Industrial Estate at Lot 210 DP1174939 (Stage 3), Tomago

Stormwater Management Plan

Northbank Enterprise Hub

1918-02-B13, 14 March 2025

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Contents

List of Figures

List of Tables

1 Introduction

1.1 BACKGROUND

Northbank Enterprise Hub Pty Ltd (NEH) proposes to develop Lot 210 (DP1174939) located adjacent to Tomago Road, Tomago (NSW) into an industrial estate (the proposed development) to be known as Tomago Estate. Figure 1.1 shows the location of the proposed development. The proposed development has an area of 50.13 ha and will consist entirely of industrial lots with associated access roads and drainage reserves. The site drains to the Hunter River North Arm.

The proposed development represents Stage 3 of an existing conditional Project Approval granted by the NSW Department of Planning and Environment (DPE) (MP07_0086) (referred to as the "Project Approval") as well as an existing conditional EPBC Approval (2007/3343) granted by the federal government (referred to as the "EPBC Approval"). Both approvals cover the development of the completed Stage 1 (the WesTrac facility located on Lot 212 DP1174939) and the future Stage 2 (Lot 211 DP1174939) both Stage 1 & 2 are owned by a third party with NEH the owner of only Stage 3 (Lot 210 DP1174939) of the project approval. A Stormwater Management Plan was completed for Stage 1 (ADW Johnson, 2010), approved by NSW DPE and the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW). The EPBC Approval area extends for 17 ha into Lot 1001 DP1127780. Annual reporting of water quality and water level data, observations and compliances has been completed for both approvals for over 10 years.

NEH currently has approval for partial filling within the development site (referred to as Stage 3.1A). However, further design and analysis of proposed stormwater management measures is required for the management of runoff from the entire Stage 3 development area approved under the Project Approval.

WRM Water & Environment Pty Ltd (WRM) was requested by NEH to prepare a Stormwater Management Plan (SMP) for the proposed development of Stage 3. The WesTrac Facility (Stage 1 - Lot 212 DP1174939) has been fully developed. Stormwater management for the neighbouring Lot 211 DP1174939 (Stage 2) will be prepared separately and independently from Lot 210 (Stage 3) as it is a separate catchment and ownership.

This report presents the methodology and results of studies undertaken to determine appropriate surface water quality and quantity management measures for the proposed development of Stage 3. Proposed stormwater quantity and quality structures presented in this report were designed to demonstrate that the proposed development complies with the approval conditions attached to the EPBC Approval 2007/3343 and the Project Approval MP07_0086.

A separate Groundwater Monitoring Plan (GMP) has been prepared by Douglas Partners Pty Ltd (DP) to address groundwater-specific requirements of Project Approval MP07_0086. The GMP (DP, 2024) should be referred to for full details.

Section 2 of this SMP provides a list of the approval conditions attached to the EPBC Approval 2007/3343 and the Project Approval MP07_0086 and a summary of how each of these conditions have been addressed.

1.2 REPORT STRUCTURE

This report is structured as follows:

- Section 2 lists the attached conditions to the approval;
- Section 3 provides a description of the existing and proposed site characteristics;
- Section 4 describes the proposed development;
- Section 5 describes the estimation of discharges;

- Section 6 describes the water quantity management strategy for the site;
- Section 7 describes the water quality management strategy for the site;
- Section 8 describes the site water balance;
- Section 9 describes the erosion and sediment control plan;
- Section 10 provides an evaluation of risk;
- Section 11 presents the monitoring strategy;
- Section 12 presents a summary of findings; and
- Section 13 provides a list of references.

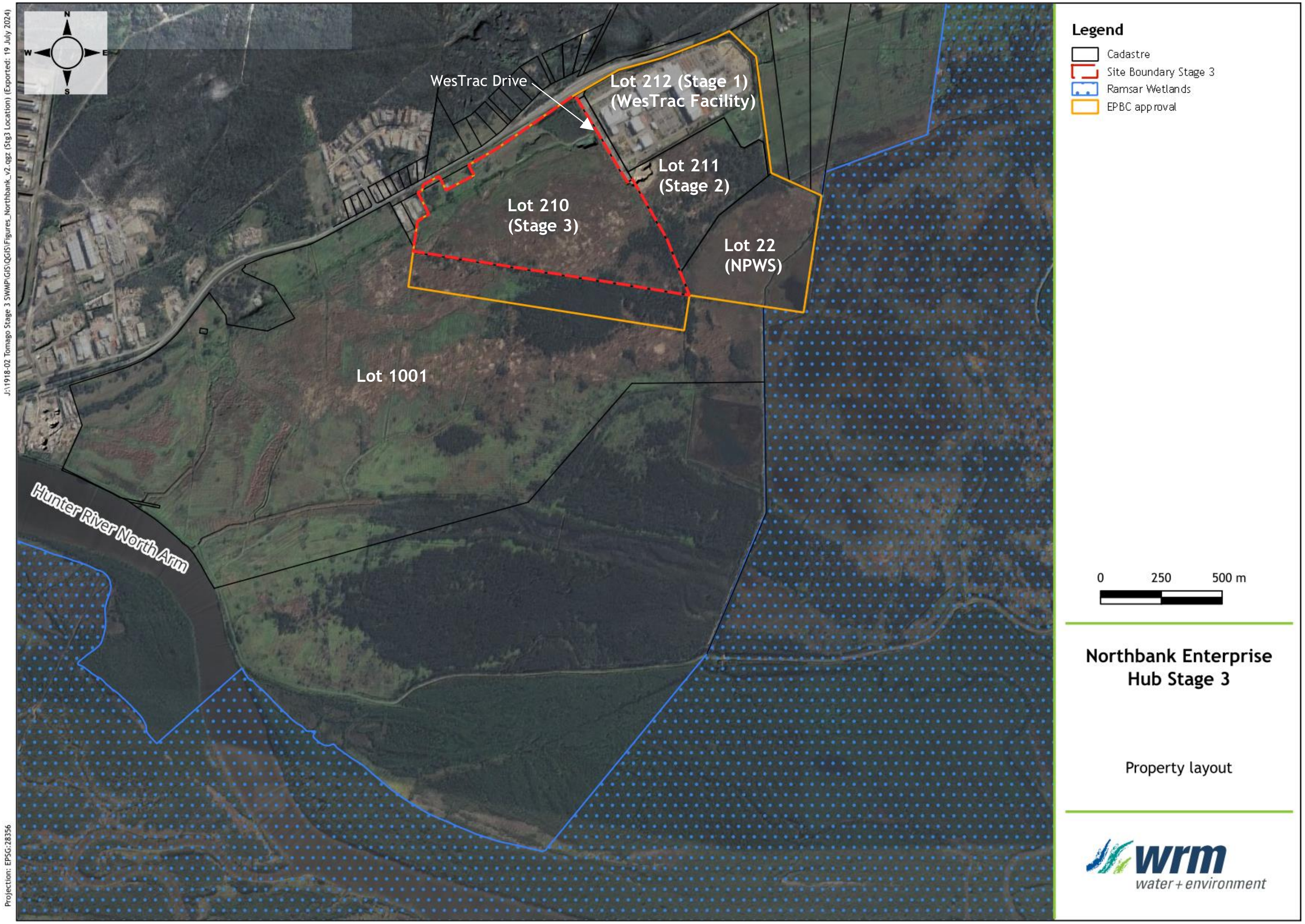


Figure 1.1 – Site locality

2 Stormwater management requirements

2.1 OVERVIEW

The proposed stormwater quantity and quality management strategy presented in this report was designed to demonstrate that the proposed development complies with conditions 2a-e and a-d of the EPBC Approval 2007/3343 (refer to Table 2.1), conditions 8,9,10 and 12 of the Project Approval MP07_0086 (refer to Table 2.2) as well as the draft statement of commitments attached to Project Approval MP07_0086 (refer to Table 2.3).

The following section lists the attached approval conditions and the section(s) of this report in which they are addressed.

2.2 EPBC APPROVAL 2007/3343

Table 2.1 lists the conditions associated with EPBC Approval 2007/3343 and how they are addressed in this report. The Australian Government Department of Environment (now the DCCEEW) Environmental Management Plan Guidelines (DCCEEW, 2014) have been considered in the preparation of this report.

2.3 PROJECT APPROVAL MP07_0086

Table 2.2 lists the conditions associated with Project Approval MP07_0086 and how they are addressed in this report.

Table 2.1 – Conditions attached to EPBC Approval 2007/3343

Item no.		Report section	Demonstration of how this item is addressed in this report
2)	*In order to minimise potential significant impacts on the Hunter River Estuary Ramsar Wetland site, prior to any commencement of works for each stage the person taking the action must submit to the Minister for approval a stormwater and groundwater management plan for that stage. Works must not commence until the plan is approved by the Minister. The approved plan must be implemented and address the following matters:*		
a)	Documented industry best practice water sensitive design principles and practices;	Section 7.2	The proposed water quality management strategy for the development was developed in accordance with water quality objectives and assessment methodologies outlined in both local and state government guidelines listed in this section.
b)	A review of the environmental values and water quality objectives for the Hunter Estuary Wetlands Ramsar Site;	Sections 3.3, 7.2	This report acknowledged that the Ramsar Wetlands are recognised as a significant area of conservation for migratory birds (Sections 3.3). Section 3.3 of this report also summarises the biodiversity values of the Ramsar Wetlands according to the *Kooragang Ramsar Wetland Ecological Character Description* (Brereton and Taylor-Wood, 2010). Water quality objectives (WQOs) from DECC (2007) and HCCREMS (2007) relevant to wetland environments have been considered in this report (Section 7.2).
c)	Replication of natural surface and groundwater flows and water quality;	Section 6 [a]	Two detention basins will be constructed so that peak discharges from the developed site do not exceed pre-development peak discharges. Surface water outflows from the developed site will drain towards the Hunter River through existing registered drainage easements (via Lot 1001) generally as per existing conditions.
d)	Protection of the environmental values of receiving waters, including the Hunter Estuary Wetlands Ramsar Site;	Sections 6.4, 6.5, 7.4.5, 11	The development preserves the environmental values of the Ramsar Wetlands by directing surface water (freshwater) outflows towards the Hunter River (via Lot 1001) and further away from the Ramsar Wetlands (which is intended to be a predominantly tidal environment). Notwithstanding this, two combined wetland-detention basins will be constructed so that peak discharges from the developed site do not exceed pre-development peak discharges, and so that pollutant reduction targets for wetland environments are achieved. In the event of prolonged rainfalls that trigger releases of freshwater from the basins to the undeveloped Lot 1001, the extensive drains and flat undeveloped topography of Lot 1001

Item no.		Report section	Demonstration of how this item is addressed in this report
			provides additional significant retention and storage. The available topographical data indicates that the existing mapped drainage channels at Lot 1001 (refer to Figure 3.1) would direct ponded runoff at Lot 1001 to the west towards the Hunter River and not east towards the Ramsar Wetlands. These drains are regularly cleared to ensure they are remain operational. The Existing Drainage Channel[1] across Lot 1001 to the Hunter River used to convey Stage 3 stormwater runoff is retained in the approved drainage strategy for the proposed industrial subdivision at Lot 1001 (Project Approval MP10_0185). Specifically, outflows from the basins will continue to be conveyed to the Hunter River via constructed open channels within the developed Lot 1001. The future development approval for Lot 1001 will accommodate the flows from Lot 210. Ongoing protection to the adjoining wetlands is also provided via monitoring of Stage 3 drainage and contingency measures. Contingency is provided by a Trigger Action Response Plan (TARP) that will be implemented from the commencement of Stage 3 at the development to define the minimum set of corrective actions required in response to unpredicted impacts to the receiving environment.
e)	The principle of continuous improvement;	Section 11	Baseline monitoring of stormwater and groundwater quality at the development site has been undertaken. Continuous monitoring of stormwater runoff quality from the development will be undertaken to review the baseline water quality parameters. An annual report will be prepared and submitted to State and Federal departments to include a record and analyse trends in stormwater quality, noting any exceedances of criteria (against the baseline values) and allowing for mitigation measures to be developed and implemented, if required. Over 10 years of post-development water quality data, levels, observations during storms and monitoring from Stage 1 provides a very strong base for understanding of the landscape and experience for managing Stage 3 stormwater. Management of Embankment vegetation, monitoring equipment selection which were all improved over time in Stage 1, will be implemented to improve Stage 3 from the outset.
	The plan must include but not be limited to the following elements:		

[1] The “Existing Drainage Channel” refers to the existing drain which runs from north to south within Lot 1001 and is within an existing drainage easement, as shown in Figure 4.1.

Item no.		Report section	Demonstration of how this item is addressed in this report
a)	The water treatment management practices and management practice treatment trains that will be used to achieve or exceed environmental performance targets as detailed in the final Redlake Enterprise Pty Ltd – Tomago Road, Tomago – Environmental Assessment Report dated 12 March 2008 "Concept Engineering, Servicing, Earthworks and Stormwater Management" Appendix F.	Section 7	The proposed water quality management strategy for the development (two constructed wetlands) ensures that the WQOs (i.e. the pollutant reduction targets) detailed in the 2007/2008 Redlake Enterprises's Stormwater Management Plan are achieved.
b)	How attainment of water quality objectives for these receiving waters will be supported by the action	Section 7	Two constructed wetlands are proposed to treat stormwater runoff from the development. MUSIC modelling demonstrates that the proposed water quality management strategy exceeds the WQOs obtained from various sources, including the DECC (2007) and HCCREMS (2007) WQOs relevant to wetland environments.
c)	How monitoring activities will be undertaken to track environmental performance of the action; and	Sections 11	Monitoring of stormwater runoff quality from the development has been undertaken for at least three quarterly monitoring rounds to establish the baseline water quality parameters. Ongoing monitoring will be undertaken on a quarterly to yearly basis (depending on the parameter) to analyse trends and identify exceedances against the baseline. Water quality trigger values have been defined to prompt further investigation and/or develop mitigation measures (if required) in the event of an exceedance against the adopted criteria. A Trigger Action Response Plan will be implemented from the commencement of Stage 3 to monitor the impacts of offsite discharges to the receiving environment and if necessary, implement mitigation measures.
d)	Groundwater and surface water monitoring must be undertaken pre, during and post development. This monitoring must continue until the Minister notifies that the construction and operation of this action is not impacting on the Hunter Estuary Wetlands Ramsar Site.	Section 11 [a]	Surface water and groundwater quality monitoring will be undertaken as described in Item 2(c) above. Annual reports will continue to be prepared and submitted to record and analyse trends in stormwater quality, noting any exceedances of criteria (against the baseline values) and allowing for mitigation measures to be developed and implemented. Annual reporting will continue until further notification from the regulatory body.

[a] – Groundwater specific requirements are addressed in a separate Groundwater Management Plan prepared by Douglas Partners Pty Ltd (DP, 2024)

Table 2.2 – Conditions attached to Project Approval MP07_0086

Item no.		Report section	Demonstration of how this item is addressed in this report
8)	*The Applicant must prepare and implement a Soil and Water Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:*		
a)	be submitted to the Planning Secretary for approval at least one month prior to the commencement of construction of Stage 1;	n/a	This SMP has been submitted per the condition stated.
b)	be updated and submitted to the Planning Secretary for approval at least one month prior to the commencement of construction of Stages 2 and 3	n/a	This SMP has been submitted per the condition stated.
c)	Be prepared in consultation with Council, HWC and OEH;	Appendix I	Draft version(s) of this SMP have been provided to Council, HWC and OEH for review and feedback.
d)	Include: • A Site Water Balance; • A Sediment and Erosion Control Plan; • An Acid Sulphate Soils Management Plan; • A Stormwater Management Scheme; and • A Groundwater Monitoring Program for Tomago sand beds; • A Wastewater Management Plan	Section 6, 7, 8, 9	This SMP presents a Site Water Balance in Section 8, a Sediment and Erosion Control Plan in Section 9. The Stormwater Management Scheme is described in Section 6 (water quantity management) and Section 7 (water quality management). Matters related to groundwater and acid sulphate soils were assessed separately by Douglas Partners Pty Ltd. Wastewater Management Plan requirement is redundant due to network authority connection.
9)	*The Site Water Balance must:*		
a)	Include details of: • sources and security of water supply; • water use/reuse on-site; • water management on-site; • reporting procedures;	Section 8, 11	Section 8 describes provides details of the sources of water supply (Section 8.2), the proposed water re-use strategy (Section 8.3), comparison of surface water discharges from the developed site compared to pre-development conditions (Section 8.4). Water management includes piped drainage and swales for conveyance and stormwater basins for detention and treatment. Water management also includes a surface and groundwater water monitoring program will be implemented for the developed site. Monitoring results are recorded and provided in Annual Reporting.

Item no.		Report section	Demonstration of how this item is addressed in this report
			A review of the SMP and GMP including the water quality and quantity monitoring program should be undertaken when improvements to performance have been recommended by the consultant in annual reports or as directed by the environmental authority.
b)	Describe measures to minimise potable water use by the development and maximise reuse of rainwater harvested from the site; and	Section 8.3	Rainwater tanks will be provided at the individual industrial lots for stormwater capture and re-use. The total rainwater tank storage volume requirement was estimated based on the rainwater harvesting scheme in place for the previous stage, Stage 1, adjacent to Stage 3. It was calculated to be approximately 5 kL per 100 m^2 of roof area, to be apportioned between the future industrial lots. This requirement has been specified in the Stage 3 Design Guidelines for development.
c)	Be reviewed and recalculated each year in light of the most recent water monitoring data; and	Section 11	Surface water and groundwater monitoring has been in place for in excess of 10 years for Stage 1 and was reviewed and used for Stage 3 calculations. A surface and groundwater water monitoring program will be implemented for the developed site. Monitoring results are recorded and provided in Annual Reporting. Monitoring results are recorded and provided in Annual Reporting. A review of the SMP and GMP including the water quality and quantity monitoring program should be undertaken when improvements to performance have been recommended by the consultant in annual reports or as directed by the environmental authority.
d)	compare measured surface water discharges and groundwater inflows, outflows and infiltration, relative to pre-development conditions.	Section 8.4.5	Section 8.4 describes the modelling, monitoring and estimation methods used to compare the surface water discharges from the developed site compared to pre-development conditions. It was estimated that the proposed development potentially increases freshwater discharge from the development site by approximately 194.7 ML based an average rainfall year. In response to Condition 12(b), the Stormwater Management Scheme was prepared to comply with HCCREMS (2007). HCCREMS (2007) states: “Excess stormwater can be exported to other catchments via pipelines and discharged into rivers as ‘environmental flows’, subject to suitable treatment”.

Item no.		Report section	Demonstration of how this item is addressed in this report
10)	*The Erosion and Sediment Control Plan must:*		
a)	be consistent with the requirements of Landcom's (2004) Managing Urban Stormwater: Soils and Construction	Section 9	Section 9 describes the Erosion and Sediment Control (ESC) Strategy for the proposed development. The ESC Plan adopts the three cornerstones of ESC: drainage control, erosion control and sediment control in accordance with Landcom (2004).
b)	identify the activities on site that could cause soil erosion and generate sediment; and	Section 9	Section 9.2 describes the list of activities that may cause erosion at the development site. However, conventional preventative measures will be implemented.
c)	describe what measures would be implemented to: • minimise soil erosion and the transport of sediment to downstream waters, including the location, function and capacity of any erosion and sediment control structures and; • maintain these structures over time;	Section 9	Primary control of sediment will be provided by two sediment basins which will be constructed within the footprints of Basins 2 and 3. The total minimum sediment basin volume has been determined based on the Landcom (2004) design standards and methodology for a Type F sediment basin. Supplementary sediment controls will be used in areas where the sediment producing catchment is small or the potential for producing sediment laden runoff is low. These measures may include check dam sediment traps and sediment fences. Section 9.6 describes the monitoring and maintenance strategy for the proposed ESC measures.
12)	*The Stormwater Management Scheme must:*		
a)	be prepared in consultation with Council and OEH;	Appendix I	Draft version(s) of this SMP have been provided to Council, HWC and OEH for review and feedback.
b)	be prepared in accordance with DECC's Managing Urban Stormwater guidelines and HCCREMS Water Sensitive Urban Design Solutions for Catchments Above Wetlands;	Section 7.2	The proposed stormwater treatment strategy was designed to satisfy the DECC (2007) and HCCREMS (2007) WQOs as a minimum. Council's WQO's have also been considered in this assessment for comparison.
c)	demonstrate that post development flows will not exceed predevelopment flows for a range of ARI from 1 year up to and including the 100 year ARI;	Section 6	Hydrologic modelling was undertaken to demonstrate that two detention basins will be sufficient for peak discharges from the developed site to not exceed pre-development peak discharges for all events up to 1% AEP (100 year ARI). Surface water outflows from the developed site will drain towards the Hunter River (via Lot 1001) generally as per existing conditions.

Item no.		Report section	Demonstration of how this item is addressed in this report
d)	investigate alternative options to avoid discharges to the adjoining wetlands to the south of the site;	Section 6.5	A drainage corridor will be provided along the southern boundary of Lot 210 for the drainage of stormwater outflows from Basin 2. Stormwater outflows from Basin 2 will drain west within this drainage corridor and then combine with outflows from Basin 3, before discharging at a single discharge point at the southwestern corner of Lot 210 to an Existing Drainage Channel within Lot 1001. The Existing Drainage Channel is within an existing easement for drainage across Lot 1001 draining to the Hunter River. The location of the discharge point is consistent with the Project Approval MP07_0086 and was also selected to discharge as far west as possible, therefore ensuring that all runoff from the fully developed site would drain southwest to the Hunter River and not east towards the Ramsar Wetlands.
e)	demonstrate that the existing stormwater drainage channels have capacity to accommodate post development flows under a range of tidal conditions;	Sections 4.2.5, 6.5 & 6.6, 8.4.6	As per the response for Item 12(d), stormwater outflows from Basins 2 and 3 will be discharged at a single discharge point at the southwestern corner of Lot 210 to the 1.7 km long Existing Drainage Channel within Lot 1001. The proposed Basin 2 and 3 outlets were configured to release stormwater from Stage 3 at a slow rate not exceeding the maximum flow rates under pre-developed conditions.

The proposed stormwater management measures for Stage 3 will be implemented in three key stages/phases referred to as Phase 1, Phase 2 and Phase 3, as summarised below:

- Phase 1 involves clearing of vegetation in the Existing Drainage Channel in Lot 1001 (which has already been undertaken in 2024), in conjunction with the proposed installation of water monitoring well with a data logger, for the monitoring of water levels in Lot 1001 near the outlet to the Hunter River.
- Phases 2 and 3 involves the construction of Basins 2 and 3, respectively, upfront in conjunction with earthworks prior to the building construction of the development areas within the upstream catchments of each basin. The basin outlet pipes will be sized and constructed to its final specification, maximising flow detention and reducing reliance on downstream drainage infrastructure.
- Ongoing maintenance of the Existing Drainage Channel in Lot 1001 will continue to be undertaken and its capacity to be verified with ongoing monitoring.

A Trigger Action Response Plan (TARP) (shown in Appendix H) has been prepared to accompany monitoring analysis post development, including the monitoring of the existing open drain capacity through Lot 1001 and the contingency responses in the event of adverse monitoring results.

The invert levels of the basin outflow pipes for attenuation in Basins 2 and 3 are above the Mean High-Water Springs (MHWS) level of 0.69 mAHD in the Hunter River North Arm. However, there are existing levees and flood control structures (such as controlled and uncontrolled floodgates) beyond the boundary of Lot 210 that prevent Hunter River water from flowing through the levee towards the development site during high tides and during floods. The levee and floodgates are managed by a government agency. In reality, Basin 2 and 3 outlets are not affected by tidal influences.

The post-development annual outflow from Stage 3 was estimated to be around 514 ML/yr for an average rainfall year. This equates to about 5.5 ML per rain day (93 rain days per year)

Item no.		Report section	Demonstration of how this item is addressed in this report
			directed into the Existing Drainage Channel. The downstream available storage and outflow capacity was found to be sufficient to convey the average daily outflows from the fully developed Stage 3 to the Hunter River under normal average rainfall conditions. Under severe or rare rainfall conditions, two-dimensional (2D) hydraulic modelling have demonstrated that there will be a reduction in runoff flow volumes draining toward the Ramsar Wetlands under the developed scenario of Stage 3 compared to existing conditions due to the redirection of Site runoff to the Existing Drainage Channel. The modelled capacity of the entire drainage system, including the Existing Drainage Channel, was analysed and is considered adequate to accommodate post-development flows under a range of tidal conditions.
f)	demonstrate that the extended detention depth of the infiltration area allows vegetation growth and minimises groundwater mounding.	Not applicable.	Not applicable.
g)	include provision for the drainage flow paths for culverts under Tomago Road through the site;	Section 4	The existing 0.6 m diameter pipe at the northeastern corner of the site (which conveys runoff from Tomago Road) would discharge into the proposed Channel 1, therefore maintaining cross drainage beneath Tomago Road.

Item no.		Report section	Demonstration of how this item is addressed in this report
h)	Includes details of the: • Stormwater detention (capacity and location); • Treatment and control infrastructure including pre-treatment for the infiltration area to reduce sediment and nutrient loads, the drainage design for the disposal of stormwater off-site and the method of controlled release from the site; and • Measures to monitor and maintain the stormwater treatment and control infrastructure; and	Sections 6, 7, 8, 11	Two combined wetland and detention basins will be constructed at the southeastern corner of the site (Basin 2) and one at the southwestern corner of the site (Basin 3) to provide stormwater detention and treatment. The two basins will have a total surface area of 5.65 ha and a total volume of 70,107 m^3 below the spillway level. Section 6 describes the outlet configuration of Basins 2 and 3, which were sized so that peak discharges from the developed site do not exceed pre-development peak discharges. Hydraulic modelling has been undertaken to evaluate overflow risks of the existing drains downstream of Stage 3. The model results demonstrated that there will be a reduction in flow volumes draining towards the Ramsar Wetlands under the developed scenario of Stage 3 compared to existing conditions due to the redirection of Site runoff to the Existing Drainage Channel on Lot 1001. The proposed wetland (at the base of Basins 2 and 3) were designed to satisfy the DECC (2007) and HCCREMS (2007) WQOs as a minimum. Trash racks and GPTs will also be installed at the inlets to Basins 2 and 3 to remove litter. Details of proposed monitoring measures are described in Section 11 and summarised in the response to Item 12(i).

Item no.		Report section	Demonstration of how this item is addressed in this report
i)	Include a program to monitor stormwater quantity (including inflows, outflows and bypass flows) and quality (including but not limited to total suspended solids, total phosphorous and total nitrogen during operation of the development.	Section 11	Monitoring of stormwater runoff quality from the development has already been undertaken by Douglas Partners for the three quarterly monitoring rounds to establish the baseline water quality parameters. Ongoing monitoring will be undertaken on a quarterly to yearly basis (depending on the parameter) to analyse trends and identify exceedances against the baseline. Water quality trigger values have been defined to prompt further investigation and/or develop mitigation measures (if required) in the event of an exceedance against the adopted criteria. A Trigger Action Response Plan will be implemented from the commencement of Stage 3 to monitor the impacts of offsite discharges to the receiving environment and if necessary, implement mitigation measures.
			Annual reports will continue to be prepared and submitted to record and analyse trends in stormwater quality, noting any exceedances of criteria (against the baseline values) and allowing for mitigation measures to be developed and implemented. Annual reporting will continue until further notification from the regulatory body.

Table 2.3 – Draft statement of commitments attached to Project Approval MP07_0086

Item no.		Report section
8.7	***Water quality***	
	Water quality measures will be installed in accordance with the report prepared by Asquith & de Witt. The water quality objective for the site was to determine a solution of 'no impact' to the downstream receiving waters. The MUSIC (Model for Urban Stormwater Improvement Conceptualisation) model was established to verify the quantity of the runoff to the wetlands for 'no impact', post development. Reuse, a treatment train, gross pollutant trap, swale and constructed wetland was sized to meet the target objective verified with MUSIC.	 Section 7.2
	Water quality will be monitored, and a management plan, as detailed in the Flora & Fauna Report prepared by Eco biological, will be prepared to address the construction and operational phases. More specifically this management plan will include: • The nature and control of sediment run-off during the construction phase particularly as a result of an exceptional storm event; • The chemical content of the fill and of the groundwater seepage from that fill that would disperse into the wetlands over the long term; • The volume, path and content of stormwater discharging from the site during and after development; • The handling of hydrocarbon waste from the site during construction and operation stages; • Existing flow regime of subsurface and groundwater flow from the subject site into the wetlands; • At times of peak rainfall, sub-surface drainage through the fill is likely to discharge into the wetland – what will be the impact of the development on the quality of this water; • The current ecological character of the wetland in the immediate vicinity of the potential impact area; and • The impact of weed invasion during and after construction phase.	Sections 0, 9
	A monitoring plan will also be put in place to document the ongoing water quality status, measured against an established baseline.	Section 11
	All products stored on-site having the potential to contaminate stormwater in the event of spillage will also be contained within a bounded area to the requirements of DECC.	Codes of Practice, Regulations and Australian Standards
	Stormwater controls	

Item no.		Report section
	Water quality control on site will be 2 proposed washpads. All vehicles and parts requiring washing will be taken to one of these, and no washing outside of these washpads will occur. WesTrac has standardised control over these facilities country wide at its existing operations.	Not applicable to Stage 3
	A Construction Management and Environmental Management Plan will be prepared to manage potential water quality issues and submitted as required prior to construction or commencement of ADW Johnson - separate cover Soil and Water Management Report for 6 WEPL Investments WesTrac facility at Tomago Road, Tomago NSW (Ref: 11886_Soil and Water Version D) Requirement Description Section reference/ Comment operations.	Addressed separately from this SMP
	The stormwater treatment train will be used for removal of the pollutants from the stormwater runoff prior to discharging to the wetlands downstream.	Section 7
	Gross Pollutant Traps will be installed at the entry to each of the constructed wetlands as a proprietary product for screening of heavy sediment and litter.	Section 7
	A large open channel swale drain has been designed into the development layout for street drainage, drainage of the intersection and secondary flows during major storm events. End of line treatment basins have been spread over the site to reduce the distances drainable for stormwater runoff.	Sections 4, 6, 7
	Basins have been located to have discharge outlets to the existing discharge points from the site along the southern boundary, post development.	Sections 4, 6, 7
	The site will be filled for development of the subdivision to a level that is flood free.	Sections 4
	Geotechnical approval will be obtained on the fill type and its properties prior to being used on the site. However, the preferred fill type is granular material with particles not greater than 100mm diameter. The fill will be pH neutral and will be screened for properties under the supervision of geotechnical engineers, prior to supply to the site. No ash will be used for filling.	Addressed separately from this SMP
	Soil and water management plan	
	The sediment basins have been designed for settlement of Type F soils. A higher criteria level of protection has been adopted for the design sizing of the sediment basins, reflecting the sensitivity of the receiving waters downstream. The 95th percentile, 5 day rainfall event has been selected as the standard for this site, which provides an increased capacity to capture runoff and minimised the potential risk of sediment laden water leaving the site and discharging to the wetlands.	Section 9
	Access is to be limited to the designated all weather roads, any truck exiting out of the site shall be thoroughly cleaned and limit the exportation of clay and sediment on public roads, and entry is prohibited on remaining land.	Section 9

Item no.		Report section
	Works shall be undertaken in the following construction sequence: 1) Install sediment fencing and cut drains to meet the requirements of the SWMP. Waste collection bins shall be installed adjacent to site office. 2) Construct stabilised site access in location nominated by the Contractor and in accordance with Port Stephens Council's requirements 3) Construct sediment basins for disturbed areas in accordance with the rate per hectare provided in the SWMP. Install risers and two pegs in the floor of the basin and have them marked to show the top of the sediment storage zone. Ensure the basin is cleared of sediment once the design capacity is reached. 4) Redirect clean water around the construction site. 5) Install sediment control protection measures at all natural and man-made drainage structures. Maintain until all the disturbed areas are stabilised. 6) Clear and strip the work areas in accordance with the Geotechnical advice provided. 7) Any disturbed areas, other than lot grading areas, shall immediately be covered with site topsoil within 7 days of clearing. Lot re-graded shall be covered with bitumen emulsion as specified. 8) Apply permanent stabilisation to site (landscaping).	Section 9.5

Sediment control conditions will include the following: • Proprietary sediment fencing shall be installed by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent to contain sediment fractions as near as possible to their source. • Sediment removed from any trapping device shall be relocated where further pollution to down slope lands and waterways cannot occur. • Stockpiles shall be located by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent. Where stockpiles are to be in place longer than 30 days they shall be stabilised by covering with mulch or with temporary vegetation. • Water shall be prevented from entering the permanent drainage system unless it is sediment free. Drainage pits are to be protected in accordance with the Contractor’s approved SWMP. • Temporary sediment traps at pits shall be retained until after lands they are protecting are completely rehabilitated. • Dust suppression will be required for the control of airborne particles during construction. This will be via standard water cart usage during earthworks and pavement construction of the hardstand areas. Site maintenance requirements include the following: • Waste bins are to be provided for all construction refuse. They are to be emptied at least weekly and refuse is to be disposed in accordance with the site manager’s recommendations.	Section 9.4
The site manager shall inspect the site at least weekly and shall: • Ensure that all drains are operating effectively and shall make any necessary repairs; • Remove any spilled material from area subject to runoff or concentrated flow; • Remove trapped sediment where the capacity of the trapping device falls below 60%; • Inspect the sediment basins after each rainfall even and/or weekly. Ensure that all sediment is removed once the sediment storage zone is full. Ensure that outlet and emergency spillway works are maintained in a fully operational condition at all times; • Ensure rehabilitated lands have effectively reduced the erosion hazard and initiate upgrading or repair as appropriate;	Section 9.6

Item no.		Report section
	• Construct additional erosion and sediment control works as may be appropriate to ensure the protection of down slope lands and waterways; • Maintain erosion and sediment control measures in a fully functioning condition at all times until the site is rehabilitated; • Ensure that the revegetation scheme is adhered to and that the all grass covers are kept healthy, including watering and mowing; and • Remove temporary soil conservation structures as the last activity in the rehabilitation program.	
8.8	***Flow regime*** The proposed development will comply with the water balance prepared by Asquith & de Witt. The water balance model outcomes will be complied with and intend to provide the following:	Not applicable to Stage 3
	A water balance model including recycling, uses and quantities associated with the operation of the WesTrac facility, as a guide for WesTrac;	Not applicable to Stage 3
	An estimate for the rainwater storage requirements to ensure water security for the project;	Section 8.3
	An estimate of recharge to the HWC Special Area;	Not applicable to Stage 3
	An estimate of the quantity of runoff discharging to the wetlands downstream; and	Section 8
	An identification of the expected key risks to water management based on the outcomes of the water balance.	Section 8
8.9	***Water reuse*** The proposed development will comply with the water harvesting and recycling plan outlined in the report prepared by Asquith & de Witt. More specifically, the washpads proposed on site for the purpose of cleaning heavy vehicle equipment prior to workshop activities will be the primary water quality control on site. The process will involve using a biodegradable detergent which releases free oil after addition of an emulsion breaker for efficient oil separation and collection, together with a detergent stripping stage using a foam fractionator. The resultant treated water will be recycled through a filtration and sterilisation stage. A portion of treated water is removed from the circuit and sent for final treatment to the site sewage treatment plant.	Not applicable to Stage 3
	Water for washpad operations is derived from three (3) sources: Rainwater harvesting; Town water; and Recycled water.	Not applicable to Stage 3
	The resultant wastewater will be pumped to a settling tank after dosing with a primary flocculant. The primary flocculant dose breaks all emulsions and presents free oil and wastewater to the skid mounted oil/water separator. Oil/water separation is achieved using a heavy duty coalescing plate separator.	Not applicable to Stage 3

Item no.		Report section
	Wastewater produced by the separator is further treated by a foam fractionator.	
	The treated washpad wastewater will be recycled after surfactant removal. Recycled water undergoes further treatment using chlorination and sand filtration. The recycled water feeds a low pressure wash unit with inline UN sterilisation. The spent washwater drains to the solids sump at the start of processing for reuse.	Not applicable to Stage 3
8.10	***Soil erosion and sedimentation*** Erosion and sedimentation controls will be installed in accordance with the report prepared by Asquith & de Witt. More specifically, measures to be implemented during construction include:	Section 9
	Disturbance only of areas to be immediately worked on and regeneration of dust and erosion free surfaces - landscaping, concrete, bitumen sealing as soon as practical thereafter.	Section 9
	Provision of and continued maintenance of sediment fencing to low perimeter locations.	Section 9
	Provision of mesh and gravel or geotextile inlet filters.	Section 9
	Contract specifications requiring stabilised site access, low flow earth flow earth banks and wind erosion screens.	Section 9
	A construction programme that provides for the sediment basin to be constructed at the outset with all site runoff, where practical, piped or channelled to this basin for primary treatment/settlement before leaving the site via a mesh supported geotextile filter/riser before discharging to the wetlands.	Section 9
	Contract specifications requiring regular maintenance of all erosion and sediment control structures and devices for the full contract and maintenance period.	Section 9
	Furthermore, sediment control conditions will include the following: Proprietary sediment fencing shall be installed by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent to contain sediment fractions as near as possible to their source. Sediment removed from any trapping device shall be relocated where further pollution to down slope lands and waterways cannot occur. Stockpiles shall be located by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent. Where stockpiles are to be in place longer than 30 days they shall be stabilised by covering with mulch or with temporary vegetation. Water shall be prevented from entering the permanent drainage system unless it is sediment free. Drainage pits are to be protected in accordance with the Contractor's approved SWMP. Temporary sediment traps at pits shall be retained until after lands they are protecting are completely rehabilitated. Dust suppression will be required for the control of airborne particles during construction. This will be via standard water cart usage during earthworks and pavement construction of the hardstand areas.	Section 9

3 Existing site characteristics

3.1 SITE LOCALITY

Figure 1.1 and Figure 3.1 shows the location of the development site. The site is bounded by Tomago Road to the north, WesTrac Drive to the northeast, Lot 211 DP1174939 (Lot 211) to the southeast and Lot 1001 DP 1127780 (Lot 1001) to the south and west. Lot 1001 is also owned by NEH and approved by NSW DPE for business/industrial development (project approval MP10_0185).

3.2 TOPOGRAPHY AND DRAINAGE CHARACTERISTICS

Figure 3.1 and Figure 3.2 shows the topography and existing regional drainage features in the vicinity of the development site. Based on LiDAR data obtained in 2014, the northern part of the development immediately adjacent to Tomago Road comprises a low sand dune formation with elevations of between 3.0 mAHD and 4.5 mAHD. LiDAR data shows that the vast majority of the development site comprises low-lying alluvial plains, with elevations of between 0.5 mAHD and 1.5 mAHD. The existing ground at the site slopes down to the southeast towards the southern site boundary. Most of the site is covered by tall and thick grasses.

Recent ground survey for an area at the northeast of the development site and adjacent to WesTrac Drive (shown in Figure 3.3) indicate that LiDAR ground levels along Tomago Road and WesTrac Drive are within 0.1 m of the surveyed ground levels. However, the surveyed ground levels within the grassed areas of the development site are on average approximately 0.5 m lower than what the LiDAR data is indicating, which is likely due to the thick grass cover. Therefore, LiDAR ground levels at the vast majority of the site is potentially about 0.5 m higher than actual ground levels subject to survey.

Runoff from the existing site (Stage 3) generally drains via sheet flow from Tomago Road towards the southern site boundary. There are a number of open channels (farm drains) that were previously excavated within and in the vicinity of the development site. These drains currently drain to the south and to Lot 1001. An existing grassed swale along the western side of WesTrac Drive convey runoff from WesTrac Drive and parts of Tomago Road towards the southeastern corner of the site. Ground survey indicates a 0.6 m diameter pipe at the upstream end of the existing swale adjacent to WesTrac Drive, which is assumed to convey runoff from Tomago Road. Existing man-made open channels, many of which are protected by drainage easements, to the south of the site (within Lot 1001) convey runoff from the southern development site boundary across Lot 1001 to the Hunter River North Arm.

There is an existing drain which runs east along the southern boundary of Lot 22 from the southeastern corner of the development site (Stage 3) (refer to Figure 3.2). A culvert exists at the upstream (western) end of this drain, which in the past would have conveyed some runoff from the development site to the east (into Lot 22). However, site observations indicate that this culvert is fully blocked and would be unable to convey flow. In addition, the existing approval for Stage 3.1A included a commitment to capping off this blocked culvert permanently. As a result, runoff from the entire development site (Stage 3) drains south and not east via this existing drain toward Lot 22 (the National Parks and Wildlife Service (NPWS) Estate).

The existing topography shown in Figure 3.1 and Figure 3.2 indicate that surface runoff from large areas to the north of Tomago Road and north of the development site would report to a topographical depression just north of Tomago Road and potentially drain across the road towards the development site. Site observations (summarised in Figure 3.4) indicate the presence of a 0.5 m diameter pipe just south of Graham Drive and underneath Tomago Road. However, a cross-drainage pipe across Graham Drive (downstream of the depression) could not be located. It was assumed that the 0.5 m diameter pipe downstream of Graham Drive connects to the 0.6 m diameter pipe at the northeastern corner of the development site.

The neighbouring WesTrac facility (Stage 1 – Lot 212) is a separate catchment from the development site (Stage 3). Runoff from Lot 212 (Stage 1, with a catchment area of approximately 23 ha), is captured in a constructed wetland at the southeastern corner of Lot 212. Runoff in excess of the wetland's capacity in Stage 1 would discharge to the south to Lot 22 (the NPWS Estate) and then into the North South Drain. Monitoring of discharges from Lot 212 (Stage 1) has been undertaken and documented by annual reporting for over 10 years to NSW DPE and DCCEEW.

A series of levees and flood control structures are in place along the Hunter River North Arm as part of the Hunter River Valley Flood Mitigation Scheme (refer to Figure 3.1). These structures have significantly changed the hydrology of the land behind the levee (including the development site). During floods and/or high tides, water from the Hunter River North Arm does not overtop the existing levee until flooding in the river reaches approximately 1.5 mAHD. According to the flood study undertaken for the Northbank Enterprise Hub and Industrial Park (BMT WBM, 2012), the levee would not be overtopped by the Hunter River during events up to and including 10% AEP event.

3.3 RAMSAR WETLANDS

The Hunter Wetlands National Park is located southeast of the site and includes wetlands of international importance (referred to as Ramsar wetlands). These wetlands are recognised as a significant area of conservation for migratory birds. The Ramsar wetlands also extend to areas to the south of the Hunter River North Arm.

According to the *Kooragang RAMSAR Wetland Ecological Character Description* (Brereton and Taylor-Wood, 2010), the Hunter Estuary Wetland Ramsar site has a range of biodiversity values and supports:

- A range of estuarine vegetation communities including intertidal sand and mud flats, saltmarsh, and freshwater/brackish wetlands which are important foraging and roosting habitat for migratory birds;
- Infauna in intertidal mudflat areas which provide food for migratory waders;
- Seventeen species of migratory shorebirds;
- More than 1% of the Australian population of red-necked avocet; and
- A high diversity of flora and fauna … including 38 bird species which are listed as migratory under the EPBC Act.

Figure 3.1 shows the extent of the Ramsar Wetlands in the vicinity of the development site. The existing "north-south drain" and its raised banks represent a physical barrier which prevent local catchment runoff from the existing site from draining east to the Ramsar wetlands.

3.4 TOMAGO SAND BEDS

3.4.1 General

The Tomago Sandbeds is an underground water source that runs parallel to the coast between Newcastle and Port Stephens, starting at Tomago and stretching northeast for 25 km towards Lemon Tree Passage (refer to Figure 3.5).

The development site (Stage 3) surface water and groundwater regime drains south away from the Tomago Sandbeds. However, the area to the north of Tomago Road is part of the contributing catchment draining from the Tomago Sandbeds. The Tomago Sandbeds flow through the site as groundwater base flows generated by the high infiltration rates over the sandbeds.

Whilst the Hunter Water Special Areas Zone ("Tomago Sandbeds" on Figure 3.5) is mapped as including the northeast corner of Stage 1, Hunter Water has previously clarified this as an overflow area rather than a drawdown catchment area. Mapping and consultation with Hunter

Water confirm that the Special Area Zone is upslope and upstream of Stage 3. As such, no part of the development site (Stage 3) is regarded as the Tomago Sandbeds catchment.

3.4.2 Contribution of surface water flows to the development site (Stage 3)

Based on the presence of the 0.5 m diameter pipe just south of Graham Drive and underneath Tomago Road, it is possible that surface runoff from the areas to the north of Tomago Road (part of the Tomago Sandbeds catchment) potentially drains to the development site via the 0.6 m diameter pipe discharging to the roadside swale adjacent to WesTrac Drive. However, historical observations indicate that runoff in areas north of Tomago Road (and north of the development site) would generally infiltrate into the underground aquifer (the Tomago Sandbeds), contributing to regional groundwater. As a result, the catchment to the north of Tomago Road historically has no significant contribution to the volume of surface runoff draining to the development site (Stage 3).

Due to significant rainfall during the major Hunter River flood event in July 2022, the Tomago Sandbeds was known to have filled up, resulting in significant ponding upstream (north) of the road up to a peak ponding level of approximately 3.5 mAHD. As a result, ponded water overflowed across Tomago Road just to the northeast of the WesTrac Facility (Lot 212). However, there was no road closure at this section of Graham Drive immediately north of the development site during this time.

On the basis of the above, the external catchment to the north of Tomago Road (and north of the development site) contributes groundwater flows, however it does not contribute significant surface runoff draining to the development site (Stage 3). Therefore, the extent of the external surface water catchment upstream of the development site would be limited parts of the intersection of Tomago Road and WesTrac Drive.

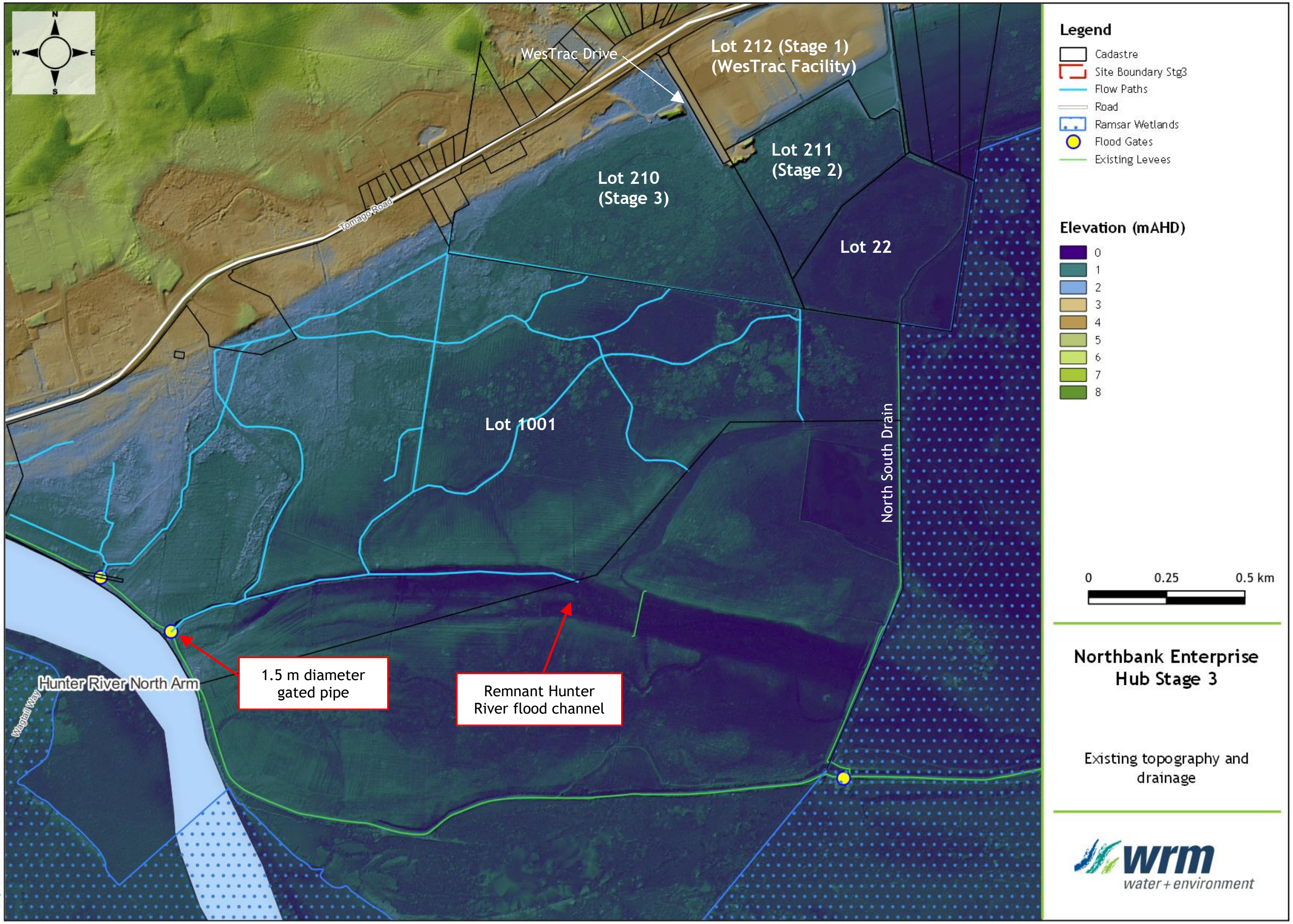
3.4.3 Contribution of groundwater flows to the development site (Stage 3)

Hunter Water have been recording groundwater level data for bore SK3520 located just northeast of the WesTrac Facility (Stage 1) since 1976, representing approximately 45 years of data to date. Based on this data, the long-term average groundwater table level between 1976 and 2022 is 1.96 mAHD. The minimum and maximum recorded groundwater levels during this period are 0.57 mAHD and 3.37 mAHD respectively.

Annual monitoring undertaken at the WesTrac Facility (Stage 1) over the past 10 years revealed that elevated groundwater levels in the Tomago Sandbeds generated above ground surface water flows that are identifiable as basin outflows from the Stage 1 wetland, observed long after a storm event. This occurs due to the interface between the sandy aquifer and the underlying clay layer daylighting at the Stage 1 site. Generally, groundwater reports as surface water at the Stage 1 wetland only during periods when the groundwater level at SK3520 is above the long-term average. When regional groundwater levels at this bore is below the long-term average, no groundwater-based surface flows would report to the Stage 1 wetland. This groundwater, regarded as base flows through the Stage 1 wetland, has previously been observed in the approximate range of 0.1 L/s to 3.0 L/s. However, these base flow rates are highly influenced by rainfall accumulation and starting water levels in the underground aquifer near the site.

