterday. Please see below meeting minutes.

Meeting date: Monday 15th July 2019

Attendees:
Leon Dawes (CCC) – LD
Andrew Killen (Northrop) – AK
Lach McRae (Northrop) – LM

Discussion items

1. **Central Coast Council – Design Requirements**
    a. LM requested an update on the amalgamation of Gosford and Wyong water and sewer design codes. LD advised that the process was ongoing and some there were still differences between the former administrative areas.
    b. LD noted that the preference was for water and sewer demands to be expressed in ET rather than EP. ~~LD to provide water and sewer demand estimation parameters.~~ Information received 16/05/19.

2. **Wallarah Industrial - Water**
   a. AK requested confirmation of the feasibility of a water feed from the Blue Haven supply area. LD confirmed that provision of a water feed from the Blue Haven supply area was not currently feasible. Currently, the highest elevation properties are at the minimum 15 m supply pressure under PDD. There are also redundancy issues with an existing DN600 bridge crossing supplying this reservoir.
   b. LD noted that a DN200 feed along the Link Road, connecting to the Blue Haven supply area had been proposed for service the future Hunter Lands development west of the Wallarah site, however water demands from this development were generally low.
   c. LM raised the significant lead-in works required to service the Wallarah site, as illustrated in the 2007 Department of Commerce Proposed Water Supply Network. LD advised that the DN200 watermain to the north of the Wallarah site is intended to be constructed to support the proposed Wallarah 2 Coal Project. Construction of this main will also be dependent on construction of the DN750 Mardi to Warnervale pipeline from Tuggerah 2 reservoir – this is expected to be completed in 2021-22. This is the Phase 1 infrastructure upgrade.
   d. LD advised that in the short term, the proposed DN200 main could be supplied from a PRV on the 375mm main on Sparks Road, which is within the Kanwal reservoir supply zone (Phase 2 upgrade). After Kanwal Reservoir reaches its capacity of minimum 12 hour PDD (approximately 2026) an additional reservoir at Kiar Ridge will be required to meet water demands. (Phase 3 upgrade)
   e. LD advised that CCC had previously proposed an alternative reservoir option to ADW Johnson on the western side of the M1, fed from an existing DN450 stub off the CCIRW-TM (not shown in 2007 Department of Commerce plan). LD noted that CCC's current preference remained the Kiar Ridge reservoir. LM also noted the proximity of the alternative reservoir to a proposed HWC reservoir at Bushells Ridge.
3. **Wallarah Industrial – Sewer**
   a. LD confirmed that the sewer servicing strategy currently documented by Northrop was generally acceptable.
   b. LD recommended a target maximum sewer depth of 3 metres at the proposed SPS. This comment was on the depth of construction of sewer gravity mains with >3m incurring an additional cost based on our estimating guide. SPS depth of construction in a lot of cases will be >3m.
4. **Lake Munmorah Residential – Water**
   a. AK confirmed that the proposed development footprint had changed significantly since the previous strategy.
   b. LD confirmed that the previously proposed water servicing strategy was still applicable. The developer will be required to provide a DN200 cross connection between Carter Road and Chain Valley Bay Road.
5. **Lake Munmorah Residential – Sewer**
   a. LD advised that ADW Johnson Option 2D remained the preferred servicing option. This would involve construction of a new SPS and rising main directly to Mannering Park WWTW.
   b. LD confirmed there are presently capacity limitations with SPS MP13 and MP12 which would be exceeded by the proposed development.

If there is anything included above that appears incorrect/inconsistent, please don't hesitate to contact me for clarification.