Based on the 2022 Annual Report for the WesTrac Facility, it is estimated that during years with average rainfalls, groundwater inflows reporting to the WesTrac Facility's basin would range between 0 to 100 ML/year. The proximity of the development site (Stage 3) to the WesTrac Facility and the Tomago Sandbeds suggest that groundwater from the Tomago Sandbeds potentially report to the development site. For the purpose of the site water balance assessment (described in Section 8), it was assumed that groundwater from the Tomago Sandbeds would report as surface flow to the development site (Stage 3) at a maximum rate of 140 ML/yr during years with average rainfalls. This was calculated by factoring up the maximum groundwater flow estimate to Stage 1 in proportion to the length of site frontage along Tomago Road (just downstream of the Tomago Sandbeds catchment) perpendicular to the groundwater flow direction to the south.

Groundwater inflows to the development site (as described in Section 3.4.3) has been managed by existing shallow drains across the site and accordingly managed within the post development design.



WesTrac Drive
Lot 212 (Stage 1)
(WesTrac Facility)
Lot 211
(Stage 2)
Lot 210
(Stage 3)
Lot 22
Tomago Road
Lot 1001
North South Drain
Hunter River North Arm
Wagtail Way
1.5 m diameter
gated pipe
Remnant Hunter
River flood channel
Legend
Cadastre
Site Boundary Stg3
Flow Paths
Road
Ramsar Wetlands
Flood Gates
Existing Levees
Elevation (mAHD)
0
1
2
3
4
5
6
7
8
0
0.25
0.5 km
Northbank Enterprise
Hub Stage 3
Existing topography and
drainage
wrm
water + environment

Figure 3.1 – Existing topography and regional drainage features

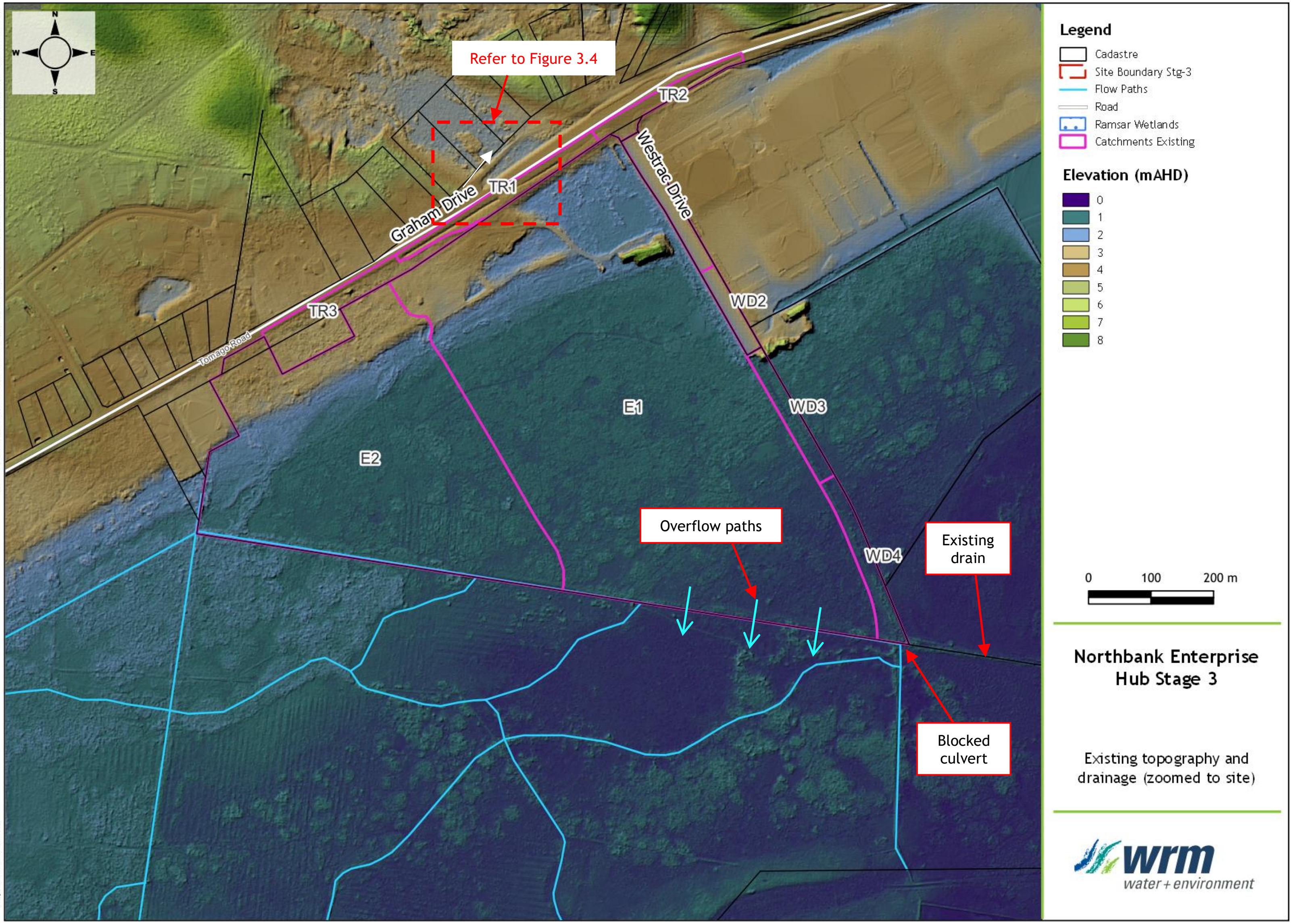


Figure 3.2 – Existing topography, local catchments and drainage features

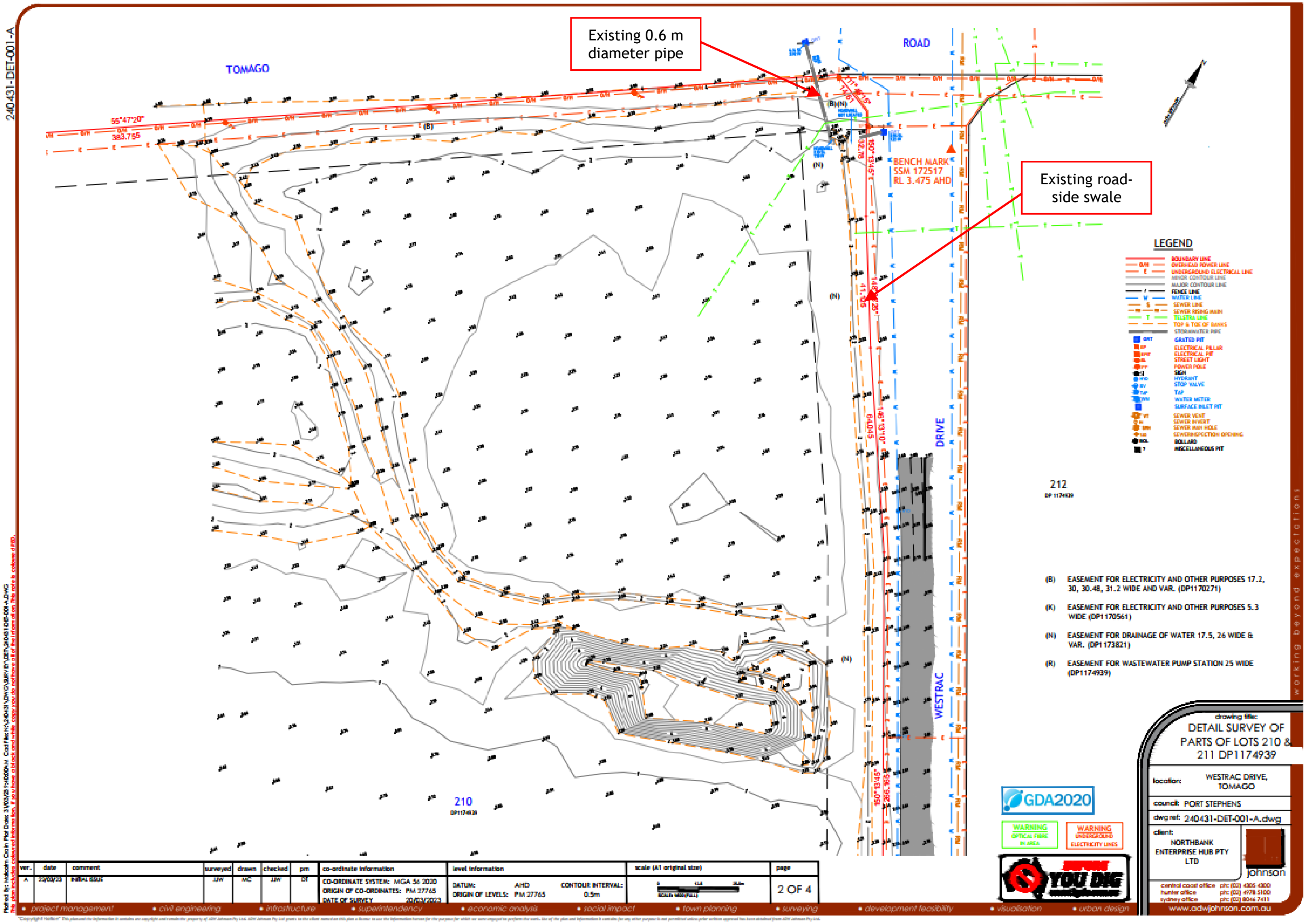


Figure 3.3 – Ground survey for the northeastern section of the development site adjacent to WesTrac Drive

Figure 3.4 – Site observations of drainage characteristics at Graham Drive and Tomago Road just north of the development site

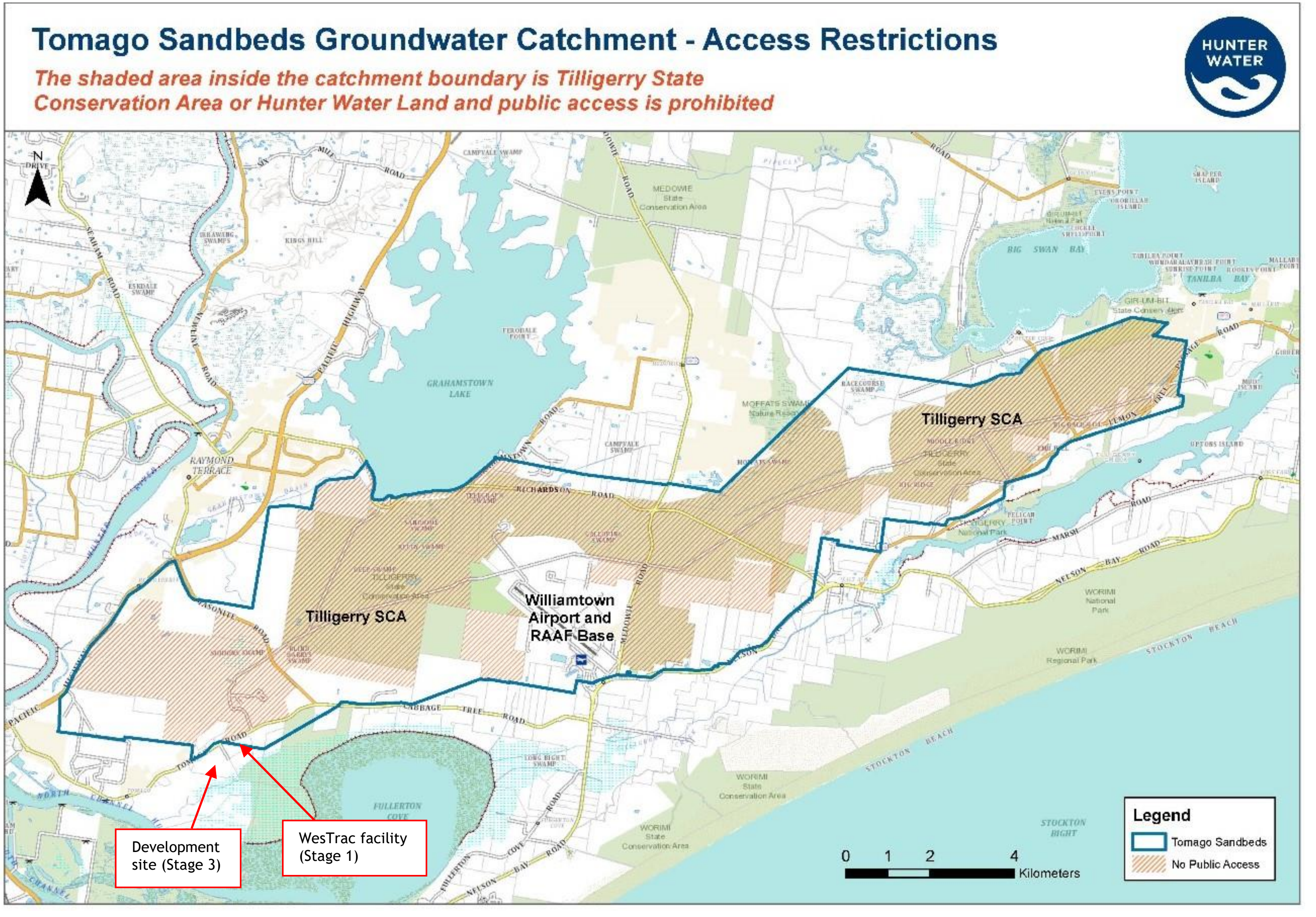


Figure 3.5 – Tomago Sandbeds groundwater catchment

4 Proposed development

4.1 OVERVIEW

It is proposed to develop the site for industrial use. Figure 4.1 shows the conceptual site layout and bulk earthworks plan. Analysis of the proposed stormwater management measures described in this report was undertaken assuming that the proposed development will increase the imperviousness of the site from zero to approximately 90% impervious. The existing WesTrac Drive will be extended to the southeastern corner of the development site.

Stormwater quantity and quality management for the proposed development will require the construction of two combined wetland and detention basins located at the southeastern and southwestern corners of the development site.

4.2 DEVELOPED SITE CHARACTERISTICS

4.2.1 Bulk earthworks

The proposed industrial lots and internal roads will be constructed on fill. The proposed industrial lots will have a minimum finished level of 3.5 mAHD, which is based on the 1% AEP Hunter River peak flood level in the year 2100 plus 0.5 m freeboard. Based on Council's Flood Certificate (provided in Appendix B), the flood planning level for Lot 210 (Stage 3) is 3.5 mAHD. The finished levels of the lots will range from 3.5 mAHD to 4.0 mAHD. WesTrac Drive will be extended to the southeastern corner of the development site. Access to the developed site will be from the east via WesTrac Drive.

4.2.2 Proposed stormwater quantity management measures

Figure 4.1 shows the proposed drainage configuration for the fully developed site. The proposed water quantity management strategy (for the management of design storm peak flows) for the proposed development is described below:

- Two combined wetland and detention basins will be constructed; one at the southeastern corner of the site (referred to as Basin 2) and one at the southwestern corner of the site (referred to as Basin 3), with a combined total surface area of 5.65 ha and peak detention volume of 79,483m3 (~79.5ML). Open Drains provide additional storage beyond the basin volume.
  - Basins 2 and 3 will mitigate the impact of the proposed development on the total peak discharges at the boundary with Lot 1001.
  - A drainage corridor will be provided along the southern boundary of Lot 210 for the drainage of stormwater outflows from Basins 2 and 3. Stormwater outflows from Basin 2 will drain west within this drainage corridor and then combine with outflows from Basin 3, before discharging at a single discharge point at the southwestern corner of Lot 210 to an existing drain which runs from north to south within Lot 1001 and is within an existing drainage easement, referred to herein as the "Existing Drainage Channel" (refer to Figure 4.1 for its location).
  - The selected discharge point at the southwestern corner of Lot 210 is consistent with the Project Approval, discharging runoff from Stage 3 into the Existing Drainage Channel within an existing drainage easement in Lot 1001.
- Three grassed open channels are proposed along the eastern site boundary (Channel 1), along the middle of the site (Channel 2) and at the western part of the site (Channel 3). Channels 1 and 2 will drain to Basin 2. Channel 3 will drain to Basin 3. Drainage corridors will be provided for the construction of the proposed open channels.

- The existing 0.6 m diameter pipe at the northeastern corner of the site (which conveys runoff from Tomago Road) would discharge into the proposed Channel 1, therefore maintaining cross drainage beneath Tomago Road.
- Basin 2 will capture runoff from approximately 67% of the developed site including developed subcatchments D1, D2, D3, D4, D5 and D6 and the Basin 2 footprint itself. Basin 2 will also capture and mitigate external runoff from parts of Tomago Road and WesTrac Drive (subcatchments TR1, TR2, WD1, WD2, WD3 and WD4) via Channel 1. The Basin 2 catchment boundaries may be adjusted in future to suit the future staging of the development, but the total catchment area draining to Basin 2 will not exceed the design catchment area adopted in this SMP, without further modelling to review the basin design specifications up to the design peak discharge limits given in this SMP.
- Basin 3 will capture runoff from approximately 33% of the developed site including developed subcatchments D7, D8, D9 and D10 and the Basin 3 footprint itself. Basin 3 will also capture and mitigate external runoff from parts of Tomago Road (subcatchment TR3) via Channel 3.
- Runoff from subcatchments D1 and D2 will drain to Channel 1. Runoff from subcatchment D5 will drain to Channel 2. Runoff from subcatchment D4 will be piped to Channel 2. Runoff from subcatchments D3 and D6 will drain directly to Basin 2.
- Runoff from subcatchment D7 will be piped to Channel 3. Runoff from subcatchment D9 will be piped to Basin 3. Runoff from subcatchments D8 will drain to Channel 3. Runoff from subcatchment D10 will drain directly to Basin 3.
- Opportunities for increased infiltration into the deeper sand layer beneath the Stage 3 site will be considered during detailed design of the development sub-stages.

4.2.3 Proposed stormwater quality management measures

The proposed water quality management strategy for the proposed development is described below:

- Two wetlands will be constructed within Basins 2 and 3 to treat stormwater runoff from the proposed development as well as parts of Tomago Road and WesTrac Drive before discharging to Lot 1001. Basins 2 and 3 will be constructed above ground with minimal excavation.
- Vegetated Channels 1, 2 and 3 will also provide additional treatment of runoff from their upstream catchments.
- Gross pollutant traps (GPT) will be installed at the roadside stormwater inlet pits. In the Stage 3 Design Guidelines, each industrial lot will have a GPT for primary stormwater treatment at source, prior to discharge to the trunk stormwater drainage system in the estate. Trash racks and GPTs will also be installed at the inlets to Basins 2 and 3.
- In the Stage 3 Design Guidelines, rainwater tanks will be installed at each of the future industrial lots, with a combined total volume equivalent to approximately 5 kL per 100 m^2 of roof area. Further details are provided in Section 8.3.
- Sub-stages of the development and the corresponding basin storage will be checked for their performance in meeting the same design objectives and principles of the overall stormwater management plan (refer to Section 4.2.5).

Detailed design for the initial basin structure will be undertaken for the first sub-stage of development, with the design to be reviewed and adjusted for future sub-stages based on monitoring results. A pit control will be required for the management of both permanent water depth in the basins and regular base flow/groundwater flow at or below natural ground level. However, the surface water management system is separate from and above the groundwater management system. Progressive filling and diversion will be implemented to satisfy NPWS and NEH’s surface water management objective of discharge away from the adjoining wetlands.

4.2.4 Drainage from Lot 211 (Stage 2)

It was assumed that future development of Lot 211 (Stage 2), located adjacent and east of the development site (Stage 3) and forms part of a different catchment to Lot 210 as referenced above, will likely include construction of a stormwater basin to manage stormwater quantity and quality from Lot 211. This basin would likely be located at the southwestern corner of Lot 211 (near the southeastern corner of Lot 210).

A drainage corridor will be provided for the drainage of stormwater outflows from Lot 211. Stormwater outflows from Lot 211 will be conveyed through this drainage corridor, bypassing the eastern edge of Basin 2 on Lot 210 and discharging to the south to Lot 1001, consistent with the project Approval.

4.2.5 Implementation sequence of proposed stormwater management measures

The proposed stormwater management measures for Stage 3 will be implemented in three key stages/phases referred to as Phase 1, Phase 2 and Phase 3, as described below:

- Phase 1:
  - Clearing of vegetation in the Existing Drainage Channel in Lot 1001, which has already been undertaken in 2024.
  - Installation of a water monitoring well with a data logger, for the monitoring of water levels in Lot 1001 near the outlet to the Hunter River (refer to Section 11 for the locations of proposed monitoring wells).
- Phase 2:
  - Construction of the eastern basin (Basin 2) and Channel 1 upfront in conjunction with runoff diversion to the west. Only runoff from developed areas of Stage 3 will be captured in Channel 1 and conveyed to Basin 2. This will provide an immediate benefit to NPWS resulting from reduced freshwater inflows to the North South Drain.

    Geotechnical considerations will determine if Basin 2 and Channel 1 are constructed to their final embankment heights. Only runoff from developed sub-stage areas of Stage 3 will be captured in Channel 1 and conveyed to Basin 2, with regional groundwater in existing drains managed beneath stormwater management levels across the basin.

    - Stage 3 will be developed in sub-stages. As a result, Basin 2 and Channel 1 will initially be oversized relative to the developed area of its upstream catchment. Outflow controls will be determined with detailed design for each sub-stage, to utilise the full storage available in the basin constructed upfront. This reduces reliance on downstream drainage infrastructure. This approach would better utilise the storage capacity of the basin during the interim substages of development.
    - Monitoring of the basin outflows (pipe and spillway) will commence in Basin 2.
    - Monitoring will also commence including at a new monitoring location downstream of Stage 3 within Lot 1001.
    - Hydrologic modelling results indicate that Basin 2 can mitigate (detain) and treat runoff from a maximum development area of 29 ha. The development sub-stages are anticipated to be in the order of 1 ha to 5 ha, however, these may be larger.
    - Channel 1 have been sized to capture runoff from a development area of 9.4 ha adjacent to WesTrac Drive. Channel 2 will be constructed once the development area exceeds the design catchment area for Channel 1.
  - The Basin 2 outlet pipes will be sized and constructed to its final specification. However, the Basin 2 and Channel 1 embankments will be constructed in stages, subject to geotechnical considerations, in conjunction with the sub-staging of the Stage 3 development area. This approach would better utilise the storage capacity of the basin during monitoring, before completion of Basin 2 and Channel 1 to their final embankment heights when the entire upstream catchment of up to 29 ha is developed.
  - Ongoing maintenance of the Existing Drainage Channel in Lot 1001 is required and its capacity to be verified with ongoing monitoring.

- Phase 3:
  - Construction of the western basin (Basin 3). Similar to Basin 2, the initial basin footprint will be large and oversized relative to developed area in its upstream catchment, which reduces reliance on downstream drainage infrastructure.
  - Ongoing maintenance of the Existing Drainage Channel in Lot 1001 is required and its capacity to be verified with ongoing monitoring.

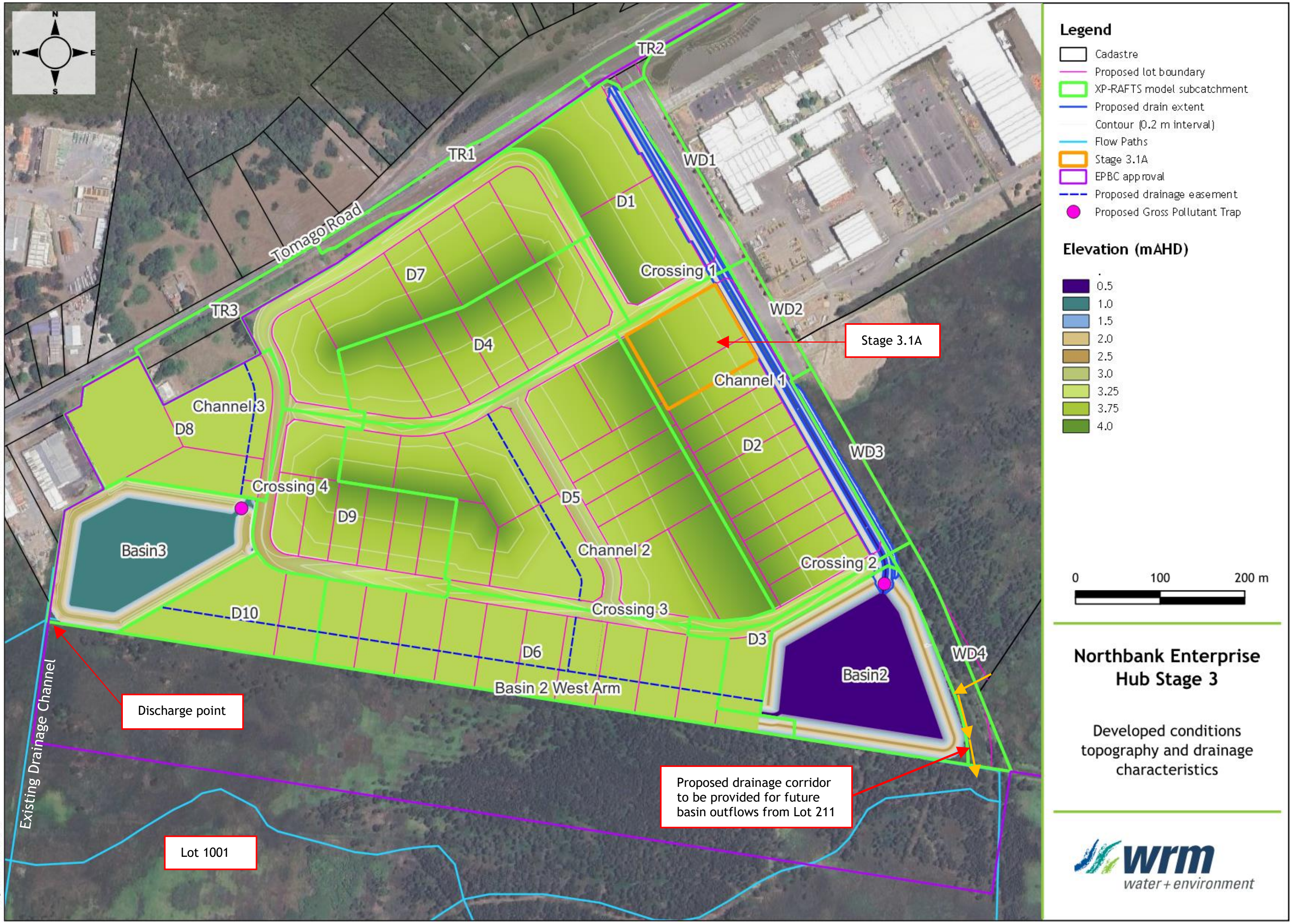


Figure 4.1 – Proposed development site layout, bulk earthworks plan, developed catchments and drainage configuration

5 Discharge estimation

5.1 METHODOLOGY

The XP-RAFTS (Innovyze, 2018) hydrological model was used to estimate the 63% (1 in 1.58), 50% (1 in 2), 20% (1 in 5), 10% (1 in 10), 5% (1 in 20), 2% (1 in 50) and 1% (1 in 100) annual exceedance probability (AEP) design discharges at the development site under existing and developed conditions. Hydrology was undertaken based on the Australian Rainfall and Runoff 2019 (ARR 2019) guidelines.

Suitable historical rainfall and stream gauge data is not available to calibrate the XP-RAFTS model. As such, the model was validated against peak discharges estimated using the Rational Method.

The XP-RAFTS model was simulated for the above seven design event AEPs and for a range of storm durations up to 18 hours.

5.2 XP-RAFTS MODEL CONFIGURATION

5.2.1 Overview

The following two XP-RAFTS models were developed:

- An “existing conditions” model was developed to represent existing site conditions. This model consists of a total of 9 subcatchments ranging in size from 0.4 ha to 32 ha, including two subcatchments representing the development site itself and eight subcatchments representing external subcatchments (see Figure 3.2).
- A “developed conditions” model was developed to represent developed site conditions. This model consists of a total of 19 subcatchments ranging in size from 0.4 ha to 9.4 ha, including 12 subcatchments representing the development site itself and 7 subcatchments representing external subcatchments (see Figure 4.1).

5.2.2 XP-RAFTS model parameters

Both the existing and developed conditions XP-RAFTS models contain subcatchments that were assigned with either “undeveloped” or “developed” subcatchment parameters. “Undeveloped” catchment parameters were assigned to the vacant development site. Developed subcatchment parameters were assigned to existing roads, future roads and future industrial lots.

Table 5.1shows the adopted XP-RAFTS model parameters used in the XP-RAFTS model for undeveloped and developed catchments, including percentage impervious, catchment PERN “n”, initial losses (IL) and continuing losses (CL). IL’s and CL’s were configured based on the NSW Government Floodplain Risk Management Guide (OEH, 2019) using the following procedure:

- IL’s for undeveloped subcatchments were initially obtained from the Probability Neutral Burst Losses available from the ARR Datahub. The ARR Datahub provides a unique value of IL for every storm duration for every event. Therefore, for simplicity, IL’s were averaged and grouped for durations and AEPs with similar Probability Neutral Burst Losses.
- A CL of 1.1 mm/hr was adopted for undeveloped subcatchments, which was based on the default ARR data hub continuing loss of 2.7 mm/hr multiplied by a factor of 0.4 as per the OEH (2019) guideline.
- IL’s and CL’s for developed subcatchments were factored from the undeveloped subcatchment losses according to the increase in imperviousness.

Table 5.1 – Adopted XP-RAFTS model parameters

XP-RAFTS catchment and rainfall parameters	Design event AEP		
	63% - 50%	20% - 2%	1%
Undeveloped subcatchments			
% Impervious	0	0	0
PERN 'n'	0.05	0.05	0.05
Initial loss (mm)	8.8	7.0	3.4
Continuing loss (mm/hr)	1.1	1.1	1.1
Storage coefficient 'Bx'	1.0	1.0	1.0
Developed subcatchments			
% Impervious	90	90	90
PERN 'n'	0.045	0.045	0.045
Initial loss (mm)	0.9	0.7	0.3
Continuing loss (mm/hr)	0.1	0.1	0.1
Storage coefficient 'Bx'	1.0	1.0	1.0

5.2.3 XP-RAFTS model discharge validation

A Rational Method calculation was undertaken for the following representative catchments:

- A 32-ha catchment represented by subcatchment E1 in the existing conditions XP-RAFTS model (refer to Figure 3.2). Local subcatchment peak discharges from subcatchment E1 were compared against Rational Method peak discharges for subcatchment E1 to validate XP-RAFTS model parameters for undeveloped catchment conditions.
- A 13-ha catchment represented by the combined areas of subcatchments D4 and D5 in the developed conditions XP-RAFTS model (refer to Figure 4.1). Local subcatchment peak discharges from combined subcatchments D4 and D5 were compared against Rational Method peak discharges for combined subcatchments D4 and D5 to validate XP-RAFTS model parameters for developed catchment conditions.

The Rational Method calculations are presented in Appendix C.

Table 5.1 compares XP-RAFTS model predicted local subcatchment peak discharges at subcatchment E1 (for undeveloped catchment conditions) and just downstream of subcatchment D5 (for developed catchment conditions) against Rational Method peak discharges for these representative catchments. The XP-RAFTS validation results indicate the following:

- For undeveloped catchment conditions, the XP-RAFTS model peak discharges are generally within 20% of the Rational Method peak discharges for the 63% to 2% AEP events. The difference is within 6% for the 1% AEP event.
- For developed catchment conditions, the XP-RAFTS model peak discharges are generally within 5% of the Rational Method peak discharges for the 2% to 1% AEP events. The XP-RAFTS model overestimates peak discharges compared to the Rational Method for the 63% to 5% AEP events.
- For the 20% to 2% AEP events, the XP-RAFTS model overestimates the Rational Method peak discharges by similar magnitudes between undeveloped and developed conditions. For the 63%, 50% and 1% AEP events, the XP-RAFTS model underestimates peak discharges for undeveloped conditions while overestimating peak discharges for developed conditions compared to the Rational Method, which is considered conservative for the purpose of assessing the impact of the proposed development.

- Overall, the XP-RAFTS model is expected to produce reasonable estimates of peak discharges from the site using the adopted model parameters. The model is likely to be conservative with regards to the impact of the development on existing conditions peak discharges.

Table 5.2 – Comparison of XP-RAFTS and Rational Method peak discharges

Design event AEP	Peak discharge m³/s)					
	Undeveloped catchment (E1)			Developed catchment (D4+D5)		
	Rational Method	XP-RAFTS	Diff. (%)	Rational Method	XP-RAFTS	Diff. (%)
63%	0.40	0.34	-15%	1.24	1.96	58%
50%	0.50	0.43	-14%	1.54	2.27	47%
20%	0.86	1.01	18%	2.59	3.35	29%
10%	1.13	1.35	19%	3.41	4.23	24%
5%	1.44	1.75	21%	4.34	5.11	18%
2%	1.98	2.24	13%	5.93	6.27	6%
1%	2.41	2.27	-6%	7.24	7.34	1%

5.3 EXISTING CONDITIONS PEAK DISCHARGES

Table 5.3 shows the existing conditions design peak discharges at the southern site boundary with Lot 1001. In accordance with ARR 2019, the design peak discharges shown in Table 5.3 represent the mean peak discharge between the 10 design storms for the critical storm duration. The critical storm duration was estimated to be 9 hours for the 63% to 20% AEP events and 6 hours for the 10% to 1% AEP events.

Flows from the development site across to Lot 1001 would drain by sheet flow as there are no clearly defined channels where flows can concentrate within the development site. As such, the peak discharges shown in Table 5.3 represents the total peak discharge just downstream of Subcatchments E1 and E2 (refer to Figure 3.2). The peak discharges shown in Table 5.3 also include the discharges from external catchments including Tomago Road and WesTrac Drive. Note that flood storage has been ignored for this analysis.

Table 5.3 – XP-RAFTS model predicted existing conditions peak discharges at the southern lot boundary with Lot 1001

Design event AEP	Peak discharge (m^3/s)
63%	0.67
50%	0.84
20%	1.50
10%	2.11
5%	2.72
2%	3.47
1%	4.18

5.4 DEVELOPED CONDITIONS PEAK DISCHARGES

5.4.1 Impact of proposed development on peak discharges to Lot 1001

Table 5.4 compares the developed conditions design peak discharges against existing conditions peak discharges at the southern site boundary with Lot 1001 assuming no mitigation occurs. For developed catchment conditions, the critical storm duration for all events was estimated to be 45 minutes for the 63% to 20% AEP events, 30 minutes for the 10% and 5% AEP events and 15 minutes for the 2% and 1% AEP events.

Flows from the developed would be concentrated at the outlet of Basins 2 and 3. To compare the unmitigated impact of the proposed development, the developed conditions peak discharges reported in Table 5.4 represent the total combined peak discharge from the outlets of Basins 2 and 3. The model results show that increased imperviousness at the development site (unmitigated) would result in design peak discharges at the southern lot boundary with Lot 1001 increasing by between 2.6 to 5.3 times compared to existing conditions peak discharges.

Table 5.4 – Comparison of XP-RAFTS model predicted peak discharges at the southern lot boundary with Lot 1001 between existing and developed (unmitigated) conditions.

Design event AEP	Peak discharge (m^3/s)		Diff. (%)
	Existing conditions	Developed (unmitigated) conditions	
63%	0.67	4.18	526%
50%	0.84	4.84	479%
20%	1.50	7.13	375%
10%	2.11	8.90	321%
5%	2.72	10.67	292%
2%	3.47	13.03	275%
1%	4.18	15.15	262%

[a] – Peak discharges are reported for the critical storm duration only

5.4.2 Stormwater detention requirements

The results of XP-RAFTS hydrologic modelling indicate that without appropriate mitigation measures, the proposed development would increase design peak discharges at the southern lot boundary with Lot 1001 by between 2.7 to 5.4 times compared to existing conditions peak discharges. Therefore, stormwater detention is proposed to ensure that developed conditions peak discharges do not exceed those generated under existing catchment conditions. The proposed detention basins are described briefly in Section 4.2.3 and are modelled and reported on in detail in Section 6.

6 Water quantity management

6.1 OVERVIEW

This section describes the stormwater quantity management measures, focusing on the design of stormwater management controls to manage design storm peak flows.

The XP-RAFTS model described in Section 5.2 was used to design the stormwater detention requirements within Basins 2 and 3. Basins 2 and 3 are combined wetland-detention basin structures. The design of the water quality management component of Basins 2 and 3 are described in Section 7.

Design discharges obtained from the XP-RAFTS model were also used to size the proposed channels and culverts that convey runoff from the development site to Basins 2 and 3.

This section describes the performance of the proposed Basins in attenuating post-development peak flows to not exceed pre-development conditions. This section also describes the potential for any impacts on increased runoff volumes from the development. Subsection 6.5 provides a summary of how post-development runoff is diverted away from the Ramsar Wetlands via the selected discharge point, as well as how the downstream drainage network is able to cater for post-development outflows from Lot 210.

Two-dimensional (2D) hydraulic modelling was undertaken of the catchment draining the development site including the downstream catchment incorporating the Existing Drainage Channel to determine the potential for any impact of the development on flows draining to the RAMSAR Wetlands. The methodology and results of this assessment is described in a separate memorandum given in Appendix J. A summary of the 2D hydraulic modelling results is also provided in Section 6.6.

6.2 CONFIGURATION OF PROPOSED CHANNELS AND CULVERTS

6.2.1 Open channels

The HEC-RAS model was used to size the proposed Channels 1, 2 and 3. These open channels were sized to convey the 1% AEP design discharge without overflowing into the adjacent industrial lots and internal roads. Table 6.1 provides the key design characteristics of the proposed open channels. The sizing of these channels has accounted for elevated tailwater levels in Basin 2 and Basin 3 corresponding to the critical storm duration in each channel.

The proposed open channels were designed with a longitudinal gradient of 0.12%, which is consistent with the adopted longitudinal gradient of the existing constructed drains at the neighbouring WesTrac facility. Due to the flat topography of the site, it would not be feasible to construct these drains with Council's preferred minimum grade of 0.5%.

Table 6.1 – Design characteristics of proposed open channels

Description	Open channel		
	Channel 1	Channel 2	Channel 3
Channel geometry			
Base width (m)	5.0	8.0	5.0
Batter slope	1V:4H	1V:4H	1V:4H
Longitudinal grade (%)	0.12	0.12	0.12
Upstream invert (mAHD)	1.33	0.82	1.22
Downstream invert (mAHD)	0.50	0.50	1.00

Hydraulic characteristics			
Design discharge (1% AEP) (m^3/s)	5.04	7.34	2.53
Peak 1% AEP flow depth (m)	0.83 - 1.08	0.99 - 1.13	0.71 - 0.75
Peak 1% AEP velocity (m/s)	0.34 - 0.56	0.52 - 0.62	0.42 - 0.45

6.2.2 Culvert crossings

There are four proposed culvert crossings at the internal roads and/or access driveways within the proposed development, including two crossings along Channel 1, one crossing at Channel 2 and one crossing at Channel 3. Figure 4.1 shows the locations of these crossings.

The HEC-RAS models used to size the drains were also used to size the proposed culverts at the four crossings. These culverts were sized to convey the 1% AEP peak discharge without overtopping of the road. Table 6.2 provides the key design characteristics of the proposed culverts. The sizing of these culverts has accounted for elevated tailwater levels in Basin 2 and Basin 3 corresponding to the critical storm duration at each channel.

Table 6.2 - Design characteristics of proposed culverts

Description	Open channel			
	Crossing 1	Crossing 2	Crossing 3	Crossing 4
Geometry				
Culvert type	RCBC	RCBC	RCBC	RCBC
Width (m)	1.20	1.20	1.20	1.20
Height (m)	0.75	0.90	0.90	0.75
No. of barrels	4	4	5	4
Upstream IL (mAHD)	1.04	0.57	0.62	1.03
Downstream IL (mAHD)	1.00	0.54	0.59	1.00
Hydraulic characteristics				
Design discharge (1% AEP) (m^3/s)	3.13	5.04	7.34	2.53
Peak velocity (1% AEP) (m/s)	0.87	1.17	1.36	0.73

6.3 DETENTION BASIN CONFIGURATION

Figure 6.1 shows a conceptual cross section of the detention basins. The basins will be used for both water quality and stormwater detention. A description of the detention storage component is given below.

6.3.1 Basin 2

Figure 6.2 shows the location and layout of the proposed Basin 2. The configuration and specifications of Basin 2 are shown in Figure 6.2 and Table 6.3 respectively. The adopted storage curve for Basin 2 is provided in Appendix D.

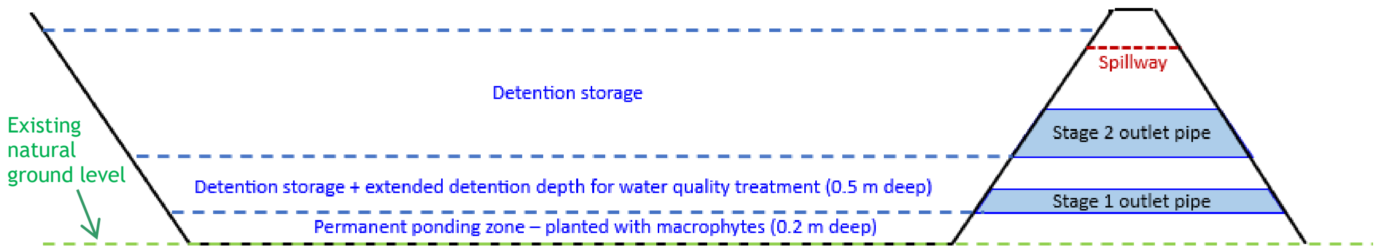


Figure 6.1 – Conceptual cross section of the combined wetland-detention basin (not to scale)

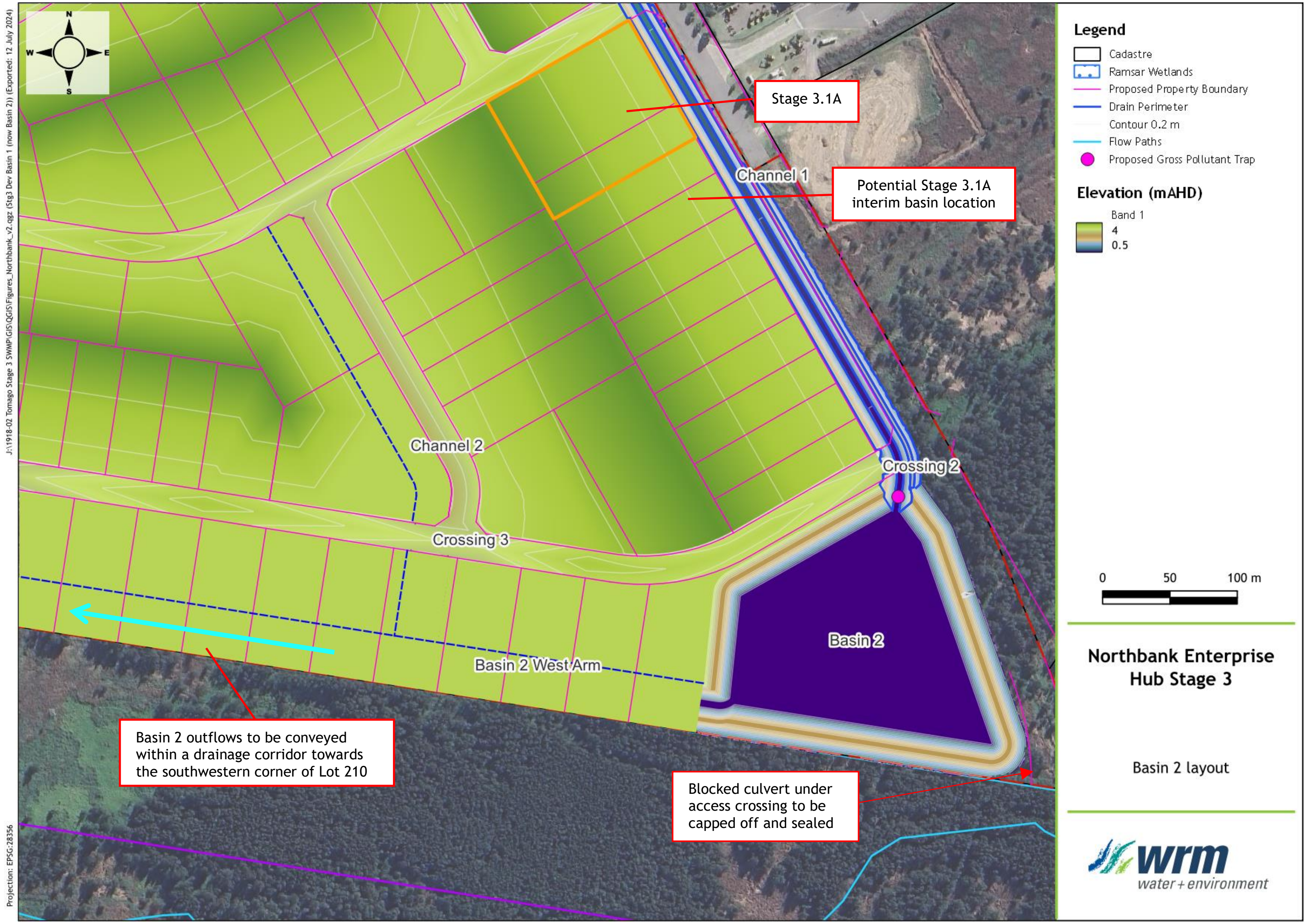


Figure 6.2 – Basin 2 layout

Table 6.3 – Basin 2 specifications

Basin 2 characteristics	
General	
Invert (basin floor) [a]	0.5 mAHD
Initial water level [b]	0.7 mAHD
Surface area at full supply level (FSL)	35,122 m^2
Hydraulics	
Peak water level (5% AEP) [c]	1.95 mAHD
Peak water level (1% AEP) [c]	2.26 mAHD
Peak detention volume (1% AEP) [c]	52,655 m^3
Outlet pipes (multi-staged)	
Stage 1	1 x 0.225 m diameter RCP Invert = 0.7 mAHD
Stage 2	4 x 0.450 m diameter RCP Invert = 1.2 mAHD
Spillway	
Width	10.0 m
Invert	2.05 mAHD
Volume below spillway	45,190 m^3
Embankments	
Embankment crest level	2.5 mAHD
Internal batters (main basin)	1V:6H
External batters (main basin)	1V:6H
Internal batters (western arm)	1V:4H
External batters (western arm)	1V:4H

[a] - Based on the minimum LiDAR elevation within the basin footprint (this will need to be confirmed by ground survey).

[b] - The bottom 0.2 m of the basin is the permanent ponding zone for the wetland macrophytes (refer to proposed wetland design in Section 7). The permanent ponding zone depth will be managed by a pit control to 0.2 m deep. The permanent ponding zone will be inundated by groundwater in existing drains.

[c] - This value is associated with the representative design storm (closest to the mean) for the critical duration only and is not the maximum between all simulated storms for the critical duration.

6.3.2 Basin 3

Figure 6.3 shows the location and layout of the proposed Basins 3. The configuration and specifications of Basin 3 are shown in Figure 6.3 and Table 6.4 respectively. The adopted storage curve for Basin 3 is provided in Appendix D.

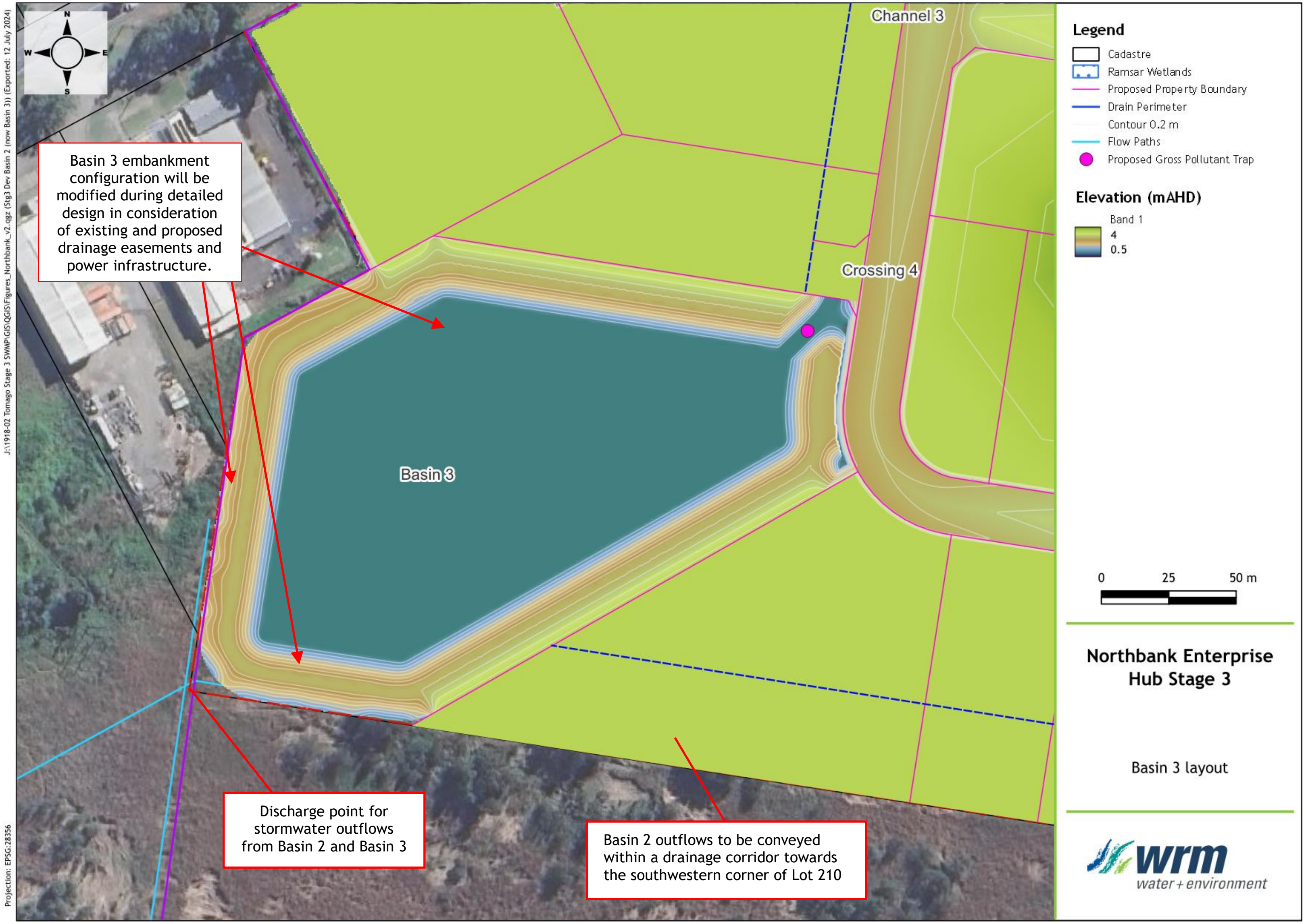


Figure 6.3 – Basin 3 layout

Table 6.4 – Basin 3 specifications

Basin 3 characteristics	
General	
Invert (basin floor) [a]	1.0 mAHD
Initial water level [b]	1.2 mAHD
Surface area at full supply level (FSL)	21,378 m^2
Hydraulics	
Peak water level (5% AEP) [c]	2.18 mAHD
Peak water level (1% AEP) [c]	2.39 mAHD
Peak detention volume (1% AEP) [c]	26,828 m^3
Outlet pipes (multi-staged)	
Stage 1	1 x 0.225 m diameter RCP Invert = 1.2 mAHD
Stage 2	3 x 0.450 m diameter RCP Invert = 1.7 mAHD
Spillway	
Width	5.0 m
Invert	2.30 mAHD
Volume below spillway	24,917 m^3
Embankments	
Embankment crest level	2.8 mAHD
Internal batters	1V:6H
External batters	1V:6H

[a] - Based on the minimum LiDAR elevation within the basin footprint (this will need to be confirmed by ground survey).

[b] - The bottom 0.2 m of the basin is the permanent ponding zone for the wetland macrophytes (refer to proposed wetland design in Section 7). The permanent ponding zone depth will be managed by a pit control to 0.2 m deep. The permanent ponding zone will be inundated by groundwater in existing drains.

[c] - This value is associated with the representative design storm (closest to the mean) for the critical duration only and is not the maximum between all simulated storms for the critical duration.

6.4 IMPACT OF DETENTION BASINS ON DESIGN PEAK DISCHARGES

The impact of the proposed detention basins on design peak discharges at the southern site boundary with Lot 1001 was assessed using the XP-RAFTS model. Under existing conditions, there is no single point at which discharges from the site would be concentrated due to the flat topography of the site and the absence of well-defined flow paths. As such, developed conditions design peak discharges were compared against existing conditions peak discharges based on the total peak outflows from Basins 2 and 3. It was not feasible to compare pre- and post-development design peak discharges for the two individual basins in isolation. The comparison of design discharges is shown for the 63%, 50%, 20%, 10%, 5%, 2% and 1% AEP design events for the critical storm duration only.

Table 6.5 shows that the total peak discharges with the proposed detention basins in place are less than existing conditions peak discharges for the critical duration of all design events. For developed (mitigated) conditions, the critical storm durations for total outflows from the site were estimated to be 24 hours for the 63% and 50% AEP events, 9 hours for the 20% and 10% AEP events and 6 hours for the 5%, 2% and 1% AEP events. For comparison, the critical duration for existing conditions ranges from 6 to 9 hours between all modelled events, while the critical duration for developed (unmitigated) conditions ranges from 15 to 45 minutes between all events. Therefore, the timing of peak discharges from the fully developed site would generally be maintained closer to existing conditions with the proposed detention basins in place.

Table 6.5 – Comparison of XP-RAFTS model predicted peak discharges at the southern lot boundary with Lot 1001 between existing and developed (mitigated) conditions

Design event AEP	Peak discharge (m^3/s)		Diff. (%)
	Existing conditions	Developed (unmitigated) conditions	
63%	0.67	0.36	-46%
50%	0.84	0.46	-45%
20%	1.50	1.02	-32%
10%	2.11	1.50	-29%
5%	2.72	1.98	-27%
2%	3.47	2.77	-20%
1%	4.18	4.04	-3%

[a] – Peak discharges are reported for the critical storm duration only

6.5 DESIGN CONSIDERATIONS FOR THE BASIN OUTFLOW

6.5.1 Location of discharge point

A drainage corridor will be provided along the southern boundary of Lot 210 for the drainage of stormwater outflows from Basin 2. Stormwater outflows from Basin 2 will drain west within this drainage corridor and then combine with outflows from Basin 3, before discharging at a single discharge point at the southwestern corner of Lot 210 to the Existing Drainage Channel within Lot 1001. The Existing Drainage Channel is within an existing easement for drainage across Lot 1001 draining to the Hunter River, the easement benefiting Lot 210.

The invert levels of the Stage 1 outflow pipes for Basins 2 and 3 are above the Mean High-Water Springs (MHWS) level of 0.69 mAHD in the Hunter River North Arm. However, there are existing levees and flood control structures (such as controlled and uncontrolled floodgates) that prevent Hunter River water from flowing through the levee towards the development site during high tides and during floods. The levee and floodgates are managed by a government agency. Therefore, in reality, Basin 2 and 3 outlets are not affected by tidal influences.

In the future scenario of development downstream, the location of the discharge point (at the southwestern corner of Lot 210) will conform with the approved drainage strategy for the future proposed industrial subdivision at Lot 1001 (Project Approval MP10_0185) (shown in Figure 6.4). Specifically, outflows from Basins 2 and 3 via the discharge point would eventually drain to the proposed Channel 2 at Lot 1001 (see Figure 6.4), consistent with the previous estate wide stormwater strategy as approved under Project Approval MP10_0185. Drainage of outflows from Lot 210 via the Existing Drainage Channel at Lot 1001 will be retained within the "Channel 2" drainage corridor when Lot 1001 is developed according to the estate-wide approved stormwater strategy under Project Approval MP10_0185.

The location of the discharge point is consistent with the Project Approval MP07_0086, legal point of discharge by the existing easement and was also selected to discharge as far west as possible, therefore ensuring that all runoff from the fully developed site would drain southwest to the Hunter River and not east towards the Ramsar Wetlands. An existing culvert for this

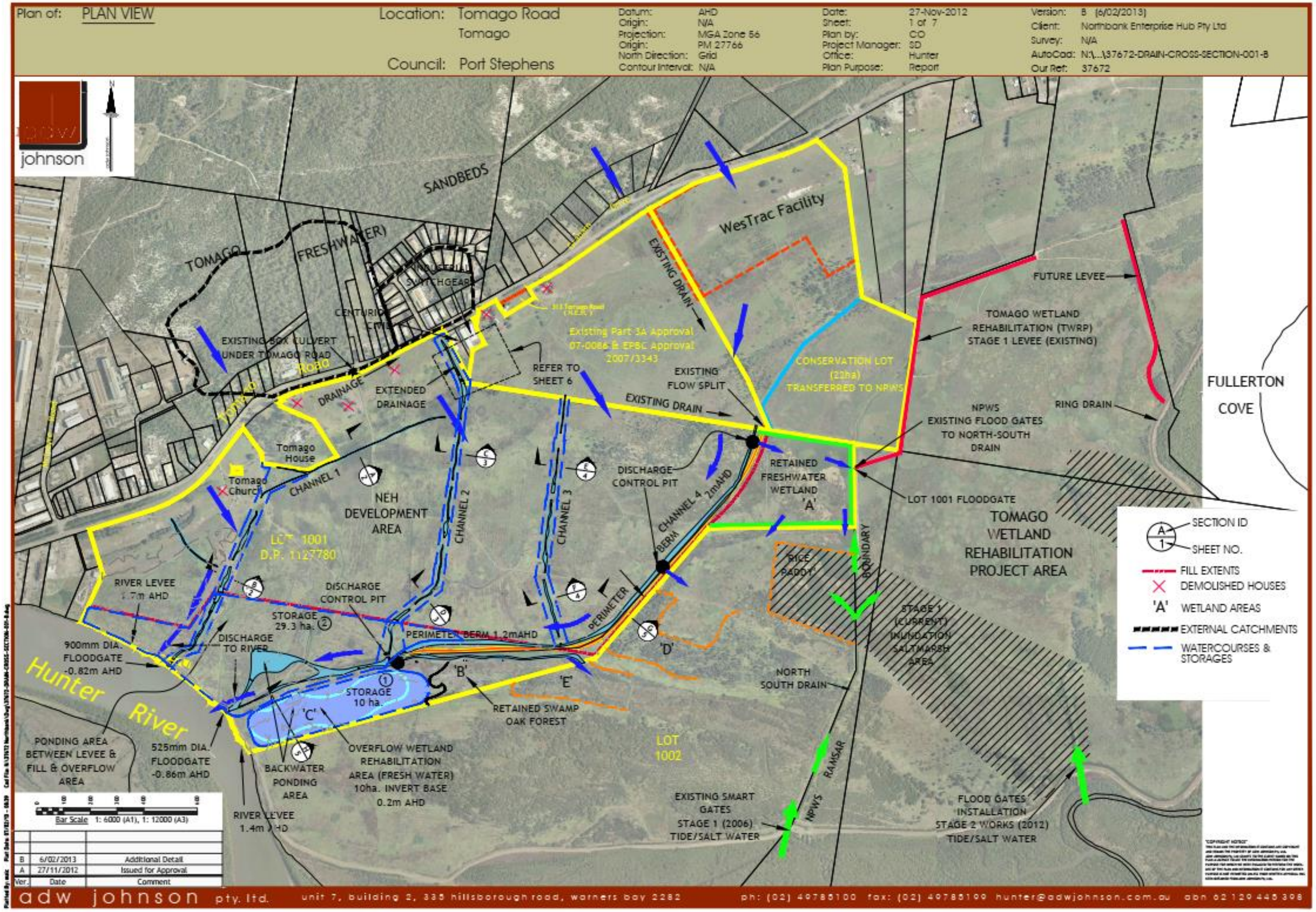


Figure 6.4 – Approved drainage strategy for proposed development at Lot 1001 (Project Approval MP10_0185)

drainage direction (at the southeastern corner of Lot 210) which is currently blocked, will be formally capped off.

6.5.2 Downstream storage capacity

Most discharge from the developed Stage 3 area will be detained in Basins 2 and 3 and then evaporate or released slowly to the Existing Drainage Channel on Lot 1001. In the event of prolonged rainfalls that trigger releases of freshwater from the basin, the Existing Drainage Channel, with a length of approximately 1.7 km across the very flat undeveloped Lot 1001, provides significant retention and storage in the order of approximately 12,000 m^3 (12 ML) based on a length of 1,770 m, depth of 1 m and width of 5 m to 8 m Additional storage is also available in the other drains within Lot 1001 including:

- the storage volume of up to 32,470 m^3 (32.5 ML) in the remnant Hunter River flood channel (refer Figure 3.1) up to a depth of 0.6 m, based on LiDAR data; and
- A storage volume of over 2,900 m^3 (2.9 ML) within the numerous existing drains within Lot 1001, estimated based on a total length of 1,460 m, depth of 0.5 m and width of 4 m.
- This maximum storage volume and capacity in the existing drains downstream of Lot 210, including the Existing Drainage Channel exceeds the average expected volume of daily outflows from the developed Lot 210 under normal rainfall conditions.
- The Stage 3/Lot 210 flow is also accommodated in the future, approved development plans for Lot 1001 – MP10_0185, with the key drainage alignments from Lot 210 maintained in the Lot 1001 development footprint.

6.5.3 Downstream outflow capacity

Runoff stored in the Existing Drainage Channel and the remnant Hunter River flood channel slowly discharges to the Hunter River via the 1.5 m diameter gated RCP (refer to Figure 3.1). A simplified analysis was undertaken to estimate the capacity of the 1.5 m gated RCP to discharge runoff to the Hunter River, over a typical two-week tidal cycle for Hexham. For this analysis, it was assumed that the remnant Hunter River flood channel has a constant water level of 0.6 mAHD. Hence discharge to the Hunter River (via the 1.5 m gated pipe) can only occur when the downstream tide level is below 0.6 mAHD (i.e. positive head difference).

The results (provided in Appendix K) show that on average, the 1.5 m gated pipe has a capacity to discharge approximately 43,000 m^3 per day (43 ML) of water to the Hunter River. This capacity is significantly larger than the expected average daily runoff volume from the fully developed Stage 3 (approximately 5.5 ML/d) estimated for the site water balance (refer to Section 8).

The potential impacts of rising sea levels due to climate change on the 1.5 m pipe outflow capacity have also been analysed for year 2040 and 2100, with an assumed sea level rise of 0.4 m and 0.9 m, respectively (refer to Appendix K). As expected, the 1.5 m pipe outflow capacity is predicted to reduce over time with rising sea levels. The landscape downstream of Stage 3 (beyond the Project Approval boundary) is potentially subject to a range of changes due to climate change, which are not specified or known at this stage.

The following contingency arrangements are documented for future decades of operation to supplement this SMP.

- In addition to adjustments to the basin outflow controls on Lot 210, the potential, future contingency infrastructure items on Lot 1001 include, but not limited to levee raising, additional floodgates, surface water pumping stations, ponding basins, channel and easement widening. The proposed channels designed through the Lot 1001 development footprint in the Lot 1001 Project Approval MP10_0185 are 28 m - 41 m wide to allow for development runoff from Lot 210 and Lot 1001 as well as vegetation growth. These channels are formed above ground through Lot 1001 and considers the existing drainage channel and easement for drainage benefiting Lot 210 to remain in place, unimpeded all the way to the Hunter River across Lot 1001. Overbank, natural surface levels adjacent to the existing channel could be widened in future for increased storage and conveyance if necessary. This plan was developed in consultation with NPWS. There is proposed open space area downstream close to the river and a 10 ha freshwater ponding basin referred to as the "Overflow Wetland Rehabilitation Area" (refer to Figure 6.4 from Project Approval MP10_0185). As future contingency, this freshwater ponding basin could be expanded to the open space area for increased freshwater overflow storage area adjacent to the outlet, if required. Owing to the large land area of Lot 1001, none of the above measures would be necessary until after Stage 2 of Lot 1001 is developed.

- Installation, operation and maintenance of the above future, contingency stormwater infrastructure will be by the landowner of Lot 1001.
- NEH as the current landowner of both Lot 210 and Lot 1001 intends to impose a levy on leasing fees within development to cover these future, potential costs of contingency stormwater infrastructure. The future potential costs rests with the landowners of Lot 210 and Lot 1001. The Landowner will charge an annual estate fee which will be used to maintain critical infrastructure such as stormwater, footpaths, cycle ways and landscaping. Access and easement adjustments may be necessary to benefit Lot 210.
- There is adequate land in the existing approval on Lot 1001, already accommodated as mentioned above, regarding Open Space, the Overflow Wetland Rehabilitation Area and wide drainage channels under the Project Approval MP10_0185, approved to not impede Lot 210 stormwater and with overbank storage which could be increased if required within the approved drainage corridors. Refer to Figure 6.4.

6.5.4 Summary

The location of the discharge point is selected to discharge as far west as possible, therefore ensuring that all runoff from the fully developed site would drain southwest directly to the Hunter River and not east towards the Ramsar Wetlands. The downstream storage capacity in the existing drains as well as the outflow capacity of the gated 1.5 m pipe were found to be sufficient to discharge the expected average daily outflows from the fully developed Stage 3 under normal average rainfall conditions. This demonstrates that the existing stormwater drainage channels have capacity to accommodate post development flows under a range of tidal conditions, therefore satisfying Schedule 3, Condition 12e and is consistent with intentions of minimising flows to the adjoining wetlands as per Schedule 3, Condition 12d of the Project Approval MP07_0086.

6.6 POTENTIAL IMPACTS ON FLOW RATES AND RUNOFF VOLUMES TO THE RAMSAR WETLANDS

Two-dimensional (2D) hydraulic modelling was undertaken of the catchment draining the development site to comprehensively determine the overflow risk of the downstream drainage system and the potential for any impact of the development site on flow rates and runoff volumes draining to the Ramsar Wetlands (refer to the memorandum in Appendix J).

To evaluate the impact of tidal conditions and rainfall runoff volumes, a severe (1% AEP) long-duration storm (48 hours) has been adopted for the assessment. The 48-hour duration storm allows the volumes exiting the Site either through the pipes to the Hunter River or flows draining easterly towards the Ramsar Wetlands to be calculated across four tide cycles (two high tides and two low tides each day). The model was run for existing conditions and for fully developed Stage 3 conditions to determine the differences in total catchment runoff that would normally drain to the wetlands. The stormwater management strategy described in this SMP was designed to improve the downstream drainage conditions. The 2D hydraulic modelling was used to analyse for any potential impacts and demonstrate the results comprehensively.

The hydraulic model results (refer to Appendix J) have demonstrated that there will be a reduction in flow volumes draining to the Ramsar Wetlands under the developed scenario of Stage 3 compared to existing conditions due to the redirection of Site runoff to the Existing Drainage Channel. The modelled capacity of the entire drainage system, including the Existing Drainage Channel, is considered adequate to accommodate post-development flows under a range of tidal conditions satisfying Schedule 3, Condition 12e and aligning with intentions of minimising flows to the adjoining wetlands as per Schedule 3, Condition 12d of the Project Approval MP07_0086.

7 Water quality management

7.1 OVERVIEW

The 'MUSIC' model for urban stormwater improvement conceptualisation (eWater, 2019) was used to assess the post-development site runoff from the proposed industrial lots as well as external catchments to determine the performance of the proposed stormwater treatment system.

The following sections describe the adopted water quality objectives (WQOs), the chosen treatment measures for the development site as well as the methodology and results of MUSIC modelling to assess the performance of the proposed stormwater treatment system. The following guidelines and/or previous assessments were considered for the water quality assessment:

- NSW Department of Environment and Climate Change's (DECC's) *Managing urban stormwater: environmental targets – Consultation Draft 2007* (DECC, 2007);
- HCCREMS' Water Sensitive Urban Design Solutions for Catchments above Wetlands (HCCREMS, 2007);
- Redlake Enterprises Pty Ltd's Volume 4 - Stormwater Management Report – Industrial Subdivision (Asquith & deWitt Pty Ltd, 2007);
- Port Stephens Council's (Council's) *Development Control Plan – General Provisions* (PSC, 2014);
- Council's *Development Design Specification – 0074 Stormwater Drainage (Design)* (PSC, 2022)
- Council's *Water Sensitive Development Strategy Guidelines* (BMT WBM, 2011);
- NSW Government's *NSW MUSIC Modelling Guidelines* (BMT, WBM, 2015); and
- Healthy Waterways Water by Design *MUSIC Modelling Guidelines – Consultation Draft November 2018* (HW, 2018).

7.2 WATER QUALITY OBJECTIVES

Table 7.1 compares load-based design objectives for site runoff in the operational phase of the development obtained from the above approvals and guidelines. The key pollutants that are generally of concern during the operational phase of the industrial development include litter, sediment and nutrients (nitrogen (N) and Phosphorous (P)). The WQOs shown in Table 7.1 indicate the pollutant reduction targets when comparing mitigated with unmitigated site annual pollutant loads. The proposed treatment train selected for the proposed development have been designed to meet the design WQOs for these key pollutants.

The EPBC Approval (2007/3343) conditions refer to the adopted WQOs previously set by the DECC (2007) (now NSW DPE). The Project Approval conditions MP07_0086 refer to the DECC (2007) and HCCREMS (2007) WQOs. As such, the proposed stormwater treatment strategy was designed to satisfy the DECC (2007) and HCCREMS (2007) as a minimum. However, Council's WQO's have also been considered in this assessment for comparison.

The DECC (2007) and HCCREMS (2007) WQOs are generally similar to the current Council WQOs set out in Council's DCP and in Council's *Water Sensitive Development Strategy Guidelines* (BMT, WBM, 2011) for sensitive catchments. It has been considered that the development site should be classified as a sensitive catchment due to the existing wetlands downstream of the site.

Table 7.1 – Water quality objectives

Water quality parameter	Percent reduction (%)			
	DECC (2007)	HCCREMS (2007)	PSC (2022) (outside drinking water catchment)	BMT WBM (2011) (sensitive catchment)
Gross pollutants	90	n/a	90	90
Total suspended solids (TSS)	85	80	90	85
Total Phosphorous (TP)	65	45	60	65
Total Nitrogen (TN)	45	45	45	50

n/a – not available

7.3 SELECTION OF TREATMENT TRAIN

A description of the proposed stormwater quality treatment measures is provided in Section 4.2.3. Figure 4.1 shows the locations of the proposed water quality treatment infrastructure, which were configured based on the assumption that the developed areas of Stage 3 will be 90% impervious.

Rainwater tanks are proposed to be installed at each of the future industrial lots, with a combined total volume of approximately 4 ML (4,000 m^3) over the entire estate (refer to Section 8.3). However, the final land use and layout of the industrial lots are unknown at this stage. As such, rainwater tanks were not included in the MUSIC model as part of the water quality treatment train. This approach is conservative for the purpose of satisfying the pollutant reduction targets.

7.4 WATER QUALITY MODELLING

7.4.1 Overview

Assessment of mitigated post-development site runoff water quality was undertaken using the MUSIC water quality model (eWater, 2018). The model was configured based on the MUSIC-Link template specific for Port Stephens Council. Using this approach, the default MUSIC node parameters including pollutant parameters are in line with the Council's preferred parameters. A review of the default MUSIC node including pollutant parameters indicate that they are generally consistent with those recommended in the *NSW MUSIC Modelling Guidelines* (BMT, WBM, 2015). Gross pollutants, suspended solids, total phosphorous and total nitrogen were estimated with the MUSIC model runoff generation parameters.

7.4.2 Rainfall and evapotranspiration

Rainfall in the MUSIC model was configured based on six-minute rainfall data for Williamtown RAAF (Station no. 061078) obtained from the Bureau of Meteorology (the Bureau). A rainfall period of ten years was used for all MUSIC modelling. The adopted period of analysis was 1 January 1998 to 31 December 2007. Evapotranspiration was also configured based on the estimates obtained from the Bureau. The default rainfall and evapotranspiration data form the Council-specific MUSIC model template were unchanged for the water quality assessment.

7.4.3 Source node parameters

The proposed development is considered to be large scale. As such, the proposed industrial lots were 'lumped' together such that the source node used represents a number of lots with similar characteristics.

The MUSIC-Link template for Port Stephens Council contains default parameters for urban nodes, which are generally consistent with the recommended parameters in the BMT WBM (2015) guideline.

Table D.1 and Table D.2 in Appendix E show the adopted MUSIC rainfall-runoff parameters and source node pollutant concentration parameters, respectively.

Routing was not used in any drainage links.

7.4.4 Model configuration

A MUSIC model was developed for post-development site conditions with the chosen stormwater treatment trains. Figure D.1 Appendix E shows the MUSIC model configuration used to assess the mitigated post-development site runoff quality for the fully developed site. Table C.3 in Appendix E shows the adopted source node type, area and percentage impervious. The following is of note with regards to the MUSIC model configuration:

- Two constructed wetlands were included in the MUSIC model and referred to as Basins 2 and 3. These basins function as a combined wetland-detention basin, but only the water quality treatment component of the basins was modelled in MUSIC. Further details of the water quality treatment components of Basins 2 and 3 are provided in Section 7.5.
- Channels 1, 2 and 3 were modelled as vegetated swales and provide stormwater treatment for the following subcatchments:
  - Channel 1 treats runoff from developed subcatchments D1 and D2 as well as external runoff from Tomago Road (subcatchments TR1 and TR2) and WesTrac Drive (Subcatchments WD1, WD2 and WD3).
  - Channel 2 treats runoff from developed subcatchments D4 and D5.
  - Channel 3 treats runoff from developed subcatchments D7 and D8 as well as external runoff from Subcatchment TR3.

  Channels 1, 2 and 3 were sized to convey the 1% AEP design discharges as described in Section 6.2. As such, the size and configuration of these channels were not determined by water quality treatment requirements.
- SPEL Stormsack GPTs were incorporated into each developed subcatchment representing industrial lots.

7.4.5 Water quality modelling results

The water quality modelling results indicate that the percentage pollutant reduction achieved by the proposed treatment train exceeds all WQOs applicable to the development site, including those applicable to the wetland environments.

Table 7.2 shows the mean annual pollutant loads for gross pollutants, TSS, TN and TP for unmitigated and mitigated post-development conditions. The water quality modelling results have been reported based on the total outflow at the southern lot boundary (i.e. the combined outflow from Basins 2 and 3).

The water quality modelling results indicate that the percentage pollutant reduction achieved by the proposed treatment train exceeds all WQOs applicable to the development site, including those applicable to the wetland environments.

Table 7.2 – Comparison of mean annual pollutant loads between post-development unmitigated and mitigated conditions

Pollutant	Annual pollutant load (kg/year)		Percent reduction (%)	WQO percent reduction			
	Developed (unmitigated)	Developed (mitigated)		DECC (2007)	PSC (2022)	HCCREMS (2007)	BMT WBM (2011) (sensitive catchment)
Gross pollutants	115,000	0	100.0	90	90	n/a	90
Suspended solids	87,800	4,030	95.2	85	90	80	85
Total phosphorous	140	27	80.6	65	60	45	65
Total nitrogen	967	464	52.0	45	45	45	50

7.5 DESIGN CHARACTERISTICS OF THE PROPOSED WETLANDS

Table 7.3 provides the key design criteria for the proposed wetlands within Basins 2 and 3. A typical cross section is shown in Figure 6.1.

Table 7.3 – Key design characteristics of proposed wetlands in Basins 2 and 3

Description	Constructed wetland	
	Basin 2	Basin 3
Storage properties		
Surface area (m^2) at the base	22,754	18,651
Extended detention depth (m)	0.5	0.5
Permanent pool volume (m^3)	4,259	3,468
Initial volume (m^3)	4,259	3,468
Exfiltration rate (mm/hr)	0.0	0.0
Evaporative loss as % of PET	125	125
Outlet properties		
Equivalent pipe diameter (mm)	225	225
Overflow weir width (m)	10.0	5.0
Notional detention time (hours)	37.9	31.1

7.6 IMPLEMENTATION OF TREATMENT TRAIN

The proposed treatment train for ultimate development will be installed during construction and will be ready for use when the development enters its operational phase. The two combined wetland-detention basins will initially function as sedimentation basins until the catchment is fully developed. An Erosion and Sediment Control Plan for the construction phase of the proposed development is provided in Section 9.

7.7 PROPOSED WATER QUALITY MONITORING STRATEGY

Details of the proposed monitoring and reporting of stormwater quality from the development site are provided in Section 11.

8 Site water balance

8.1 OVERVIEW

This section describes the site water balance for the proposed development, providing details of:

- sources and security of water supply;
- water use/re-use on-site;
- comparison of surface water discharges from the developed site compared to pre-development conditions; and
- reporting procedures.

8.2 SOURCES OF WATER SUPPLY

The sources of water supply and security for the proposed development are:

- water main from the Hunter Water Corporation's (Hunter Water's) regional water supply system (potable town water supply); and
- rainwater tank storage to be provided in the individual industrial lots to capture roof stormwater runoff and re-use for non-potable water uses such as irrigation of landscaped areas, toilet flushing and possibly showers and canteens.

8.3 PROPOSED WATER RE-USE STRATEGY

It is proposed that rainwater tanks will be provided at the individual industrial lots for stormwater capture and re-use. However, the future landuses at the proposed industrial lots are unknown at this stage of the development. Therefore, the proposed rainwater tank storage to be provided, as well as the operational water uses from the rainwater tanks cannot be determined accurately at this stage.

Notwithstanding the above, details of the stormwater harvesting strategy adopted for the neighbouring WesTrac facility (Stage 1) obtained from the *Soil and Water Management Report for WesTrac Facility at Tomago Road, Tomago* (ADW Johnson, 2010), were used to derive the indicative rainwater tank volume requirement and the indicative rates of non-potable water use at the future industrial lots at the proposed development (Stage 3).

Based on the ADW Johnson (2010) report, roof water at the WesTrac facility is collected by a 2 ML (2,000 kL) rainwater tank based on a total roof area of 4 ha (40,000 m^2), which is equivalent to approximately 5 kL per 100 m^2 of roof area. The estimated total non-potable water use including irrigation of landscaped areas is 15.5 ML/year. The estimated rainwater tank storage requirement and non-potable water use rates for the proposed development (Stage 3) was proportioned based on the relative difference in catchment area to the WesTrac facility.

Based on a total development site area of 50.1 ha, the estimated rainwater tank storage requirement and non-potable water use rates for the proposed development (Stage 3) are as follows:

- The total rainwater tank storage volume requirement is approximately 5 kL per 100 m^2 of roof area, to be apportioned between the future industrial lots.
- The total non-potable water use including irrigation of landscaped areas is approximately 31 ML/year.

The installation of rainwater tanks is a requirement in the Stage 3 Design Guidelines for development of the future industrial lots within Stage 3. However, the final land use and layout of the industrial lots are unknown at this stage. As such, rainwater tanks were not included as part of the water balance calculations. This approach is to be conservative for the purpose of estimating post-development outflow volumes for management from the site, due to the exclusion of the required stormwater re-use component reducing the developed outflow volume.

8.4 SITE WATER BALANCE

8.4.1 Overview

The MUSIC model described in Section 7 was used to estimate the surface water outflows from the development site under both pre-and post-development conditions. The MUSIC model was primarily used as a tool to assess the stormwater treatment performance of the proposed development as described in Section 7. The MUSIC model also calculates the volume of stormwater runoff generation from the site and accounts for the differences in catchment characteristics (such as soil storage capacities and evapotranspiration losses) between pre- and post-development conditions. Therefore, the MUSIC model is suitable for assessing impact of the proposed development on the volume of the surface water outflows from the development site compared to pre-development conditions.

8.4.2 Development of MUSIC model for pre-development conditions

The MUSIC model described in Section 7 reflects mitigated developed conditions. To determine the volume of surface water outflows for pre-developed conditions, a pre-development conditions MUSIC model was developed by converting the MUSIC nodes for the proposed industrial lots into “forest” nodes (see Appendix E for the adopted MUSIC node rainfall-runoff parameters).

8.4.3 Meteorological conditions

The MUSIC model was configured to use rainfall data for Williamtown RAAF (Station no. 061078) for a 10-year period from 1 January 1998 to 31 December 2007. The average annual rainfall over this 10-year period is 1,125 mm. For comparison, the long-term average annual rainfall for this station (obtained from the Bureau’s statistics) is 1,132 mm (consistent with the MUSIC model) over a 72-year period between 1942 and 2023. Therefore, the rainfall data and simulation period adopted in the MUSIC model is considered appropriate.

The average annual evapotranspiration for the 10-year MUSIC model simulation period is approximately 1,394 mm.

8.4.4 External groundwater inflows

Based on flow monitoring data at the neighbouring WesTrac facility (described in Section 3.4.3), it is estimated that under average annual rainfall conditions, there is a potential for up to approximately 140 ML/year of groundwater inflow from the Tomago Sandbeds that could potentially report to the surface just downstream of the development site. This potential groundwater inflow volume has been included in the site water balance for both pre- and post-development conditions.

8.4.5 Site water balance

Table 8.1and Table 8.2 compare summaries of the site water balance for an average annual rainfall year between the existing and developed sites, respectively. The results indicate that the proposed development potentially increases freshwater discharge from the development site by approximately 194.7 ML based an average rainfall year.

Table 8.1 – Summary of site water balance for existing (pre-developed) conditions

Pre-development conditions	
Rainfall (mm/yr)	1125.5
Rainfall volume (ML/yr)	610.3
Catchment evapotranspiration loss (ML/yr)	431.0
Flow generated on-site (ML/yr)	179.3
External groundwater inflow (ML/yr)	140.0
Total outflow from site (ML/yr)	319.3

Table 8.2 – Summary of site water balance for developed conditions

Post-development conditions	
Rainfall (mm/yr)	1125.5
Rainfall volume (ML/yr)	610.3
Catchment evapotranspiration loss (ML/yr)	167.3
Flow generated on-site (ML/yr)	443.1
External groundwater inflow (ML/yr)	140.0
Evapotranspiration loss from wetlands (ML/yr)	70.0
Outflows from Basins 2 and 3	374.0
Total outflow from site (ML/yr)	514.0

8.4.6 Discussion on impact of increased freshwater discharges

Discharges from the developed Stage 3 site including from external catchments would be captured in the combined wetland-detention basins at the southern corners of the site (Basins 2 and 3). The outlet configuration of the proposed Basins 2 and 3 has been designed to discharge runoff to the Existing Drainage Channel within an existing drainage easement across Lot 1001 to the Hunter River.

The storage and outlet configurations of Basins 2 and 3 were also designed to attenuate peak instantaneous flows from the developed site to below pre-development conditions peak flows (further details in Section 6). However, the proposed basin would not significantly reduce the volume of runoff other than through evapotranspiration from the basin surface. Although peak runoff volumes from the site would increase significantly post-development, the MUSIC model results (refer to Section 7.5) indicate that runoff retained in the proposed basins up to the extended detention depth would be discharged gradually via a 0.225 m low-flow outlet pipe in each basin, over a period of over 31 hours. Therefore, the proposed basins would provide some degree of mitigation to increased runoff volumes from the developed site.

The estimated post-development runoff volume from Stage 3 is 514 ML/yr (excluding water re-use) for an average rainfall year, all of which will be conveyed to the Existing Drainage Channel across Lot 1001. In comparison, the outflow of 319 ML/yr under existing conditions is not directed to the Existing Drainage Channel. The region experiences on average about 93 rainfall days per year (obtained from the Bureau's statistics). Under post-development conditions, this equates to about 5.5 ML of runoff per rain day from Stage 3 on average. Analysis of the downstream storage and outflow capacity (refer to Section 6.5) indicate that the daily outflows from the fully developed Stage 3 during an average rain day can be conveyed adequately to the Hunter River.

Due to the existing topography of Lot 1001, discharges from the site would be stored on site and eventually conveyed west to the Hunter River under normal rainfall conditions. In addition, surface water runoff from the site would not drain east to the Ramsar Wetlands under both pre- or post-development conditions under normal rainfall conditions. Under severe rainfall conditions, hydraulic modelling of the entire catchment (refer to Appendix J) demonstrated a reduction in flow volumes draining toward the Ramsar Wetlands under the developed Stage 3 scenario compared to existing conditions due to the redirection of Site runoff to the Existing Drainage Channel. Therefore, the increase in freshwater discharges form the site would not have any impact on the hydrologic characteristics of the Ramsar Wetlands. The specification from the Project Approval, Schedule 3, Condition 12b (HCCREMS, 2007) states that it is acceptable for excess stormwater to be diverted and discharged into rivers as environmental flows, subject to suitable treatment.

8.5 MONITORING

Details of the proposed monitoring and reporting of stormwater quantities from the development site are provided in Section 11.

9 Erosion and sediment control

9.1 OVERVIEW

This section presents the Erosion and Sediment Control (ESC) strategy for the proposed development. It is intended to assist in the management, reduction and mitigation of erosion and consequent sediment transport at the development site. More detailed plans will be prepared for each stage of the development and be based on this strategy.

During construction of the proposed development, preventing unacceptable levels of sediments from leaving the development site and entering the receiving surface water environment downstream is one of the most important functions of ESC. ESC measures are temporary and are required until the proposed industrial lots and roads are sealed and/or landscaped and revegetated.

As per Landcom's *Managing Urban Stormwater – Soils and Construction* (Landcom, 2004) guideline, this ESC Plan adopts the three cornerstones of ESC as follows:

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

For ESC to be effective, the following fundamentals are required:

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

9.2 POTENTIAL SOURCES OF EROSION

Construction at the development site may result in the alteration of existing surface water flow patterns by proposed activities and through diversion channels. Erosion may occur due to the following activities:

- topsoil and subsoil stockpiles;
- filling and excavation as part of bulk earthworks;
- cleared land ahead of construction activities;
- changes to catchments;
- runoff from the access road(s);
- vehicle and equipment movements; and
- disturbed areas not yet sealed and/or landscaped or revegetated.

9.3 EROSION AND SEDIMENT CONTROL MEASURES

9.3.1 General

ESC measures to be implemented during construction include:

- Disturbance is limited to areas to be immediately worked on and regeneration of dust and erosion free surfaces – landscaping, concrete, bitumen sealing as soon as practical thereafter.
- Provision of and continued maintenance of sediment fencing to low perimeter locations.
- Provision of mesh and gravel or geotextile inlet filters.
- Contract specifications requiring stabilised site access, low flow earth flow earth banks and wind erosion screens.
- A construction programme that provides for the sediment basin to be constructed at the outset with all site runoff, where practical, piped or channelled to this basin for primary treatment/settlement before leaving the site via a mesh supported geotextile filter/riser before discharging to the wetlands.
- Contract specifications requiring regular maintenance of all erosion and sediment control structures and devices for the full contract and maintenance period.

9.3.2 Primary sediment control measures

Primary control of sediment will be provided by two sediment basins which will be constructed within the footprints of Basins 2 and 3. The total minimum sediment basin volume has been determined based on the following design standards and methodology for a Type F sediment basin (Landcom, 2004):

- It was assumed that the proposed sediment basins will capture runoff and sediment from the entire site area of 49 ha.
- Total sediment basin volume = settling zone volume + sediment storage volume as shown in Figure 9.1. The sediment storage volume is the portion of the basin storage volume that progressively fills with sediment until the basin is de-silted. The settling zone is the minimum required free storage capacity that must be restored within 5 days after a runoff event.
- The sediment basin settling zone volume was determined by adopting volumetric runoff coefficient (Cv) of 0.57 based on Group B soils, a 95th percentile 5-day duration rainfall of 77 mm, calculated using formula $R_{(Y\%,\ 5\text{-day})} = K1 * I_{(1yr,\ 120hr)} + K2$.
- The sediment storage volume was determined based on two months soil loss calculated using with RUSLE.

A summary of the sediment pond volume requirement is provided in Table 9.1. The detailed calculations are provided in Appendix F. The total required minimum sediment basin volume was calculated to be 21,651 m^3. This total sediment basin storage volume can be apportioned as appropriate between Basins 2 and 3 depending on the catchments draining to each basin during the construction phase of the development. Alternatively, this total sediment basin storage volume can also be apportioned to a number of smaller intermediate basins in conjunction with the staging of bulk earthworks.

Table 9.1 – Minimum total size requirement for the sediment basins

Catchment area	Settling volume (m^3)	Sediment storage volume (m^3)	Total volume (m^3)
48.6	21,322	329	21,651

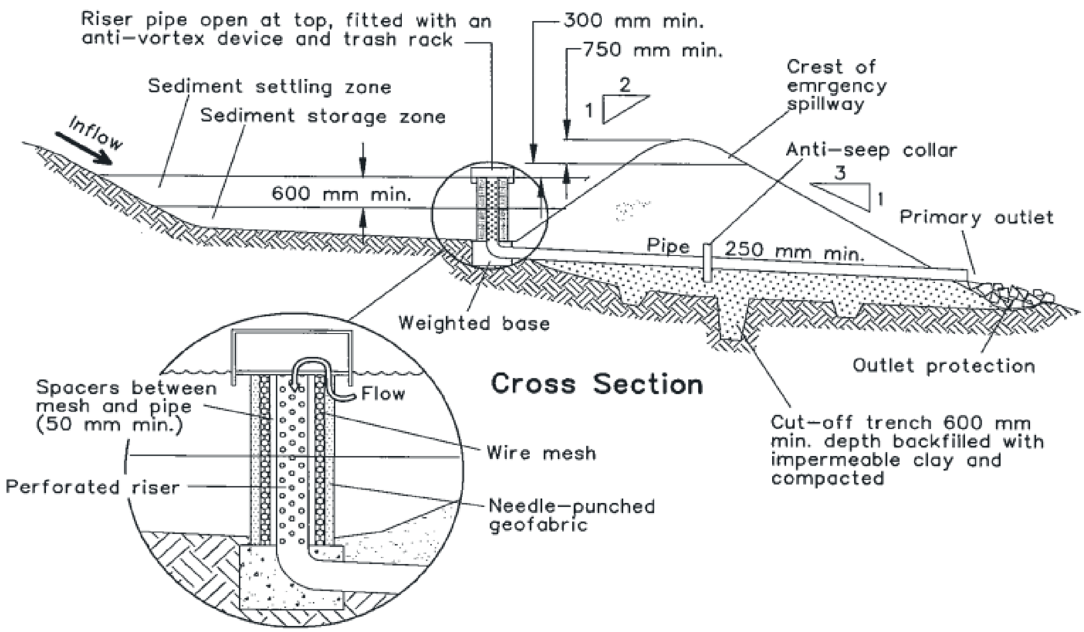


Figure 9.1 – Typical Type-F sediment basin cross section (Landcom, 2004)

9.3.3 Supplementary sediment control measures

Supplementary sediment controls are used in areas where the sediment producing catchment is small or the potential for producing sediment laden runoff is low. Supplementary sediment controls can be used in conjunction with the primary sediment control (i.e. to capture sediment before sediment-laden runoff reaches the sediment basins). A list of appropriate primary and secondary supplementary sediment control techniques is given in Table 9.2.

Table 9.2 – Summary of supplementary sediment control measures

Technique	Typical use
Check dam sediment trap	• Supplementary sediment trap in minor concentrated flow areas. • Trapping sediments in table drains and minor drainage lines. • Check dams may be constructed of rock, sandbags or compost filled socks.
Sediment fence	• Supplementary device for sheet flow from minor catchment areas. • Suitable for all soil types. • Require maintenance after every runoff event.

9.4 GENERAL RECOMMENDATIONS

The following general recommendations are adopted from Landcom (2004) to provide general guidelines that should be followed for correct implementation of sediment controls:

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

Other considerations include:

- Proprietary sediment fencing shall be installed by the contractor at the discretion of the site superintendent to contain sediment fractions as near as possible to their source.
- Sediment removed from any trapping device shall be relocated where further pollution to down slope lands and waterways cannot occur.
- Stockpiles shall be located by the Contractor in accordance with their approved SWMP and elsewhere at the discretion of the site superintendent. Where stockpiles are to be in place longer than 30 days, they shall be stabilised by covering with mulch or with temporary vegetation.
- Water shall be prevented from entering the permanent drainage system unless it is sediment free. Drainage pits are to be protected in accordance with the Contractor's approved SWMP.
- Temporary sediment traps at pits shall be retained until after lands they are protecting are completely rehabilitated.
- Dust suppression will be required for the control of airborne particles during construction. This will be via standard water cart usage during earthworks and pavement construction of the hardstand areas.

9.5 CONSTRUCTION SEQUENCE

Works will be undertaken in the following construction sequence:

1. Install sediment fencing and cut drains to meet the requirements of the SWMP. Waste collection bins shall be installed adjacent to site office.
2. Construct stabilised site access in location nominated by the Contractor and in accordance with Port Stephens Council's requirements.
3. Construct sediment basins for disturbed areas in accordance with the rate per hectare provided in the SWMP. Install risers and two pegs in the floor of the basin and have them marked to show the top of the sediment storage zone. Ensure the basin is cleared of sediment once the design capacity is reached.
4. Redirect clean water around the construction site.

5. Install sediment control protection measures at all natural and man-made drainage structures. Maintain until all the disturbed areas are stabilised.
6. Clear and strip the work areas in accordance with the Geotechnical advice provided.
7. Any disturbed areas, other than lot grading areas, shall immediately be covered with site topsoil within 7 days of clearing. Lot re-graded shall be covered with bitumen emulsion as specified.
8. Apply permanent stabilisation to site (landscaping).

9.6 MONITORING AND MAINTENANCE

An effective monitoring program is recommended to assess the effectiveness of the ESC measures during construction. Maintenance and routine inspection options are:

- An inspection prior to expected rainfall events.
- An inspection post rainfall events.
- For sediment control structures (e.g. sediment dams), check for sediment deposition and the requirement for its removal.
- Waste bins to be provided for all construction refuse. They are to be emptied at least weekly and refuse is to be disposed in accordance with the site manager's recommendations.

The inspection and monitoring regime should collect and record the following key information:

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

The site manager shall inspect the site at least weekly and shall:

- Ensure that all drains are operating effectively and shall make any necessary repairs;
- Remove any spilled material from area subject to runoff or concentrated flow;
- Remove trapped sediment where the capacity of the trapping device falls below 60%;
- Inspect the sediment basins after each rainfall event and/or weekly. Ensure that all sediment is removed once the sediment storage zone is full. Ensure that outlet and emergency spillway works are maintained in a fully operational condition at all times;
- Ensure rehabilitated lands have effectively reduced the erosion hazard and initiate upgrading or repair as appropriate;
- Construct additional erosion or sediment control works as may be appropriate to ensure the sediment basins are the final measure, not the only measure;
- Maintain erosion and sediment control measures in a fully functioning condition at all times until the site is rehabilitated;
- Ensure that the revegetation scheme is adhered to and that grass covers are kept healthy, including watering and mowing; and
- Remove temporary soil conservation structures as the last activity in the rehabilitation program.

10 Risk evaluation

10.1 OVERVIEW

The development is adjacent to the Ramsar Wetlands, which is recognised as a matter of national environmental significant as defined by the EPBC Act. Hydrologic modelling (refer to Section 6) and water quality modelling (refer to Section 7) were undertaken to assess the potential impact of the development on the Ramsar Wetlands.

This section summarises the risk evaluation undertaken to qualitatively assess the potential environmental risks on the Ramsar Wetlands associated with the development, specifically the impacts on water quantity and quality. This risk evaluation was undertaken in accordance with the DCCEEW (2014) guideline and Australian Standard (AS) 31000:2009 (SA, 2009).

10.2 METHODOLOGY FOR ASSIGNING RISK RATING

The environmental risks associated with the development were identified as follows:

- Increased frequency and magnitude of inundation; and
- Contamination of surface water.

These environmental risks were given a rating in terms of likelihood and consequence using the criteria in Table 10.1 and Table 10.2. These ratings were then combined using the criteria in Table 10.3 to generate a risk rating of Low, Medium or High.

Table 10.1 – Qualitative measure of likelihood

Qualitative measure of likelihood (how likely is it that this event/issue will occur after control strategies have been put in place	
Highly likely	Is expected to occur in most circumstances
Likely	Will probably occur during the life of the development
Possible	Might occur during the life of the development
Unlikely	Could occur but considered unlikely or doubtful
Rare	May occur in exceptional circumstances

Table 10.2 – Qualitative measure of consequence

Qualitative measure of consequences (what will be the consequence/result if this issue does occur rating)	
Minor	Minor incident of environmental damage that can be reversed
Moderate	Isolated but substantial instances of environmental damage that could be reversed with intensive efforts
High	Substantial instances of environmental damage that could be reversed with intensive efforts
Major	Major loss of environmental amenity and real danger of continuing
Critical	Severe widespread loss of environmental amenity and irrecoverable environmental damage

Table 10.3 – Risk rating matrix

Likelihood	Consequence				
	Minor	Moderate	High	Major	Critical
Highly likely	Medium	High	High	Severe	Severe
Likely	Low	Medium	High	High	Severe
Possible	Low	Medium	Medium	High	Severe
Unlikely	Low	Low	Medium	High	High
Rare	Low	Low	Low	Medium	High

10.3 RISK EVALUATION

10.3.1 Risk of increased inundation at the Ramsar Wetlands

The environmental risk to the Ramsar Wetlands due to potential increases in surface water quantities from the development was determined in terms of consequence and likelihood, as summarised below:

- Consequence – The significant increase in site imperviousness associated with the development potentially increases surface water volume and discharges from the site, which in turn could increase the frequency and magnitude of inundation at the Ramsar Wetlands. The consequence of this on sensitive flora and fauna at the Ramsar Wetlands is potentially **High**.
- Likelihood – Two combined wetland-detention basins will be constructed to ensure non-worsening of peak discharges from the developed site (compared to pre-developed conditions) for all events up to 1% (1 in 100) AEP. Under normal average rainfall conditions, outflows from the proposed basins will drain towards the Hunter River (via Lot 1001) and not towards the Ramsar Wetlands. Under severe rainfall conditions, hydraulic modelling has demonstrated that there will be a reduction in flow volumes draining to the Ramsar Wetlands under the developed scenario of Stage 3 compared to existing conditions due to the redirection of Site runoff. Therefore, the likelihood of increased water quantities from the site affecting the Ramsar Wetlands is considered **Rare**.
- Risk – On the basis of High consequence and Rare likelihood, the risk of environmental harm to the Ramsar Wetlands due to increased frequency and magnitude of inundation is **Low**.

10.3.2 Risk of water contamination at Ramsar Wetlands

- Consequence – The significant change in land use associated with the development potentially increases surface water runoff of typical urban pollutants from the site, which in turn could adversely affect sensitive flora and fauna at the Ramsar Wetlands. On this basis, the consequence is potentially **High**.
- Likelihood:
  - Two combined wetland-detention basins will be constructed to provide water quality treatment and to meet the WQOs set out by local and state governments including WQOs relevant to wetland environments. In addition, outflows from the proposed basins will drain towards the Hunter River distant from and not towards the Ramsar Wetlands.
  - It is possible that during rare and extreme storm events, sufficient water could pond within the topographical depression downstream of the site causing some water to overflow to the Ramsar Wetlands. However, the likelihood of this occurring is rare and when this occurs the runoff will be diluted. Further, hydraulic modelling has demonstrated that under such rare and severe rainfall conditions, there will be a reduction in flow volumes draining to the Ramsar Wetlands under the developed

scenario of Stage 3 compared to existing conditions due to the redirection of Site runoff.

- Therefore, it is unlikely for surface water runoff from the development to drain to the Ramsar Wetlands and hence the likelihood is considered **Rare**.
- Risk – On the basis of High consequence and Rare likelihood, the risk of the development adversely impacting water quality at the Ramsar Wetlands **Low**.

11 Monitoring strategy

11.1 OVERVIEW

Surface water quality and quantity will be monitored at the outlets of Basins 2 and 3. In addition, a groundwater monitoring strategy has been developed, which is described in the GMP (DP, 2024) and in the following sections of this SMP. It is assumed that some of the groundwater monitoring results would be reasonably representative of surface water.

Flow measuring instrumentation will be used at the Basin outlet to measure flow quantity.

11.2 CONTINUOUS IMPROVEMENT AND DETAILED DESIGN

It is noted that the proposed development is at conceptual planning stages, and detailed design will be completed for each stage to achieve appropriate management strategies for groundwater, surface water and geotechnical considerations.