Regards,

Andrew Killen
Civil Engineer

Northrop Consulting Engineers
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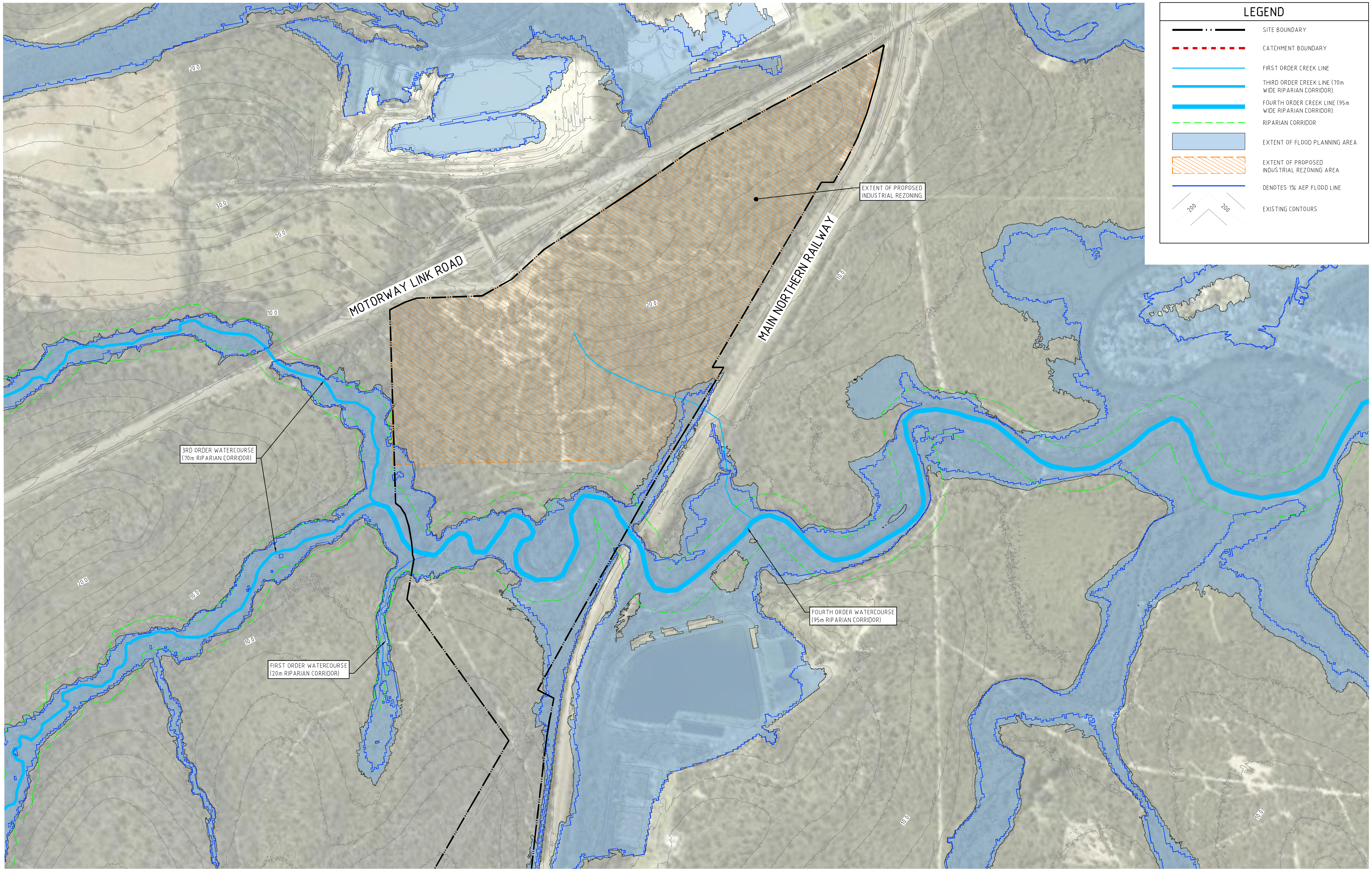
Level 1, 215 Pacific Highway Charlestown NSW 2290
PO Box 180 Charlestown NSW 2290
www.northrop.com.au

Appendix B

Figures



REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
1	ISSUED FOR INFORMATION	JB	BC	BB	12.08.19
2	ISSUED FOR APPROVAL	JB	BC	BB	18.11.19

CLIENT
DARKINJUNG LALC

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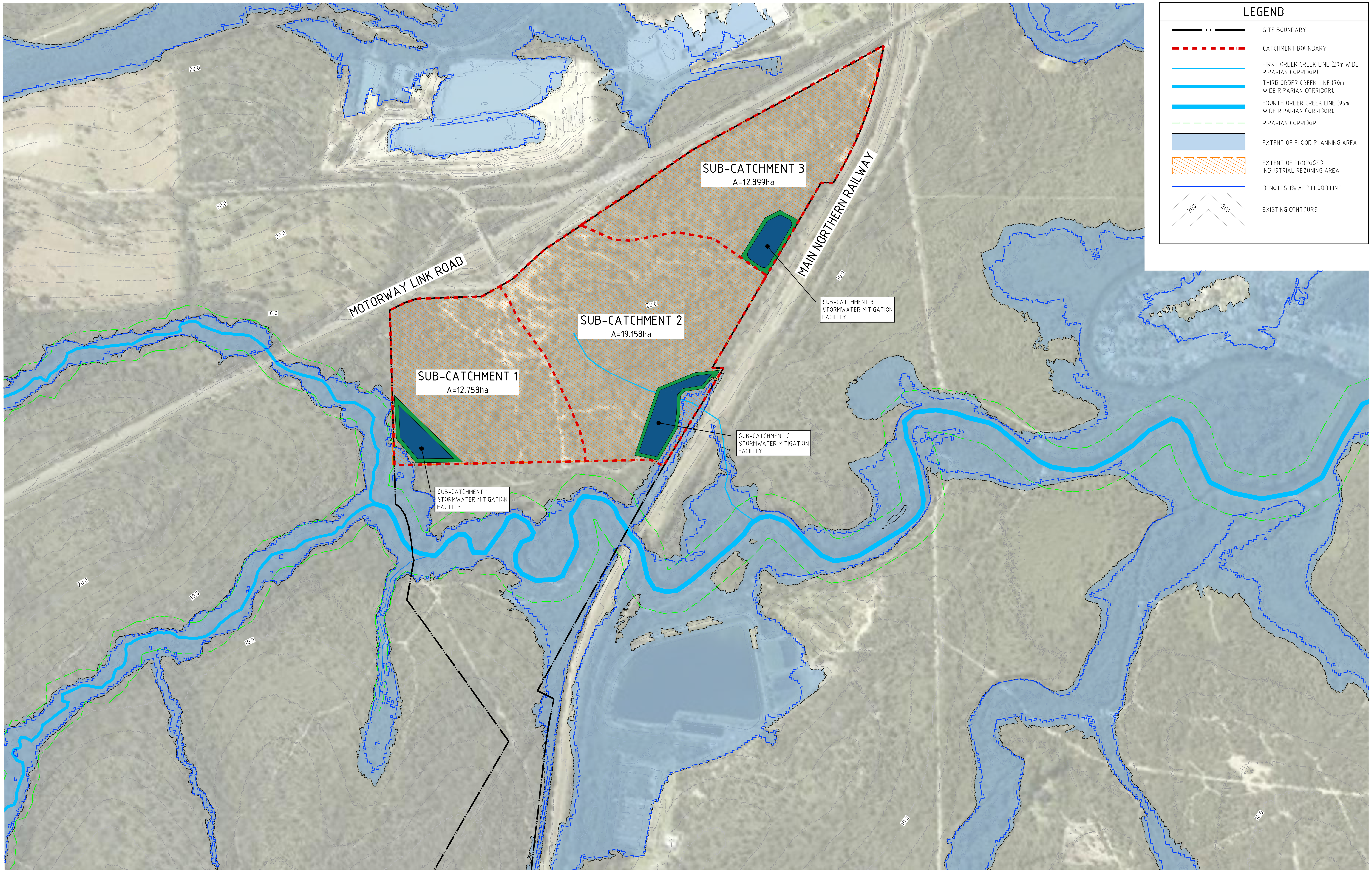
Email newcastle@northrop.com.au ABN 81 094 433 100

PROJECT
**DARKINJUNG RE-ZONING
380 MOTORWAY LINK ROAD,
WALLARAH**

DRAWING TITLE
WALLARAH CREEK RIPARIAN CORRIDOR AND FLOOD EXTENTS

JOB NUMBER **NL191021**
DRAWING NUMBER **WA1.1**
REVISION **2**
DRAWING SHEET SIZE = A1



REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
1	ISSUED FOR INFORMATION	JB	BC	BB	12.08.19
2	ISSUED FOR APPROVAL	JB	BC	BB	15.11.19

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PROJECT

DARKINJUNG RE-ZONING
380 MOTORWAY LINK ROAD, WALLARAH

DRAWING TITLE

PRELIMINARY STORMWATER STRATEGY

JOB NUMBER **NL191021**

DRAWING NUMBER **WA1.2**

REVISION **2**

DRAWING SHEET SIZE = A1

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
1	PRELIMINARY ISSUE	AK		LM	29.07.19

CLIENT: DARKINJUNG LALC

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PROJECT: 380 MOTORWAY LINK WALLARAH