In addition to the requirements for on-going monitoring to achieve continuous improvement, detailed design will include the following:

- Details of fill materials, drainage blanket, and sizing of subsoil drains and possibly diversion trenches for the respective stage area;
- Geotechnical review of bulk fill, subject to identification of source materials;
- Confirm groundwater level ranges at specific locations based on historical data for determination of design invert levels for inflow and outflow points;
- Groundwater modelling of scenarios to confirm impacts can be mitigated;
- Continuing site wide integration of monitoring results for groundwater, surface water and geotechnical considerations as staging progresses;
- Monitoring equipment improvements to provide greater resolution for observing the water level responses to rainfall via equipment/technology which relay 'live' water levels.

In summary, detailed design of controls will be undertaken for respective stages to mitigate impacts and implement management strategies.

Flow measurement results will be compared to Williamtown rainfall data and reviewed against the Hunter Water monitoring data for regional groundwater levels. Options for any changes should be verified by a professional stormwater engineer and raised with authorities.

11.3 STANDARDS

Table 11.1 shows the standards that have been identified by DP (2024) for the groundwater management strategy.

Table 11.1 – Summary of monitoring network (DP, 2024)

Item	DECC (2007)
Groundwater monitoring well installation	• *Minimum Construction Requirements for Water Bores in Australia* (NUDLC, 2020).
Groundwater level and quality monitoring procedures	• Monitoring sampling, testing and assessment of groundwater shall be undertaken by appropriately qualified hydrogeologists or environmental scientists. • NEPC. (2013). *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM]*. Australian Government Publishing Services Canberra: National Environment Protection Council. • Australian/New Zealand Standard (AS/NZS) 5667.1:1998 Water quality: sampling part 1 – guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples; • AS/NZS 5667.4 Water quality: sampling guidance on sampling from lakes, natural and manmade; • AS/NZS 5667.6 Water quality: sampling guidance on sampling of rivers and streams; • AS/NZS 5667.11 Water quality: sampling guidance on sampling of groundwaters.
Laboratory testing	• Environment Protection Authority Approved methods for the sampling and analysis of water pollutants in NSW, 2022. • NATA accredited laboratory to test methods.
Review of groundwater quality, level and hydrogeological trends	• Appropriately qualified hydrogeologists or environmental scientists.

11.4 GROUNDWATER MONITORING NETWORK

DP (2024) noted that the groundwater quality should be monitored using a network of nine wells on Lot 210, comprising two existing wells and six new wells specifically for Lot 210/Stage 3 as shown on Figure 11.1 and Table 11.2. In addition, one new monitoring well is proposed at Lot 1001, at the confluence of existing drains (refer to Figure 11.2). Well locations have been selected with consideration of upgradient, mid site and downgradient locations which would be suitable for long term monitoring (before and during construction). Access for personnel and machinery was notably limited by site vegetation and wet ground conditions at the downgradient locations.

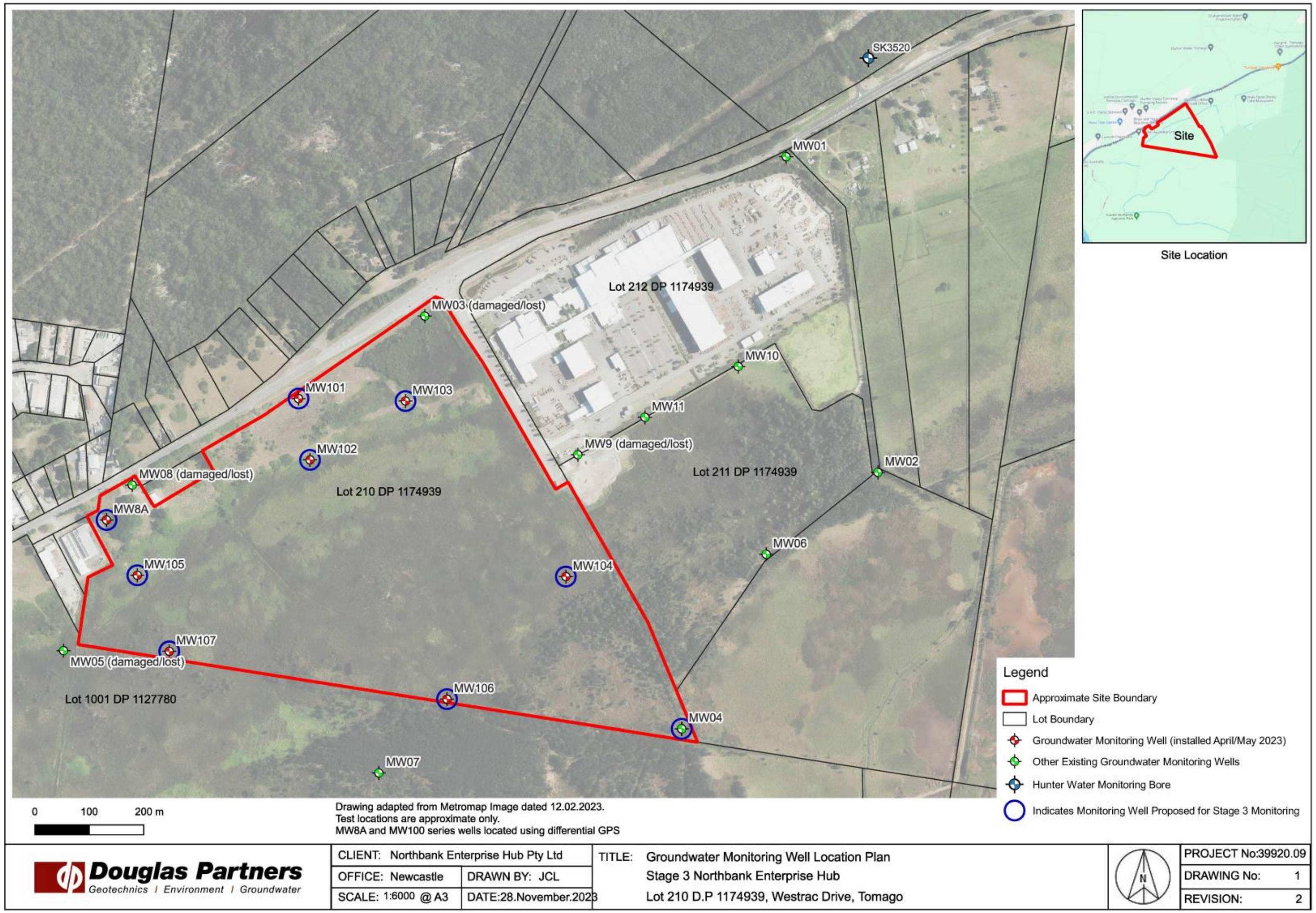


Figure 11.1 – Monitoring well location plan (source: DP (2024) – Drawing 1 in Appendix C)

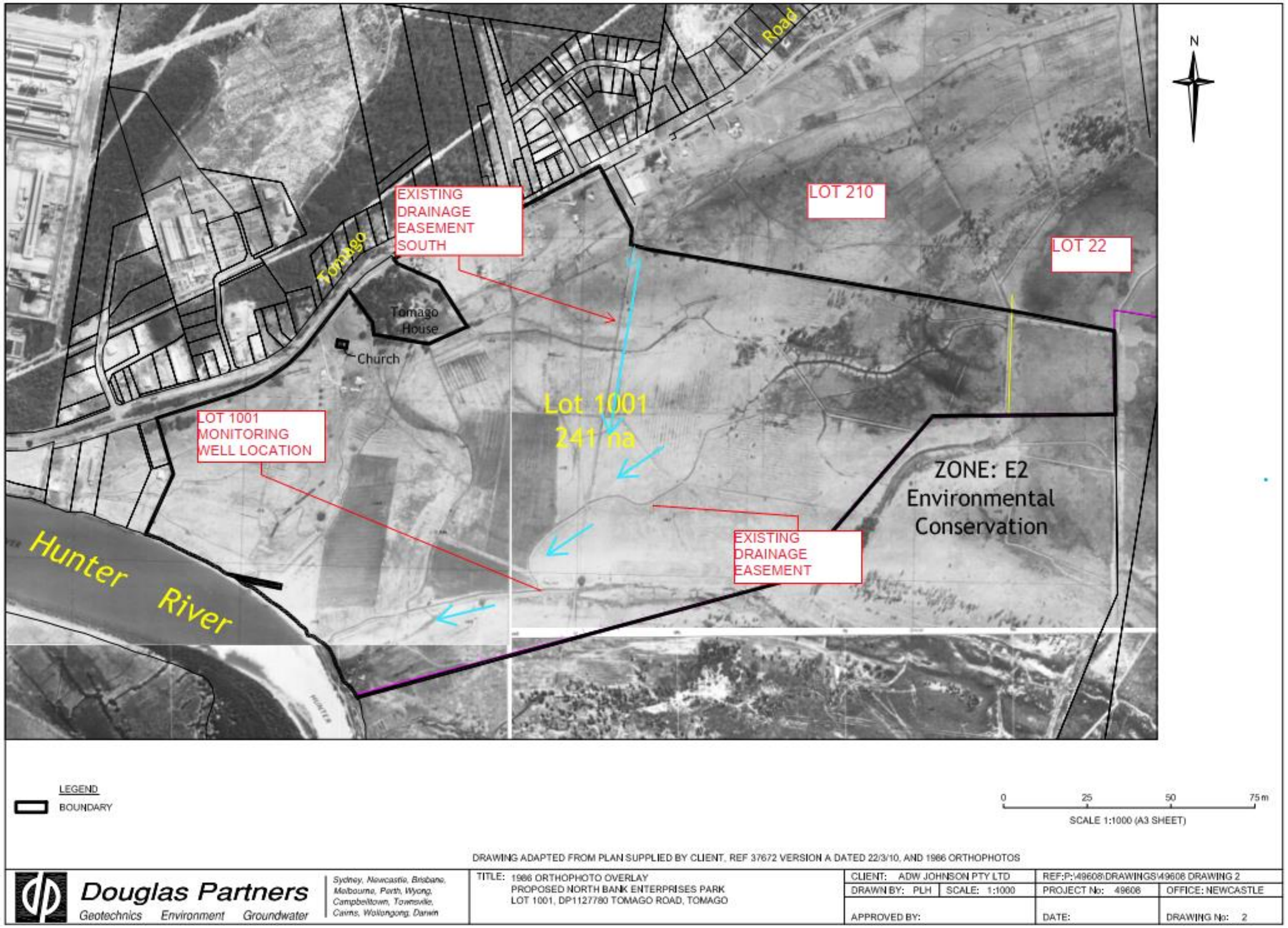


Figure 11.2 – Proposed monitoring well location at Lot 1001

Table 11.2 – Summary of Monitoring Network (DP, 2024)

Well ID	New/Existing	Location within site	Rationale
MW04	Existing	Southeastern corner Near southern boundary	Downgradient location Adjacent to future Basin 2
MW8A	New (replacement for MW8)	North-western corner Near northern boundary	Upgradient location Replacement / relocation of MW8 (damage and boundary adjustment)
MW101	New	Northwestern corner	Upgradient location
MW102	New	Central / northern part of the site	Downslope of elevated costal sand deposits
MW103	New	Northeastern corner	Accessible and suitable location for long term monitoring West and downgradient of proposed Stage 3.1 A fill area
MW104	New	Eastern portion	Mid site location Downgradient of proposed Stage 3.1 A fill area
MW105	New	Western corner	Accessible location on western part of site Downgradient of northern surface water flow path Near future western basin
MW106	New	Central/southern boundary	Downslope of future fill area and industrial lots Downslope / adjacent to surface water
MW107	New (to be installed)	Southern/southwestern boundary	Downslope of future fill area and industrial lots and western discharge area

The early installation of additional wells in Stage 3 and aim of upgradient locations is to further provide "background" water levels and quality with respect to groundwater flowing into the site. Similarly, downgradient locations provide water levels and quality for groundwater leaving the site. The wells near the initial Stage 3 fill area will allow for monitoring of groundwater responses and assist in detailed design of the remaining Stage 3 development.

The monitoring wells are screened to assess the upper water conditions in the unconfined aquifers.

Details of well logs, monitoring wells strata and installation depths are given in the GMP (DP, 2024).

11.5 WATER QUALITY PARAMETERS

DP (2024) noted that the parameters to be measured fall into three categories as shown in Table 11.3. The analytes comprise contaminants of concern based a typical suite of general water quality indicators and potential contaminants of concern considering future commercial/industrial use which has yet to be confirmed. The assessment criteria are shown on Tables G.1 and G.2 in Appendix G.

Table 11.3 – Water quality parameters

Category	Parameter	
Category 1 Parameters (Field parameters)	• Temperature (T) • pH • Electrical Conductivity (EC) • Dissolved oxygen • Oxidation-reduction potential (ORP) • Turbidity	
Category 2 Parameters (laboratory)	• Total Suspended Solids (TSS) • Cations ○ Calcium (Ca) ○ Potassium (K) ○ Magnesium (Mg) ○ Sodium (Na) ○ Iron (Fe)	
	• Anions ○ Chloride (Cl) ○ Sulphate (SO4) ○ Ammonia (NH3) ○ Bicarbonate (HCO3) ○ Carbonate (CO3) ○ Total alkalinity	○ Nitrite (NO2) ○ Nitrate (NO3) ○ Total Kjeldahl Nitrogen (TKN) ○ Total Phosphorous (PO4) ○ Fluoride (F)
	• Heavy metals ○ Aluminium (Al) ○ Arsenic (As) ○ Cadmium (Cd) ○ Chromium (Cr) ○ Copper (Cu) ○ Iron (Fe)	○ Lead (Pb) ○ Manganese (Mn) ○ Mercury (Hg) ○ Molybdenum (Mo) ○ Nickel (Ni) ○ Zinc (Zn)

Category	Parameter
Category 3 Parameters (laboratory)	• Total recoverable hydrocarbons (TRH) • Polycyclic aromatic hydrocarbons (PAH) • Benzene, toluene, ethyl benzene, xylene (BTEX) • Polychlorinated biphenyl (PCB) • Phenols • Organochlorine pesticides (OCP) / organophosphorus pesticides (OPP) • Per- and polyfluoroalkyl substances (PFAS)

11.6 SAMPLING AND TESTING PROTOCOL

DP (2024) noted that sampling should be undertaken in accordance with standard industry practice, including:

- Purging of at least three bore volumes or until T, pH, EC, DO, ORP and turbidity readings are steady;
- Filtering and preservation of samples;
- Chain of custody documentation;
- Duplicate samples on at least 10% of samples or one per monitoring event; and
- Reporting (NSW EPA, 2020).

Laboratory testing should be undertaken at a NATA-accredited chemical laboratory and Practical Quantification Limits (PQLs) should be no greater than half of the relevant criteria for each parameter.

11.7 BASELINE MONITORING (PRIOR TO CONSTRUCTION OF STAGE 3)

Monitoring water quality for Stage 1 and the broader area of Lot 210 has been undertaken since 2010, therefore, groundwater quality has in part been established relevant to Lot 210/Stage 3. Stage 3.1A is already approved by NSW DPE and NPWS and is located well within site boundaries and of small scale and therefore can be compared to baseline monitoring data.

Prior to commencement of further filling of Stage 3, beyond Stage 3.1A, a baseline monitoring program "Baseline 2" has been undertaken comprising:

- Quarterly groundwater quality sampling, including Category 1, 2 and 3 parameters (refer to Table 11.3); and
- Continuous groundwater level monitoring at hourly intervals using dataloggers in at least five of the monitoring wells and manual level measurements taken at the time of the water quality sampling events in every well.

The three Baseline 2 monitoring events were undertaken in September 2023, January 2024 and April 2024.

11.8 POST-BASELINE MONITORING (DURING AND AFTER CONSTRUCTION OF STAGE 3)

Following baseline monitoring (i.e. during and after construction of Stage 3), monitoring will continue on a 6 monthly basis. The exact number of wells and suite of analytes that need monitoring will be reviewed based on the outcome of the baseline monitoring program. Some initial advice is provided below.

Monitoring wells should be retained for as long as possible to assess for potential impacts, especially wells MW102 to MW104 which are located downgradient of initial fill areas. Monitoring wells in the northern and central areas of the site will be adjusted if required as staging of the development progresses. Reinstallation or replacement well at suitable long term monitoring locations will be at the advice of the environmental/hydrogeological consultant. Monitoring wells will be replaced as soon as practicable and within three months.

For example, post-baseline monitoring for Stage 3 could comprise the following:

- Monitoring of wells MW04, MW8A and MW101 to MW106 for as long as possible. Key / minimum monitoring wells to be retained long term are MW04, MW106, MW8-A and MW101;
- The monitoring well coverage will generally maintain upstream and downstream locations for development staging. The interval and frequency of well installations will be confirmed by an environmental/hydrogeological consultant as staging progresses;
- Water quality sampling for the following parameters:
  - Category 1 and 2 Parameters on a 6 monthly basis during and after construction;
  - Category 3 Parameters on a 12 monthly basis;
- Groundwater level gauging on a 3 monthly basis if not subject to automated datalogger monitoring.

11.9 MONITORING SUMMARY

The groundwater monitoring program developed by DP (2024) is summarised in Table 11.2 with the nominated monitoring wells shown on Figure 11.1.

Table 11.4 – Summary of monitoring program

Parameters	Baseline monitoring (Baseline 2) (Note 1)	During Stage 3 Construction
Wells to be Monitored	MW04, MW8A and MW101 to MW107 (all Stage 3 wells)	TBC (Note 2)
Water Levels	Continuous (dataloggers) 3 monthly (manual) (Note 3)	Continuous (dataloggers) 3 monthly (manual)
Category 1 and 2 Parameters	3 Monthly, min of 3 rounds	6 Monthly
Category 3 Parameters	3 Monthly, min of 3 rounds	12 Monthly
Reporting	On completion	12 Monthly
Monitoring Program Review	On Completion	3 Yearly

Notes:
1. Baseline 1 was conducted as part of Stage 1 development and GMP (2009)
2. Exact wells that will be monitoring during and after construction will be determined based on the outcome of the baseline monitoring program. As a Minimum, we recommend monitoring of MW04, MW106, MW107, MW8A and MW101 be continued in addition to new wells installed for the project (if required).
3. Hourly water level monitoring by datalogger in wells MW04, MW8A and MW101 to MW106, 3 monthly manual measurements in all wells.

The three Baseline 2 monitoring events were undertaken in September 2023, January 2024 and April 2024.

11.10 ASSESSMENT CRITERIA

11.10.1 Groundwater levels

DP (2024) noted that groundwater levels will fluctuate with variations in climatic conditions and therefore comparison will need to be made with the background fluctuations as well as with climatic conditions. The ongoing results of monitoring should be reviewed on an annual basis for variations in groundwater levels which are inconsistent with rainfall trends (measured at Williamtown Meteorological Station) and/or outside the range of measured background fluctuations.

11.10.2 Groundwater quality

Available groundwater quality data have been reviewed by DP (2024) to analyse baseline conditions and noticeable trends and to determine site-specific trigger levels. The trigger levels were based on the historical data set and the first of the Baseline 2 monitoring event undertaken in September 2023. The trigger levels will be updated following completion of the remaining Baseline 2 monitoring rounds (January 2024 and April 2024).

The ANZG (2018; 2023) guidelines recommend the use of site baseline data and relevant default guideline values (DGVs) to derive site-specific trigger levels, particularly where background concentrations naturally exceed DGVs. In this approach, the natural range of values for key indicators at reference sites is used to provide a suitable baseline for comparison against values derived from similar aquatic ecosystems' (ANZG, 2023). It is noted that adoption of site-specific data, where lower than the DGV, would be an overconservative approach and not reflect the level of protection required.

Trigger levels do not guarantee a level of protection, rather, are defined as the 'concentration recorded by monitoring which would trigger further investigation to assess the potential for adverse impact on groundwater quality from a site. Periodic exceedances of the groundwater quality Trigger Levels can be expected to occur, particularly where values are based on the $20^{th}/80^{th}$ percentile calculations from the baseline data.

It is proposed that different criteria be used for monitoring bores screened in the Tomago Sandbeds aquifer and those in the overlying clay soils given the difference in water chemistry and beneficial uses of the two groundwater systems.

Typically, the guidelines (ANZG 2018) recommend the 80^{th} percentile of the available baseline data be used as criterion for each analyte. For stressors that cause problems at low levels, it is recommended that the lower criterion be the 20^{th} percentile of the baseline data (i.e. pH which is expressed as an upper range by the 80^{th} percentile and lower range by the 20^{th} percentile to provide a trigger level range, commensurate with the generic ANZG pH criteria).

Statistical analysis of groundwater quality data was undertaken on available site monitoring data to determine the 80th percentile for each analyte to establish site specific upper trigger levels, and the 20th percentiles for analytes requiring lower trigger levels (Section 6.3).

The methodology used to select preliminary trigger levels in each groundwater system is described below. Proposed criteria for each analyte are provided in Table G.1 and G.2 in Appendix G.

The statistical analysis and associated trigger levels will be reviewed and refined:

- At the end of the Stage 3 baseline monitoring program in April 2024 (refer Section 11.7); and
- Regularly thereafter as additional water quality data become available.

It should be noted that the site-specific trigger levels for groundwater are not applicable to surface water quality. However, the applicable values for surface water are the ANZG (2018) 95% Freshwater protection criteria which are indicated in Tables G.1 and G.2 as 'Note A'.

11.10.2.1 Tomago Sandbeds Trigger Levels

DP (2024) noted that potential GDEs (GDE Atlas) in the Tomago Sandbeds are present upstream of the site. Risks of impacts from the project to these GDEs are currently considered to be low given their upstream location. However, the 95% freshwater species protection DGVs (ANZECC & ARMCANZ 2000) was considered to establish trigger criteria for bores in the Tomago Sandbeds aquifer. The Drinking Water Guidelines (NHMRC, 2021) have also been considered due to the proximity to drinking water supply bores in the Tomago Sandbeds aquifer. The guideline value for the most sensitive beneficial use should be adopted for each analyte (i.e. the lower of ANZECC & ARMCANZ 2000 and NHMRC, 2021).

It is recognised, however, that groundwater in the region can have background levels (e.g. dissolved metals attributed to historical mining activities) with concentrations higher than the guideline values. Analytes for which the background 80th percentile is higher than the guideline value for the most sensitive beneficial use have been assigned the 80th percentile background concentration as a trigger level. Otherwise, the guideline value for the most sensitive beneficial use has been adopted (i.e. the lower of ANZECC & ARMCANZ 2000 and NHMRC, 2021). Where no criteria or site-based data exists, the trigger level has been adopted as the laboratory limit of reporting (LOR).

The trigger level and basis for derivation of the value is highlighted in Table G.1 in Appendix G.

11.10.2.2 Clay Aquitard Trigger Levels

DP (2024) noted that due to the presence of the potential GDEs downgradient of the site, the 95% freshwater species protection DGVs (ANZECC & ARMCANZ 2000) have been considered to establish trigger criteria for bores in the clay aquitard. The adopted trigger levels for bores in the clay have been taken as the higher of the 80th percentile background concentrations and 95% freshwater species protection DGVs. Where no criteria or site based data exists, the trigger level has been adopted as the laboratory LOR.

The trigger level and basis for derivation of the value is highlighted in Table G.2 in Appendix G.

11.11 REPORTING REQUIREMENTS

An annual report should be prepared which shall include the following:

- Time and date of sampling;
- Sampling methods, including well purging records;
- Sample Chain of Custody Documentation;
- Results of QA/QC protocols;
- Laboratory test methods and LOR;
- Tabulated results of current round of testing;
- Plot of results over time to allow assessment of trends;
- Groundwater levels plotted against rainfall records;
- Comparison with groundwater quality trigger levels and assessment of trends in groundwater levels noting any exceedances of criteria; and
- Areas of recommended improvement or improvements to site practices such as to meet the object of continuous improvement and/or improve overall water quality targets.

11.12 CONTINGENCY MEASURES

11.12.1 Groundwater levels

If a consistent trend in variations in groundwater level are recorded, then the potential implications of the long-term variation should assess. The management strategy will depend on the nature of the groundwater variation and its expected effects as outlined in Sections 8 and 9 of the GMP (DP, 2024).

11.12.2 Groundwater quality

It is considered that the UCL95-mean values could be used to indicate when monitored values are above average background levels, prompting review and closer scrutiny if levels are consistently above average. Exceedance of the adopted trigger levels would prompt further sampling and testing. This procedure is summarised in Table 11.5.

Table 11.5 – Actions Prompted by Monitoring Results

Event	Action
Consecutive results exceed UCL95-mean value	Review trend in parameter(s) concerned and note in monitoring report.
Result exceeds trigger level	Review the significance of the exceedance against the adopted guideline value. Undertake additional round of sampling as soon as practicable and analysis for parameter(s) concerned. Temporarily increase monitoring frequency until results have returned to below the trigger levels
Three consecutive results exceed the trigger level	Notify NSW DPE within 7 days: Investigate possibility of a contaminant plume or adverse changes to the groundwater quality/flow regime and if necessary, implement appropriate actions to mitigate contamination.

11.13 TRIGGER ACTION RESPONSE PLAN

A Trigger Action Response Plan (TARP) has been developed to define the minimum set of corrective actions required in response to unpredicted impacts.

The TARP is included in Appendix H. The TARP defines different levels of impacts defined from 1 to 5. Level 1 applies to normal conditions (i.e. no noticeable impacts). Levels 2 to 5 refer to abnormal conditions with various degrees of impacts rated based on increased risk.

The TARP should be reviewed and updated at the end of the baseline monitoring period, following detailed design stages or as required.

11.14 WATER MANAGEMENT STRATEGY AND PLAN REVIEW

A review of the SMP and GMP including the water quality and quantity monitoring program should be undertaken as follows:

- If there are additional monitoring requirements as a result of detailed design;
- Following completion of significant project work stages;
- Following significant environmental incidents;
- When improvements to performance have been recommended by the consultant in annual reports or as directed by the environmental authority;
- Every 3 years by a suitably qualified groundwater consultant to:
    - Review land uses and potential contamination sources (given the development is staged and future use is unknown);

- Analyse trends in groundwater levels and quality;
- Assess effectiveness of existing monitoring program;
- Review trigger levels as additional baseline data are collected;
- Recommend any changes to provide an efficient and effective monitoring program.

Parameters which have been established to be of minimal concern from the results of monitoring may be dropped from the program and others may be added if warranted from changes to site use.

12 Summary

A Stormwater Management Plan (SMP) has been prepared for the proposed industrial subdivision of Lot 210 (DP1174939), which is Stage 3 of NSW Project Approval MP07_0086 and federal government EPBC Approval (2007/3343). This SMP has been prepared to address the conditions attached to both approvals.

Stormwater quantity and quality at the site will primarily be managed by constructing two combined wetland and detention basins (referred to as Basins 2 and 3) at the southwest and southeast corners of the development site, with a combined total surface area of 5.65 ha. Additional stormwater quality management measures to be implemented at the site include the construction of three grassed swales and the installation of GPTs at the industrial lots, at the roadside stormwater gully pits and at the inlets to Basins 2 and 3.

The results of hydrologic modelling using XP-RAFTS show that the proposed stormwater detention components of Basins 2 and 3 and their associated outlet configurations would ensure that the total post-development peak discharge from the development site to Lot 1001 do not exceed pre-development conditions peak discharges.

The results of MUSIC water quality modelling show that the proposed wetland component of Basins 2 and 3 would ensure that the pollutant reduction targets from the development site are satisfied for gross pollutants (litter), total suspended solids, total phosphorous and total nitrogen.

Runoff from the development site under existing and developed conditions drain south to Lot 1001 and are conveyed by existing channels to the west towards the Hunter River under. The proposed basins discharge to a single discharge point at the southwestern corner of Lot 210, consistent with the Project Approval, discharging runoff from Stage 3 into the Existing Drainage Channel within an existing drainage easement in Lot 1001. In addition, the existing "North South Drain" and its raised banks represent a physical barrier which prevent local catchment runoff from the development site (Stage 3) from draining east to the Ramsar wetlands. Therefore, any changes stormwater runoff quantities and quality from the development site would not result in any material impact on the Ramsar Wetlands.

Analysis of the downstream storage and outflow capacity indicate that the downstream drainage system has sufficient capacity to convey the average daily outflow from the fully developed Stage 3 to the Hunter River and away from the Ramsar Wetlands under normal rainfall conditions. In addition, under severe rainfall conditions, hydraulic modelling of the entire catchment demonstrated a reduction in flow volumes draining toward the Ramsar Wetlands under the developed Stage 3 scenario compared to existing conditions due to the redirection of Site runoff to the Existing Drainage Channel that flows and drains directly to the river.

A surface and groundwater water monitoring annual reporting program will be implemented for the developed site and then reviewed on a three-yearly basis. Monitoring results are recorded and provided in Annual Reporting. Monitoring results will be provided to NPWS every 12 months. A Trigger Action Response Plan (TARP) will be implemented from the commencement of Stage 3 works. The TARP contains a number of monitoring verification steps and contingency responses of any adverse monitoring results are identified.

13 References

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PSC, 2022	Port Stephens Council, 2022, *Development Design Specification – 0074 Stormwater Drainage (Design)*

Appendix A - Not used

Appendix B - Port Stephens Council Flood Certificate

PORT STEPHENS
COUNCIL

FLOOD CERTIFICATE

File No: PSC2013-05401
Issue date: 19-Aug-19
Property ID: 45555

Scott Day
Torque Projects Pty Limited
Newcastle NSW 2300

Certificate number: 83-2019-421-1

Property details: 2 Westrac Drive TOMAGO LOT: 210 DP: 1174939

Thank you for your recent flood enquiry regarding the above property. This certificate confirms that this property is located in a **flood prone** area. This is a "flood control lot" for the purposes of the *State Environmental Planning Policy (Exempt and Complying Development Codes) 2008.* This lot is part of a Declared Floodplain and has a levee or other structure on or adjacent to it, as part of the Hunter Valley Flood Mitigation Scheme, conditions and restrictions may apply see *Water Management Act 2000.*

Flood Planning Level	**3.5 metres AHD** (velocity = 0.9 m/s)	(This level defines the minimum floor level for habitable rooms and land that is subject to flood-related development controls (refer to Port Stephens LEP Section 7.3, Port Stephens DCP Section B5).
Highest Hazard Category	**High Hazard Floodway**	

Flood levels that may be useful are:

Probable maximum flood level	6.0 metres AHD (velocity = 1.6 m/s)	(The highest flood level that could conceivably occur at this location. If required, onsite flood refuges are built at or above this level, refer to the Port Stephens Development Control Plan B5.2)
Surveyed floor level	3.38 metres AHD	(Council may have a floor level at the entrance to the residence on this site that was surveyed June 2013 as part of the preparation of a Floodplain Risk Management Study for this area.)
Current day 1% AEP flood level	2.2 m – 2.3 m AHD	(This level is useful for insurance purposes, refer to your insurance policy and the Insurance Contracts Regulation 1985 (Cwealth).)
Adaptable minimum floor level	3.4 metres AHD	(The 1% AEP flood level plus 0.5m, 50 years from now, refer to the Port Stephens Development Control Plan B5.2.)
Minimum onsite wastewater level	1.1 metres AHD	(The 5% AEP level 50 years from now, refer to the Port Stephens On-site Sewage Management Development Assessment Framework and AS/NZS 1547:2012 5.5 land application system design.)

Flooding extent on subject lot, categorised by hazard

Crown © NSW Land and Property Information, © Port Stephens Council

Flood Hazard Categories

- Flood Prone Land
- Flood Planning Level
- Low Hazard Flood Fringe area
- Low Hazard Flood Storage area
- Low Hazard Overland Flow Path area
- Low Hazard Floodway area
- High Hazard Flood Fringe area
- High Hazard Flood Storage area
- High Hazard Overland Flow Path area
- High Hazard Floodway area
- Flood Prone Land subject to further investigation

Information derived from Port Stephens Council 2017, *Williamtown / Salt Ash Floodplain Risk Management Study & Plan*, BMT WBM, Newcastle.

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Appendix C - Rational Method calculations

Table C.1: Rational Method calculation for existing catchment condition

Catchment:	**Subcatchment E1**

Catchment area and coefficient of runoff	
Catchment Area (ha)	32.00
C_{10}	0.35

Overland flow travel time (Friend's Equ)	
Horton's 'n'	0.060
Length (m)	200
Slope (m/m)	0.0015
Overland flow travel time (mins)	54.8

Channel characteristics	
Channel length (m)	620
Channel slope (m/m)	0.0015
Manning's 'n'	0.050
Channel bottom width (m)	10.00
Channel side slope (m/m)	0.010

Design Discharges

ARI (years)	AEP (%)	Frequency Factor F_y	C_y	Channel Velocity[a] (m/s)	Channel Travel Time (mins)	t_c[b] (mins)	Rainfall Intensity (mm/h)	Peak Discharge (m^3/s)
1	63	0.80	0.28	0.14	71.87	126.64	16.1	0.40
1.44	50	0.85	0.30	0.15	67.66	122.43	19.0	0.50
4.48	20	0.95	0.33	0.18	58.88	113.66	29.0	0.86
10	10	1.00	0.35	0.19	54.80	109.57	36.4	1.13
20	5	1.05	0.37	0.20	51.50	106.27	44.2	1.44
50	2	1.15	0.40	0.22	47.48	102.25	55.4	1.98
100	1	1.20	0.42	0.23	45.20	99.97	64.5	2.41

a - Channel velocity calculated using Mannings's equation

b - Time of Concentration (t_c) = Overland Flow Travel Time + Channel Travel Time

Table C.2: Rational Method calculation for developed catchment condition

Catchment:	**Combined subcatchments D4 + D5**

Catchment area and coefficient of runoff	
Catchment Area (ha)	13.20
C_{10}	0.90

Standard inlet time	
Standard inlet time (mins)	12.0

Channel characteristics	
Channel length (m)	230
Channel slope (m/m)	0.0012
Manning's 'n'	0.045
Channel bottom width (m)	10.00
Channel side slope (m/m)	0.250

Design Discharges

ARI (years)	AEP (%)	Frequency Factor F_y	C_y	Channel Velocity[a] (m/s)	Channel Travel Time (mins)	t_c[b] (mins)	Rainfall Intensity (mm/h)	Peak Discharge (m^3/s)
1	63	0.80	0.72	0.33	11.66	23.66	46.8	1.24
1.44	50	0.85	0.77	0.36	10.79	22.79	54.9	1.54
4.48	20	0.95	0.86	0.42	9.06	21.06	82.5	2.59
10	10	1.00	0.90	0.46	8.27	20.27	103.2	3.41
20	5	1.05	0.95	0.50	7.65	19.65	125.1	4.34
50	2	1.15	1.04	0.55	6.92	18.92	156.3	5.93
100	1	1.20	1.08	0.59	6.51	18.51	182.9	7.24

a - Channel velocity calculated using Mannings's equation

b - Time of Concentration (t_c) = Overland Flow Travel Time + Channel Travel Time

Appendix D - Basin storage curves

Table D.1 - Basin 2 stage-storage relationship

Stage (mAHD)	Volume (m³) [a]
0.5	0
0.6	2,366
0.7	4,807
0.8	7,322
0.9	9,913
1.0	12,578
1.1	15,319
1.2	18,136
1.3	21,029
1.4	23,998
1.5	27,044
1.6	30,167
1.7	33,368
1.8	36,645
1.9	40,001
2.0	43,435
2.1	46,947
2.2	50,538
2.3	54,208
2.4	57,957
2.5	61,786

[a] - Includes the storage within the Basin 2 West Arm

Table D.2 - Basin 3 stage-storage relationship

Stage (mAHD)	Volume (m^3)
1.0	0
1.1	1,718
1.2	3,468
1.3	5,250
1.4	7,066
1.5	8,914
1.6	10,796
1.7	12,711
1.8	14,660
1.9	16,643
2.0	18,660
2.1	20,711
2.2	22,797
2.3	24,917
2.4	27,073
2.5	29,263
2.6	31,489
2.7	33,751
2.8	36,048

Appendix E - MUSIC model configuration

Table E.1 – MUSIC rainfall-runoff parameters (MUSIC-link default parameters)

Parameter	Urban (pervious)	Forest (pervious)
Rainfall Threshold (mm)	1.4	1.0
Soil Capacity (mm)	120	120
Initial Storage (%)	30	25
Field Capacity (mm)	40	80
Infiltration Capacity Coefficient a	150	200
Infiltration Capacity Coefficient b	3.5	1.0
Initial Depth (mm)	10	10
Daily Recharge Rate (%)	90	25
Daily Drainage Rate (%)	5	5
Daily Deep Seepage Rate (%)	0	0

Table E.2 – MUSIC base and storm flow pollutant concentrations

Land use type for MUSIC source nodes	Parameter	Total Suspended Solids (Log_{10} mg/L)		Total Phosphorous (Log_{10} mg/L)		Total Nitrogen (Log_{10} mg/L)	
		Base flow	Storm flow	Base flow	Storm flow	Base flow	Storm flow
Industrial	Mean	1.20	2.15	-0.85	-0.60	0.11	0.30
	Std Deviation	0.17	0.32	0.19	0.25	0.12	0.19
Forest	Mean	0.78	1.60	-1.22	0.13	-0.52	-0.05
	Std Deviation	0.13	0.20	0.13	0.25	0.13	0.24

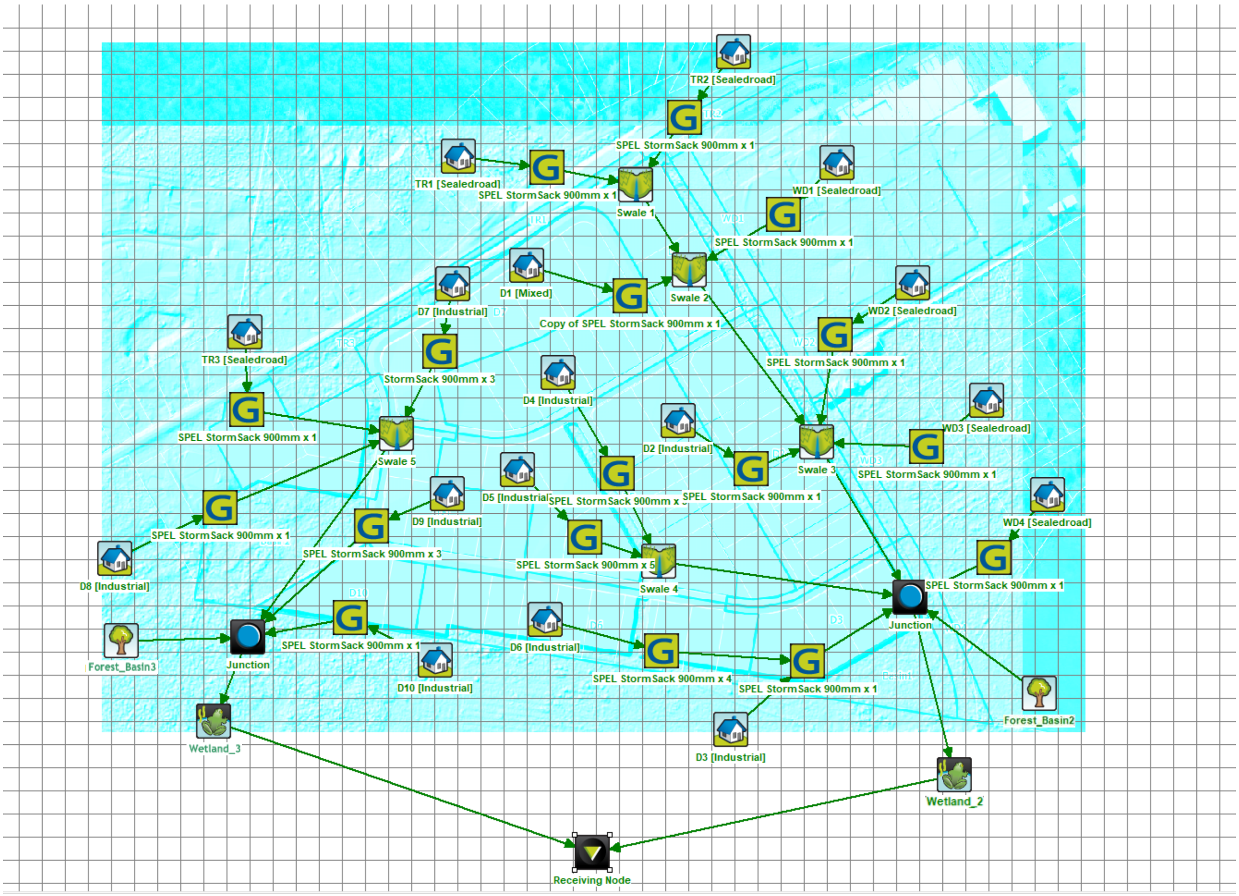


Figure E.1 – MUSIC model configuration (developed mitigated conditions)

Table E.3 - Source node parameters

Source node ID	Source node type	Area (ha)	% impervious
D1	Urban	3.30	90
D2	Urban	6.05	90
D3	Urban	0.73	90
D4	Urban	3.77	90
D5	Urban	9.43	90
D6	Urban	5.34	90
D7	Urban	5.00	90
D8	Urban	3.10	90
D9	Urban	3.25	90
D10	Urban	1.77	90
Basin2	Forest	3.75	0
Basin3	Forest	3.13	0
TR1	Urban	0.83	90
TR2	Urban	0.60	90
TR3	Urban	1.56	90
WD1	Urban	0.69	90
WD2	Urban	0.39	90
WD3	Urban	0.66	90
WD4	Urban	0.86	90

Appendix F - Sediment basin sizing

Table F.1 – Calculation of required total minimum sediment basin storage volume

Description	Value
Basin type	F
Catchment area (ha)	48.6
Settling zone	
Runoff coefficient (C_v)	0.57
95th %ile, 5-day rainfall event (mm)	77.0
Settling zone volume (m^3)	21,322
Sediment storage zone	
Rainfall erosivity factor, R	2,500
Soil erodibility factor, K	0.059
Slope length gradient factor, LS	0.27
Erosion control practice factor, P	1.30
Cover factor, C	1.0
Sediment storage zone volume (m^3)	329
Total storage required (sediment + settling zones)	
Total storage required (m^3)	21,651

Appendix G - Water quality assessment criteria

Table G.1 – Groundwater Quality Assessment Criteria for bores in the Tomago Sandbeds (i.e. MW8A, MW101, MW102, MW103, MW105)

Parameter	Unit	Ecological Guidelines (Note A)	Human Health Guidelines (Note A)	Most Sensitive Beneficial Use (i.e. lower of ANZG or DWG)	Background Quality (Note E)		Laboratory LOR	Adopted trigger Level
		ANZG (2018) 95% Freshwater protection criteria (Note A)	Drinking Water Guidelines (Note B)	Corresponding Guideline	UCL_{95}-mean	80th Percentile		Higher of Most Sensitive Beneficial Use Criteria and 80th Percentile of Background Quality (or LOR where applicable)
Physio chemical parameters								
pH	pH units	pH 6.5-8.5	NC	ANZG (2018)	5.89	5.17 (P20) - 6.38 (P80)	0.1	5.2 - 8.5
Electrical Conductivity	µS/cm	NC	NC	NC	357	529	1	529
Dissolved oxygen	mg/L	NC	NC	NC	11.3	9.62	0.1	-
Total suspended solids	mg/L	NC	0.6	NHMRC (2021)	253	251	1	-
Anions and non-metallic inorganics								
Chloride (Cl)	mg/L	NC	250	NHMRC (2021)	47	57	1	250
Sulphate (SO_4^{2-})	mg/L	NC	500	NHMRC (2021)	15	23	1	500
Fluoride	mg/L	NC	1.5	NHMRC (2021)	0.1	0.1	0.1	1.5
Hydroxide Alkalinity	mg/L	NC	NC	NC	1	1	5	1
Carbonate (CO_3^{2-})	mg/L	NC	NC	NC	6	5	5	5
Bicarbonate (HCO_3^-)	mg/L	NC	NC	NC	56	37	5	37
Total Alkalinity	mg/L	NC	NC	NC	25	32	5	32
Nutrients								
Ammonia (NH_3) as N	mg/L	0.9	0.5	NHMRC (2021)	0.4	0.5	0.005	0.5
Nitrite + Nitrate as N	mg/L	NC	NC	NC	0.07	0.04	0.05	0.04
Nitrite as N	mg/L	NC	3	NHMRC (2021)	0.2	0.1	0.05	3
Nitrate as N	mg/L	0.7	50	ANZG (2018)	0.014	0.02	0.005	0.7
Total Kjeldahl Nitrogen as N	mg/L	NC	NC	NC	0.85	1.1	0.1	1.1
Total Phosphorus	mg/L	0.025	NC	ANZG (2018)	0.14	0.086	0.05	0.086
Cations								
Calcium	mg/L	NC	NC	NC	12	13	0.5	13
Magnesium	mg/L	NC	NC	NC	5	6	0.5	6
Potassium	mg/L	NC	NC	NC	3	4	0.5	4
Sodium	mg/L	NC	180	NHMRC (2021)	45	66	0.5	180
Total / dissolved metals								
Aluminium	mg/L	**0.055 (pH>6.5) (M) 0.0008 pH <6.5 (L)**	0.2 (C)	ANZG (2018)	NR	NR	0.01	0.055 (pH>6.5) 0.0008 (pH <6.5)
Arsenic	mg/L	0.013	0.01	NHMRC (2021)	0.002	0.002	0.001	0.01
Cadmium	mg/L	0.0002	0.002	ANZG (2018)	0.0001	0.0001	0.0001	0.0002
Chromium	mg/L	0.001	0.05	ANZG (2018)	0.002	0.002	0.001	0.002
Copper	mg/L	0.0014	2	ANZG (2018)	0.001	0.001	0.001	0.001
Iron	mg/L	0.7	0.3 (C)	NHMRC (2021)	0.6	0.8	0.01	0.8
Manganese	mg/L	1.9	0.5	NHMRC (2021)	0.07	0.07	0.01	0.50
Molybdenum	mg/L	NC	0.05	NHMRC (2021)	0.001	0.001	0.001	0.05
Nickel	mg/L	0.011	0.02	ANZG (2018)	0.001	0.001	0.001	0.011
Lead	mg/L	0.0034	0.01	ANZG (2018)	0.001	0.001	0.001	0.0034
Zinc	mg/L	0.008	3	ANZG (2018)	0.007	0.010	0.001	0.01
Mercury	mg/L	**0.00006**	1	ANZG (2018)	0.0001	0.0001	0.00005	0.0001
Total Recoverable Hydrocarbons (Note D)								
C6 - C10 Fraction	mg/L	NC	NC	NC	<LOR	<LOR	0.01	0.01
C6 - C10 Fraction minus BTEX (F1)	mg/L	NC	NC	NC	<LOR	<LOR	0.01	0.01
>C10 - C16 Fraction	mg/L	NC	NC	NC	<LOR	<LOR	0.05	0.05
>C16 - C34 Fraction	mg/L	NC	NC	NC	<LOR	<LOR	0.1	0.1
>C34 - C40 Fraction	mg/L	NC	NC	NC	<LOR	<LOR	0.1	0.1
>C10 - C40 Fraction (sum)	mg/L	LOR	NC	NC	<LOR	<LOR	0.1	0.1
>C10 - C16 Fraction minus Naphthalene (F2)	mg/L	NC	NC	NC	<LOR	<LOR	0.05	0.05
Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene (BTEXN)								
Benzene	mg/L	0.95	0.001	NHMRC (2021)	<LOR	<LOR	0.001	0.001
Toluene	mg/L	*0.18*	0.8	ANZG (2018)	0.0009	0.0011	0.001	0.18
m- & p-Xylene	mg/L	*0.08*	0.3	ANZG (2018)	<LOR	<LOR	0.001	0.08
ortho-Xylene	mg/L	0.075	NC	ANZG (2018)	<LOR	<LOR	0.002	0.075
Total xylenes	mg/L	NC	0.6	NHMRC (2021)	<LOR	<LOR	0.002	0.6
Naphthalene	mg/L	0.0016	NC	ANZG (2018)	<LOR	<LOR	0.001	0.0016
Polycyclic Aromatic Hydrocarbons (PAH)								
Naphthalene	mg/L	0.0016	NC	ANZG (2018)	<LOR	<LOR	0.0001	0.0016
Phenanthrene	mg/L	**0.0006**	NC	ANZG (2018)	<LOR	<LOR	0.0001	0.0006
Anthracene	mg/L	***0.00001***	NC	ANZG (2018)	<LOR	<LOR	0.0001	0.00001
Fluoranthene	mg/L	***0.001***	NC	ANZG (2018)	<LOR	<LOR	0.0001	0.001
Benzo(a)pyrene	mg/L	***0.0001***	0.00001	NHMRC (2021)	<LOR	<LOR	0.0001	0.00001
Phenols								

Parameter	Unit	Ecological Guidelines (Note A)	Human Health Guidelines (Note A)	Most Sensitive Beneficial Use (i.e. lower of ANZG or DWG)	Background Quality (Note E)		Laboratory LOR	Adopted trigger Level
		ANZG (2018) 95% Freshwater protection criteria (Note A)	Drinking Water Guidelines (Note B)	Corresponding Guideline	UCL_{95}-mean	80th Percentile		Higher of Most Sensitive Beneficial Use Criteria and 80th Percentile of Background Quality (or LOR where applicable)
Total Phenol	mg/L	0.32	NC	ANZG (2018)	0.1610	0.0125	0.001	0.32
2-Chlorophenol	mg/L	0.34	0.3	NHMRC (2021)	<LOR	<LOR	0.001	0.30
2-Methylphenol	mg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
3- & 4-Methylphenol	mg/L	NC	NC	NC	<LOR	<LOR	0.002	0.002
2-Nitrophenol	mg/L	0.002	NC	ANZG (2018)	<LOR	<LOR	0.001	0.002
2.4-Dimethylpheno	mg/L	0.002	NC	ANZG (2018)	<LOR	<LOR	0.001	0.002
2.4-Dichlorophenol	mg/L	0.12	0.2	ANZG (2018)	<LOR	<LOR	0.001	0.12
2.6-Dichlorophenol	mg/L	0.034	NC	ANZG (2018)	<LOR	<LOR	0.001	0.034
4-Chloro-3-methylphenol	mg/L	NC	NC	NC	<LOR	<LOR	0.005	0.005
2.4.6-Trichlorophenol	mg/L	0.003	0.02	ANZG (2018)	<LOR	<LOR	0.001	0.003
2.4.5-Trichlorophenol	mg/L	0.00005	NC	ANZG (2018)	<LOR	<LOR	0.001	0.00005
Pentachlorophenol	mg/L	0.0036	0.01	ANZG (2018)	<LOR	<LOR	0.005	0.0036
Organophosphorous Pesticides (OPP)								
Dichlorvos	µg/L	NC	5	NHMRC (2021)	<LOR	<LOR	0.00005	5
Dimethoate	µg/L	0.15	7	ANZG (2018)	<LOR	<LOR	0.0001	0.15
Diazinon	µg/L	0.01	4	ANZG (2018)	<LOR	<LOR	0.00001	0.01
Chlorpyrifos-methyl	µg/L	NC	NC	NC	<LOR	<LOR	0.00005	0.00005
Parathion-methyl	µg/L	NC	0.7	NHMRC (2021)	<LOR	<LOR	0.00005	0.7
Malathion	µg/L	0.05	70	ANZG (2018)	<LOR	<LOR	0.00005	0.05
Fenthion	µg/L	NC	7	NHMRC (2021)	<LOR	<LOR	0.00005	7
Chlorpyrifos	µg/L	0.01	10	ANZG (2018)	<LOR	<LOR	0.00005	0.01
Parathion	µg/L	0.004	20	ANZG (2018)	<LOR	<LOR	0.000004	0.004
Chlorfenvinphos	µg/L	NC	2	NHMRC (2021)	<LOR	<LOR	0.000009	2
Bromophos-ethyl	µg/L	NC	NC	NC	<LOR	<LOR	0.00005	0.00005
Fenamiphos	µg/L	NC	0.5	NHMRC (2021)	<LOR	<LOR	0.00005	0.5
Ethion	µg/L	NC	4	NHMRC (2021)	<LOR	<LOR	0.00005	4
Azinphos Methyl	µg/L	**0.01**	30	ANZG (2018)	<LOR	<LOR	0.0002	0.01
Organochlorine Pesticides (OCP)								
alpha-BHC	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
Hexachlorobenzene (HCB)	µg/L	***0.05***	NC	ANZG (2018)	<LOR	<LOR	0.001	0.05
beta-BHC	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
gamma-BHC	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
delta-BHC	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
Heptachlor	µg/L	***0.01***	0.3	ANZG (2018)	<LOR	<LOR	0.001	0.01
Aldrin	µg/L	*0.001*	NC	ANZG (2018)	<LOR	<LOR	0.001	0.001
Heptachlor epoxide	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
trans-Chlordane	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
alpha-Endosulfan	µg/L	*0.0002*	NC	ANZG (2018)	<LOR	<LOR	0.002	0.0002
cis-Chlordane	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
Dieldrin	µg/L	*0.01*	NC	ANZG (2018)	<LOR	<LOR	0.001	0.01
4.4`-DDE	µg/L	*0.03*	NC	ANZG (2018)	<LOR	<LOR	0.001	0.03
Endrin	µg/L	**0.01**	NC	ANZG (2018)	<LOR	<LOR	0.001	0.01
beta-Endosulfan	µg/L	*0.007*	NC	ANZG (2018)	<LOR	<LOR	0.002	0.007
4.4`-DDD	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
Endrin aldehyde	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
Endosulfan sulfate	µg/L	**0.03**	20	ANZG (2018)	<LOR	<LOR	0.001	0.03
4.4`-DDT	µg/L	0.006	9	ANZG (2018)	<LOR	<LOR	0.001	0.006
Methoxychlor	µg/L	0.005	300	ANZG (2018)	<LOR	<LOR	0.001	0.005
Total chlordane	µg/L	**0.03**	0.2	ANZG (2018)	<LOR	<LOR	0.001	0.03
Sum of DDD + DDE + DDT	µg/L	NC	NC	NC	<LOR	<LOR	0.001	0.001
Sum of Aldrin + Dieldrin	µg/L	NC	0.3	NHMRC (2021)	<LOR	<LOR	0.001	0.3
Polychlorinated Biphenyls (PCB)								
Aroclor 1016	µg/L	*0.001*	NC	ANZG (2018)	<LOR	<LOR	0.00001	0.001
Aroclor 1221	µg/L	*1*	NC	ANZG (2018)	<LOR	<LOR	0.00001	1
Aroclor 1232	µg/L	*0.3*	NC	ANZG (2018)	<LOR	<LOR	0.00001	0.3
Aroclor 1242	µg/L	***0.3***	NC	ANZG (2018)	<LOR	<LOR	0.00001	0.3
Aroclor 1248	µg/L	*0.03*	NC	ANZG (2018)	<LOR	<LOR	0.00001	0.03
Aroclor 1254	µg/L	***0.01***	NC	ANZG (2018)	<LOR	<LOR	0.00001	0.01
Aroclor 160	µg/L	*25*	NC	ANZG (2018)	<LOR	<LOR	0.00001	25
Per- and polyfluoroalkyl substances (PFAS)								
Perfluorooctanesulfonic acid (PFOS)	µg/L	0.00023	NC	ANZG (2018)	-	-	0.001	0.00023
Perfluorooctanoic acid (PFOA)	µg/L	19	0.56	NHMRC (2021)	-	-	0.001	0.56
Sum of PFHxS and PFOS	µg/L	NC	0.07	NHMRC (2021)	-	-	0.001	0.07

Notes:

A - Guidelines values can be applied to surface water quality.
B - ANZG (2018) suggest use of ANZECC & ARMCANZ (2000) DGVs
C - NHMRC Australian Drinking Water Guidelines, 2011
D - TRH only detected in the first sample of some bores, could be attributed to residual drilling fluids
E – Background data is expressed as <LOR as the LOR at times has varied between monitoring events in the indicative range of +/- one order of magnitude. Higher LORs were mostly associated with historical data. With improvements in laboratory techniques, more consistent LORs are routinely achieved.
DGV - Default guideline value
LOR - Limit of reporting
NC - No current criteria
NHMRC arsenic guidelines are based on total arsenic
Guidelines for chromium are based on Cr (VI)
Total Phenolics guideline based on Phenol
Guidelines for mercury are based on inorganic mercury.
NHMRC guideline for TSS are based on TDS in the absence of a TSS value.
NHMRC guidelines for mercury are based on total mercury.
Default trigger values for TP and TN are for NSW & Vic. east flowing coastal rivers for slightly disturbed ecosystems (ANZECC 2000)
Guidelines in *italics* are low level reliability guidelines
Guidelines in **bold** indicates the 99% protection level should be adopted for slightly-moderately disturbed ecosystems protection level due to potential for bioaccumulation or acute toxicity to particular species PFAS criteria based for human health based on HEPA (2020)

Table G.2 – Groundwater Quality Assessment Criteria for bores in the clay aquitard (i.e. MW4, MW104, MW106, MW107)

Parameter	Unit	Ecological Guidelines (Note A)	Background Quality (Note E)		Laboratory LOR	Adopted trigger Level
		ANZG (2018) 95% Freshwater protection criteria (Note A)	UCL_{95}-mean	80th Percentile		Higher of DGVs and 80th Percentile of Background Quality
Physio chemical parameters						
pH	pH units	pH 6.5-8.5	7.12	6.56 (P20) - 7.38 (P80)	0.1	6.5 - 7.4
Electrical Conductivity	(µS/cm)	NC	17100	24500	1	24500
Dissolved oxygen	mg/L	NC	25	5.77	0.1	-
Total suspended solids	mg/L	NC	-	-	1	-
Anions and non-metallic inorganics						
Chloride (Cl)	mg/L	NC	6200	8560	1	8560
Sulphate (SO_4^{2-})	mg/L	NC	2540	3690	1	3690
Fluoride	mg/L	NC	0.6	0.7	0.1	0.7
Hydroxide Alkalinity	mg/L	NC	1	1	5	1
Carbonate (CO_3^{2-})	mg/L	NC	290	18	5	18
Bicarbonate (HCO_3^-)	mg/L	NC	609	808	5	808
Total Alkalinity	mg/L	NC	798	949	5	949
Nutrients						
Ammonia (NH_3) as N	mg/L	0.9	8.7	2.0	0.005	2.0
Nitrite + Nitrate as N	mg/L	NC	0.12	0.07	0.05	0.07
Nitrite as N	mg/L	NC	0.02	0.03	0.05	0.03
Nitrate as N	mg/L	0.7	0.08	0.04	0.005	0.7
Total Kjeldahl Nitrogen as N	mg/L	NC	6.6	4.6	0.1	4.6
Total Phosphorus	mg/L	0.025	1.4	2.1	0.05	2.1
Cations						
Calcium	mg/L	NC	349	478	0.5	478
Magnesium	mg/L	NC	684	977	0.5	977
Potassium	mg/L	NC	147	208	0.5	208
Sodium	mg/L	NC	3760	5310	0.5	5310
Total / dissolved metals						
Aluminium	mg/L	**0.055 (pH>6.5) (M) 0.0008 pH <6.5 (L)**	NR	NR	0.01	0.055 (pH>6.5) 0.0008 (pH <6.5)
Arsenic	mg/L	0.013	0.017	0.009	0.001	0.013
Cadmium	mg/L	0.0002	0.0001	0.0001	0.0001	0.0002
Chromium	mg/L	0.001	0.005	0.004	0.001	0.004
Copper	mg/L	0.0014	0.007	0.005	0.001	0.005
Iron	mg/L	0.7	60.8	55.2	0.01	55.2
Manganese	mg/L	1.9	7.25	10.10	0.01	10.10
Molybdenum	mg/L	NC	0.004	0.003	0.001	0.003
Nickel	mg/L	0.011	0.021	0.011	0.001	0.011
Lead	mg/L	0.0034	0.002	0.002	0.001	0.0034
Zinc	mg/L	0.008	1.14	0.14	0.001	0.14
Mercury	mg/L	**0.00006**	<LOR	<LOR	0.00005	0.00006
Total Recoverable Hydrocarbons (Note C)						
C6 - C10 Fraction	mg/L	NC	0.018	0.018	0.01	0.01
C6 - C10 Fraction minus BTEX (F1)	mg/L	NC	0.013	0.017	0.01	0.01
>C10 - C16 Fraction	mg/L	NC	0.14	0.12	0.05	0.05
>C16 - C34 Fraction	mg/L	NC	0.21	0.17	0.1	0.1
>C34 - C40 Fraction	mg/L	NC	0.09	0.12	0.1	0.1
>C10 - C40 Fraction (sum)	mg/L	LOR	0.28	0.19	0.1	0.1
>C10 - C16 Fraction minus Naphthalene (F2)	mg/L	NC	0.17	0.14	0.05	0.05
Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene (BTEXN)						
Benzene	mg/L	0.95	<LOR	<LOR	0.001	0.95
Toluene	mg/L	*0.18*	0.003	0.003	0.001	0.18
m- & p-Xylene	mg/L	*0.08*	<LOR	<LOR	0.001	0.08
ortho-Xylene	mg/L	0.075	<LOR	<LOR	0.002	0.075
Total xylenes	mg/L	NC	<LOR	<LOR	0.002	0.002
Naphthalene	mg/L	0.0016	<LOR	<LOR	0.001	0.0016
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	mg/L	0.0016	<LOR	<LOR	0.0001	0.0016
Phenanthrene	mg/L	**0.0006**	<LOR	<LOR	0.0001	0.0006
Anthracene	mg/L	***0.00001***	<LOR	<LOR	0.0001	0.0000
Fluoranthene	mg/L	***0.001***	<LOR	<LOR	0.0001	0.0010
Benzo(a)pyrene	mg/L	***0.0001***	<LOR	<LOR	0.0001	0.0001
Phenols						
Total Phenol	mg/L	0.32	0.0198	0.0044	0.001	0.32
2-Chlorophenol	mg/L	0.34	<LOR	<LOR	0.001	0.34
2-Methylphenol	mg/L	NC	<LOR	<LOR	0.001	0.001

Parameter	Unit	Ecological Guidelines (Note A)	Background Quality (Note E)		Laboratory LOR	Adopted trigger Level
		ANZG (2018) 95% Freshwater protection criteria (Note A)	UCL_{95}-mean	80th Percentile		Higher of DGVs and 80th Percentile of Background Quality
3- & 4-Methylphenol	mg/L	NC	0.039	0.006	0.002	0.002
2-Nitrophenol	mg/L	0.002	<LOR	<LOR	0.001	0.002
2.4-Dimethylpheno	mg/L	0.002	<LOR	<LOR	0.001	0.002
2.4-Dichlorophenol	mg/L	0.12	<LOR	<LOR	0.001	0.12
2.6-Dichlorophenol	mg/L	0.034	<LOR	<LOR	0.001	0.034
4-Chloro-3-methylphenol	mg/L	NC	<LOR	<LOR	0.005	LOR
2.4.6-Trichlorophenol	mg/L	0.003	<LOR	<LOR	0.001	0.003
2.4.5-Trichlorophenol	mg/L	0.00005	<LOR	<LOR	0.001	0.00005
Pentachlorophenol	mg/L	0.0036	<LOR	<LOR	0.005	0.0036
Organophosphorous Pesticides (OPP)						
Dichlorvos	µg/L	NC	<LOR	<LOR	0.00005	0.00005
Dimethoate	µg/L	0.15	<LOR	<LOR	0.0001	0.15
Diazinon	µg/L	0.01	<LOR	<LOR	0.00001	0.01
Chlorpyrifos-methyl	µg/L	NC	<LOR	<LOR	0.00005	0.00005
Parathion-methyl	µg/L	NC	<LOR	<LOR	0.00005	0.00005
Malathion	µg/L	0.05	<LOR	<LOR	0.00005	0.05
Fenthion	µg/L	NC	<LOR	<LOR	0.00005	0.00005
Chlorpyrifos	µg/L	0.01	<LOR	<LOR	0.00005	0.01
Parathion	µg/L	0.004	<LOR	<LOR	0.000004	0.004
Chlorfenvinphos	µg/L	NC	<LOR	<LOR	0.000009	0.000009
Bromophos-ethyl	µg/L	NC	<LOR	<LOR	0.00005	0.00005
Fenamiphos	µg/L	NC	<LOR	<LOR	0.00005	0.00005
0.00005Ethion	µg/L	NC	<LOR	<LOR	0.00005	0.000009
Azinphos Methyl	µg/L	**0.01**	<LOR	<LOR	0.0002	0.01
Organochlorine Pesticides (OCP)						
alpha-BHC	µg/L	NC	<LOR	<LOR	0.001	0.001
Hexachlorobenzene (HCB)	µg/L	***0.05***	<LOR	<LOR	0.001	0.05
beta-BHC	µg/L	NC	<LOR	<LOR	0.001	0.001
gamma-BHC	µg/L	NC	<LOR	<LOR	0.001	0.001
delta-BHC	µg/L	NC	<LOR	<LOR	0.001	0.001
Heptachlor	µg/L	***0.01***	<LOR	<LOR	0.001	0.01
Aldrin	µg/L	*0.001*	<LOR	<LOR	0.001	0.001
Heptachlor epoxide	µg/L	NC	<LOR	<LOR	0.001	0.001
trans-Chlordane	µg/L	NC	<LOR	<LOR	0.001	0.001
alpha-Endosulfan	µg/L	*0.0002*	<LOR	<LOR	0.002	0.0002
cis-Chlordane	µg/L	NC	<LOR	<LOR	0.001	0.001
Dieldrin	µg/L	*0.01*	<LOR	<LOR	0.001	0.01
4.4`-DDE	µg/L	*0.03*	<LOR	<LOR	0.001	0.03
Endrin	µg/L	**0.01**	<LOR	<LOR	0.001	0.01
beta-Endosulfan	µg/L	*0.007*	<LOR	<LOR	0.002	0.007
4.4`-DDD	µg/L	NC	<LOR	<LOR	0.001	0.001
Endrin aldehyde	µg/L	NC	<LOR	<LOR	0.001	0.001
Endosulfan sulfate	µg/L	**0.03**	<LOR	<LOR	0.001	0.03
4.4`-DDT	µg/L	0.006	<LOR	<LOR	0.001	0.006
Methoxychlor	µg/L	0.005	<LOR	<LOR	0.001	0.005
Total chlordae	µg/L	**0.03**	<LOR	<LOR	0.001	0.03
Sum of DDD + DDE + DDT	µg/L	NC	<LOR	<LOR	0.001	0.001
Sum of Aldrin + Dieldrin	µg/L	NC	<LOR	<LOR	0.001	0.001
Polychlorinated Biphenyls (PCB)						
Aroclor 1016	µg/L	*0.001*	<LOR	<LOR	0.00001	0.001
Aroclor 1221	µg/L	*1*	<LOR	<LOR	0.00001	1
Aroclor 1232	µg/L	*0.3*	<LOR	<LOR	0.00001	0.3
Aroclor 1242	µg/L	***0.3***	<LOR	<LOR	0.00001	0.3
Aroclor 1248	µg/L	*0.03*	<LOR	<LOR	0.00001	0.03
Aroclor 1254	µg/L	***0.01***	<LOR	<LOR	0.00001	0.01
Aroclor 160	µg/L	*25*	<LOR	<LOR	0.00001	25
Per- and polyfluoroalkyl substances (PFAS)						
Perfluorooctanesulfonic acid (PFOS)	µg/L	0.00023	-	-	0.001	0.00023
Perfluorooctanoic acid (PFOA)	µg/L	19	-	-	0.001	19
Sum of PFHxS and PFOS	µg/L	NC	-	-	0.001	0.001

Notes:

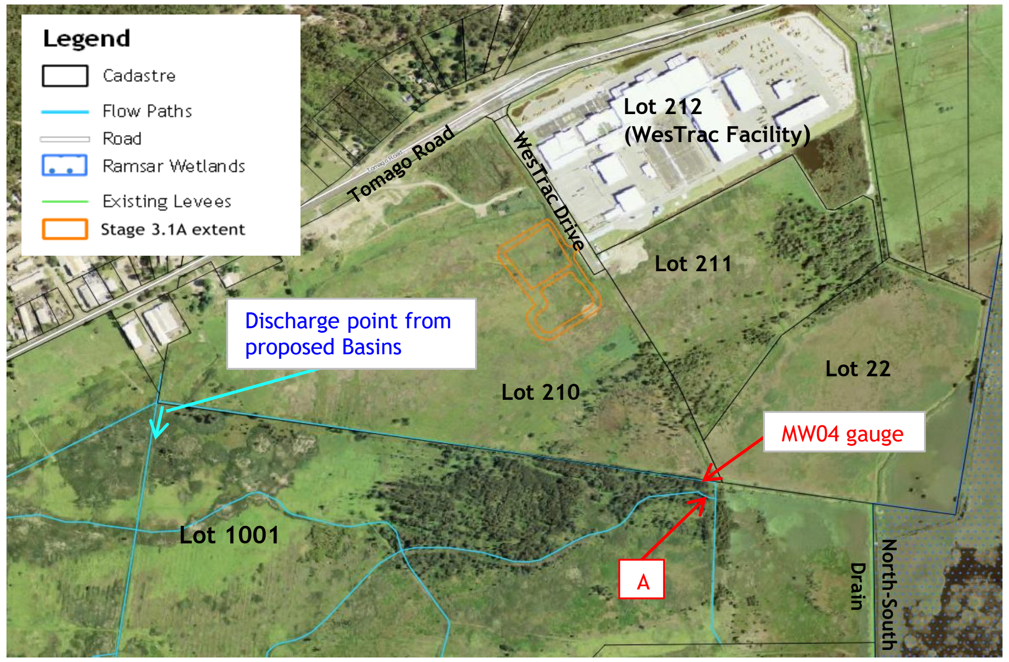
A Guidelines values can be applied to surface water quality. B ANZG (2018) suggest use of ANZECC & ARMCANZ (2000) DGVs
C TRH only detected in the first sample of some bores, could be attributed to residual drilling fluids
E Background data is expressed as <LOR as the LOR at times has varied between monitoring events in the indicative range of +/- one order of magnitude. Higher LORs were mostly associated with historical data. With improvements in laboratory techniques, more consistent LORs are routinely achieved.
LOR Limit of reporting NC No current criteria
DGV Default guideline value
DVGs for TP and TN are for NSW & Vic. east flowing coastal rivers for slightly disturbed ecosystems (ANZECC & ARMCANZ 2000).

Guidelines for chromium are based on Cr (VI)
Total Phenolics guideline based on Phenol
Guidelines for mercury are based on inorganic mercury.
Guidelines in *italics* are low level reliability guidelines
Guidelines in **bold** indicates the 99% protection level should be adopted for slightly-moderately disturbed ecosystems protection level due to potential for bioaccumulation or acute toxicity to particular species
PFAS criteria based for human health based on HEPA (2020)

Appendix H - Trigger Action Response Plan

Worksheet title: **Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago**

Locality and drainage map



Estate Layout Plan

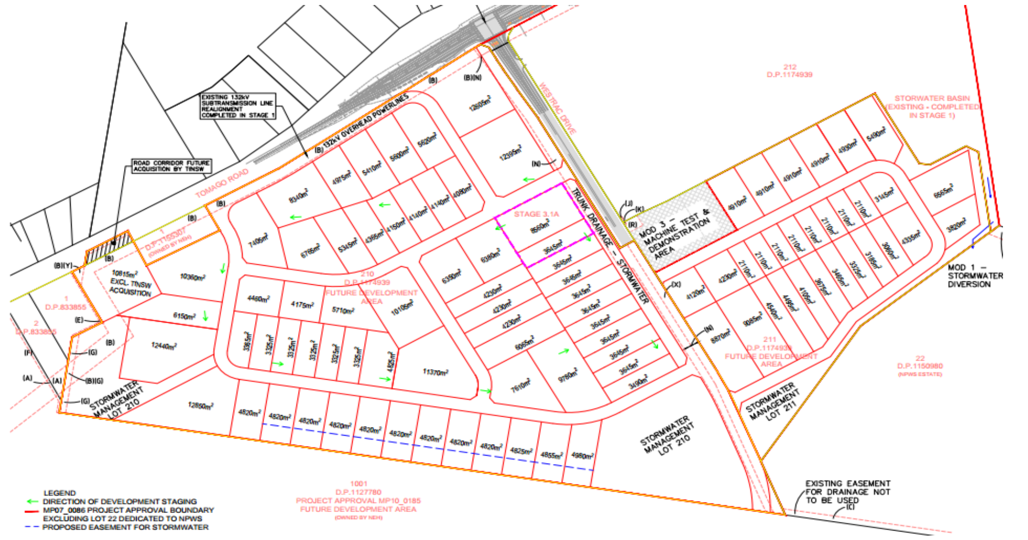


Photo of Location "A"

Purpose of this TARP (TARP #1)

TARP #1 describes the adopted triggers, proposed actions and responses to identify and mitigate the potential impacts of the Project due to changes in groundwater quality and quantity downstream of the Project (i.e. the potential impact to the environmental receptors).

Commitments and monitoring

1) The following will be undertaken prior to the commencement of Stage 3 works:
   - Existing drains will be cleared as per the drain clearing plan (refer to Figure 1 on Page 4).
   - Assessment of water level data at MW04 and the downstream data provided by NPWS to establish baseline water level trends.
   - Monitoring of observation areas to establish baseline site conditions (refer to Figure 2 on Page 5 for potential observation areas).
   - Installation of live water level monitoring device at MW04 (telemetry).

2) The following will be undertaken during the first 3 months from the commencement of Stage 3 works:
   - Continued monitoring and assessment of water level data at MW04 to establish baseline water level trends.
   - Continued site observations on the ground and/or by drone.
   - Continued observations of the cleared drains for integrity and function.

3) The following will be assessed and reported to NPWS every 6 months from the commencement of Stage 3 works:
   - Observation area monitoring results.
   - Water level monitoring results at MW04.
   - Observations on the integrity and function of the cleared drains.

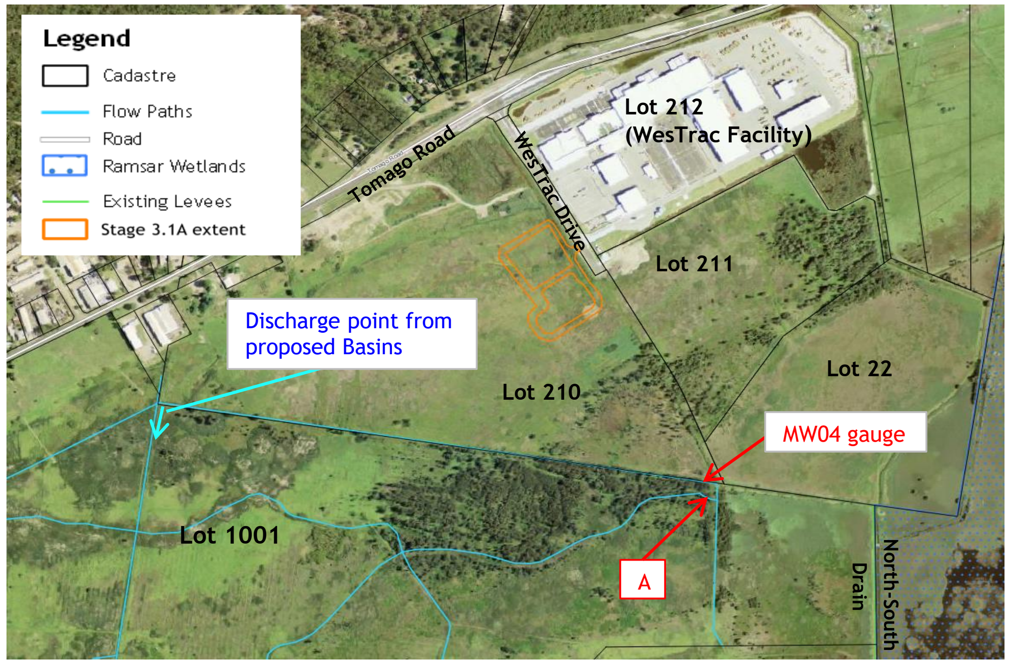
TARP

Level	Trigger (see note [a])	Action	Response
Level 1 (Normal)	• Trend in peak water levels at MW04 and Lot 1001 well are not adversely increased compared to the baseline.	• Continue to monitor water level at MW04, Lot 1001 well and NPWS Floodgate.	• No further response required.
Level 2 (Mitigation measures required)	• Trend in peak water levels at MW04 is adversely increased compared to the baseline.	• Inspect the integrity of the cleared drains and undertake remediation if required. • Check NPWS Drains • Check the recorded data at MW04 and confirm the increase in peak water level trend. • Continue to monitor water level at MW04 and NPWS Floodgate.	• Response 1 - Undertake capping of the existing culvert at the southeastern corner of Lot 210 (refer to Figure 2 on Page 2).
Level 3 (Additional mitigation measures required)	• Trend in peak water levels at MW04 is adversely increased compared to the baseline. • Level 3 trigger applies if: o Culvert at the southeastern corner of Lot 210 has been capped in response to Level 2 trigger.	• Inspect the integrity of the cleared drains and undertake remediation if required. • Check NPWS Drains • Check the recorded data at MW04 and confirm the increase in peak water level trend. • Continue to monitor water level at MW04 and NPWS Floodgate.	• Response 2 - Grade fill layer for runoff control across Lot 210 to south and southwest corner of Lot 210 for overflow onto Lot 1001 DP1127780, including berms for control of runoff from any interim basins within Lot 210 (refer to Figure 3 on Page 2).
Level 4 (Additional mitigation measures required)	• Trend in peak water levels at MW04 is adversely increased compared to the baseline. • Level 4 trigger applies if: o Culvert at the southeastern corner of Lot 210 has been capped in response to Level 2 trigger; and o Existing graded fill layer across Lot 210 to the southwest corner of Lot 210 has been remediated in response to Level 3 trigger.	• Inspect the integrity of the cleared drains and undertake remediation if required. • Check NPWS Drains • Check the recorded data at MW04 and confirm the increase in peak water level trend. • Continue to monitor water level at MW04 and NPWS Floodgate.	• Response 3 - Undertake additional drain muck out of the existing drain within the drainage easement further south within Lot 1001 for extended length of the existing deeply incised drains within Lot 1001. Refer to Figure 4 on Page 2).
Level 5 (Additional mitigation measures required)	• Trend in peak water levels at MW04 is adversely increased compared to the baseline; or • Trend in peak water level at Lot 1001 monitoring well increases above bank • Level 5 trigger applies if: o Culvert at the southeastern corner of Lot 210 has been capped in response to Level 2 trigger; o Graded fill layer across Lot 210 in response to Level 3 trigger; and o Additional drain clearing on Lot 1001 in response to Level 4 trigger. o Muck out of the existing drain within Lot 1001.	• Inspect the integrity of the cleared drains and undertake remediation if required. • Check NPWS Drains • Check the recorded data at MW04 and confirm the increase in peak water level trend. • Continue to monitor water level at MW04 and NPWS Floodgate. • Review the observation area monitoring results and assess any correlations with the recorded water level data at MW04.	• Response 4 - Consider increased basin storage of Basin 3 within Lot 210. (refer to Figure 5 on Page 2) • Initiate an investigation on the reasons for increased water levels at MW04 and develop additional mitigation measures of further catchment diversions to the Hunter River.

[a] - The criteria for what would be considered an "adverse increase" in peak water level trends will be confirmed based on analysis of recorded water level data to date. This criteria will be reviewed on a quarterly basis and updated if required as additional monitoring data becomes available.

Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Locality and drainage map



Estate Layout Plan

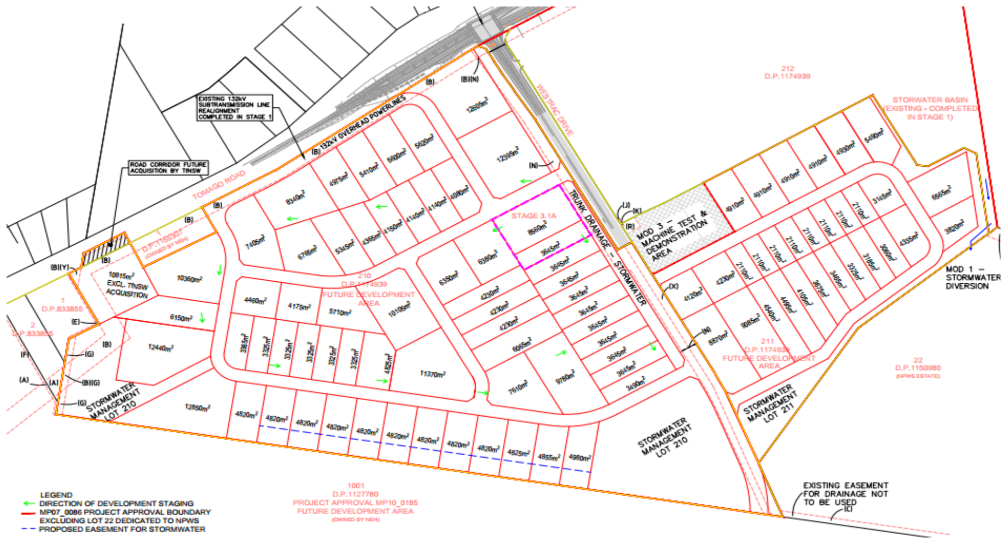


Photo of Location "A"

Purpose of this TARP (TARP #2)

TARP #2 describes the adopted triggers, proposed actions and responses to identify and mitigate the potential impacts of the Project on the drinking water supply (Hunter Water Corporation) due to changes in groundwater quantity in the Tomago Sandbeds.

Commitments and monitoring

1) The following will be undertaken prior to the commencement of Stage 3 works:
   - Installation of live water level monitoring device at MW101 and SK3520 (refer to Figure 5 on Page 8 for monitoring locations).
   - Assessment of baseline conditions at MW101 screened in the Tomago Sandbeds and located near the upstream boundary of the site.
   - Collection and review of monitoring data collected at the HWC bore (SK3520) screened in the Tomago Sandbeds and located about 1 km northeast of the project to assess baseline conditions at this location.

2) The following will be undertaken during the first 3 months from the commencement of Stage 3 works:
   - Continued monitoring and assessment of water level data at MW101 and SK3520 to establish baseline water level trends.

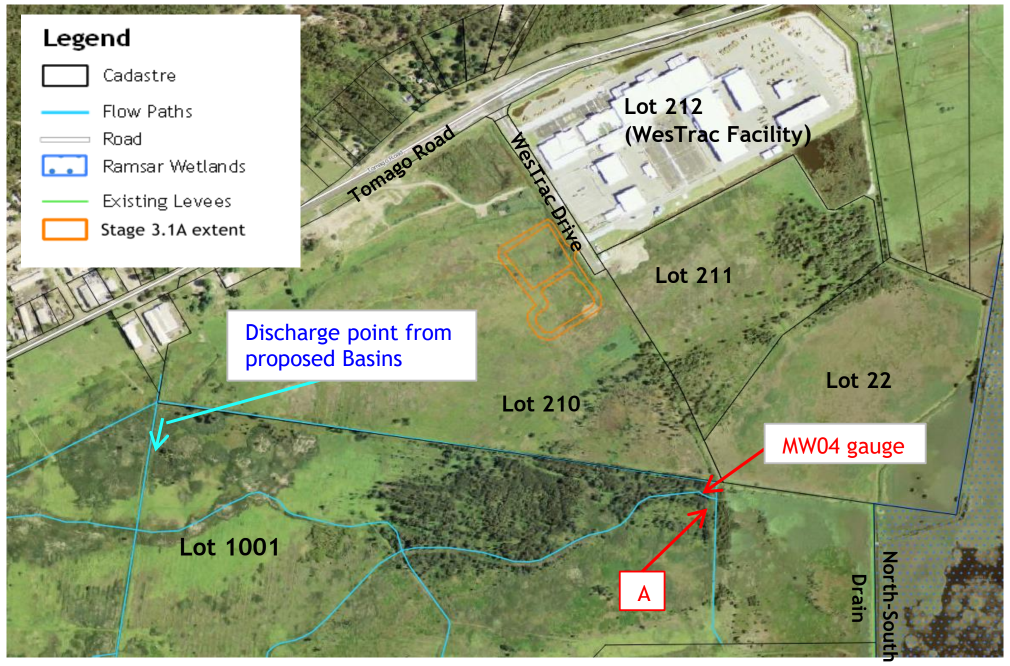
3) The following will be assessed and reported to NPWS every 6 months from the commencement of Stage 3 works:
   - Review of water level monitoring results at both MW101 and SK3520.

MW101 and SK3520 are both screened in the Tomago Sandbeds. The purpose of monitoring both MW101 located within the site and SK3520 located outside of the site is to assess whether any observed trends are attributable to the project or to regional stressors.

TARP

Level	Trigger	Action	Response
Level 1	• Groundwater levels at MW101 are within the baseline range; and • any noticeable trends are attributed to external stressors (e.g. climate, pumping).	• Continue to monitor as planned.	• No response required.
Level 2	• Groundwater levels at MW101 are outside baseline range; and • trends can be noticed that are not obviously attributable to external stressors.	• Review recorded data at SK3520 to check if trend is general. If so, trend would be considered not attributable to the project.	• Response 1 - investigate possible causes for the change.
Level 3	• Groundwater levels at MW101 are outside baseline range; • trends can be noticed that are not attributable to external stressors; • similar change is not observed at SK3520.	• If increase in water level (mounding): review drainage requirements in northern part of the site. • If decrease in water level (drawdown): review groundwater inflows in excavations.	• Response 2 (if mounding): installation of a drain at the northern boundary of the project to divert any runoff to Lot 210 (stormwater management basin area). • Response 2 (if drawdown): control and reduce inflows in excavation areas, discharge clean surplus water to the northern part of the site (on the sand beds) for infiltration and recharge.
Level 4	• Same as above; and • Response 2 was implemented but trends are still observed.	• Review performance of measures implemented as part of Response 2. • If increase in water level (mounding): review drainage system in northern part of the site. • If decrease in water level (drawdown): review groundwater inflows in excavations.	• Response 3 (if mounding): additional drain to divert water to Lot 210 (stormwater management basin area). • Response 3 (if drawdown): increased control to reduce inflows in excavation areas, discharge clean surplus water to the northern part of the site (on the sand beds) for infiltration and recharge.
Level 5	• Same as above; and • Response 3 was implemented but trends are still observed.	• Review performance of measures implemented as part of Response 3. • If increase in water level (mounding): review drainage system in northern part of the site • If decrease in water level (drawdown): review groundwater inflows in excavations.	• Response 4 - Stop work, initiate detailed investigations to understand the cause(s) of the changes in water levels, develop additional mitigation measures.

Locality and drainage map



Estate Layout Plan

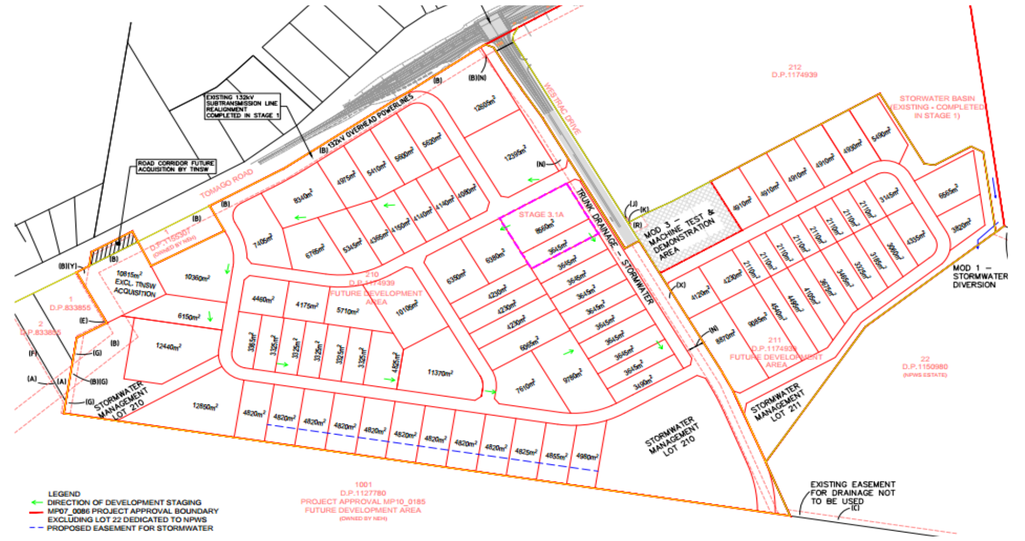


Photo of Location "A"

Purpose of this TARP (TARP #3)

TARP #3 describes the adopted triggers, proposed actions and responses to identify and mitigate the potential impacts of contamination/changes in groundwater and/or surface water quality as a result of the Project.

Commitments and monitoring

Monitoring of water quality will be implemented as outlined in the groundwater and surface water management plans.

TARP

Level	Trigger	Action	Response
Level 1	• Groundwater quality is within baseline range; and • any noticeable trends are attributed to external stressors (e.g. climate, pumping).	• Continue to monitor as planned.	• No response required.
Level 2	• Single exceedance for any one analyte and bore; or • Any noticeable trends / changes in water quality.	• Review water quality data for all analytes. • Organise additional monitoring rounds to confirm the exceedances / change in water quality	• Response 1 - keep monitoring water quality and assessing trends.
Level 3	• Three consecutive results exceeding trigger levels for any one bore and analyte.	• Advise and seek advice from DPE Water. • Review water quality data for all analytes. • Organise additional monitoring rounds to confirm the exceedances / change in water quality.	• Response 2 - investigate possible causes for the change.
Level 4	• Exceedances continue and cannot be attributed to external factors.	• Collect water quality data outside of the project area (e.g. at monitoring locations at other projects). • Compare site-specific data to those collected from surrounding areas. • If change in water quality appears to be caused by the project, advise relevant authorities, adjacent water users and conduct detailed investigations to plan for remediation.	• Response 3 (If change in water quality appears to be caused by the project) - Prepare remediation plan based on results of investigations. • Response 3 (if change is regional and not caused by project) - review and update trigger values.
Level 5	• Response 3 (if change is regional and not caused by project) - review and update trigger values; and • More analytes exceed their trigger levels.	• Review performance of measures implemented as part of Response 3.	• Response 4 - Stop work, develop additional remediation measures if consultation with experts.

Page 3 of 8

Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Figure 1: Drain clearing plan (for TARP#1 on Page 1)

Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

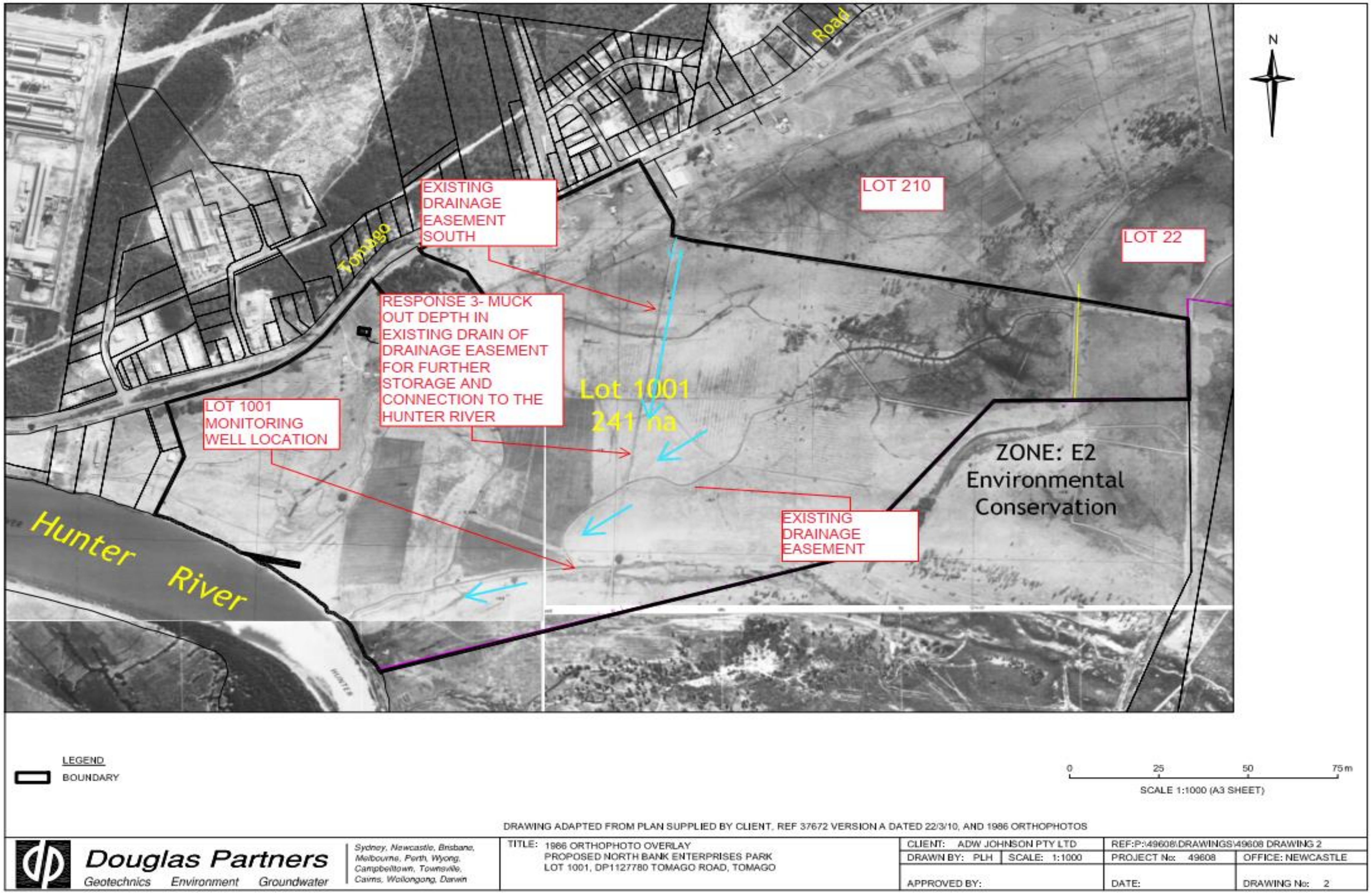
Figure 2: Response 1 (for TARP#1 on Page 1) - Capping of the existing culvert at the southeastern corner of Lot 210

Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Figure 3: Response 2 (for TARP#1 on Page 1) - Extent of proposed initial fill layer, graded towards the south and southwestern boundaries of Lot 210

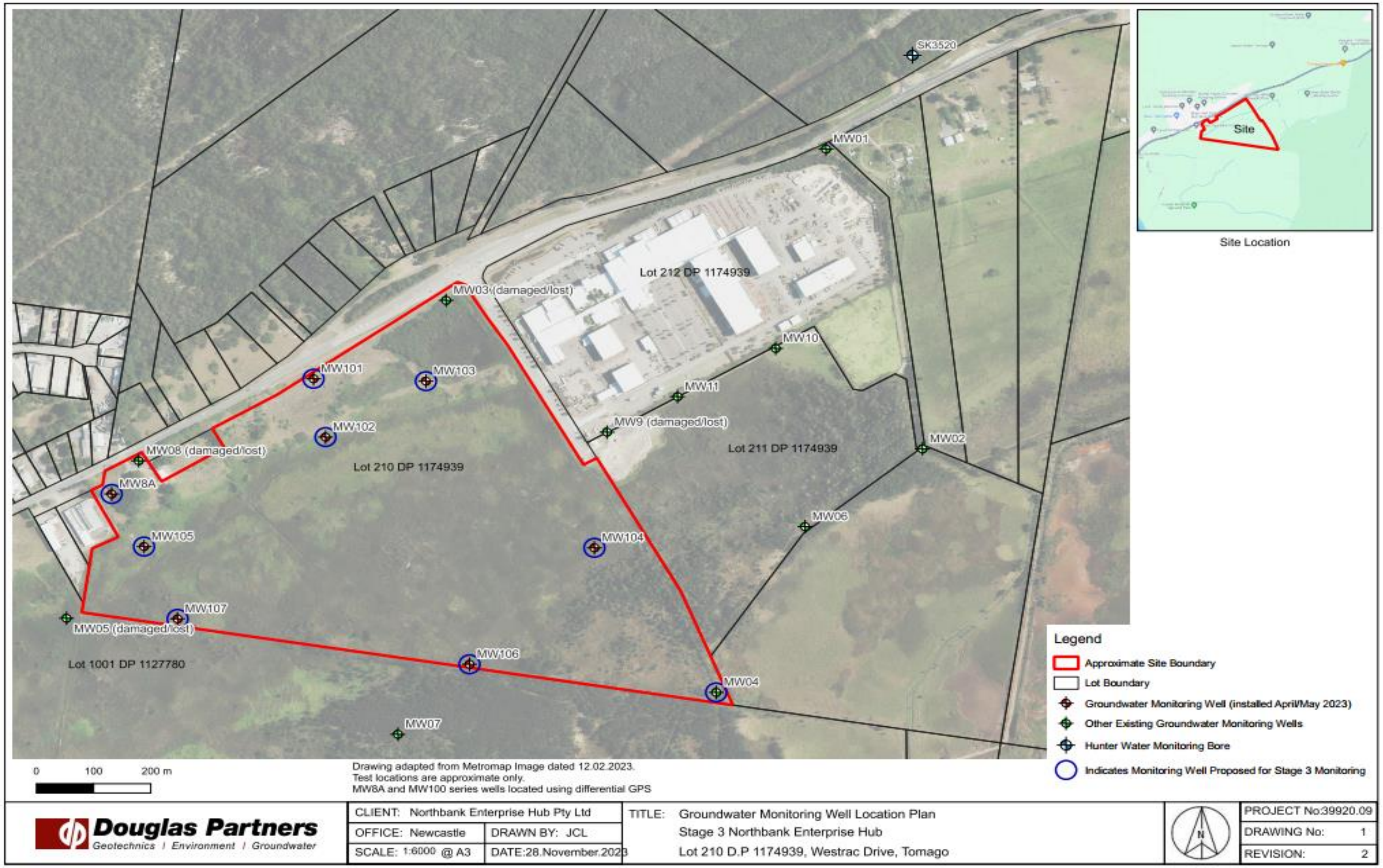
Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Figure 4: Response 3 (for TARP#1 on Page 1) - Additional drain clearing along the existing drainage easement at Lot 1001



Page 7 of 8

Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago
Figure 5: Groundwater monitoring well location plan	



Page 8 of 8

Appendix I - Consultation responses letters dated 9 August 2024 and 20 December 2023

Experience Communication Energy

9 August 2024

Our Ref.: TP-100

NSW Department of Planning, Housing and Infrastructure
Locked Bag 5022
PARRAMATTA NSW 2124

Attention: Ms Joanna Bakopanos/Mr Jeffrey Peng
Emailed

Dear Joanna & Jeffrey

RE: MP07_0086 – Tomago Estate updated Stage 3 SWMP Submission & Response to RFI

We refer to:

- your correspondence dated 5 March 2024 below in relation to the Stage 3 Stormwater Management Plan (**Stage 3 SWMP**) for the project; and
- our conference on 2 April 2024 on related matters.

We thank the NSW Department of Planning, Housing and Infrastructure (**DPHI**) and other agencies for providing comments on the Stage 3 SWMP. Northbank Enterprise Hub Pty Limited and its consultants (**NEH**) has updated the Stage 3 SWMP and a copy of the plan has been submitted via the NSW Planning Portal for review by the Planning Secretary under Condition 8 of Schedule 3 of Project Approval No. MP07_0086 as modified (**Project Consent**).

We note the federal environmental Department of Climate Change, Energy, the Environment and Water (DCCEEW) responsible for the adjoining wetlands, has provided approval of both the Stage 3 Stormwater and Groundwater Management Plans for industrial development over Lot 210 on 12 July 2024. DCCEEW's EPBC Approval of the Stage 3 Management Plans confirms sound management outcomes have been achieved for development of Lot 210, in conjunction with protection of the adjoining wetlands under federal environmental responsibility. The EPBC Approval completed under bilateral assessment references the Project Approval MP07_0086, further confirming these management plans have met requirements, without Modification of conditions.

To assist the Planning Secretary's review of the Stage 3 SWMP, we provide the following comments.

Torque Projects Pty Limited ABN: 52 619 902 304
E: admin@torqueprojects.com W: torqueprojects.com

Summary

Based on DPHI and other agency feedback, NEH has updated and finalised the Stage 3 SWMP for the project NEH confirms that the following key changes to Figure 4.1 (refer to attached **Plan 1** in **Appendix A**) and the updated Stage 3 SWMP:

- the additional discharge point has been removed from the management plan;
- a Gross Pollutant Trap has been added to the inlet of both basins;
- basin numbering has been updated to match the numbering under the Project Consent;
- drainage linework has been simplified on plan as conventional drainage easement notation using dashed lines;
- Water quality monitoring has been updated to be the same as satisfying the federal Department of Climate Change, Energy, the Environment and Water (DCCEEW) requirements for monitoring as completed in parallel with the DPHI approval process;
- A sequencing of stormwater control phases with capacity for the runoff from development sub-stages and associated monitoring for controlled discharge inline with report objectives;
- The monitoring network has been extended; and
- Trigger Action Response Plan (TARP) has been amended for consistency with these updates.