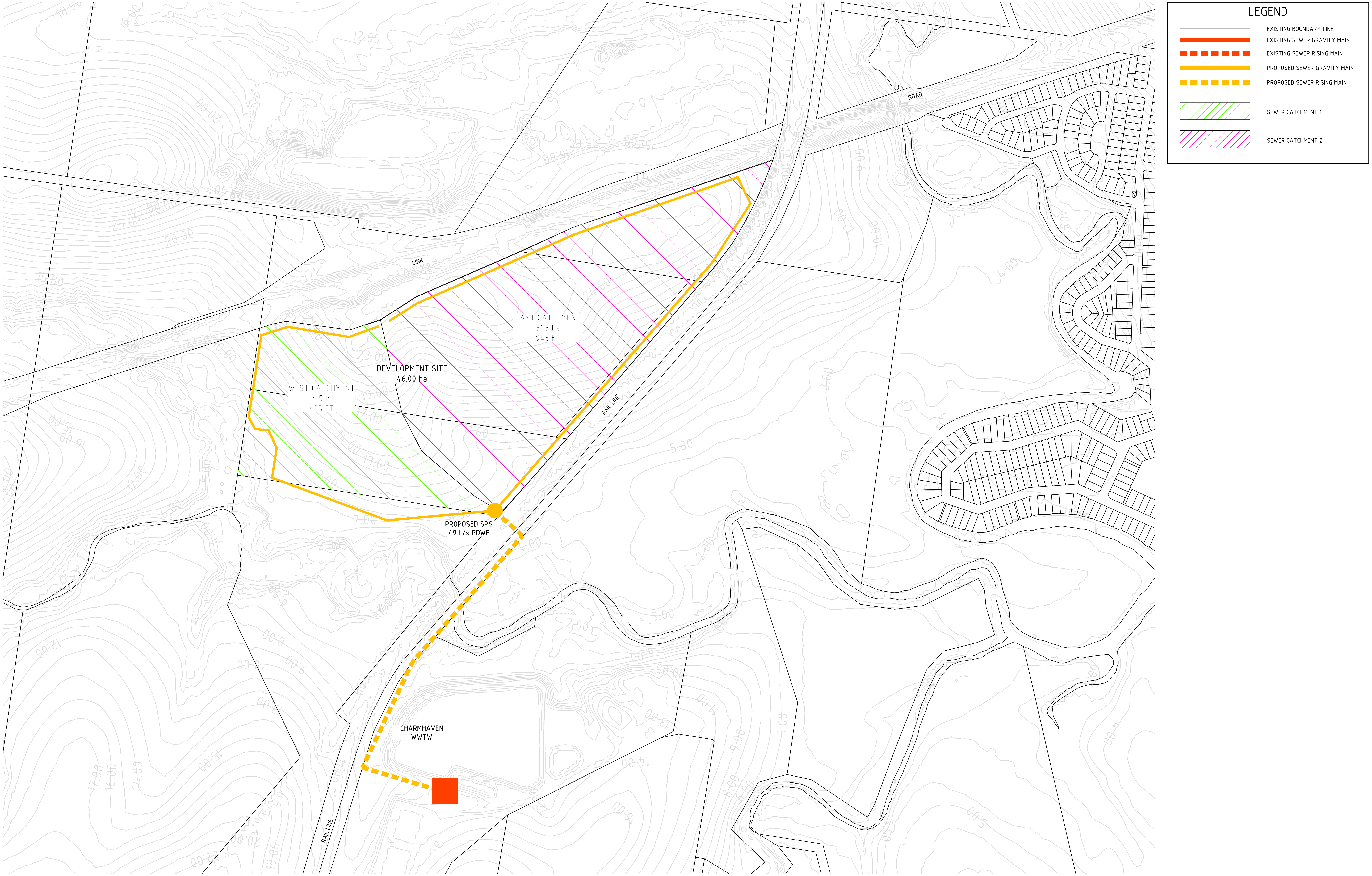
DRAWING TITLE: WATER SERVICING

JOB NUMBER: NL191021

DRAWING NUMBER: WA.20

REVISION: 1

DRAWING SHEET SIZE = A1



REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
1	PRELIMINARY ISSUE	AK		LM	29.07.19

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PROJECT
**380 MOTORWAY LINK
WALLARAH**

DRAWING TITLE
SEWER SERVICING

JOB NUMBER
NL191021

DRAWING NUMBER **WA.30** REVISION **1**

DRAWING SHEET SIZE = A1

Appendix C

MUSIC Link Report

MUSIC-***link*** Report

Project Details		Company Details	
Project:	NL191021 - Wallarah Rezoning	**Company:**	Northrop Consulting Engineers
Report Export Date:	13/08/2019	**Contact:**	Brittany Balcombe
Catchment Name:	NL191021_WALLARAH_V01_BB	**Address:**	Level 1, 215 Pacific Highway Charlestown NSW 2290
Catchment Area:	44.815ha	**Phone:**	4943 1777
Impervious Area*:	81.37%	**Email:**	bbalcombe@northrop.com.au
Rainfall Station:	66062 SYDNEY		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1974 - 31/12/1993 11:54:00 PM		
Mean Annual Rainfall:	1297mm		
Evapotranspiration:	1261mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.32		
Study Area:	Lowland		
Scenario:	Central Coast Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Post-Development Node	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	9.96%	Wetland Node	3	Urban Source Node	6
TSS	82.9%	Swale Node	3		
TP	61%	Rain Water Tank Node	3		
TN	45.2%	Buffer Node	3		
GP	100%	GPT Node	3		

Comments

Central Coast Council

musiclink

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Buffer	Buffer	Proportion of upstream impervious area treated	None	None	0.1
Buffer	Buffer	Proportion of upstream impervious area treated	None	None	0.1
Buffer	Buffer	Proportion of upstream impervious area treated	None	None	0.1
GPT	Humegard 1	Hi-flow bypass rate (cum/sec)	None	99	0.634
GPT	Humegard 2	Hi-flow bypass rate (cum/sec)	None	99	0.813
GPT	Humegard 3	Hi-flow bypass rate (cum/sec)	None	99	0.663
Post	Post-Development Node	% Load Reduction	None	None	9.96
Post	Post-Development Node	GP % Load Reduction	90	None	100
Post	Post-Development Node	TN % Load Reduction	45	None	45.2
Post	Post-Development Node	TP % Load Reduction	45	None	61
Post	Post-Development Node	TSS % Load Reduction	80	None	82.9
Swale	Swale	Bed slope	0.02	0.05	0.02
Swale	Swale	Bed slope	0.02	0.05	0.02
Swale	Swale	Bed slope	0.02	0.05	0.02
Urban	Urban Stage 1 - Road	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Urban Stage 1 - Road	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Urban Stage 1 - Road	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Urban Stage 1 - Road	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Urban Stage 1 - Road	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Urban Stage 1 - Road	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Urban Stage 1 - Roof x 20	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Urban Stage 1 - Roof x 20	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Urban Stage 1 - Roof x 20	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Urban Stage 1 - Roof x 20	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Urban Stage 1 - Roof x 20	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Urban Stage 1 - Roof x 20	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Urban Stage 2 - Road	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Urban Stage 2 - Road	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Urban Stage 2 - Road	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Urban Stage 2 - Road	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Urban Stage 2 - Road	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Urban Stage 2 - Road	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Urban Stage 2 - Roof x 32	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Urban Stage 2 - Roof x 32	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Urban Stage 2 - Roof x 32	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Urban Stage 2 - Roof x 32	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Urban Stage 2 - Roof x 32	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Urban Stage 2 - Roof x 32	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Urban Stage 3	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Urban Stage 3	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	Urban Stage 3	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Urban Stage 3	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Urban Stage 3	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Urban Stage 3	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Urban Stage 3 - Roof x 20	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Urban Stage 3 - Roof x 20	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Urban Stage 3 - Roof x 20	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Urban Stage 3 - Roof x 20	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Urban Stage 3 - Roof x 20	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Urban Stage 3 - Roof x 20	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Wetland	Wetland	Evaporative Loss as % of PET	125	125	125
Wetland	Wetland	Exfiltration Rate (mm/hr)	0	0	0
Wetland	Wetland	Extended detention depth (m)	0.25	0.75	0.5
Wetland	Wetland	Notional Detention Time (hrs)	48	72	48.2
Wetland	Wetland	Number of CSTR Cells	4	4	4
Wetland	Wetland 2	Evaporative Loss as % of PET	125	125	125
Wetland	Wetland 2	Exfiltration Rate (mm/hr)	0	0	0
Wetland	Wetland 2	Extended detention depth (m)	0.25	0.75	0.5
Wetland	Wetland 2	Notional Detention Time (hrs)	48	72	51.8
Wetland	Wetland 2	Number of CSTR Cells	4	4	4
Wetland	Wetland 3	Evaporative Loss as % of PET	125	125	125
Wetland	Wetland 3	Exfiltration Rate (mm/hr)	0	0	0
Wetland	Wetland 3	Extended detention depth (m)	0.25	0.75	0.5
Wetland	Wetland 3	Notional Detention Time (hrs)	48	72	48.9
Wetland	Wetland 3	Number of CSTR Cells	4	4	4

Only certain parameters are reported when they pass validation