Based on our review, the Stage 3 SWMP that has been submitted via the NSW Planning Portal complies with the relevant conditions of the Project Consent, including any other applicable requirements incorporated by reference in those conditions.

Ongoing Monitoring, Investigations and Maintenance

In parallel with this consultation and assessment time with DPHI and DCCEEW, prior to commencement of Stage 3, NEH have:

- Completed 12 months of water level analysis via data loggers in monitoring wells and this water level monitoring continues at the time of writing;
- Installed 8 additional monitoring wells;
- Completed the 3, 3 monthly rounds of water quality analysis closing out the requirement for water quality pre-commencement. These 3 water quality reports have been provided in our Annual Reporting to DCCEEW and DPHI and can be provided to you if required;
- Organised Drain Clearing activities in a manner which is to reduce risk of water flow toward the NPWS Project area;
- Undertaken Geotechnical investigations; and
- Continued to document observations of the landscape responses and changes over time.

Detailed comments

NEH provide the following detailed comments in relation to the submitted Stage 3 SWMP in **Appendix A**. If DPHI would like to discuss any aspect of the submitted Stage 3 SWMP or has any technical queries for NEH's specialist consultants, please let us know.

Benefits to NPWS Project

The implementation of the Stage 3 SWMP has benefit to the NPWS Project on adjoining wetlands, within the parameters and consistent with the **Project Consent**. This is because following approval of the Stage 3 SWMP, stormwater and groundwater discharge can be diverted over a 1 kilometre away from the NPWS Project. This reduces risk of flow toward the NPWS Project from the undeveloped Lot 210 area.

Consultation has been extensive and we now look forward to achieving approval of the submitted Stage 3 SWMP along with all Stage 3 Management Plans.

If you have any questions, please contact me on 0414 689 091 or scottd@torqueprojects.com

Yours Sincerely,

Scott Day
Torque Projects Pty Limited

Encl.

Appendix A – Detailed Response to DPHI & Government Agency RFIs

Appendix A – Detailed Response to DPHI & Government Agency RFIs

#	Subject	DPHI or other agency feedback	NEH response
Response to matters raised on 5 March 2024			
1.	Discharge point	The Stage 3 SWMP is proposing an additional point of discharge from the site which was not contemplated as part of the original assessment and it is unclear whether this is a legal point of discharge.	Northbank Enterprise Hub Pty Limited (**NEH**) has considered Department of Planning, Housing & Infrastructure (**DPHI**)'s feedback and the additional discharge point has been removed from the Stage 3 Soil & Water Management Plan (**Stage 3 SWMP**). Relevantly, Condition 2 of Schedule 2 of the NSW Major Project Approval MP07_0086 (**Project Consent**) requires NEH to carry out the development generally in accordance with a number of documents, including the Environmental Assessment (**EA**) (as defined in the Project Consent). Section 3.4 (Stormwater Controls/Site Design) in Volume 4 of the EA states: *3.4.3 Discharge* *From Figure 2, there are three (3) existing discharge points from the site along the southern boundary. These are open channel farm drains continuing downstream of the site toward the Hunter River. Basins have been suitably located to have discharge outlets to these existing discharge points from the site, post development. Refer to Figure 6.* For reference, we extract Figure 4.1 in the Stage 3 SWMP below (refer to attached **Plan 1**) and Figure 6 in the EA (refer to attached **Plan 2**) below. Figure 4.1 in the Stage 3 SWMP shows a plan that is consistent with the number of discharge points at the same locations as required under the Project Consent. This confirms 2 of the discharge points to be consistent. The third discharge point referenced is for Stage 1, to the east and not relevant to the Stage 3 SWMP.

Basin 2

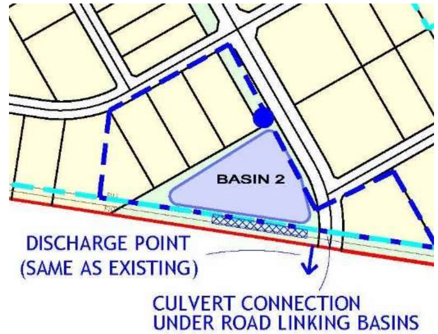


Fig 6 Treatment Train Layout, EA
(refer to attached **Plan 2**)

Fig 4.1, Stage 3 SWMP
(refer to attached **Plan 1**)

Basin 3

Fig 6 Treatment Train Layout, EA
(refer to attached **Plan 2**)

Fig 4.1, Stage 3 SWMP
(refer to attached **Plan 1**)

2.	Easement to drain water	As per Council's recommendation, an easement to drain water needs to be created over the channel(s) from Stage 3 basin's discharge point to the watercourse.	NEH considers that Port Stephens Council (**Council**)'s recommendation relates to the proposed additional discharge point, which has been removed from the Stage 3 SWMP. The Stage 3 discharge point is directly into an existing open drain, as identified in Figure 2 in Volume 4 of the EA (refer to attached **Plan 3**). This existing drain is covered by an existing easement to drain water which extends the full distance across Lot 1001 to the Hunter River – see (J) Easement for Drainage marked with indicative blue arrows on the Deposited Plan (refer to attached **Plan 4**). If Council's recommendation relates to a different matter, please let us know.
3.	Discharge in a controlled manner	Further, any drainage system within the downstream property (i.e. Lot 1001) would need to be designed and constructed prior to Stage 3 discharge to that point to ensure it occurs in a controlled manner.	NEH has considered DPHI's feedback on the potential ponding on Lot 1001 and has addressed this matter in **Item 6** below. Until recently, NEH had respectfully considered a best management approach of minimised site activities whilst Lot 1001 remains undeveloped. However, during the investigations for the Stage 3 SWMP, NEH has recently recognised the benefits to National Parks & Wildlife Service (NPWS) for certain drain clearing activities and has commenced selected property maintenance measures to assist NPWS. By this maintenance activity of clearing an existing easement for drainage will improve the existing drain capacity downstream prior to a sub-stage of development (beyond Stage 3.1A) on Lot 210, and consequently providing the drain control across Lot 1001. Downstream control is provided for Stage 3 runoff by discharge into the existing drain, which lies within an existing easement to drain water across Lot 1001 to the Hunter River. An aerial photo of the existing drain is indicatively shown in the attached Plan 5 and is consistent with the EA, which had identified the same existing drain for discharge. The Stage 3 SWMP consists of drains, basins and basin outlet structures with drain connections for discharge in a controlled manner. There is no proposed design or construction of drainage systems in Lot 1001. The Project Consent does not require NEH to await construction of the drainage system within the downstream property before discharges from the development of Stage 3.

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(a) The Stage 3 SWMP provides an appropriate discharge control framework

In any case, NEH provides the following comments.

Condition 2 of Schedule 2 of the Project Consent requires NEH to carry out the development generally in accordance with a number of documents, including the EA (as defined in the Project Consent).

Consistent with the referenced documents in Condition 2 of Schedule 2, Stage 3 will be undertaken in several smaller sub-stages. This approach is also reflected in DPHI’s approval of Stage 3.1A and the approved staging of lot registration in the revised layout plan.

In terms of stormwater management from the smaller sub-stages, the contributing runoff is also smaller, which minimises the extent of control required and enables simplified monitoring for capacity. Based on approximately 1.7km existing drain length for any tides, runoff from the initial substages would not overwhelm the downstream drainage capacity.

Stormwater management sequencing in a series of phases has been added into Section 4.2.5 of the Stage 3 SWMP to outline the control of discharge onto Lot 1001, as follows:

Phase 1

Clearing of vegetation in the existing drain in Lot 1001 prior to Stage 3 works.
Installation of a water monitoring well with a data logger, for the monitoring of water levels in Lot 1001 near the outlet to the Hunter River (refer to Plan 5 & Section 11 of the Stage 3 SWMP for the locations of proposed monitoring wells).

Phase 2

Construction of the eastern basin (Basin 2) and Channel 1 upfront in conjunction with runoff diversion to the west. This will provide an immediate benefit to NPWS resulting from reduced freshwater inflows toward the North South Drain. Geotechnical considerations will determine if these are constructed to final embankment heights. Only runoff from developed sub-stage areas of Stage 3 will be captured in Channel 1 and

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			conveyed to Basin 2, with regional groundwater in existing drains managed beneath stormwater management levels across the basin. • Stage 3 will be developed in sub-stages. As a result, Basin 2 and Channel 1 will initially be oversized relative to the developed area of its upstream catchment. Outflow controls will be determined with detailed design for each sub-stage, to utilise the full storage available in the basin constructed upfront. This reduces reliance on downstream drainage infrastructure. This approach would better utilise the storage capacity of the basin during the interim substages of development. • Monitoring of the basin outflows (pipe and spillway) will commence from Basin 2. • Monitoring will also commence including at a new monitoring location downstream of Stage 3 within Lot 1001. • Hydrologic modelling results indicate that Basin 2 can mitigate (detain) and treat runoff from a maximum development area of 29 ha. The development sub-stages are anticipated to be in the order of 1 ha to 5 ha, however may be larger. • Channel 1 has been sized to capture runoff from a development area of 9.4 ha adjacent to WesTrac Drive. Channel 2 will be constructed once the development area exceeds the design catchment area for Channel 1. ○ The Basin 2 outlet pipes will be sized and constructed to its final specification. However, the Basin 2 and Channel 1 embankments may be constructed in stages subject to geotechnical considerations in conjunction with the sub-staging of the Stage 3 development area. ○ Ongoing maintenance of the existing drain in Lot 1001 is required and its capacity to be verified with ongoing monitoring. • Phase 3 ○ Construction of the western basin (Basin 3). Similar to Basin 2, the initial basin footprint will be large and oversized relative to developed area in its upstream catchment, which reduces reliance on downstream drainage infrastructure. ○ Ongoing maintenance of the existing drain in Lot 1001 is required and its capacity to be verified with ongoing monitoring. The modelled peak discharge for the fully developed Stage 3 under the updated Stage 3 SWMP is smaller than the modelled peak discharge in the EA and Project Consent. In particular:

- the peak 1 in 100 Annual Exceedance Probability (1% AEP) discharge in the EA was 13.86 m3/s (Table 7, Volume 4- Stormwater Management Industrial Subdivision);
- in comparison, the peak 1% AEP discharge in the:
  - Stage 1 SWMP is 1.57 m3/s; and
  - updated Stage 3 SWMP is 4.18 m3/s;
- the combined total 1% AEP peak discharge for the Stage 1 SWMP and updated Stage 3 SWMP is less than half of the predicted peak discharge in the EA for the combined development area of Stages 1 and 3 (being, ~80% of the project catchment area modelled as developed).

Considering above, the Stage 3 SWMP is consistent and within the approved discharge limits of the modelled predictions. The above reductions were envisaged in the Project Consent due to the dedication of an additional 17 ha of conservation land (that was originally proposed to be developed), totalling 22 ha by NEH with Stage 1.

(b) Ongoing monitoring and Trigger Action Response Plan (TARP)

Further, NEH submits that:

- over 10 years of monitoring stormwater control has already been undertaken for the runoff from ~25 hectares of development, being Stage 1 under the Project Consent;
- the Project Consent imposes monitoring obligations (see conditions 9(c) and 12(h) of Schedule 3 and condition 44(f) and (g) of Schedule 4); and
- through consultant relating to Condition 12A(a) of Schedule 3, a TARP has been completed to accompany monitoring analysis post development. Relevantly:
  - the management for monitoring of control and response to the existing open drain capacity through Lot 1001 is described by Figure 4, Response 3 of the TARP;
  - the existing easement allows for property maintenance of the drain capacity to be undertaken; and
  - the existing drain provides the controlled direction toward the Hunter River. At its nearest point, the existing drain is 1.15 km from Lot 22 (being, the land dedicated as conservation land by NEH with Stage 1) and over 1.4 km from the North South Drain Tomago Wetland Rehabilitation Project, which represents a significant buffer distance from the adjoining wetlands.

			Overall, the progressive sub-stages of the Stage 3 development will enable continued monitoring and management for stormwater control on the downstream property. In particular, the Stage 3 SWMP sets out the monitoring, reporting, management and responses relating to discharge control that complies with the Project Consent.
4.	Other matters	The Department notes other changes are also being proposed under the Stage 3 stormwater management plan, such as changes to subdivision layout and additional trunk drainage which go beyond what has been approved.	NEH has considered DPHI's feedback and provides the following response in relation to the following additional matters raised by DPHI: a) subdivision layout; and b) additional trunk drainage. Relevantly, for the above matters, under the Project Consent: • Condition 2 of Schedule 2 requires NEH to carry out the development generally in accordance with a number of documents, including the EA (as defined in the Project Consent); • Condition 1 of Schedule 3 requires NEH to revise the subdivision plan prior to the commencement of construction of Stages 2 and 3, which includes the identification of the location and size of lots, the location of estate roads, and the proposed staging of lot registration; and • Condition 12(b) of Schedule 3 requires the Stormwater Management Scheme (as defined in the Project Consent) to "*be prepared in accordance with DECC's Managing Urban Stormwater guidelines and HCCREMS Water Sensitive Urban Design Solutions for Catchments Above Wetlands*". **(a) Subdivision layout** The Project Consent provides flexibility in the subdivision layout for Stages 2 and 3 (for example, see Condition 2 of Schedule 2 and Condition 1 of Schedule 3 summarised above). In particular, Condition 1 of Schedule 3 expressly allows for revisions to the subdivision plan to the satisfaction of the Planning Secretary. On 16 August 2023, NEH received confirmation that the Planning Secretary was satisfied of the revised subdivision plan dated 30 June 2023. The Stage 3 SWMP is consistent with the revised subdivision plan.

			Further, the documents incorporated by reference in Condition 2 of Schedule 2: • describe the stormwater basins to be sized for a ‘no impact’ water quality outcome. The footprint sizing of these basins to meet this criteria is shown in Figure 6 in the EA (refer to attached **Plan 2**); • support a flexible approach to stormwater treatment controls – see Sections 3.2 and 4.0 of Volume 4 of the EA extracted below; and *3.2 Water Quality and Reuse Modelling* *Due to the uncertainty of the specifics of the operations on the industrial uses, assumptions have been made to determine land take for the stormwater treatment controls. There are several options for combining the treatment controls to meet the objective and no one unique solution. For example, a greater emphasis could be placed on the individual lot treatments for the reduction of the constructed wetland sizes, or vice versa. A typical section and concept design of the constructed wetlands have been provided. Final detailed design of the constructed wetland for configuration will be necessary at the detailed design phase of the development. Refer to Figure 6.* *Section 4.0 Conclusion* *The treatment train configuration described in Section 3.2 is only one solution to demonstrate that the water quality objectives of ‘no impact’ can be achieved. There are several solutions that could also be used to achieve the same target objective. This would include different combinations of controls, for example varying the assumptions of water usage, tank sizes and the size of constructed wetlands. Redlake Enterprises Pty Ltd may choose to vary the water quality design in the future to suit different needs, provided that the objectives remain the same.* • support appropriate water quality facilities (see Section 4.1.3 of the Statement of Commitments extracted below). *Industrial Subdivision* *The proposed subdivision incorporates appropriate water quality facilities to address runoff from both roads and lots.*

			Based on above, NEH submits that there is flexibility in basin/constructed wetland sizing provided water requirements are still met. WRM has modelled the Stage 3 SWMP (see Table 7.2) in accordance with sizing the basins to comply with Condition 12(b) of Schedule 3, which prevails to the extent of any inconsistency over the stormwater basin ‘no impact’ footprint sizing in the EA due to the application of Condition 3 of Schedule 2 of the Project Consent. Accordingly, NEH submits that: • the Stage 3 SWMP modelled to ‘appropriate’ sized water quality facilities in accordance with Condition 12(b) of Schedule 3; • the basin sizing in the Stage 3 SWMP is determined by modelling and complies with the Project Consent, being less than and within the basin extents shown in Figure 6 in the EA (refer to attached **Plan 2** and the figures shown in the ‘Discharge points’ row above), whilst meeting the requirements of the condition; and • the Stage 3 development layout and associated stormwater basin sizing complies with the Project Consent. **(b) Additional trunk drainage** We understand that DPHI is referring to the open channels indicated by WRM across the broader estate shown on the former Stage 3 SWMP plan to be “additional trunk drainage”. If this is incorrect, please let us know. One trunk drain was shown on plan adjacent to the public entry to the estate specifically responding to an assessment matter. Conventionally, the road carriageway supported by either pipe or open drain may be a form of trunk drainage and neither method was specified across the estate layout in the EA. Relevantly, NEH submits that: • Section 8.18 of the Statement of Commitments states: *Section 8.18 Road Construction & Drainage*

Road Construction and drainage works will comply with Port Stephens Council & Roads and Traffic Authority Standards.

- The Port Stephens Council Standard “0074 Stormwater Drainage (Design) Development Design Specification” defines a minor system to include open drains:

    Minor system: The gutter and pipe network capable of carrying and controlling flows from frequent runoff events. It includes kerb and channels, inlet structures, open drains and underground pipes and on-site detention facilities.

- From the above Council stormwater standard, consistent with the Project Consent, open drains are permitted with development for conveyance of stormwater for minor storm events/capacities. There is no single drainage method of pipe or open drains specified in the EA across the Stage 3 development and there are no drainage easements for interallotment drainage shown on any of the EA plans for stormwater. Further, there is no detail to identify the drainage method to be a change from the EA.
- It is industry standard practice:
    - to use a combination of both piped drainage or open (swale) drainage for this size of estate land area; and
    - that there is interallotment drainage provided in industrial estates for stormwater management and these are typically a combination of piped drainage and open drains.
- With reference to condition 12(b) of Schedule 3, we note that pages 16 and 17 of *HCCREMS Water Sensitive Urban Design Solutions for Catchments Above Wetlands* for industrial subdivision development applying to road, stormwater or other works comprise management measures for “major performance contribution” including grassed swales, ponds and wetlands.

Considering above and the requirements of the Project Consent, there is an expectation of open drainage conveyance measures in the Stage 3 SWMP. In particular:
- page 25 of the Director-General Assessment Report states:

    The proposed stormwater management for the site consists of swales and constructed wetlands…..

			• the above statement confirms that swales (being, open drains) were to form part of the stormwater management for Stage 3; • Stage 1 SWMP specifies a combination of both piped drainage and open (swale) drainage; and • the Stage 3 SWMP is consistent with the EA, Stage 1 SWMP and standard practices of relying on both drainage methods for stormwater management of development. Overall, the open drains in the Stage 3 SWMP comply with the Project Consent.
Response to matters raised on 2 April 2024			
5.	Stormwater discharge	The proposed development will increase off-site stormwater freshwater discharge from 319 ML/year to 514 ML/year	The combined surface area of the Stage 3 stormwater control basins is 5.65ha and NEH clarifies that the volume difference equates to a small increase of 9mm/day in the proposed stormwater control basins of Stage 3. NEH respectfully submits that the actual water balance is dependent on the final hardstand area of the development projects yet to be constructed across the estate of Stage 3. Water balance modelling for Stage 3 has been conservative, by overestimating the freshwater discharge quantities, for adequate on-site management provisions to be made in Stage 3. It is the modelling prediction of the <u>potential</u> excess stormwater runoff with high level of imperviousness assumed and yet to be constructed on site. Regular reviews and updates of the water balance are required by Schedule 3, Condition 9(c) of the Project Consent, which states: *The Site Water Balance must: …* *(c) be reviewed and recalculated each year in light of the most recent water monitoring data.* Water monitoring data has been collected for over 10 years, including this year, meeting this requirement. Best management practices have been followed for design and management of stormwater runoff and demonstrated by modelling for Stage 3 development. Recalculation of the water balance has been completed by WRM, as presented in the Stage 3 SWMP. NEH will continue to comply with this annual requirement under the Project Consent.

			Further, Schedule 3, Condition 12(b) of the Project Consent states: *The Stormwater Management Scheme must: …* *(b) be prepared in accordance with DECC's Managing Urban Stormwater guidelines and HCCREMS Water Sensitive Urban Design Solutions for Catchments Above Wetlands;* Relevantly, HCCREMS states that it is acceptable for the flow diversion of excess stormwater to be discharged into rivers as environmental flows, subject to suitable treatment. The flow diversion is 1.15km from the National Park, into an existing drain and associated easement for drainage, consistent with the EA. The existing drain is to a river in this case, the Hunter River. Suitable treatment has been demonstrated by modelling of the constructed wetland sizing within Lot 210 for this flow volume and controlled release from the proposed development of Stage 3, meeting best management practice targets. As stated above, the proposed stormwater management scheme for Stage 3 SWMP includes very large basin controls, up to a total surface area of 5.65ha. In addition to the large basins, there are large open channels for storage and conveyance to stormwater control basins within Stage 3. There is an inherent conservatism in the water balance calculations as the large open channels are not accounted for. Further, conveyance of runoff volumes is slow due to the flat natural grades. The conservative increase is minor, barely detectable as an increase within the basins and hence is consistent and generally in accordance with the EA.
		& the actual increase could be significantly higher if the site is not able to achieve the proposed 31ML/year operational reuse of rainwater proposed to be harvested from the site	The estimate of 31ML/year in operational reuse for development includes the future development of the entire Stage 3 area and irrigation of landscaping areas. The rate has been estimated following actual monitored results of Stage 1 for ~25 hectares of development. The water re-use requirements are specified in the Design Guidelines for development of the estate. Design Guidelines are required to be prepared to the satisfaction of the Planning Secretary in accordance with Schedule 3, Condition 2 of the Project Consent. Future land uses of the proposed industrial lots (including final hardstand and pervious areas) are project dependent and yet to be finalised. NEH adopted a conservative approach for the site

			water balance in the Stage 3 SWMP, by assuming that the proposed 31ML/year of operational water reuse is not implemented. To test the significance of this assumption, the additional freshwater discharge of 31ML/year was calculated to be equivalent to a level increase of 1.5mm per day in the stormwater control basins. This level difference in the basins is immeasurable within the basins. In environmental assessment for the NPWS Project east of Stage 3, 120ML of tidal volume wetland inundation was measured to be reached in 10 days. For these reasons and in the context of the magnitude of Hunter River flows, 31ML in a year is not considered "significant" across a site this large. Nonetheless, water re-use has been implemented in the Stage 3 SWMP and Design Guidelines, in keeping with best management practices and consistent with the EA. At a high level, monitoring and contingency for the project includes: • Monitoring of water levels has commenced on Lot 210, with 12 months of data collected. • Property management and maintenance will be undertaken on the existing drain within the existing drainage easement and been undertaken recently. • Substages of development of Lot 210 will be monitored for actual runoff volumes over time. It is anticipated to take years for the entire Stage 3 to be built out, during which time, progressive monitoring results continue to be collected. • If the Stage 3 SWMP is approved, NEH has undertaken to additionally report monitoring results to NPWS every six (6) months beyond the Project Consent requirements of Annual Reporting to DPHI in accordance with Schedule 4, Condition 44. • Contingency plans have been made under the TARP as part of the Stage 3 SWMP for the monitoring runoff from substage area increasing over time for management as required.
6.	Drainage channels	The SWMP has not adequately demonstrated that the existing stormwater drainage channels have capacity to accommodate post development flows	NEH's response to this feedback is structured as follows: a) stormwater scheme – proposed storage onsite; b) existing drain connection; and c) management, monitoring and contingency. **(a) Stormwater scheme – proposed storage onsite** NEH respectfully submits that the stormwater management scheme of onsite controls for stormwater management and associated capacity must be considered in responding to this feedback. The Stage 3 SWMP basins are very large, totalling:

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Surface Area – 5.65ha
Volume/Storage – 70,107m^3

The basin construction method in the Stage 3 SWMP is the same as in the EA, with little/no excavation and the basin embankments formed aboveground.
Best management practices for stormwater from Lot 210 have been employed for the developed conditions of mitigated outflows for controlled release of runoff from Stage 3 into the drainage easement on Lot 1001. The basin outlets were configured to release stormwater from Stage 3 at a slow rate not exceeding the maximum flowrates under pre-developed conditions. Large open channels within Stage 1 for storage and conveyance to the basins, convey the runoff volumes slowly due to the flat natural grades. This provides further transient storage and retention.
On review of the Stage 3 SWMP there is proposed onsite basin storage within Stage 3 for ~140mm of equivalent rainfall as runoff. Open swale drainage also creates further transient storage for runoff upslope of the two (2) basins, not included in this calculation. This confirms the onsite storages are significant and the overall stormwater management scheme has less reliance on the capacity of the existing drain.
The Project Consent does not require NEH to await construction of the drainage system within the downstream property before discharges from the development of Stage 3.
In any case, NEH refers to the additional comments at Item 3(a) above.
(b) Existing drain connection
NEH has considered the feedback and submits that:

The Stage 3 discharge location is consistent with the EA, entering the same existing drain as was identified in the EA, off the western corner of Lot 210, into Lot 1001.
NEH owns both properties Lot 210 and Lot 1001 which contains the existing drain.

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			• Historical aerial photos indicate this existing drainage connection from Lot 210 across Lot 1001 to the Hunter River has existed at least since 1939. • The existing drain was man made during farming activities, 1.7km long to the Hunter River and approximately 7m wide at the floodgate outlet and levee bank. There is a fall, down gradient to the Hunter River. • The existing drain is within an existing easement for drainage across Lot 1001. • The discharge point from Lot 210 is 1.15km from National Park, away from adjoining wetlands. • The existing drain is into Lot 1001, property which is approved for industrial development under NSW Project Approval MP10_0185. • The existing drain is retained to the Hunter River in the Project Approval MP10_0185 and remains intact, functioning within all MP10_0185 approved documentation of estate layout, Wetland Interface Strategy and Stormwater Management Plan. • An aerial photo of the existing easement to drain water is indicatively shown in the attached **Plans 1 & 2**. Please also refer to our comments at **Item 7** below. **(c) Management, monitoring and contingency** NEH has considered this feedback and included further management detail of the delivery sequencing of stormwater management controls for sub-stages of developing Stage 3 in the Stage 3 SWMP. In summary, the existing drain downstream has capacity for post development flows. However, for assurance on the capacity, upfront construction of the stormwater controls ahead of development of each sub-stage provides excess capacity for ongoing monitoring before the next sub-stage proceeds. This is because the two (2) large basins are designed for capacity to take runoff from the multiple sub-stages of developing the Stage 3 area.

			Further, NEH submits that: • the comments on sequencing and phases of stormwater controls with sub-stages of development at **Item 3** above apply; • the sequencing of the development phases, as described above and the Stage 3 SWMP, allows for measured checking by monitoring for the final footprint size of the western basin (Basin 3). • the TARP has been updated for contingency responses. If in the event of adverse monitoring results after many years of completed sub-stages within Stage 3, the physical attributes of the site support engineering upgrade capacity of the existing drain, if required. The drain can be widened and floodgates at the Hunter River levee bank upgraded, if required. The existing drain lies within a drainage easement, and widening can be reviewed as a property management matter of an easement for drainage. NEH has committed in the TARP to be providing monitoring reporting of increased frequency, every six (6) months to NPWS. NEH restates that: • overall, the progressive sub-stages of the Stage 3 development will enable monitoring and management for stormwater control on the downstream property; and • in particular, the Stage 3 SWMP sets out the monitoring, reporting, management and responses relating to discharge control that complies with the Project Consent.
7.	Drainage channels	The SWMP suggests that the existing drainage network does not currently have sufficient capacity for the increased flows and that drain clearing may be required	NEH confirms that the Stage 3 SWMP describes observed vegetation in drainage channels at the time of reporting in 2023. NEH has since, recently undertaken preliminary drain clearing, with further clearing works booked in July 2024. A commitment has been made in the Stage 3 SWMP to have the drain cleared prior to works beyond Stage 3.1A proceeding with sub-stages of development on Lot 210. Until recently, NEH had respectfully considered a best management approach of minimised site activities whilst Lot 210 remains undeveloped. However, during the investigations for the Stage 3 SWMP, NEH has recently recognised the benefits to NPWS for certain drain clearing activities and has commenced selected property maintenance measures to assist NPWS.

			We note the drains managed by NPWS downstream of Stage 1 and neighbouring properties were observed to be blocked in August 2023 with sediment and vegetation growth within obscuring one (1) pipe entry. This drain was cleared out by NPWS later in 2023.  *Photo of sediment deposition with plant growth prior to recent drain clearing activities, the blockage at the NPWS floodgate - the only drain downstream of Stage 1 and neighbouring properties (28 August 2023).* Discharge from Stage 3 is into an existing drain within an existing easement for drainage across Lot 1001 and ongoing drain clearing is proposed in the Stage 3 SWMP. Drain clearing is identified in the TARP, contingency and response plan of the Stage 3 SWMP. Having consulted with both DCCEEW and DPHI including notification of NPWS, the existing drain across Lot 1001 has been cleared.
8.	Drainage channels	BCD recommends that the SWMP assess if the existing stormwater drainage channels have	Please refer to our comments at I**tem 6** above.

		capacity to accommodate post development flows under a range of tidal conditions, and what mitigation works would be required	
9.	Drain clearing activities	BCD recommends that drain clearing activities are done in accordance with the recommendation in the Acid Sulphate Soil Management Plan, Douglas Partners, Nov 2009	Douglas Partners has completed an Acid Sulphate Soils Management Plan for Stage 3 and has attended, tested and monitored for acid sulphate soils during drain clearing in July 2024. NEH notes recent feedback from NPWS drain clearing activities downstream of Stage 1 involving sediment removal, NPWS advised NEH that no acid sulphate soils were encountered.
10.	Groundwater	Groundwater interaction needs to be comprehensively assessed, noting that new channels could become conduits for groundwater	NEH has comprehensively assessed the groundwater. NEH respectively submits that there are a number of existing drains conveying groundwater within Lot 210 (and adjoining properties) at a much lower elevation than the proposed level of Channels 2 & 3 of the Stage 3 SWMP. The existing drains for conveying regional groundwater will continue to operate beneath the level of the stormwater management system for Stage 3 SWMP, in conjunction with Stage 3 SWMP discharge objectives. NEH has completed comprehensive assessment by: • Consulting with Hunter Water Corporation (**HWC**), the water authority managing the Tomago Sandbeds to confirm their management preferences in relation to groundwater; • Engaging Douglas Partners, geotechnical engineering consultants, who are comprehensively assessing groundwater interaction to HWC requirements; • Installing eight (8) additional monitoring wells;

			• Installing data loggers, having recorded groundwater level responses to rainfall over the past 12 months; • Reviewing background history, aerial photos, 13 years of observations in monitoring across La Nina and El Nino events; and • Reviewing survey information of existing drains prior to development. For clarification, the new channels, Channels 2 & 3 referred to in the Stage 3 SWMP, have been designed with invert levels with respect to future development fill. That is, Channels 2 & 3 are mostly aboveground drains formed by the fill of development either side. HWC management preferences for interaction with groundwater levels are known from consultation during Stage 3 SWMP and GWMP, and Douglas Partners will be undertaking the detailed design for construction.
11.	Tomago Sandbeds	Relationship to the Tomago Sandbeds needs to be better understood, noting that the way in which Hunter Water manages Tomago Sandbeds is different today to when the modelling was originally undertaken around 2007-2008	NEH has considered DPHI's feedback and confirms having completed the following: • Extensive observations for over 13 years and over 10 years of monitoring; • Data review; • Engagement with Douglas Partners, groundwater specialists; and • Consultation with HWC as part of the Stage 3 SWMP process. NEH confirms that HWC has not raised any management changes to Tomago Sandbeds during our extended consultation. NEH respectfully submits, for information purposes, the following landscape differences today in comparison to 2007-2008. • Natural surface ground levels of private land vary between 0.2-0.4mAHD along the downstream, common boundaries of private lands with the Tomago East Wetland Rehabilitation Project (**NPWS Project**) area. The Review of Environmental Factors by NSW Department of Industry and Investment dated March 2011 for the NPWS Project describes the existing NPWS Project site of ~450ha prior to the tidal water re-introduction as containing natural surface ground levels of: "*Over 200 hectares of the site is below 0.2 metres AHD.*" Essentially, in 2007-2008 and prior, the 200ha provided storage for drainage from the Tomago Sandbeds and private lands from a wide area, before exit to the Hunter River at low tide.

- The 200ha of downstream storage for freshwater has been replaced by tidal water for the NPWS Project.

Photo of NPWS floodgate at low tide (28 August 2023).

- On this occasion, freshwater was observed as unable to drain into the North South Drain at low tide. Residual, accumulated tidal water of the NPWS Project continues to occupy the North South Drain during low tide, by a sustained a high level of tidal water in the North South Drain. The freshwater from Tomago Sandbeds and private land drainage is then limited and remains impounded, upstream of the NPWS floodgate, with freshwater accumulating in all upstream drains.

NEH recognises that the Stage 3 SWMP, with discharge into the existing drain 1.15km west of Lot 22, can assist by reducing risk of freshwater discharge toward the NPWS floodgate.

			For these reasons, NEH submits that the stormwater management scheme for Stage 3 SWMP has been managed to the requirements of the Project Consent to avoid stormwater discharge from Stage 3 to the adjoining wetlands and thereby assist NPWS, generally in accordance with Schedule 3, Condition 12(d). Stage 3 SWMP specifies drainage separately across Lot 1001 to the Hunter River using an existing drainage channel that has been historically used since at least 1939.
12.	Cumulative impacts	Cumulative impact assessment is required to understand water interaction (incl. subject development, Lot 1001 industrial/business park, Hunter Water discharge into north-south drain etc.)	NEH understands that DPHI's feedback of cumulative impact assessment relates to discharge into the North South Drain. We note the approved stormwater management scheme for development of Lot 1001 (Project Approval MP10_0185) as consulted with NPWS, is toward the Hunter River not the North South Drain identified in this item. NEH respectfully submits that the stormwater management scheme for Stage 3 SWMP has been managed to the Project Consent to avoid the adjoining wetlands and North South Drain, generally in accordance with Schedule 3, Condition 12(d). After considering DPHI's feedback, the Stage 3 SWMP has been updated and aligns with the stormwater discharge points as shown in the EA. The Stage 3 discharge point is 1.15km away from National Parks, within an easement for drainage toward the Hunter River. NEH has consulted with Hunter Water Corporation (**HWC**), the water authority managing the Tomago Sandbeds to confirm their management preferences in relation to groundwater. Lot 1001 is land owned by NEH and is approved for industrial development. The existing drain containing the Stage 3 discharge is retained to the Hunter River in the Lot 1001 layout and not blocked by the Lot 1001 development. An on site conservation area of Lot 1001 land is to be retained as a buffer in the vicinity of Lot 22 and the North South Drain. The Lot 1001 industrial development included approval of a Wetland Interface Strategy which identified and included the Project Consent land upstream.
13.	Sea levels	Sea level rise could render stormwater assets ineffective so assessment of climate change scenario is required	NEH has considered DPHI's feedback for assessment of sea level rise (**SLR**)/climate change scenario and adopted the increases of 0.4m rise by 2050 and 0.9m rise by 2100 from the *NSW Sea Level Rise Policy Statement* (Department of Environment, Climate Change and Water NSW, October 2009). On review, the tidal planes for Hunter River at Mallabula Point (BMT 2017 sourced from Manly Hydraulics Laboratory (MHL) 2012) are set out in the table below.

Tidal Plane 2022 Water Level	**(m AHD)***
High Water Solstices Springs (HHWSS)	1.08
Mean High Water Springs (MHWS)	0.69
Mean High Water (MHW)	0.56
Mean High Water Neaps (MHWN)	0.42
Mean Sea Level (MSL)	-0.01
Mean Low Water Neaps (MLWN)	-0.44
Mean Low Water (MLW)	-0.58
Mean Low Water Springs (MLWS)	-0.71
Indian Spring Low Water (ISLW)	-0.99
* Conversion to AHD from Port Stephens Height Datum (PSHD) = -0.949m (MHL, 2012)	

In summary, with 0.9m SLR in 2100, the MLWN is predicted to increase to ~0.46m AHD. This elevation remains lower than the lowest proposed Stage 3 basin outlet level of 0.7mAHD and therefore gravity drainage from the Lot 210 estate basins is achievable at the highest of low tides with SLR added.

Although this is not the exact location for the tidal planes, it is likely to be closely matching this available data and the outcome of this check with SLR added has provided confidence that gravity drainage is achievable and maintained under these ‘predicted’ scenarios.

The two gated culverts along the western boundary of Lot 1001 (adjacent to the Hunter River) have invert levels as low as -0.86m AHD. These culverts, combined with the existing levee, are designed to minimize the ingress of tidal water into Lot 1001. Assuming this infrastructure will remain unchanged and functional during the future development of Stage 3, backwater flooding on Lot 1001 during high tides (which potentially impacts the capacity of the Stage 3 drainage infrastructure), would only occur if these gated culverts fail and/or the levee is overtopped. This is unlikely to happen during relatively short duration local catchment storm events which are critical for the Stage 3 drainage infrastructure, while the critical storm duration for Hunter River flooding is significantly longer.

14.	Monitoring	There need to be mechanisms in place requiring the applicant to monitor and ensure actual performance is consistent with predicted performance.	NEH confirms the following Project Consent requirements for monitoring of actual and predicted performance and notes the proactive, voluntary allowances made in the Stage 3 SWMP approval process. The Project Consent requirements are: • Schedule 4, Condition 44(f) of the Project Consent requires NEH to analyse monitoring results and document these in an Annual Environmental Monitoring Report that is submitted to the Planning Secretary and NPWS. • Annual reporting includes a comparison to predicted performance. Monitoring equipment has been used for over 10 years on Stage 1. The proactive, voluntary actions/commitments by NEH are: • NEH has offered a greater frequency of reporting data to NPWS in the TARP, to be provided every six (6) months with approval of the Stage 3 SWMP. • NEH has additionally collected groundwater level data collected for the past 12 months and continues to be collected in groundwater wells prior to development commencing on Stage 3, increasing the database of monitoring records.
15.		The provided modelling indicates that significant reductions in pollutant loads vs the nontreated option are achieved. This however still results in a net increase in pollutants discharged to the environment. In an area where the released stormwater may not be able to drain away from the site there is a risk that pollutant load will accumulate over time	NEH has considered this feedback and respectively disagree with the contentions and respond on the key points below. The first point is that the comment related to the Stage 3 SWMP which previously described extensive ponding of stormwater on Lot 1001. The Stage 3 SWMP has been updated and aligns with the stormwater discharge points as shown in the EA. The Stage 3 discharge point is 1.15km away from National Parks, within an easement for drainage toward the Hunter River. The second point is whether stormwater quality predicted by modelling will be achieved by the design or not. The Stage 3 SWMP contains actual monitoring commitments, improvement of existing drainage and a TARP in the event of contingency requirements. Refer to Item 14 above.

		and result in algal blooms, weed growth in drainage lines and potentially groundwater contamination, given groundwater is present as surface water in the low-lying areas of the site. NPWS are concerned the stated stormwater quality may not be achieved by the design. (From NPWS Letter 23 June 2023)	The third point is NEH refers to the environmental record and experience from the previous stage where predictions were made by modelling and actual monitoring of water quality has been undertaken for over 10 years. Stage 1 water quality monitoring has been undertaken for the runoff from ~25ha development without incident. Reporting on actual water quality has been provided annually to DPHI, NPWS and DCCEEW (federal) without comment.

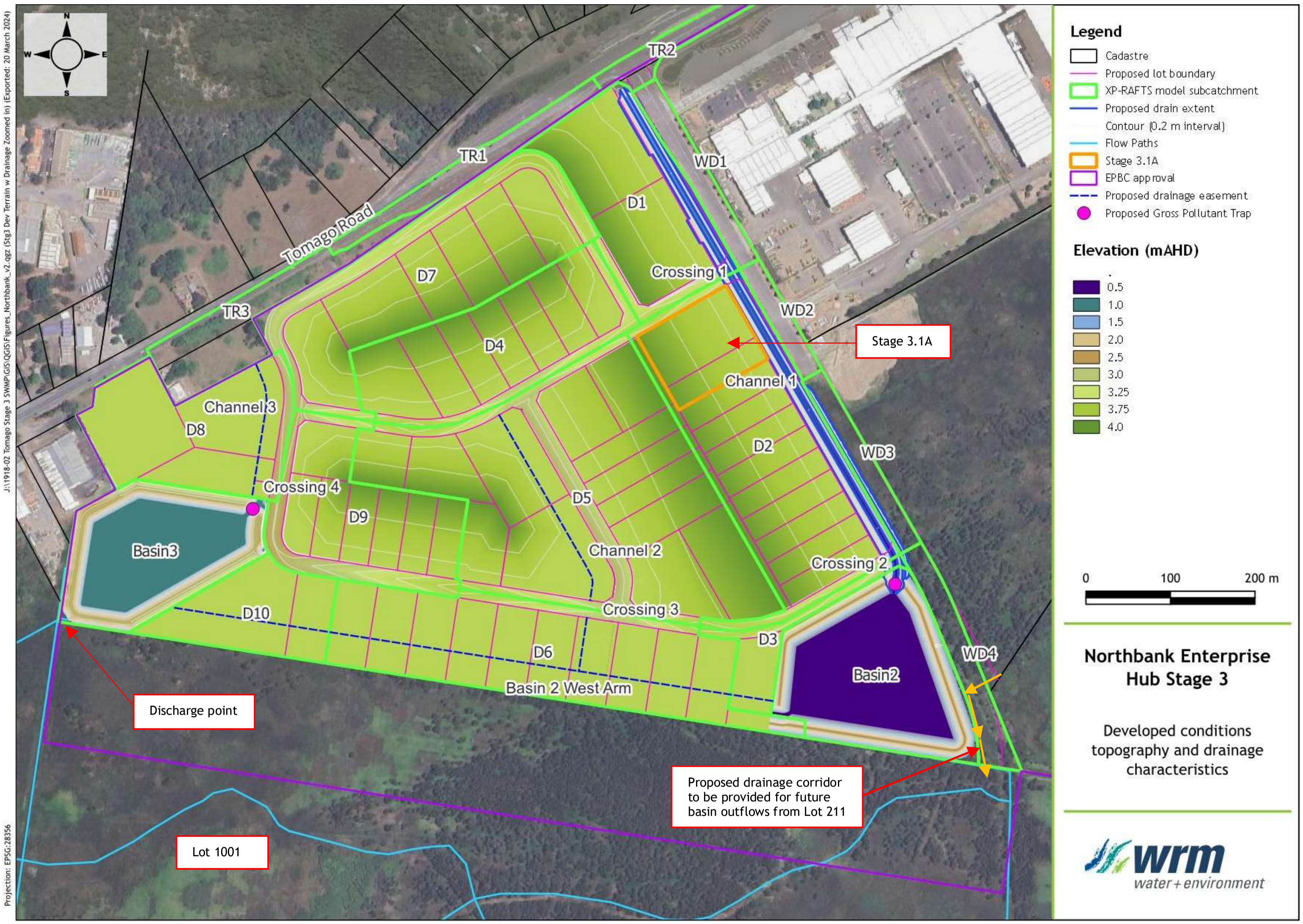


Figure 4.1 – Proposed development site layout, bulk earthworks plan, developed catchments and drainage configuration

Plan of Industrial Subdivision Tomago Road, Tomago	Date: November 2007 Version: A (November 2007) Drawn: MJH	AutoCAD Ref: Job No:	N:\11886\Dwg\Eng\Report\Nov\Vol 4\11886fig-6a 11886

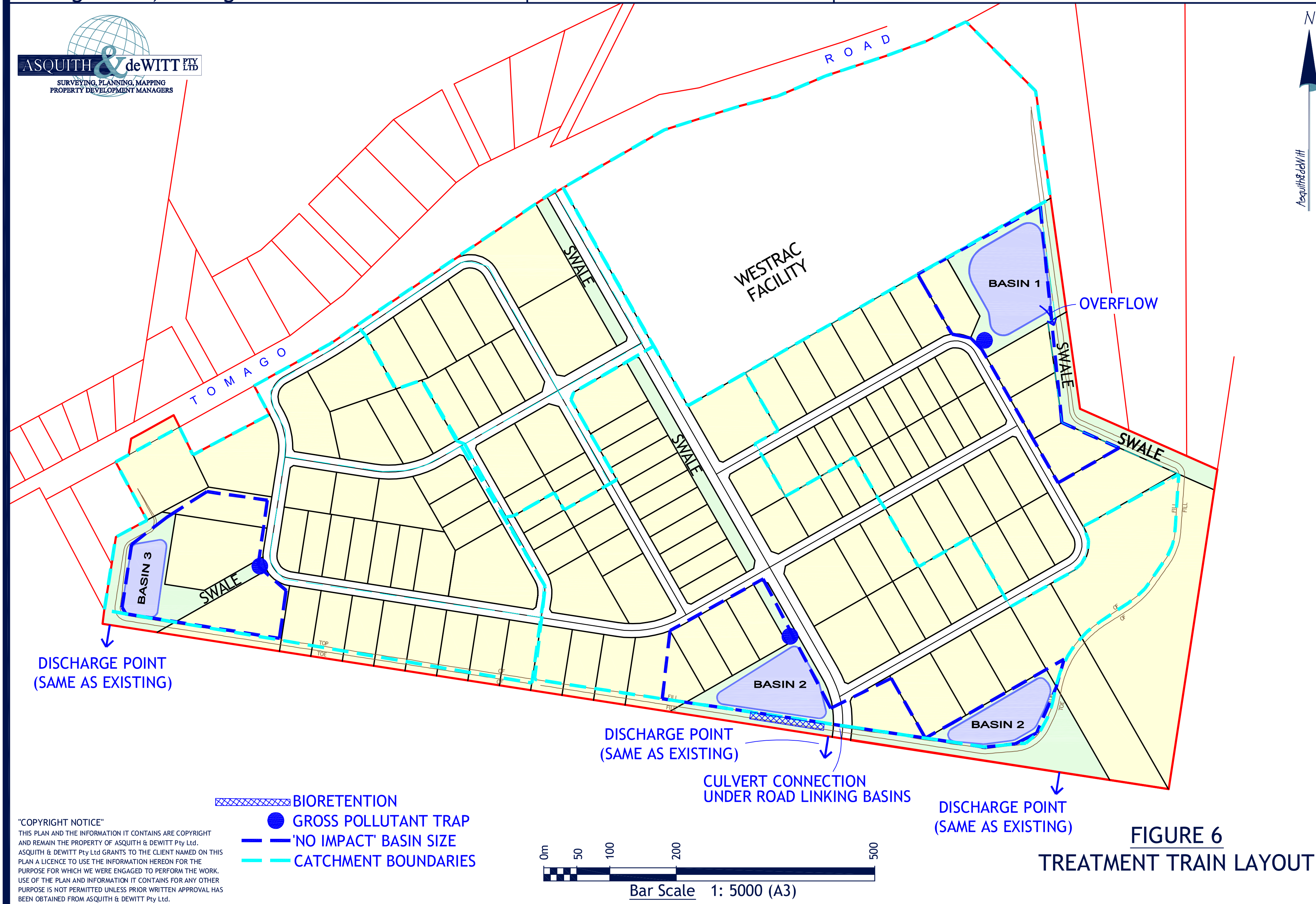


FIGURE 6
TREATMENT TRAIN LAYOUT

Plan of Industrial Subdivision Tomago Road, Tomago	Date: November 2007 Version: A (November 2007) Drawn: MJH	AutoCAD Ref: N:\11886\Dwg\Eng\Report\Nov\Vol 4\11886fig-2a Job No: 11886

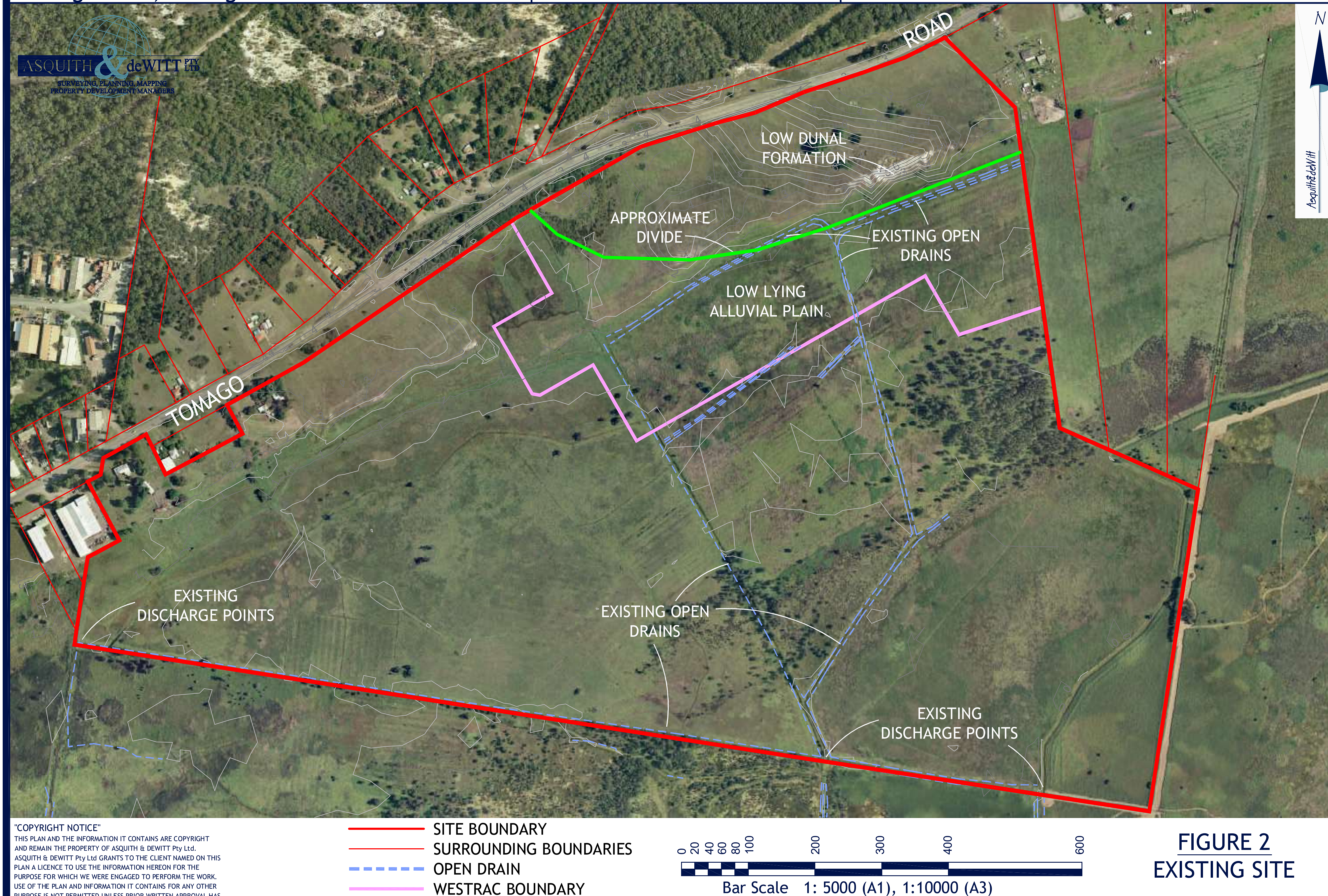
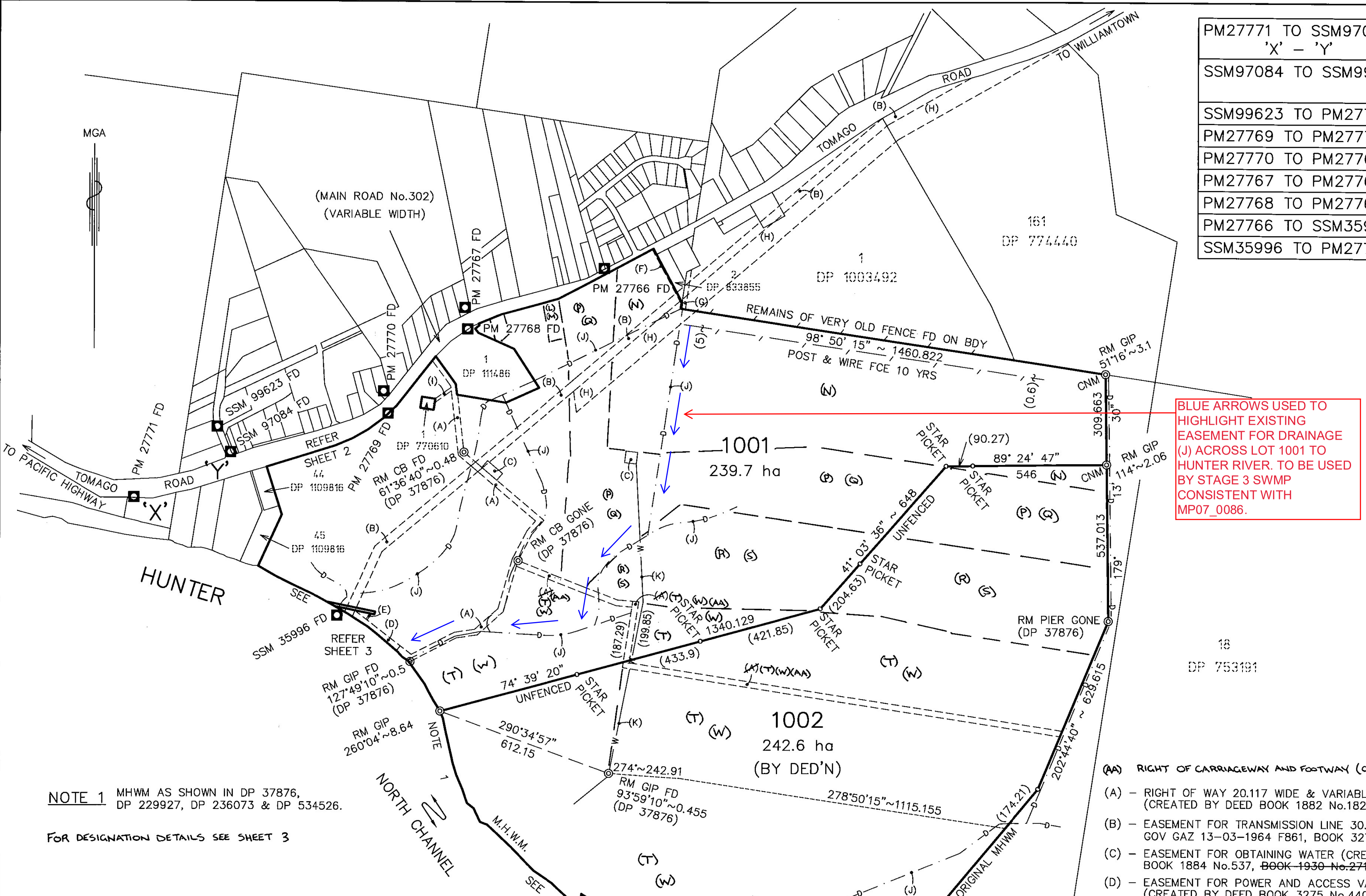


FIGURE 2
EXISTING SITE

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

PM27771 TO SSM97084 'X' – 'Y'	64°39'52"~361.397 (SURVEY) 64°39'52"~361.401 (MGA GRND)
SSM97084 TO SSM99623	332°41'~97.548 (SURVEY) 332°41'10"~97.543 (MGA GRND)
SSM99623 TO PM27769	85°16'53"~582.964
PM27769 TO PM27770	314°03'28"~42.323
PM27770 TO PM27767	42°07'30"~404.275
PM27767 TO PM27768	142°28'26"~48.39
PM27768 TO PM27766	65°49'12"~510.797
PM27766 TO SSM35996	216°37'58"~1470.069
SSM35996 TO PM27771	298°23'53"~820.657



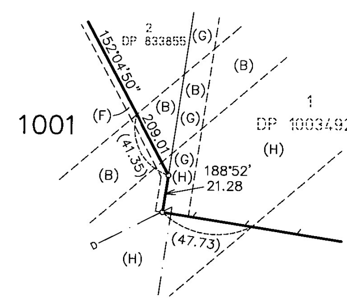


DIAGRAM 'E'

SCALE – 1:2000

NOTE 1 MHWM AS SHOWN IN DP 37876, DP 229927, DP 236073 & DP 534526.

FOR DESIGNATION DETAILS SEE SHEET 3

(AA) RIGHT OF CARRIAGEWAY AND FOOTWAY (CREATED VIDE BK1884 No537 AND BK1930 No.271)
(A) – RIGHT OF WAY 20.117 WIDE & VARIABLE (CREATED BY DEED BOOK 1882 No.182, BOOK 1884 No.537, BOOK 1930 No.271)
(B) – EASEMENT FOR TRANSMISSION LINE 30.48 WIDE (GOV GAZ 28-11-1952 F4354, GOV GAZ 13-03-1964 F861, BOOK 3277 No.819)
(C) – EASEMENT FOR OBTAINING WATER (CREATED BY DEED BOOK 1882 No.182, BOOK 1884 No.537, ~~BOOK 1930 No.271~~, BOOK 1885 No.135)
(D) – EASEMENT FOR POWER AND ACCESS VARIABLE WIDTH (DP 534526) (CREATED BY DEED BOOK 3275 No.440)
(E) – EASEMENT FOR POWER 5.03 WIDE (DP 534526) (CREATED BY DEED BOOK 3275 No.440)
(F) – EASEMENT TO DRAIN WATER 4 WIDE (DP 577334)
(G) – EASEMENT TO DRAIN WATER 10 WIDE (CREATED BY DEED BOOK 3887 No.834)
(H) – PROPOSED EASEMENT FOR TRANSMISSION LINE 60.96 WIDE (DP 557698)
(I) – RIGHT OF WAY 10.06 WIDE (CREATED BY DEED BOOK 1882 No.182)
(J) — · —D— · — EASEMENT FOR DRAINAGE (CREATED BY DEED BOOK 1882 No.537, BOOK 1884 No.539, BOOK 1884 No.537, BOOK 1930 No.271, BOOK 1882 No.283)
(K) — W — EASEMENT TO LAY WATER PIPES (CREATED BY DEED BOOK 1882 No.283, BOOK 1884 No.537, BOOK 1884 No.539, BOOK 1930 No.271, BOOK 1885 No.135)

SURVEYING REGULATION 2006 : CLAUSE 35(1)(b) & CLAUSE 61(2)

MARK	M.G.A. COORDINATES		CLASS	ORDER	METHOD	ORIGIN
	EASTING	NORTHING				
SSM 99623	380670.470	6366752.638	C	3	–	SCIMS
SSM 97084	380715.210	6366665.985	C	3	–	SCIMS
SSM 35996	381110.398	6366121.165	B	2	–	SCIMS
PM 27771	380388.643	6366511.369	C	3	–	SCIMS
PM 27770	381220.920	6366829.971	C	3	–	SCIMS
PM 27769	381251.317	6366800.558	A	1	–	SCIMS
PM 27768	381521.461	6367091.386	C	3	–	SCIMS
PM 27767	381492.024	6367129.757	C	3	–	SCIMS
PM 27766	381987.347	6367300.569	C	3	–	SCIMS
COMBINED SCALE FACTOR = 0.999774				ZONE 56		
SOURCE : M.G.A. COORDINATES ADOPTED FROM SCIMS AS AT 10 SEPTEMBER 2007.						

SURVEY TECHNIQUE USED DIFFERENTIAL GNSS WITH DUAL FREQUENCY RECEIVERS FOR PART OF THIS SURVEY.

10 | 20 | 30 | 40 | 50 | 60 | Table of mm | 90 | 100 | 110 | 120 | 130 | 140

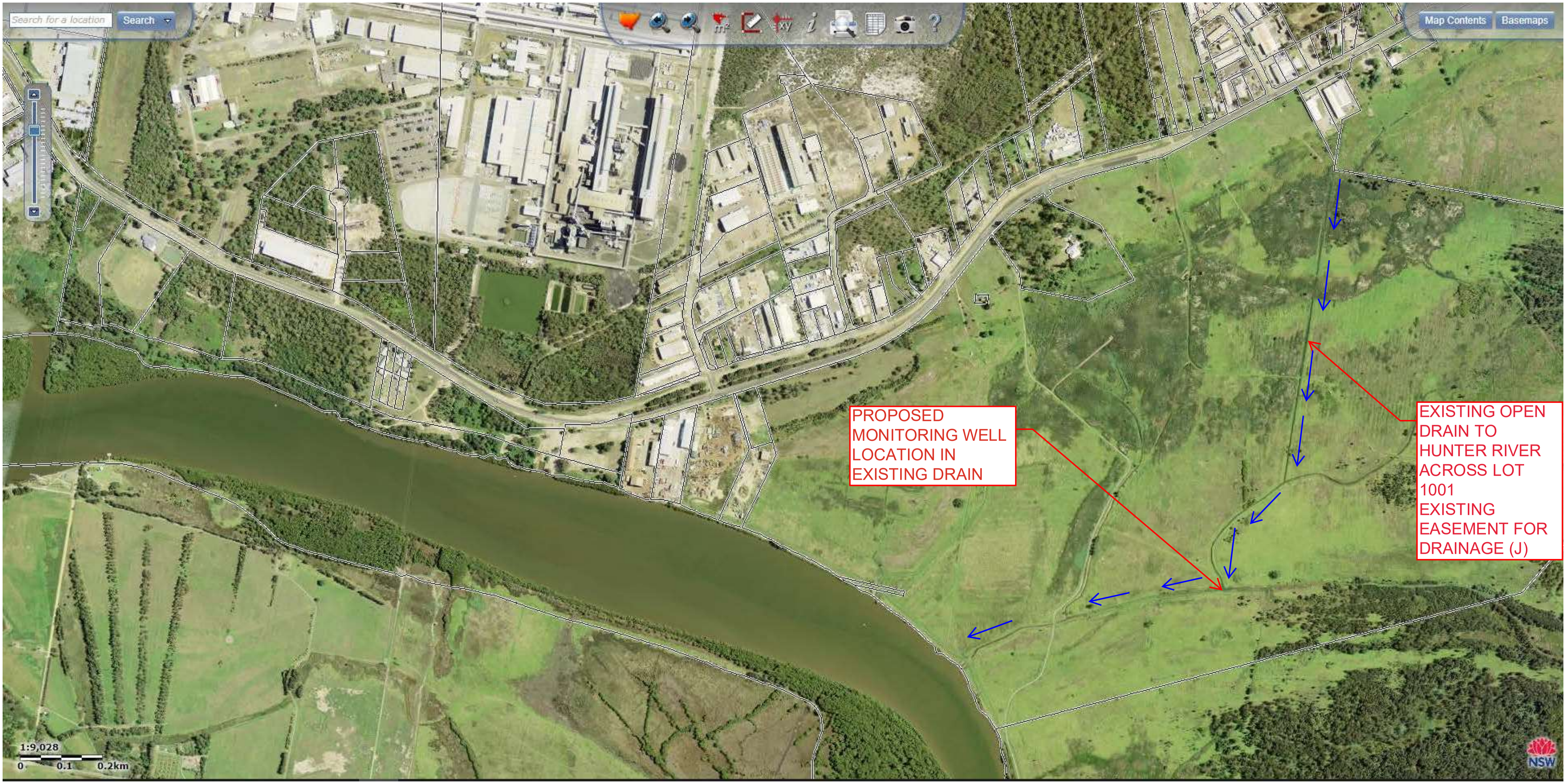
Surveyor: BENJAMEN JOHN BELFIELD
Date of Survey: 12/09/07
Surveyor's Ref: 03084DPA.DWG 2007M7100 (1086) COMP

PLAN OF
OF SUBDIVISION OF LOTS 4, 6, 7 & 8 DP 37876, LOT 52 DP 577334, LOT 11 DP 774442 & LOTS 151, 152 & 153 DP 625755

LGA: PORT STEPHENS
Locality: TOMAGO
Subdivision No: - SUC003
Lengths are in metres. Reduction Ratio 1: 10000

Registered
25.6.2008

DP1127780 P



Search for a location
Search
Map Contents
Basemaps
PROPOSED MONITORING WELL LOCATION IN EXISTING DRAIN
EXISTING OPEN DRAIN TO HUNTER RIVER ACROSS LOT 1001
EXISTING EASEMENT FOR DRAINAGE (J)
1:9,028
0
0.1
0.2km
NSW

Experience Communication Energy

20 December 2023

Our Ref.: TP-100

Department of Planning and Environment
Locked Bag 5022
PARRAMATTA NSW 2124

Attention: Ms Joanna Bakopanos/Mr Jeffrey Peng
Lodged on Portal

Dear Joanna & Jeffrey
RE: MP07_0086 – Tomago Estate
Stage 3 SWMP & GWMP Submission

We are pleased to be submitting the Stage 3 Stormwater Management Plan and Groundwater Monitoring Plan for MP07_0086 at Tomago Rd, Tomago, lodged on the portal today.

Consultation has been both extensive and rigorous, commencing in May 2023 with several government agencies and stakeholders. In summary, Northbank Enterprise Hub (NEH) and it's consultants have completed consultation as follows:

- Port Stephens Council – 2 rounds of RFI's and a meeting.
- National Parks & Wildlife Service – 2 rounds of RFI's and 2 meetings.
- Hunter Water Corporation – 1 round of RFI's and 1 meeting.
- Department of Climate Change, Energy, the Environment and Water (Stormwater and Groundwater Plans under EPBC Approval 2007/3343) – 1 round of RFIs and 2 meetings.
- DPE Water – 1 Comment received 19 December 2023, which is easily addressed with detailed design in due course.
- Biodiversity, Conservation and Science – Consultation period expired 19 December 2023, no response received.

The RFI's for the above consultation are contained in **Appendix A**.
The RFI Response letters to Council, Hunter Water and NPWS are contained in **Appendix B**.

Whilst the meetings were not essential, these demonstrate both a high degree of engagement by NEH and it's consultants and the commitment to producing appropriate management plans for development of Stage 3. The consultation process has been beneficial to produce final management plans which meet a wide range of stakeholder perspectives and requirements. The management plans finalised and presented now to NSW DPE represent the balanced outcome of extensive work in meeting objectives and requirements.

By our Project Approval MP07_0086, Schedule 3, Condition 8 b), we note that these management plans are to be lodged at least one (1) month prior to commencement of construction.

We write to confirm the **construction commencement date of Monday 19th February 2024**, providing NSW DPE 2 months' notice to allow for the holiday period. We note that the approval of the Management Plans by NSW DPE is required prior to construction commencing which is after NEH and it's consultants having completed 7 months of consultation in developing and finalising the management plans to a high level.

Accordingly, we seek NSW DPE's approval of the Stage 3 Stormwater Management Plan and Groundwater Monitoring Plan.

If you have any questions, please contact me on 0414 689 091 or scottd@torqueprojects.com

Yours Sincerely,

Scott Day

Torque Projects Pty Limited

Encl.

Appendix A - Package of all Consultation letters

Appendix B – RFI Response letters to Council, NPWS and Hunter Water.

Appendix A – Consultation Letters (RFI's)

Department of Planning and Environment

NSW GOVERNMENT

Our ref: OUT23/20778

Alaine Roff

Urbis

Email: aroff@urbis.com.au

19 December 2023

Subject: **Tomago Industrial Estate (MP07_0086) – Draft Design Guidelines and Stormwater Management Scheme for Stage 3**

Dear Alaine

I refer to your request for advice sent on 17 November 2023 to the Department of Planning and Environment (DPE) Water about the above matter.

DPE Water has reviewed the Draft Design Guidelines and Stormwater Management Scheme for Stage 3 of the Tomago Industrial Estate and provides the following recommendation.

Post-approval

- Works within waterfront land should be designed and constructed in accordance with the Guidelines for Controlled Activities on Waterfront land. This should include the proposed outlets from the detention basins.

Should you have any further queries in relation to this submission please do not hesitate to contact DPE Water Assessments water.assessments@dpie.nsw.gov.au.

Yours sincerely

Rob Brownbill,
Manager, Assessments, Knowledge Division
Department of Planning and Environment: Water

Department of Planning and Environment

Our ref: OUT23/16279

Scott Day

Email: scottd@torqueprojects.com

4/10/2023

Subject: **Tomago Industrial Estate - Groundwater Monitoring Plan (MP07_0086-PA-16)**

Dear Scott,

I refer to your request for advice sent on 6 September 2023 to the Department of Planning and Environment (DPE) Water about the above matter.

The Department of Planning and Environment- Water has reviewed the latest Groundwater Monitoring Plan and has provided recommendations in **Attachment A** to ensure appropriate water management.

Should you have any further queries in relation to this submission please do not hesitate to contact DPE Water Assessments at water.assessments@dpie.nsw.gov.au

Yours sincerely,

Rob Brownbill

Manager, Assessments, Knowledge Division
Department of Planning and Environment: Water

Attachment A

Detailed advice to proponent regarding Tomago Industrial Estate - Groundwater Monitoring Plan (MP07_0086-PA-16)

1.0 Groundwater monitoring

1.1 Recommendation

The proponent should install an additional monitoring bore on the southern downgradient boundary of the Stage 3 site between the damaged MW05 and existing MW106 monitoring wells.

Explanation

There are currently more upgradient monitoring bores than downgradient monitoring bores. An additional monitoring bore should be installed on the southern downgradient boundary of Stage 3 site between the damaged MW05 and existing MW106 bore. This monitoring well should be protected from development operations (e.g., trucks transporting fill material) which can threaten the integrity of the monitoring bore. Appropriate signage should be installed near the new monitoring bore to prevent damage.

1.2 Recommendation

The proponent should monitor and report water temperature in Category 1 of water quality parameters for both baseline and ongoing monitoring.

Explanation

Temperature monitoring is missing from the physicochemical parameters list. Addition of this parameter will allow temperature correction of water quality parameter readings, sensitive to temperature variations such as DO, EC and pH.

1.3 Recommendation

Baseline monitoring should be established for all monitoring bores, including the new bore listed in recommendation 1.1. Groundwater monitoring should include:

- Water quality parameters for all three categories (Table 7), to be monitored quarterly.
- Monthly water level measurements from data loggers.

1.4 Recommendation

Upon the completion of one year of baseline monitoring, ongoing monitoring can proceed as outlined in the current monitoring plan. The number of bores analysed during ongoing monitoring may be reassessed based on a groundwater consultants review of the results.

Explanation (1.3 and 1.4)

Limited valuable baseline information can be deduced from six-monthly monitoring. A 12-month baseline monitoring program should be established for all monitoring bores, including an extra downgradient bore (recommendation 1.1).

The selection and quantity of monitoring bores may need to be rationalised for ongoing monitoring after the completion of baseline monitoring. During the operational phase, the downgradient monitoring wells will enable the detection of potential contamination resulting from the infiltration of stormwater runoff into the underlying aquifer. This may carry contaminants as it leaves the site and permeates into the aquifer through recharge points. The existing monitoring plan my need to be amended once the future land use is determined, and potential contaminants are identified.

1.5 Recommendation

The proponent should update the Mitigation Action Plan (Table 9; page 23) to include:

- a requirement to notify agencies on the outcome of the investigation of three consecutive trigger level exceedances.
- additional sampling due to trigger level exceedance for the relevant parameter(s). The frequency of groundwater monitoring should be temporarily increased followed by rectification/mitigation until monitoring results have decreased below the trigger thresholds.
- all monitoring bores installed on Stage 3 site.

Explanation

The existing mitigation action plan aims to notify the government agencies within seven days for one trigger level exceedance (80th percentile) and investigation upon three consecutive exceedances. Such investigation should be carried out by suitably qualified environmental scientist and outcomes be communicated to the department in a reasonable timeframe. If the siteworks are identified as the cause of non-compliance, the proponent must rectify the cause of non-compliance and increase the monitoring frequency until monitoring results drop below the trigger threshold.

Further Guidance

For further guidance, the applicant is encouraged to refer the department's guidelines for groundwater management plans outlined in 'Guidelines for Groundwater Documentation for SSD/SSI Projects. Technical guideline'
URL: https://water.nsw.gov.au/__data/assets/pdf_file/0020/507611/Guidelines-for-Groundwater-Documentation-for-SSD-SSI-Projects.pdf

End Attachment A

DOC23/839682-1

Scott Day- Principal Engineer
Torque Projects Pty Limited
E: scottd@torqueprojects.com

NPWS reply on Northbank Tomago Stormwater Management Plan for Industrial Subdivision at Lot 210 DP1174939 (Stage 3 MP07_0086)

I refer to your response to comments made by the National Parks and Wildlife Service (NPWS) on the WRM's Stormwater Management Plan (SWMP) for the Industrial subdivision proposal at Lot 210 DP1174939 Tomago, and the minutes forwarded following a meeting to discuss the SWMP on 1 August 2023. Thankyou also for providing a copy of the groundwater management plan.

NPWS appreciates the constructive discussions however retains ongoing concerns regarding potential impacts on both the adjoining Hunter Wetlands National Park and neighbouring private properties. The focus of NPWS's concerns is the Tomago Wetlands Rehabilitation Project area that adjoins the proposal and the drainage system that supports this.

Northbank Enterprise Hub have committed to ensuring site discharge from Basin 1 occurs approximately 700m further to the west to direct water flows away from Lot 22 and the national park. NPWS acknowledges Northbank has also committed to preparing a trigger action response plan (TARP) to address site management responses if monitoring indicates this is required. While NPWS appreciates these positive provisions, it remains unclear if they will ensure no additional water inflows to the national park and associated drains.

With respect to the minutes supplied for the meeting held on 1 August 2023, NPWS does not support the statement at the bottom of page 2 that agreement to the SWMP would be provided subject to monitoring and TARP to be put in place. While these aspects were discussed as positive measures, NPWS still has concerns regarding the potential performance of water management across the development site. NPWS also requests point 17 (which notes NPWS is not anti-development) is removed from the minutes, as this is not relevant.

Following further consideration and review of supplied materials, including the surface and groundwater management plans, NPWS make the following comments for consideration:

- It appears both the SWMP and the Groundwater Management Plan have not populated background or trigger values for water quality parameters (Table 10.2).
- The surface discharge points shown on Figure 3.1 in the Torque consulting (ref:TP100) response to NPWS's concerns are shown remote (approx. 700m west) from the national park, however it is unclear how these will be achieved. This commitment appears to be made in Torque's response only. NPWS would require all relevant plans, including the SWMP and Groundwater Management Plan, to be revised to reflect the same commitment.
- The proposed discharge point from future basin outflows from Lot 211 is not included in the revised plan (Figure 3.1 in the response) and remains very close to the national park and the North-South Drain. Once works are carried out to provide fill on the adjacent lot there will be limited other options for this discharge unless it is designed into the current proposed works.

- The Groundwater Management Plan notes that the fill platform will trap groundwater in the Tomago Sandbeds, leading to potentially higher groundwater levels on the opposite side of Tomago Road. The information you provided in the response shows that groundwater adjacent to the Westrac development, when expressed as surface water during 2022, flowed into the drain on Cottons property. The Groundwater Management Plan recommends that provision be made for collection and transport of groundwater flows through the proposed fill platform. NPWS would require that the SWMP be updated to demonstrate how groundwater flows through fill platforms will be achieved so that groundwater flow continues through the site in a manner which matches existing flows.
- It is noted that drain maintenance is proposed to reduce time of ponding on land where discharge will take place. This action is supported because, while the development can control rate of discharge, it cannot control the volume of discharge. Therefore, maintaining the effectiveness of drains to remove water at the correct stage of the tidal cycle will be important.

NPWS also maintains that water management for the Stage 1 development (on Lot 212) should be considered relevant to the SWMP and overall water management strategy for Stage 3. The position by Northbank that this is a separate matter (due to a change in land ownership) is not supported by NPWS given the development site is covered by the one project approval (Major Project Approval MP07_0086) held by Redlake (Northbank Enterprise Hub).

NPWS has been consulting with the Department of Planning and Environment to clarify the consultation requirements for the various management plans required under this project approval. NPWS was a part of the Office of Environment and Heritage at the time of the previous modification approval (and DECC prior to that) however we note there are other agencies within this cluster which have an interest in this project and consultation with OEH/DECC should be broader than just NPWS.

As noted above, further consultation is required with the Department to ensure an appropriate technical review of the proposal occurs.

NPWS appreciates the opportunity to engage and comment on these matters. Should you any questions regarding this response, please contact me on 0459 827 410 or at mitchell.carter@environment.nsw.gov.au .

Yours sincerely

Mitchell Carter
Manager, Lower Hunter Area
NSW National Parks and Wildlife Service

20 September 2023

Australian Government
Department of Climate Change, Energy, the Environment and Water

EPBC Ref: 2007/3343

Review of plan against conditions of approval and other relevant requirements

Tomago Road Industrial Development, Tomago, NSW

Approval holder	Northbank Enterprise Hub Pty Ltd
Name of document under review	Stormwater Management Plan (Stage 3) *Industrial Estate at Lot 210 DP1174939 (Stage 3), Tomago* *Stormwater Management Plan* *1918-02-B4 dated 12 July 2023*
Reviewing officer(s)	Stuart Jamieson
Date issued to approval holder	6/09/2023

Condition or other relevant requirement	Departmental review
General comments	**General Comment 1:** This Stormwater Management Plan was submitted to the department on 13 July 2023 and has been reviewed alongside the Groundwater Management Plan for Stage 3 in accordance with the condition which requires a stormwater and groundwater management plan for this stage. Table 2.1 of the plan provides an overview of how and where the plan meets the approval conditions. **Action 1:** Please update Appendix A – The declaration of accuracy should be from the Approval Holder (as per Section 3.1 of the *Environmental Management Plan Guidelines (2014)*)
Relevant Approval Conditions	
2. In order to minimise potential significant impacts on the Hunter River Estuary Ramsar Wetland site, prior to any commencement of works for each stage the person taking the action must submit to the Minister for approval a stormwater and groundwater management plan for that stage. Works must not commence until the plan is approved by the Minister. The appro**ved** plan must be implemented and address the following matters:	Note: General Comment 1 **Action 2**: Amend minor typo in condition table in report.
a. documented industry best practice water sensitive design principles and practices;	Addressed.
b. a review of the environmental values and water quality objectives for the Hunter Estuary Wetlands Ramsar Site;	**Action 3:** Expand the review of environmental values in Section 3.3 or reference the appropriate section in the Groundwater Monitoring Plan for further details.

	The EPBC Approval (2007/3343) conditions refer to the adopted WQOs previously set by the DECC (2007) (now the Department Climate Change, Energy, the Environment and Water [DECCEEW][sic]). - The 2007 DECC guidelines were produced by the relevant NSW department, not Federal. **Action 3:** Please amend the above throughout the report to refer to correct department.
c. replication of natural surface and groundwater flows and water quality;	Addressed (surface water component).
d. protection of the environmental values of receiving waters, including the Hunter Estuary Wetlands Ramsar Site;	Table 1 and sections throughout the report refer to discharge onto Lot 1001, which is also proposed for future development, as being an additional buffer and therefore further protection for receiving waters. **Action 4:** Justify the appropriateness of Lot 1001 providing additional buffer for discharge for protection of the environmental values of receiving waters.
e. the principle of continuous improvement;	Addressed.
The plan must include but not be limited to the following elements:	**Action 5:** Please amend in table 2.1: *The plan must not [sic] include but not be limited to the following elements:*
a. The water treatment management practices and management practice treatment trains that will be used to achieve or exceed environmental performance targets as detailed in the final Redlake Enterprise Pty Ltd – Tomago Road, Tomago – Environmental Assessment Report dated 12 March 2008 "Concept Engineering, Servicing, Earthworks and Stormwater Management" Appendix F.	**Action 6:** Please amend in Table 2.1 to include "Appendix F" for completeness.

b. how attainment of water quality objectives for these receiving waters will be supported by the action	Addressed.
c. how monitoring activities will be undertaken to track environmental performance of the action; and	**Action 7:** Ensure all guidelines referenced and values from these are up to date, including the ANZECC (2000) Guidelines which have been superseded by ANZG (2018).
d. groundwater and surface water monitoring must be undertaken pre, during and post development. This monitoring must continue until the Minister notifies that the construction and operation of this action is not impacting on the Hunter Estuary Wetlands Ramsar Site.	Section 11.2.4 states '*It is possible that stormwater in the region can have background levels of various parameters, in particular metals, with concentrations higher than the ANZECC or NHMRC parameters.'* **Action 8:** Justify the inclusion of metals as a 'Category 3' parameters (which are proposed for ongoing monitoring on an annual basis only). **Action 9:** Include, or justify the exclusion of, pH as a parameter in Table 11.1 Table 11.2 contains levels for background quality and proposed trigger levels as 'TBC' despite Table 2.1 describing *'over 13 years of existing background water quality data provides the 'pre-development' conditions.'* **Action 10:** Clarify whether trigger values are derived from the minimum of 3 baseline monitoring rounds or from background data for the site, or both. **Action 11:** Table 11.2 contains criteria for some parameters as 0 mg/L – please clarify whether this should be NC- no criteria.

Australian Government
Department of Climate Change, Energy, the Environment and Water

EPBC Ref: 2007/3343

Review of plan against conditions of approval and other relevant requirements

Tomago Road Industrial Development, Tomago, NSW

Approval holder	Northbank Enterprise Hub Pty Ltd
Name of document under review	Groundwater Management Plan (Stage 3) *Groundwater Management Plan EPBC 2007/3343* *Proposed Industrial Subdivision* dated 3 August 2023
Reviewing officer(s)	Stuart Jamieson
Date issued to approval holder	6 September 2023

Condition or other relevant requirement	Departmental review
General comments	**General Comment 1:** This Groundwater Management Plan was submitted to the department on 4 August 2023 and has been reviewed alongside the Stormwater Management Plan for Stage 3 in accordance with the condition, which requires a stormwater and groundwater management plan for this stage.
Relevant Approval Conditions	
2. In order to minimise potential significant impacts on the Hunter River Estuary Ramsar Wetland site, prior to any commencement of works for each stage the person taking the action must submit to the Minister for approval a stormwater and groundwater management plan for that stage. Works must not commence until the plan is approved by the Minister. The approved plan must be implemented and address the following matters:	Note: General Comment 1 **Action 1**: Amend minor typo in condition table in report.
a. documented industry best practice water sensitive design principles and practices;	N/A - Refer to Stormwater Management Plan.
b. a review of the environmental values and water quality objectives for the Hunter Estuary Wetlands Ramsar Site;	Addressed.
c. replication of natural surface and groundwater flows and water quality;	Groundwater component addressed. Refer to SWMP for surface flows.

d. protection of the environmental values of receiving waters, including the Hunter Estuary Wetlands Ramsar Site;	Table 1 and Section 9.9 refer to discharge onto Lot 1001, which is also proposed for future development, as being an additional buffer and therefore further protection for receiving waters. **Action 2:** Justify the appropriateness of Lot 1001 providing additional buffer for discharge for protection of the environmental values of receiving waters.
e. the principle of continuous improvement;	Section 9.1 states *"It is noted that the proposed development is at conceptual planning stages, and further detailed analysis and review will be required to achieve appropriate management strategies which consider both groundwater, surface water issues and geotechnical issues as outlined in Section 8."* **Action 3:** Clarify whether and justify that the current stormwater and groundwater plans are able to achieve appropriate management strategies. *…it is anticipated that further assessment may include the following:* **<u>Section 9.1</u>** *…anticipates that further assessment may include…* **Action 4:** Please clarify commitments to further assessment in this section, and throughout report where relevant, using committal languages (e.g., **will include** instead of **may include**).
The plan must include but not be limited to the following elements:	
a. The water treatment management practices and management practice treatment trains that will be used to achieve or exceed environmental performance targets as detailed in the final Redlake Enterprise Pty Ltd – Tomago Road, Tomago – Environmental Assessment Report dated 12 March 2008 "Concept Engineering, Servicing, Earthworks and Stormwater Management" Appendix F.	N/A - Refer to Stormwater Management Plan.

b. how attainment of water quality objectives for these receiving waters will be supported by the action	
c. how monitoring activities will be undertaken to track environmental performance of the action; and	Section 9.7 details ongoing monitoring and that groundwater monitoring bores may need to be replaced as development progresses. **Action 5:** Provide time-bound commitment to replace wells which have not been retained or justify how four of eight wells remaining is sufficient to ensure environmental performance of the action will be appropriately tracked.
d. groundwater and surface water monitoring must be undertaken pre, during and post development. This monitoring must continue until the Minister notifies that the construction and operation of this action is not impacting on the Hunter Estuary Wetlands Ramsar Site.	The report states that the early installation of additional wells in Stage 3 and aim of upgradient locations is to further provide "background' water levels and quality with respect to groundwater flowing into the site. **Action 6:** Please clarify the groundwater monitoring that has been/will be undertaken pre-development, including justification for how one monitoring event for the 'Baseline 2' round will provide appropriate baseline data for all parameters for this stage. Appendix B lists the trigger values as 'TBC' from the results of baseline water quality testing. Table 6 notes that management measures include *"collation of the existing ten years of water level and quality data to confirm the full baseline data set for future data assessment."* **Action 7:** Provide background quality and trigger level values for groundwater quality or a timeline for provision of these parameters.

Dear Sir/Madam,

Please find enclosed a Request for Further Information in regards to your application.

Please make note to amend/resolve any issues or comments outlined below.
This is necessary in order to assess and approve your Works.

If you have any questions please direct your enquiry to the Development Engineering Team via email at Development.Engineering@portstephens.nsw.gov.au or by phone on (02) 4988 0409, quoting the file number below.

Yours sincerely,

Nigel Plumb
Development Engineer

28 August 2023

File No: 25-2008-5-2
Parcel No: 13930

Adelaide Street (PO Box 42), Raymond Terrace NSW 2324
Phone 4988 0255
Email development.engineering@portstephens.nsw.gov.au

Further Information Request

File No: **25-2008-5-2**

Date: **28 August 2023**

Proposed Works: **REQUEST FOR REVIEW OF STAGE 3 PROPOSED STORMWATER MANAGEMENT**

Report Prepared By: **Nigel Plumb**

Although every effort has been made for completeness, these comments may not be all encompassing and there may be further requests on the design prior to approval.

DETERMINATION:

☒**Request Additional Information** ☐**Submission Considered Acceptable**

The Following items are required to be actioned prior to further assessment:

1. The following item was requested to be addressed in previous RFI:

   It is unclear where the Legal Discharge Points for stormwater are and whether downstream infrastructure is adequate to convey flows. Basin 1 and Basin 2 appear to be discharging water to the downstream property without any legal right. Additionally, there does not appear to be any existing downstream channel to convey the concentrated stormwater discharging from the development. As such, there is concern that discharging stormwater onto downstream property Lot 1001, DP 1127788 without any defined flowpath would facilitate erosion, frequent flooding of the property, and potentially reducing usable land. As such, it is recommended that a drainage system within downstream property be designed and constructed to discharge the water.

   It is still unclear what impact the discharging of concentrated water will have on downstream. It is recommended further details be provided on this now instead of at construction stage. The concerns are:

   - Displacing the existing flood storage onto the adjacent property

   - Detention basin will only slow down post development flows to predevelopment flows but not reduce the significant increase in the volume of water due to paving almost 90% proposed development area. The increase in volume of water would spread onto downstream properties if the downstream channel is not sufficient to carry post development flows.

Adelaide Street (PO Box 42), Raymond Terrace NSW 2324
Phone 4988 0255
Email development.engineering@portstephens.nsw.gov.au

- Water levels in the detention basins are higher than the water levels in the property. Hydraulically, development flows from the basin will flow though the downstream drainage faster and will not allow the property water to drain through the existing channel.

- Council's mapping when compared to the applicant map show the downstream channels in a different location (see map below). Clarification is necessary and location of the downstream channels and basin's discharge points are to be drawn in a plan to show the basin discharges can be directed to the existing watercourses. Some of the channels are not watercourses and therefore, legal drainage easement are to be created over the channels from basin's discharge point to the watercourse.

25-2008-5-2

2. The following item was requested to be addressed in previous RFI:

   The plan below indicates that there will be channels constructed at the discharge points of basin 1 and basin 2 but, there is no details provided in the report.

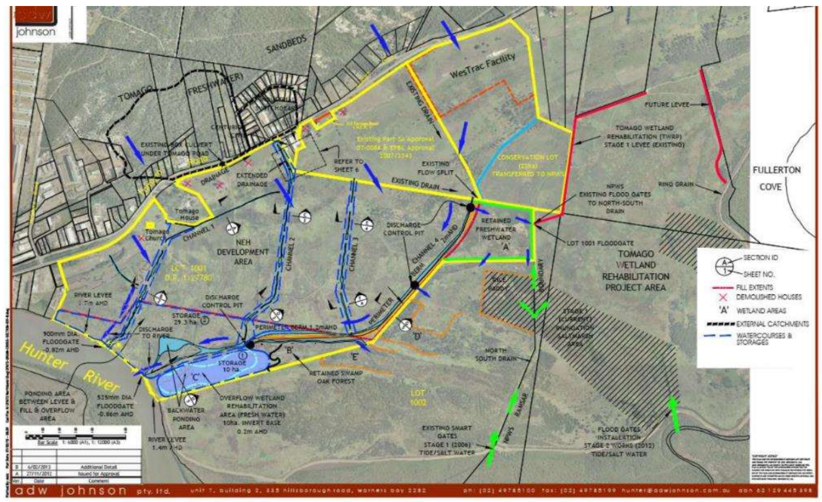


Figure 6.4 - Approved drainage strategy for proposed development at Lot 1001 (Project Approval MP10_0185)

   No details have been provided to address this. It is recommended that details be provided to certifier prior to construction approvals being issued.

3. MUSIC modelling was provided and reviewed. The retention time for wetlands does not appear to satisfy the correct value however, this could be addressed at detailed design stage.

4. The previous RFI requested details to be addressed around filling. It is noted that given NSW DPI issued approval for filling, and comments around this should be discussed with DPI.

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Phone 4988 0255
Email development.engineering@portstephens.nsw.gov.au

Hunter Water Corporation
ABN 46 228 513 446

PO Box 5171
HRMC NSW 2310
36 Honeysuckle Drive
NEWCASTLE NSW 2300
1300 657 657
enquiries@hunterwater.com.au
hunterwater.com.au

10 August 2023

Hunter Water Ref: 2006-126/14/1.003

Northbank Enterprise Hub Pty Ltd
32 Kings Park Road
WEST PERTH WA 6005

Attention: Bryant Stokes
Via: Email

Dear Bryant

RE: HUNTER WATER REVIEW OF THE STORMWATER MANAGEMENT PLAN FOR STAGE 3 OF NORTHBANK ENTERPRISE HUB, 142 - 162 TOMAGO RD, TOMAGO (MP07_0086-MOD-3)

Thank you for providing Hunter Water with the opportunity to review the stormwater management plan for Stage 3 of the proposed industrial subdivision at Lot 210 DP1174939 on Tomago Road, Tomago.

In accordance with Schedule 3 - Condition 8 of NSW Major Projects consent MP07_0086-Mod-3, Northbank Enterprise Pty Ltd is required to prepare and implement a Soil and Water Management Plan for the satisfaction of the Planning Secretary. The plan must:

(a) be submitted to the Planning Secretary for approval at least one month prior to the commencement of construction of Stage 1;

(b) be updated and submitted to the Planning Secretary at least one month prior to the commencement of construction of Stages 2 and 3.

(c) Be prepared in consultation with Council, Hunter Water Corporation and Office of Environment and Heritage.

(d) Include:

- a Site Water Balance;
- a Sediment and Erosion Control Plan;
- an Acid Sulfate Soils Management Plan;
- a Stormwater Management Scheme;
- a Groundwater Monitoring Program for Tomago sand beds; and
- a Wastewater Management Plan.

Hunter Water understands that the report *Industrial Subdivision at Lot 210 DP1174939 (Stage 3), Tomago: Stormwater Management Plan – Northbank Enterprise Hub (WRM Water & Environmental, 1918-02-B2 9 May 2023)* has been submitted for our review in respect to Condition 8(b), Condition 8(c) and point 4 of Condition 8(d) outlined above. Hunter Water has reviewed this report and has no comment nor objection to the report being lodged with Planning Secretary.

However, a stormwater water management plan is just one component of the Soil and Water Management Plan described in Schedule 3 - Condition 8(d). Hunter Water notes the requirement for a Site Water Balance, with Schedule 3 - Condition 9 outlining that the Site Water Balance must:

(a) include details of:
   - sources and security of water supply;
   - water use/re-use on site;
   - water management on site;
   - reporting procedures;

(b) describe measures to minimise potable water use by the development and maximise reuse of rainwater harvested from the site; and

(c) be reviewed and recalculated each year in light of the most recent water monitoring data;

(d) compare measured surface water discharges and groundwater inflows, outflows and infiltration, relative to pre-development conditions.

Hunter Water is particularly interested in the Site Water Balance component of the Soil and Water Management Plan, as Stage 3 of the proposed development lies on an interface between the Tomago Sandbeds and an adjacent estuarine mud and clay system. Hunter Water has identified the potential for the development to impact groundwater flow out of the Tomago Sandbeds and into surface drainage systems on the estuarine mud and clay system. Depending on the engineering controls designed for Stage 3, there are potential impacts that Hunter Water would be concerned about. Specifically, the design must ensure that the following impacts do not occur:

1. Increase in groundwater discharge from the Tomago Sandbeds to above pre-development levels.
2. Restriction of groundwater discharge from the Tomago Sandbeds to below pre-development levels.

Neither impact would be acceptable to Hunter Water. The first would negatively impact the quantity of water that is stored in the Tomago Sandbeds. The second would lead to increased concentration and surface expression of groundwater upstream and adjacent to the development with associated impacts on ecology (within the Tomago Special Area) and nuisance for neighbouring properties.

Hunter Water notes that the EPBC approval (EPBC 2007/3343) for this project requires *"replication of natural surface and groundwater flows and water quality",* which is consistent with our requirements.

In accordance with Schedule 3 - Condition 8 of NSW Major Projects consent MP07_0086-Mod-3, Hunter Water requires the opportunity to review the updated Site Water Balance for the development, and in particular the engineering controls proposed for Stage 3 to address the interface between the Tomago Sandbeds and the adjacent estuarine mud and clay system.

If you require further advice or clarification regarding this letter, please contact the undersigned on 02 4081 5835 or at greg.mcharg@hunterwater.com.au.

Yours sincerely

Greg McHarg
Account Manager Major Development

From: Nigel Plumb <Nigel.Plumb@portstephens.nsw.gov.au>
Sent: Monday, June 26, 2023 11:16 AM
To: Scott Day <scottd@torqueprojects.com>
Cc: Development Engineering <Development.Engineering@portstephens.nsw.gov.au>
Subject: RE: Westrac Development - Stormwater Management Plan Consultation - 25-2008-5-2

Hi Scott,

As requested, Council has reviewed the stormwater management plan for Industrial Subdivision at lot 210 DP1174939 (stage 3), Tomago dated 9/5/23 by WRM water & environment, in accordance with the following Department of Planning, Industry and Environment condition provided below:

> *NEH has engaged WRM to complete the Stormwater Management Plan for Stage 3 of the Project Approval. Schedule 3, Condition 12 states:*
> *12. The Stormwater Management Scheme must:*
> *(a) be prepared in consultation with Council and OEH.*

Upon review of the stormwater management plan, council has the following comments:

1. The runoff from the existing site generally runs southward as sheet flow across the boundary. There are a number of open channels within and adjacent to the development site. Graham road is draining across Tomago road via a 600mm dia pipe and draining to a swale adjacent to Wes Trac Drive. It is noted that the Stormwater management Report – 3.4.2 indicates that there is less surface water contribution from the north catchment to Graham Road and north of Tomago Rd, however it was noted that during a storm in 2022, Tomago Road was flooded by upstream catchment and had to be closed. Northern catchment contributes runoff to Graham Road depression area and pond just north of Tomago Rd. As the capacity of the pipe drainage (600mm dia) is not sufficient enough, water pond north of Tomago road and flood Tomago road. This culvert may need to upgrade in the future and therefore it is recommended that the swale adjacent to the Wes Trac Drive be upgraded now to cater for this.
2. Freeboard for the basins are shown as; basin 1 - 240mm and basin 2 - 410mm. A minimum 500mm freeboard is required for all basins.
3. It is unclear where the Legal Discharge Points for stormwater are and whether downstream infrastructure is adequate to convey flows. Basin1 and Basin 2 appear to be discharging water to the downstream property without any legal right. Additionally, there doesn’t appear to be any existing downstream channel to convey the concentrated stormwater discharging from the development. As such there is concern that discharging stormwater onto downstream property Lot 1001, DP 1127788 without any defined flowpath would facilitate erosion, frequent flooding of the property, and potentially reducing usable land. As such it is recommended that a drainage system within downstream property be designed and constructed to discharge the water in a controlled manner with legal rights to do so put in place.

4. While it is noted the overall Stormwater management strategy report is good, the report does not address the impact of the development on downstream properties including:
   - dramatically increased volume of water,
   - displacement of water as a result of filling the land,
   - frequencies of flooding,
   - legal discharge point,
   - requirement for a downstream channel etc.
5. The plan below indicates that there will be channels constructed at the discharge points of basin 1 and basin 2 but, there is no details provided in the report.

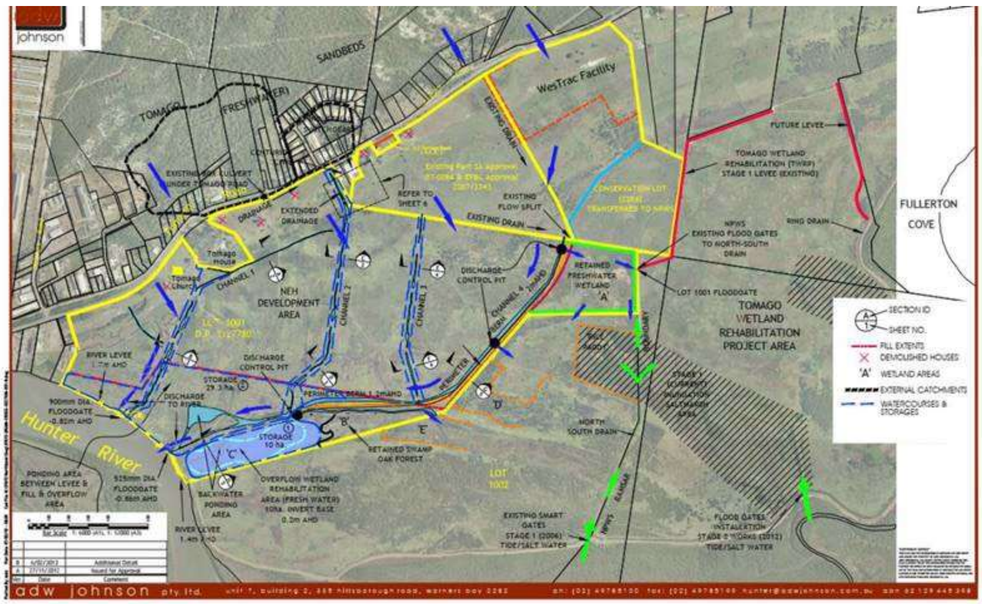


Figure 6.4 - Approved drainage strategy for proposed development at Lot 1001 (Project Approval MP10_0185)

6. The report indicates Music modelling has been carried out and water quality targets achieved. However, Music model and MUSIC link report were not provided for review.
7. It should be noted that the Development is located within High Hazard flood way. It is expected that filling this area would impact upstream and downstream properties, with the potential to impact the region (Newcastle Council area). As such it is recommended that a flood impact Assessment be undertaken to assess the impact of this development as well as cumulative impact of all development in this area.

Should you require clarity on the above, please don't hesitate to get in touch.

Kind Regards,

Nigel Plumb
Development Engineer

PORT STEPHENS COUNCIL

p 02 4988 0311
w portstephens.nsw.gov.au

DOC23/533025

Scott Day- Principal Engineer
Torque Projects Pty Limited
E: scottd@torqueprojects.com

NPWS comments on Tomago Stormwater Management Plan for Industrial Subdivision at Lot 210 DP1174939 (Stage 3 MP07_0086)

I refer to your email seeking comments from National Parks and Wildlife Service (NPWS) regarding WRM's Stormwater Management Plan (SWMP) for the Industrial subdivision proposal at Lot 210 DP1174939 Tomago.

Following review of the SWMP, NPWS holds major concerns regarding likely impacts to both the adjoining Hunter Wetlands National Park and neighbouring private properties. NPWS is particularly concerned regarding anticipated impacts to the Tomago Wetlands Rehabilitation Project that adjoins the proposal.

As part of the Tomago Wetlands Rehabilitation Project, NPWS manages floodgate infrastructure, an earth bund and constructed drains to re-establish a saltmarsh mosaic wetland environment to support threatened migratory shorebird habitat, improve fish passage, improve the health of the Lower Hunter wetland system and manage local hydrology to avoid negative impacts to neighbouring properties. All of these assets are likely to be adversely impacted by the proposal.

NPWS is particularly concerned the development will result in significant increased runoff into the nearby 'North-South' drain. This drain is relied on by NPWS and park neighbours to drain water to the Hunter River. Recent technical reports, commissioned by NPWS, indicate the upstream catchment in the area is much larger than originally estimated, resulting in larger volumes reporting to the drain than previously modelled.

NPWS understands, from a comparison of Table 8-1 and Table 8-2 in section 8.4.5 of the SWMP, that the development will result in an estimated increase in discharge from 319ML per year to 500ML per year. However, the plan provides no detailed analysis on where water will go offsite within the National Park and how it will be managed.

It is requested the SWMP adequately responds to and demonstrates how the development will mitigate the following points of concern –

- Greater pressure on the already marginal North-South drain system that is relied on by NPWS and park neighbours to support adequate drainage
- National Park areas adjoining the development becoming less accessible due to increased water volumes caused by runoff. Reduced access will impede NPWS's ability to maintain critical infrastructure, including An earthen bund, drains and floodgates, associated with the Tomago Wetlands Rehabilitation Project.
- Increased impervious area will result in runoff from small rainfall events which would not previously have flowed into the adjacent wetland. Increased frequency and volume of flow may affect wetland hydrology which relies on natural cycles of wet and dry periods to allow for regeneration of critical vegetation. Onsite detention systems can manage increased flow rates to some extent but will not mitigate increased frequency or volume of runoff.

Further to the above, NPWS makes the following detailed comments on the Plan.

- The shallow, low gradient drainage structures within the Tomago area were developed as part of the Hunter Valley Flood Mitigation Scheme to direct surface water from agricultural land use towards floodgate-controlled outlets. These outlets were installed as part of the flood control levee which provides some protection to agricultural land from Hunter River flooding. The drains and flood gates, including the North-South drain, were not intended to serve the volumes of drainage elicited from an industrial development. NPWS believes much of the water generated by Stage 3 of the industrial development will not be able to be drained to the Hunter River via the existing structures and will pond onsite or on lands adjacent to Lot 210, including the National Park. Flood gates (3170) do not have the capacity to drain large volumes of water as described in the SWMP.
- **Table 2.1 (p 9**) The conditions of consent in the EPBC approval 2007/3343 requires the proponent to demonstrate that the existing storm water channels have capacity to accommodate flows under a range of tidal conditions. There does not appear to be any analysis in the Plan to show that this has occurred.
- **Section 3.43 (p19)** of the SWMP estimates that 140 ML/year of water travels from Tomago sand beds through the development site and expresses as surface flow in the low-lying area. NPWS is concerned that increased fill on the site will cause groundwater mounding on adjacent private land. NPWS receives ongoing complaints from private landholders adjacent to the existing Westrac development regarding ponding of water on their agricultural land. This did not occur as frequently prior to the Westrac Development stage 1. Any increase in volume of discharge and/or decrease in available land to accommodate this discharge puts increased pressure on existing drainage structures.
- Following repeated complaints by adjoining landholders, NPWS commissioned a consultant to carry out a review of flows reporting to the North-South Drain and a condition assessment of the existing earth bund. Section 3.4.2 of the SWMP claims that limited offsite surface flow needs to be catered for in Westrac development (page 19). Reviews by NPWS consultants indicates the catchment upstream is much larger than originally estimated and NPWS is concerned the existing fill platform for Westrac has not allowed for collection and transfer of flows from Tomago Road. Any expansion of fill platform will increase the catchment which needs to drain through the development site. If this is not adequately diverted away from the adjacent private properties, or if it reports to the North-South drain, NPWS is likely to receive increased complaints from landholders.
- The SWMP also indicated the existing pipe under Tomago Road will support sufficient drainage. NPWS's consultant report and field experience indicates Tomago Road was overtopped on at least one occasion in 2022 with significant flow diverted onto private properties. Surface water was observed overtopping NPWS's earth bund wall on the Tomago Wetlands Rehabilitation Project at that time, from the fresh side (Northern side of bund) to the salt side (Southern side of bund). Erosion of the bund wall has occurred due to extended wet weather and potentially due to overtopping events. NPWS is currently carrying out repair works on eroded sections of the bund. The bund wall is very narrow and cannot be accessed by large machinery. No access is possible to the bund wall, flood gates or North-South drain in extended wet periods. NPWS is concerned that added flows to this area will put increased pressure on the existing bund wall and associated drainage structures and is likely to lead to the area remaining wet for long periods. This will make critical maintenance activities more difficult and result in increased complaints from neighbouring landholders.
- **Figure 4.1 (p 26)** shows proposed drainage for Stage 3 however it does not account for diversion of flows from the existing Stage 1. It is understood that, in response to neighbour complaints, the drainage from Stage 1 was diverted to sheet flow across areas proposed to be filled in Lot 211. This was not successful in mitigating the additional flow volumes because the existing topography of Lot 1001 still sends the sheet flow towards the wetland on the National Park (page 47) and the North-South Drain. The drain cannot cope with the flows already reporting to this drain and will not be able to accept further flows once Lot 211 is filled. **Review of the drainage design is recommended** so that all surface flows are drained away from NPWS managed lands and assets as per consent conditions. In addition, the location of

proposed treatment wetlands beside NPWS land is likely to increase ground water flows onto NPWS managed land unless these structures are lined and drained away from NPWS assets.

- **Tables 8.1, 8.2 (page 47)** Calculations have been provided to show compliance with onsite detention discharge rates. Managing flow **rate** however does not manage the **volumes** of water which are released by the development. Water balance calculations provided have indicated that, with optimistic assumptions for stormwater reuse onsite, the runoff volume is expected to increase from 319ML/year to 514 ML/year. No justification has been given for the reuse values of 15.5ML/year assumed in calculations and it is noted that the end use of the development is unknown at this stage. Rainwater tanks are only effective as a water quality and quantity management tool if sufficient headroom is available at the commencement of rainfall. It is considered likely that there will not be sufficient reuse onsite to allow rainwater tanks to provide the level of treatment and management indicated in the SWMP. The provided MUSIC model relies on removal of significant portions of the runoff by reuse to achieve the treatment values claimed. It is also mentioned that one reuse of water will be in an onsite wash bay and that this water will be treated onsite and discharged to the onsite sewage system. If onsite wastewater treatment is proposed, reuse of water does **not** remove the water from the system and added nutrients may occur due to the wastewater disposal.
- **Section 7.1** Water quality (wetland) basins are combined with onsite detention basins. This is not in line with best practice where water quality is generally provided offline so that wetland vegetation is not subject to high flows, scour or remobilisation of nutrients. The provided music modelling may not represent wetlands subject to high flows.
- The provided modelling indicates that significant reductions in pollutant loads vs the non-treated option are achieved. This however still results in a net increase in pollutants discharged to the environment. In an area where the released stormwater may not be able to drain away from the site there is a risk that pollutant load will accumulate over time and result in algal blooms, weed growth in drainage lines and potentially groundwater contamination, given groundwater is present as surface water in the low-lying areas of the site. NPWS are concerned the stated stormwater quality may not be achieved by the design.
- The development discharges onto land which will experience increased flooding with sea level rise and/or climate change induced extreme rainfall events. There is no mention in the SWMP regarding how the proposed drainage and stormwater management systems will perform under climate change scenarios. Given that the development will be in place for an extended period, climate change should be considered. NPWS is already considering adaptation strategies for Tomago Wetlands in this respect.
- The provided design indicates there is monitoring of groundwater levels and pollution performance for the existing development. Will this information be provided to NPWS and who reviews the results to demonstrate ongoing compliance with the consent?

NPWS appreciates the opportunity to provide comment on the Stormwater Management Plan and requests these matters are addressed. A copy of this response will be sent to the Department of Planning to document NPWS's ongoing concerns with MP07_0086.

Should you any further questions regarding this response, please contact me on 0459 827 410 or at mitchell.carter@environment.nsw.gov.au .

Yours sincerely

Mitchell Carter
Manager, Lower Hunter Area
NSW National Parks and Wildlife Service

23 June 2023

Appendix B – RFI Letter Responses to Council,

NPWS and Hunter Water

Experience Communication Energy

20 December 2023

Our Ref.: TP-100

Your Ref: 25-2008-5-2

The General Manager
Port Stephens Council
PO Box 42
RAYMOND TERRACE NSW 2324

Attention: Mr Nigel Plumb

Dear Nigel,

RE: MP07_0086 – Tomago Estate
Response to RFI Regarding Stage 3 SWMP

Thank you for the correspondence dated 28 August 2023 regarding the Stormwater Management Plan for Stage 3 at Tomago Estate, Major Project Approval MP07_0086. You will recall we also had a follow up meeting at which time we passed through the matters raised in Council's letter.

Our delay in responding is due to extended consultation with other stakeholders and government agencies being undertaken. We are now in a position to respond to your items conclusively.

Council's RFI items have been converted to text format in the letter with individual responses provided in red below.

1. The following item was requested to be addressed in previous RFI:

   It is unclear where the Legal Discharge Points for stormwater are and whether downstream infrastructure is adequate to convey flows. Basin 1 and Basin 2 appear to be discharging water to the downstream property without any legal right.

   Additionally, there does not appear to be any existing downstream channel to convey the concentrated stormwater discharging from the development. As such, there is concern that discharging stormwater onto downstream property Lot 1001, DP 1127788 without any defined *flowpath would facilitate erosion, frequent flooding of the property, and potentially reducing usable land. As such, it is recommended that a drainage system within downstream property be designed and constructed to discharge the water.*

There is an existing drainage easement within Lot 1001 south of Basin 2 to the Hunter River and in addition, Northbank Enterprise Hub Pty Limited as the owner of Lot 1001 has provided a letter of commitment for receiving stormwater for the Basin 1 discharge point (attached). The location of the discharge point is preferred, having been agreed to by National Parks & Wildlife Service (managers of neighbouring conservation land, dedicated by NEH) and aligns with the future stormwater plan under the MP10_0185 project. Based on these basins being constructed in a similar manner to the Stage 1 basin, which has had no erosion issues for over 10 years through a range of major storm events, we are informed to document these future basins with controls at the detailed design stage of the project.

It is still unclear what impact the discharging of concentrated water will have on downstream. It is recommended further details be provided on this now instead of at construction stage. The concerns are:

- Displacing the existing flood storage onto the adjacent property

Lot 1001 is approved for industrial subdivision under MP10_0185. NPWS is supportive of drain clearing to the Hunter River and accordingly, flood storage is not being displaced by the Stage 3 project.

- Detention basin will only slow down post development flows to predevelopment flows but not reduce the significant increase in the volume of water due to paving almost 90% proposed development area. The increase in volume of water would spread onto downstream properties if the downstream channel is not sufficient to carry post development flows.

Monitoring of water levels indicates that there is currently rainfall falling on the ponded water on the property due to changes downstream in which case, the difference in water volumes is not currently as significant as being described by Council. 90% is a conservative assumption of the development imperviousness, as a precautionary overestimate of the final development impervious area. There is significant storage within the proposed drainage system on Lot 210 and combined with recent NPWS support for drain clearing toward the river along the existing drainage easement within Lot 1001, any increases are being managed within NEH owned land approved for development.

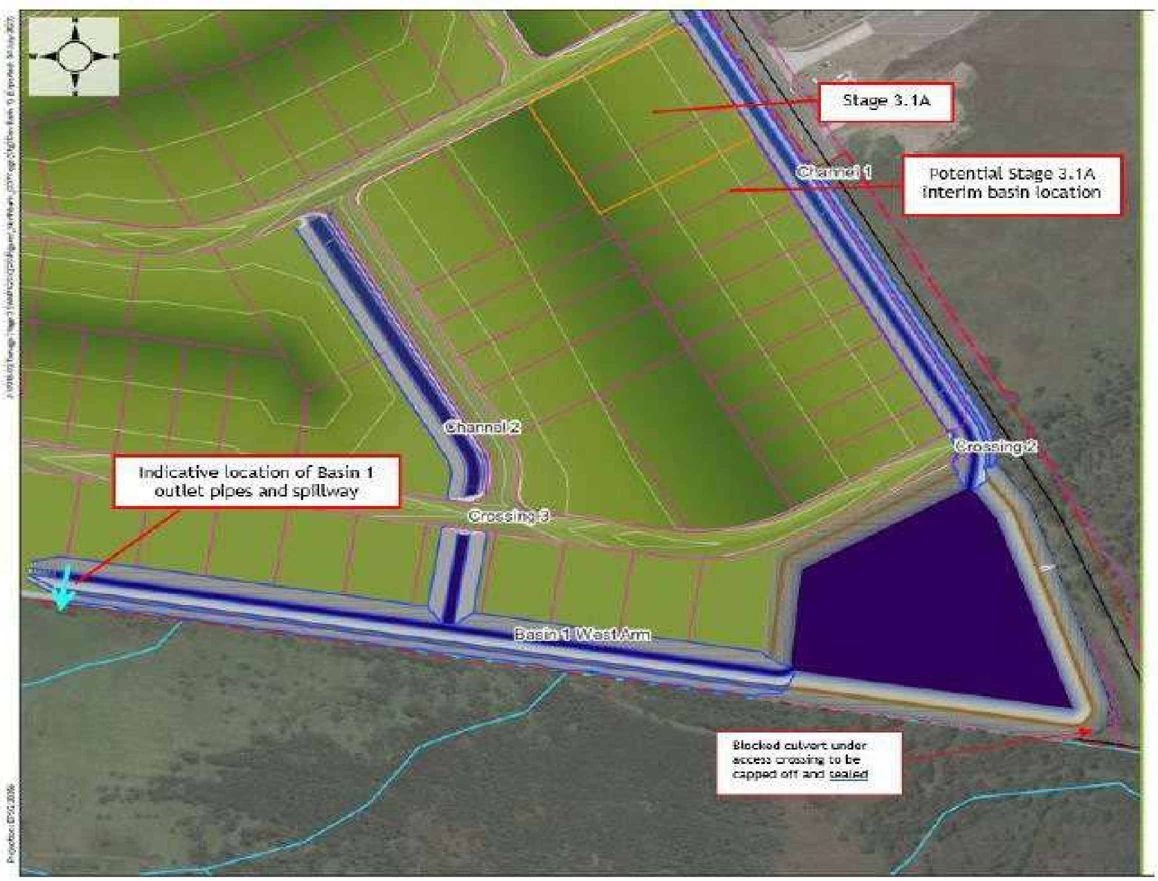
- Water levels in the detention basins are higher than the water levels in the property. Hydraulically, development flows from the basin will flow though the downstream drainage faster and will not allow the property water to drain through the existing channel.

The lower elevations mentioned on the property, presumably referring to Lot 1001, occur within the Lot 1001 property. This is an overflow area, as the channel along the southern boundary represents significant storage within Stage 3 on Lot 210. We note elevations of Lot 210 increase in elevation prior to adjoining property and therefore this is not regarded as a concern.

- Council's mapping when compared to the applicant map show the downstream channels in a different location (see map below). Clarification is necessary and location of the downstream channels and basin's discharge points are to be drawn in a plan to show the basin discharges can be directed to the existing watercourses. Some of the channels are not watercourses and therefore, legal drainage easement are to be created over the channels from basin's discharge point to the watercourse.

The location has been selected to be consistent with the approved industrial development, Major Project Approval MP10_0185 and represents a positive location for NPWS. NEH has provided a letter of commitment toward creation of the drainage easements in due course - attached.


DP 1174939
DP 1174939
22


Stage 3.1A
Channel 1
Potential Stage 3.1A
interim basin location
Channel 2
Crossing 2
Indicative location of Basin 1
outlet pipes and spillway
Crossing 3
Basin 1 West Arm
Blocked culvert under
access crossing to be
capped off and sealed

2. The following item was requested to be addressed in previous RFI:

   The plan below indicates that there will be channels constructed at the discharge points of basin 1 and basin 2 but, there is no details provided in the report.

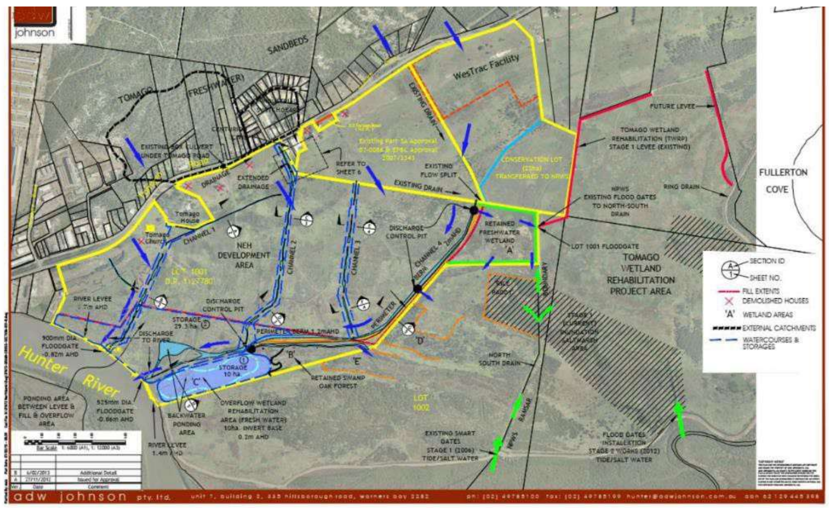


Figure 6.4 - Approved drainage strategy for proposed development at Lot 1001 (Project Approval MP10_0185)

No details have been provided to address this. It is recommended that details be provided to certifier prior to construction approvals being issued.

The above plan was approved in the Major Project Approval MP10_185 when construction of industrial development occurs over Lot 1001. The plan was developed in consultation with NPWS to agree on the interface with conservation land and not to impound stormwater on Lot 210. The plan provided represents future works, not necessary until Lot 1001 is developed. This downstream drainage was not required in the assessment for the issuing of the Major Project Approval MP07_0086 approval, nonetheless the Stage 3 Management Plan has captured the discharge locations for consistency with these future connections and to assist NPWS.

3. MUSIC modelling was provided and reviewed. The retention time for wetlands does not appear to satisfy the correct value however, this could be addressed at detailed design stage.

This has been noted, thank you.

4. The previous RFI requested details to be addressed around filling. It is noted that given NSW DPI issued approval for filling, and comments around this should be discussed with DPI.

Noted thank you, as mentioned previously, the fill approved under MP07_0086 is significantly less fill than the further fill approval for MP10_0185. Lot 210 is ~50 hectares, much less by comparison to the 150 ha of development, including fill that has been assessed and approved under MP10_0185 which included cumulative assessment for the filling of Lot 210.

We thank you for this consultation and trust the above additional information is satisfactory.

If you have any questions, please contact me on 0414 689 091 or by email, scottd@torqueprojects.com

Yours Sincerely,

Scott Day
Principal Engineer
Torque Projects Pty Limited
Encl. NEH letter

NORTHBANK ENTERPRISE HUB PTY LTD

ABN 77 063 271 625

21st November 2023

To whom it may concern,

Northbank Enterprise Hub Pty Limited (NEH) as the owner of Lot 1001 DP1127780 accepts the stormwater discharge from the parent lot, Lot 210 DP1174939. NEH understands Lot 210 will be subdivided for industrial development purposes. NEH accepts stormwater discharge onto Lot 1001 from all industrial development including all public roads created within Lot 210.

The necessary easements will be created on the completed design prior to occupation certificate of any new buildings and prior to registration of the public roads.

Please contact Bryant Stokes on 0417187247 should you require further information with regards to this.

Kind Regards

Bryant Stokes

Level 3, 30 Kings Park Road, WEST PERTH WA 6005
PO Box 1398, WEST PERTH WA 6872
Telephone: +61 8 9215 8888 | Facsimile: +61 8 9215 8889

Experience Communication Energy

20 December 2023

Our Ref.: TP-100

Your Ref: DOC23/839682-1

National Parks & Wildlife Service
1 Wetland Place
SHORTLAND NSW 2307

Attention: Mr Mitch Carter

Sent by Email: mitchell.carter@environment.nsw.gov.au

Dear Mitch

RE: MP07_0086 – Tomago Estate

Response to RFI Regarding Stage 3 SWMP

Thank you for the correspondence dated 20 September 2023 regarding the Stormwater Management Plan for Stage 3 at Tomago Estate, Major Project Approval MP07_0086 and our 2 follow up meetings with you and your team.

Our delay in responding is due to our extended consultation with other stakeholders and government agencies being undertaken. We are now able to respond to your items conclusively.

We have completed the Trigger Action Response Plan (TARP) after extensive review of historical records, investigations and observations on stormwater and groundwater with our consultants WRM and Douglas Partners. We have increased our management and monitoring with NPWS to be working with NPWS on monitoring the interface of Lot 210 with conservation lands. It needs to be recognised that the NPWS Project downstream of the Northbank Enterprise Hub (NEH) lands is having a greater influence on freshwater levels at the downstream edges of the site. NEH reserves rights in this matter. We have demonstrated willingness to cooperate with NPWS and the NPWS Project for the federal commitments and objective of minimal or reduced freshwater to be managed through the NPWS Project area. Accordingly, we are continuing to work with NPWS in a direction of minimising surface water discharge for appropriate management of stormwater from Stage 3/Lot 210.

During our consultation with you, NPWS' support for drain clearing on the NEH properties has been received and you are aware NEH has taken the initiative to commence these works now in a

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manner to benefit NPWS. There is extensive historical records of existing drainage from the previous landuses on Lot 210 directing stormwater east into the NPWS lands of Lot 22 (dedicated by NEH) and the NPWS Project area, however NEH has considered the NPWS Project objectives for selective drain clearing on site to benefit NPWS. We summarise our responses to the points made in the letter dated 20 September 2023 in Table 1 below.

Table 1 – Responses to NPWS RFI matters

NPWS Issue	Response Comments
NPWS assurance on additional inflows not heading toward National Parks and Drains	The Stage 3 stormwater management system, including the swale along the southern boundary within Lot 210 has significant capacity, however, NEH and its consultants are considering the overflow areas on Lot 1001. Property management works of clearing an existing drain on Lot 1001 are proposed to be undertaken in the near future, for which we understand NPWS is supportive. The existing drain in the western most corner of Lot 210 is covered by an existing drainage easement on Lot 210 and Lot 1001 and is connected to the Hunter River. Following drain clearing, there will be improved conveyance of any overflows to the Hunter River in addition to the additional storage area for ponding on Lot 1001. This provides further buffer and certainty for NPWS in terms of drainage.
Background water quality compilation	Agreed – this has been comprehensively completed and updated in our Stage 3 SWMP.
Surface Water Discharge points – how this will be achieved	There is some evidence from historical photos that portions of Lot 210 surface water drainage went directly toward the Hunter River across Lot 1001. Clearing of existing drains on Lot 1001, within the existing drainage easement provides the improved conveyance and certainty of direction, which further minimises ponding potential on Lot 1001 and improves buffer protection for NPWS lands to the east.
Lot 211 (Dexus) Discharge point for Stage 2	There are existing monitoring obligations in the Project Approval MP07_0086 for freshwater wetland vegetation areas being maintained on Lot 22. In addition, this discharge from Lot 211 onto Lot 1001 in the south east corner of Lot 210 is adjacent to an on site offset freshwater wetland area of Project Approval MP10_0185. The flow direction from these 2 properties is consistent with existing discharge directions prior to the Project Approval MP07_0086. A reduction of freshwater discharge toward 2 recognised freshwater wetlands which are to be conserved presents a risk of both potential impacts and non-compliance on MP07_0086 during drier times. Accordingly we disagree with this request, being contrary to conservation outcomes for 2 existing Project Approvals.

Clearing of existing drains on Lot 1001 toward Hunter River is supported by NPWS	Thank you for NPWS support, this is being actioned as a property management matter - as per flow directions described above
NPWS wanting Stage 1/WesTrac discharge also part of the Stage 3 SWMP	As per Lot 211/Stage 2 response above. Stage 1 discharges onto Stage 2.
NPWS wanting extended consultation of the SWMP with further OEH agencies	NSW DPE has clarified and advised the Stage 3 SWMP consultation is to include Biodiversity, Conservation and Science and DPE Water, which was commenced in November 2023.
TARP	The TARP has been included in the updated Stage 3 SWMP - attached.
Existing Drain Clearing	Thank you, this is being actioned as a property management matter - as per flow directions described above. Selective drain clearing also proposed in a manner to assist NPWS.
Water level data for North South Drain to be provided by NPWS	Thank you, NPWS has provided this data which will be reviewed.
Downstream system issues	We acknowledge the conservation objectives of the NPWS Project demonstrated by proactively designing and managing the Lot 210 stormwater scheme to assist and benefit NPWS. However we strongly disagree with any contention of downstream issues being a result of the Project Approval on the basis of several documents of evidence suggesting otherwise. For example, regional groundwater documentation suggests ~500ha of Tomago Sandbeds discharges south into NPWS Project Area before the NPWS Project existed. The Review of Environmental Factors (REF) for the NPWS Project states the existing environment of the NPWS Project Area as having storage of 200ha of 0-0.2mAHD freshwater wetland area. That is, this existing (NPWS Project) area downstream of the Tomago Rd properties, was previously storing the freshwater runoff from the Sandbeds at suitable elevations, prior to their discharge to the river at low tide. However with the NPWS Project in place this freshwater storage area is unable to be accessed and is inundated by tidal water. The freshwater from the 500ha catchment of Tomago Sandbeds continues to flow south, however is impounded on the Tomago Rd properties of Lot 22, NEH land and neighbours land upstream of the NPWS project.

We thank you for this consultation and trust the above additional information is satisfactory.

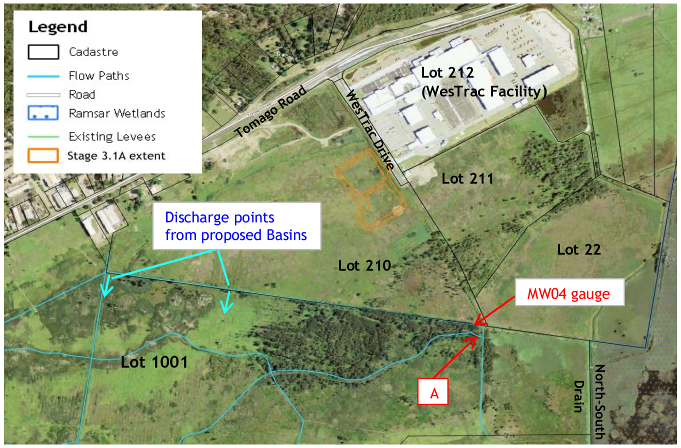
If you have any questions, please contact me on 0414 689 091 or scottd@torqueprojects.com

Yours Sincerely,

Scott Day
Torque Projects Pty Limited
Encl. **TARP**

Worksheet title: Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Locality and drainage map



Estate Layout Plan

Photo of Location "A"

Purpose of this TARP (TARP #1)

TARP #1 describes the adopted triggers, proposed actions and responses to identify and mitigate the potential impacts of the Project due to changes in groundwater quality and quanity downstream of the Project (i.e. the potential impact to the environmental receptors).

Commitments and monitoring

1) The following will be undertaken prior to the commencement of Stage 3 works:
- Existing drains will be cleared as per the drain clearing plan (refer to Figure 1 on Page 4).
- Assessment of water level data at MW04 and the downstream data provided by NPWS to establish baseline water level trends.
- Monitoring of observation areas to establish baseline site conditions (refer to Figure 2 on Page 5 for potential observation areas).
- Installation of live water level monitoring device at MW04 (telemetry).

2) The following will be undertaken during the first 3 months from the commencement of Stage 3 works:
- Continued monitoring and assessment of water level data at MW04 to establish baseline water level trends.
- Continued site observations on the ground and/or by drone.
- Continued observations of the cleared drains for integrity and function.

3) The following will be assessed and reported to NPWS every 6 months from the commencement of Stage 3 works:
- Observation area monitoring results.
- Water level monitoring results at MW04.
- Observations on the integrity and function of the cleared drains.

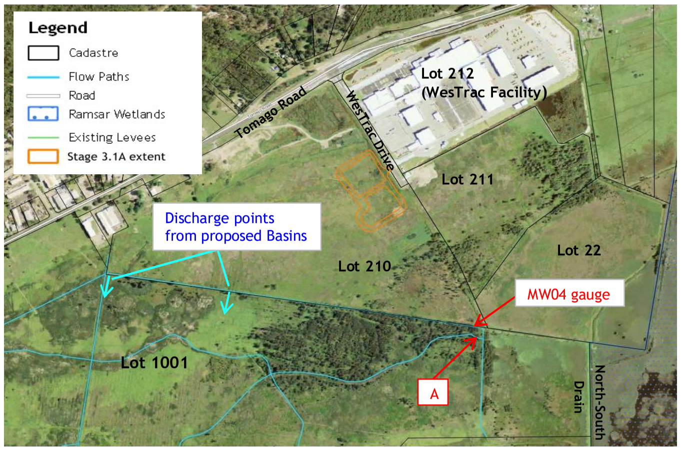
TARP

Level	Trigger (see note [a])	Action	Response
Level 1 (Normal)	• Trend in peak water levels at MW04 is not adversely increased compared to the baseline.	• Continue to monitor water level at MW04 and NPWS Floodgate.	• No further response required.
Level 2 (Mitigation measures required)	• Trend in peak water levels at MW04 is adversely increased compared to the baseline.	• Inspect the integrity of the cleared drains and undertake remediation if required. • Check NPWS drains. • Check the recorded data at MW04 and confirm the increase in peak water level trend. • Continue to monitor water level at MW04 and NPWS Floodgate.	• Response 1 - Undertake capping of the existing culvert at the southeastern corner of Lot 210 (refer to Figure 2 on Page 5).
Level 3 (Additional mitigation measures required)	• Trend in peak water levels at MW04 is adversely increased compared to the baseline. • Level 3 trigger applies if: ○ Culvert at the southeastern corner of Lot 210 has been capped in response to Level 2 trigger.	• Inspect the integrity of the cleared drains and undertake remediation if required. • Check NPWS drains. • Check the recorded data at MW04 and confirm the increase in peak water level trend. • Continue to monitor water level at MW04 and NPWS Floodgate.	• Response 2 - Grade fill layer for runoff control across Lot 210 towards the south and southwestern boundaries of Lot 210 to direct runoff to Lot 1001 DP1127780, including berms to control runoff from any interim basins within Lot 210 (refer to Figure 3 on Page 6).
Level 4 (Additional mitigation measures required)	• Trend in peak water levels at MW04 is adversely increased compared to the baseline. • Level 4 trigger applies if: ○ Culvert at the southeastern corner of Lot 210 has been capped in response to Level 2 trigger; and ○ Graded fill layer across Lot 210 is in place in response to Level 3 trigger.	• Inspect the integrity of the cleared drains and undertake remediation if required. • Check NPWS drains. • Check the recorded data at MW04 and confirm the increase in peak water level trend. • Continue to monitor water level at MW04 and NPWS Floodgate.	• Response 3 - Undertake additional drain clearing along the existing drainage easement further south within Lot 1001 to reinstate the drains from Lot 210 to the more deeply incised drains within Lot 1001 (refer to Figure 4 on Page 7).
Level 5 (Additional mitigation measures required)	• Trend in peak water levels at MW04 is adversely increased compared to the baseline. • Level 5 trigger applies if: ○ Culvert at the southeastern corner of Lot 210 has been capped in response to Level 2 trigger; ○ Graded fill layer across Lot 210 is in place in response to Level 3 trigger; and ○ Additional drain clearing on Lot 1001 has been undertaken in response to Level 4 trigger.	• Inspect the integrity of the cleared drains and undertake remediation if required. • Check NPWS drains. • Check the recorded data at MW04 and confirm the increase in peak water level trend. • Continue to monitor water level at MW04 and NPWS Floodgate. • Review the observation area monitoring results and assess any correlations with the recorded water level data at MW04.	• Initiate an investigation on the reasons for increased water levels at MW04 and develop additional mitigation measures for further catchment diversions to the Hunter River.

[a] - The criteria for what would be considered an "adverse increase" in peak water level trends will be confirmed based on analysis of recorded water level data to date. This criteria will be reviewed on a quarterly basis and updated if required as additional monitoring data becomes available.

Worksheet title: Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Locality and drainage map



Estate Layout Plan

Photo of Location "A"

Purpose of this TARP (TARP #2)

TARP #2 describes the adopted triggers, proposed actions and responses to identify and mitigate the potential impacts of the Project on the drinking water supply (Hunter Water Corporation) due to changes in groundwater quantity in the Tomago Sandbeds.

Commitments and monitoring

1) The following will be undertaken prior to the commencement of Stage 3 works:
- Installation of live water level monitoring device at MW101 and SK3520 (refer to Figure 5 on Page 8 for monitoring locations).
- Assessment of baseline conditions at MW101 screened in the Tomago Sandbeds and located near the upstream boundary of the site.
- Collection and review of monitoring data collected at the HWC bore (SK3520) screened in the Tomago Sandbeds and located about 1 km northeast of the project to assess baseline conditions at this location.

2) The following will be undertaken during the first 3 months from the commencement of Stage 3 works:
- Continued monitoring and assessment of water level data at MW101 and SK3520 to establish baseline water level trends.

3) The following will be assessed and reported to NPWS every 6 months from the commencement of Stage 3 works:
- Review of water level monitoring results at both MW101 and SK3520.

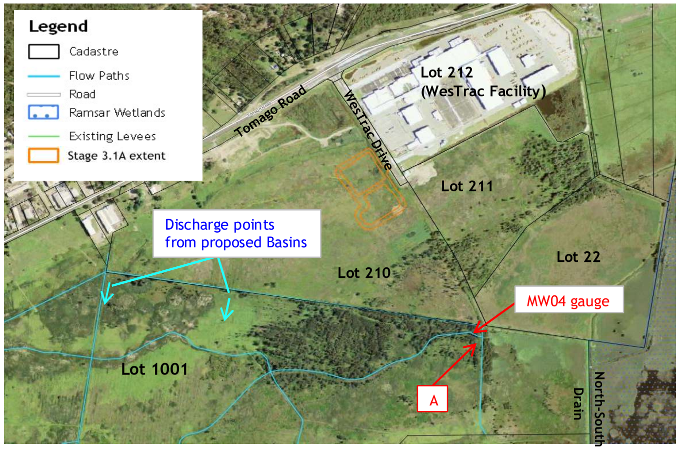
MW101 and SK3520 are both screened in the Tomago Sandbeds. The purpose of monitoring both MW101 located within the site and SK3520 located outside of the site is to assess whether any observed trends are attributable to the project or to regional stressors.

TARP

Level	Trigger	Action	Response
Level 1	• Groundwater levels at MW101 are within the baseline range; and • any noticeable trends are attributed to external stressors (e.g. climate, pumping).	• Continue to monitor as planned.	• No response required.
Level 2	• Groundwater levels at MW101 are outside baseline range; and • trends can be noticed that are not obviously attributable to external stressors.	• Review recorded data at SK3520 to check if trend is general. If so, trend would be considered not attributable to the project.	• Response 1 - investigate possible causes for the change.
Level 3	• Groundwater levels at MW101 are outside baseline range; • trends can be noticed that are not attributable to external stressors; • similar change is not observed at SK3520.	• If increase in water level (mounding): review drainage requirements in northern part of the site. • If decrease in water level (drawdown): review groundwater inflows in excavations.	• Response 2 (if mounding): installation of a drain at the northern boundary of the project to divert any runoff to Lot 210 (stormwater management basin area). • Response 2 (if drawdown): control and reduce inflows in excavation areas, discharge clean surplus water to the northern part of the site (on the sand beds) for infiltration and recharge.
Level 4	• Same as above; and • Response 2 was implemented but trends are still observed.	• Review performance of measures implemented as part of Response 2. • If increase in water level (mounding): review drainage system in northern part of the site. • If decrease in water level (drawdown): review groundwater inflows in excavations.	• Response 3 (if mounding): additional drain to divert water to Lot 210 (stormwater management basin area). • Response 3 (if drawdown): increased control to reduce inflows in excavation areas, discharge clean surplus water to the northern part of the site (on the sand beds) for infiltration and recharge.
Level 5	• Same as above; and • Response 3 was implemented but trends are still observed.	• Review performance of measures implemented as part of Response 3. • If increase in water level (mounding): review drainage system in northern part of the site • If decrease in water level (drawdown): review groundwater inflows in excavations.	• Response 4 - Stop work, initiate detailed investigations to understand the cause(s) of the changes in water levels, develop additional mitigation measures.

Worksheet title: **Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago**

Locality and drainage map



Estate Layout Plan

Photo of Location "A"

Purpose of this TARP (TARP #3)

TARP #3 describes the adopted triggers, proposed actions and responses to identify and mitigate the potential impacts of contamination/changes in groundwater and/or surface water quality as a result of the Project.

Commitments and monitoring

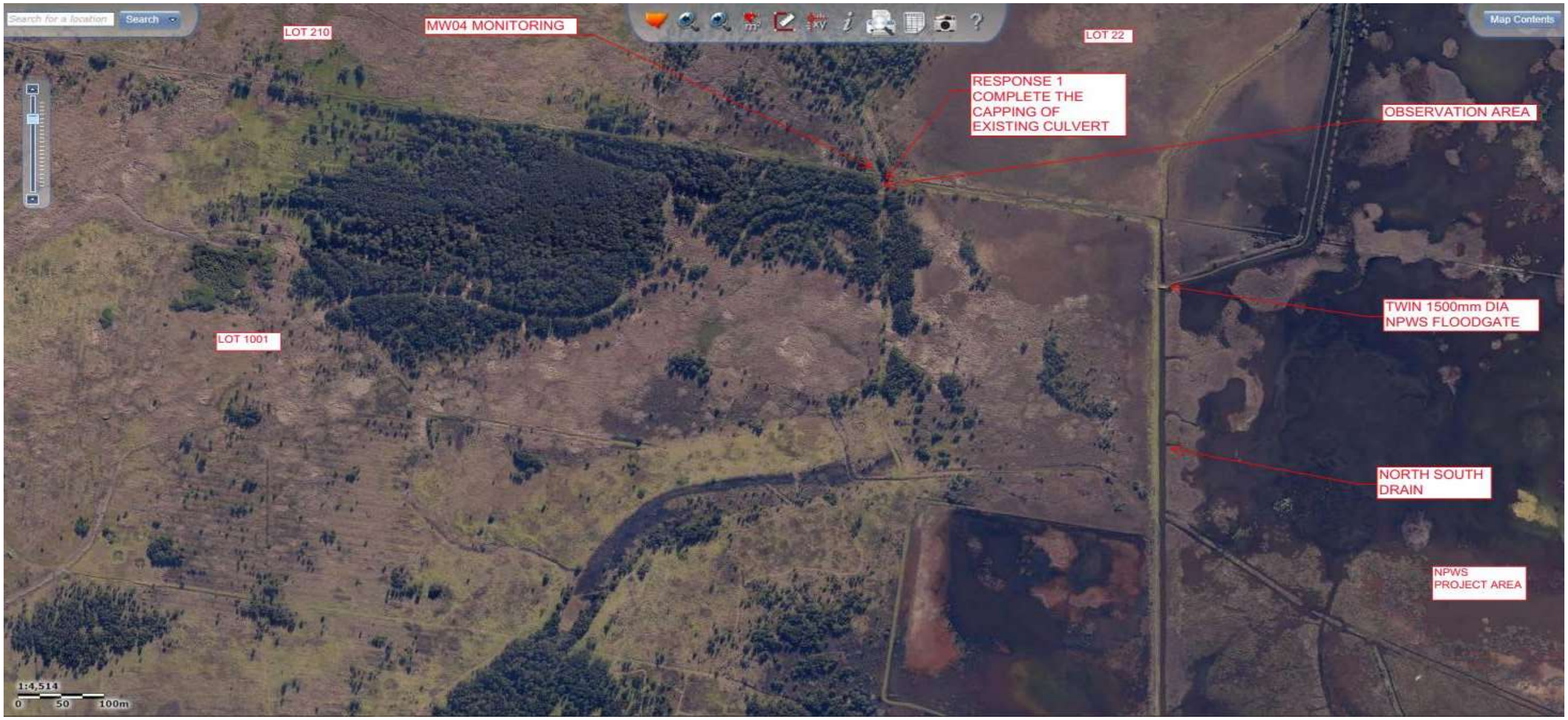
Monitoring of water quality will be implemented as outlined in the groundwater and surface water management plans.

TARP

Level	Trigger	Action	Response
Level 1	• Groundwater quality is within baseline range; and • any noticeable trends are attributed to external stressors (e.g. climate, pumping).	• Continue to monitor as planned.	• No response required.
Level 2	• Single exceedance for any one analyte and bore; or • Any noticeable trends / changes in water quality.	• Review water quality data for all analytes. • Organise additional monitoring rounds to confirm the exceedances / change in water quality	• Response 1 - keep monitoring water quality and assessing trends.
Level 3	• Three consecutive results exceeding trigger levels for any one bore and analyte.	• Advise and seek advice from DPE Water. • Review water quality data for all analytes. • Organise additional monitoring rounds to confirm the exceedances / change in water quality.	• Response 2 - investigate possible causes for the change.
Level 4	• Exceedances continue and cannot be attributed to external factors.	• Collect water quality data outside of the project area (e.g. at monitoring locations at other projects). • Compare site-specific data to those collected from surrounding areas. • If change in water quality appears to be caused by the project, advise relevant authorities, adjacent water users and conduct detailed investigations to plan for remediation.	• Response 3 (If change in water quality appears to be caused by the project) - Prepare remediation plan based on results of investigations. • Response 3 (if change is regional and not caused by project) - review and update trigger values.
Level 5	• Response 3 (if change is regional and not caused by project) - review and update trigger values; and • More analytes exceed their trigger levels.	• Review performance of measures implemented as part of Response 3.	• Response 4 - Stop work, develop additional remediation measures if consultation with experts.

Figure 1: Drain clearing plan (for TARP#1 on Page 1)

Figure 2: Response 1 (for TARP#1 on Page 1) - Capping of the existing culvert at the southeastern corner of Lot 210

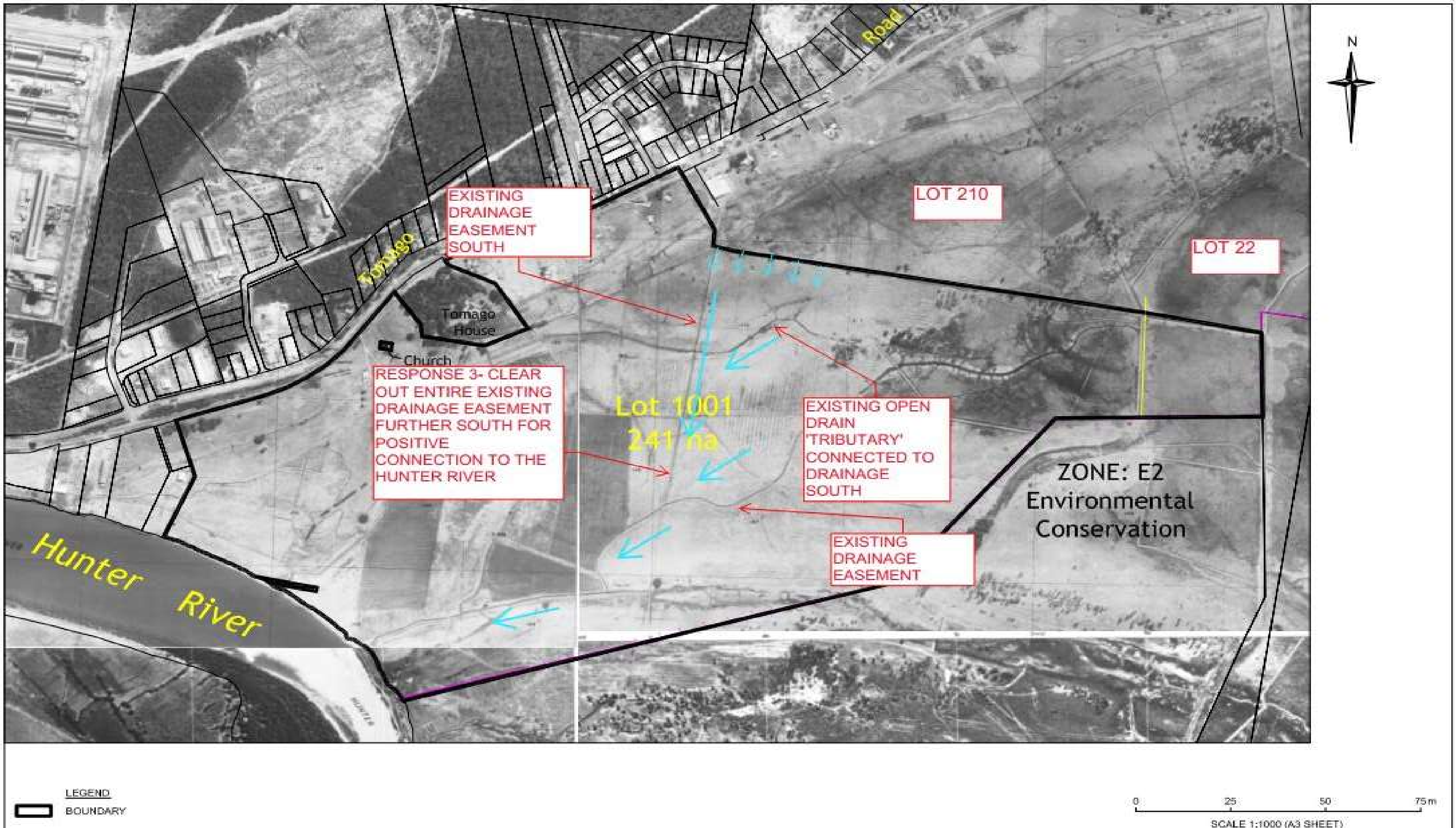


Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Figure 3: Response 2 (for TARP#1 on Page 1) - Extent of proposed initial fill layer, graded towards the south and southwestern boundaries of Lot 210

Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Figure 4: Response 3 (for TARP#1 on Page 1) - Additional drain clearing along the existing drainage easement at Lot 1001



DRAWING ADAPTED FROM PLAN SUPPLIED BY CLIENT, REF 37672 VERSION A DATED 22/3/10, AND 1986 ORTHOPHOTOS

Douglas Partners Geotechnics Environment Groundwater	Sydney, Newcastle, Brisbane, Melbourne, Perth, Wyong, Campbelltown, Townsville, Cairns, Wollongong, Darwin	TITLE: 1986 ORTHOPHOTO OVERLAY PROPOSED NORTH BANK ENTERPRISES PARK LOT 1001, DP1127780 TOMAGO ROAD, TOMAGO	CLIENT: ADW JOHNSON PTY LTD DRAWN BY: PLH SCALE: 1:1000 APPROVED BY:	REF:P:\49608\DRAWINGS\49608 DRAWING 2 PROJECT No: 49608 OFFICE: NEWCASTLE DATE: DRAWING No: 2

Worksheet title:	Trigger Action and Response Plan (TARP) for Industrial Estate at Lot 210 DP1174939, Tomago

Figure 5: Groundwater monitoring well location plan

Site Location

Drawing adapted from Metromap Image dated 12.02.2023.
Test locations are approximate only.
MW8A and MW100 series wells located using differential GPS

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Northbank Enterprise Hub Pty Ltd		TITLE: Groundwater Monitoring Well Location Plan Stage 3 Northbank Enterprise Hub Lot 210 D.P 1174939, Westrac Drive, Tomago	PROJECT No:39920.09
OFFICE: Newcastle	DRAWN BY: JCL		DRAWING No: 1
SCALE: 1:6000 @ A3	DATE:28.November.2023		REVISION: 2

Experience Communication Energy

20 December 2023

Our Ref.: TP-100

Your Ref: DOC23/839682-1

Hunter Water Corporation
PO Box 5171
HRMC NSW 2310

Attention: Mr Greg McHarg

Sent by Email: Greg.McHarg@hunterwater.com.au

Dear Greg

RE: MP07_0086 – Tomago Estate

Response to RFI Regarding Stage 3 SWMP

Thank you for Hunter Water's correspondence dated 10 August 2023 regarding the Stormwater Management Plan for Stage 3 at Tomago Estate, Major Project Approval MP07_0086 and our follow up meeting with you and your team.

Our delay in responding is due to our extended consultation with other stakeholders and government agencies being undertaken. We are now in a position to respond to your items conclusively.

Hunter Water is particularly interested in the Site Water Balance component of the Soil and Water Management Plan, as Stage 3 of the proposed development lies on an interface between the Tomago Sandbeds and an adjacent estuarine mud and clay system. Hunter Water has identified the potential for the development to impact groundwater flow out of the Tomago Sandbeds and into surface drainage systems on the estuarine mud and clay system. Depending on the engineering controls designed for Stage 3, there are potential impacts that Hunter Water would be concerned about. Specifically, the design must ensure that the following impacts do not occur:

1. Increase in groundwater discharge from the Tomago Sandbeds to above predevelopment levels.

2. Restriction of groundwater discharge from the Tomago Sandbeds to below pre-development levels.

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Neither impact would be acceptable to Hunter Water. The first would negatively impact the quantity of water that is stored in the Tomago Sandbeds. The second would lead to increased concentration and surface expression of groundwater upstream and adjacent to the development with associated impacts on ecology (within the Tomago Special Area) and nuisance for neighbouring properties.

We understand Hunter Water's preferred management and identification of potential impacts. NEH and its consultant Douglas Partners have provided a subsoil drainage design (attached) as was the agreed engineering control to manage the Tomago Sandbeds upstream water level. Geotechnical fieldwork logs, historical photos and survey of existing drains all inform the design. The design will be customised to the location and extent of the relevant stage to meet this requirement in conjunction with detailed civil design.

Hunter Water notes that the EPBC approval (EPBC 2007/3343) for this project requires "replication of natural surface and groundwater flows and water quality", which is consistent with our requirements.

NEH and it's consultants are working closely with NPWS as the land manager of the EPBC matters at Tomago in terms of addressing these requirements. NEH has extensive water quality records of background and development recorded water quality from Stage 1 to draw upon in completion of this requirement. The water quality records from development have been reported annually under the EPBC Approval for the past 10 years without incident.
Based on this record for Stage 1 development which was operational in 2012 to the current date, NEH is confident of management and monitoring for Stage 3 development.

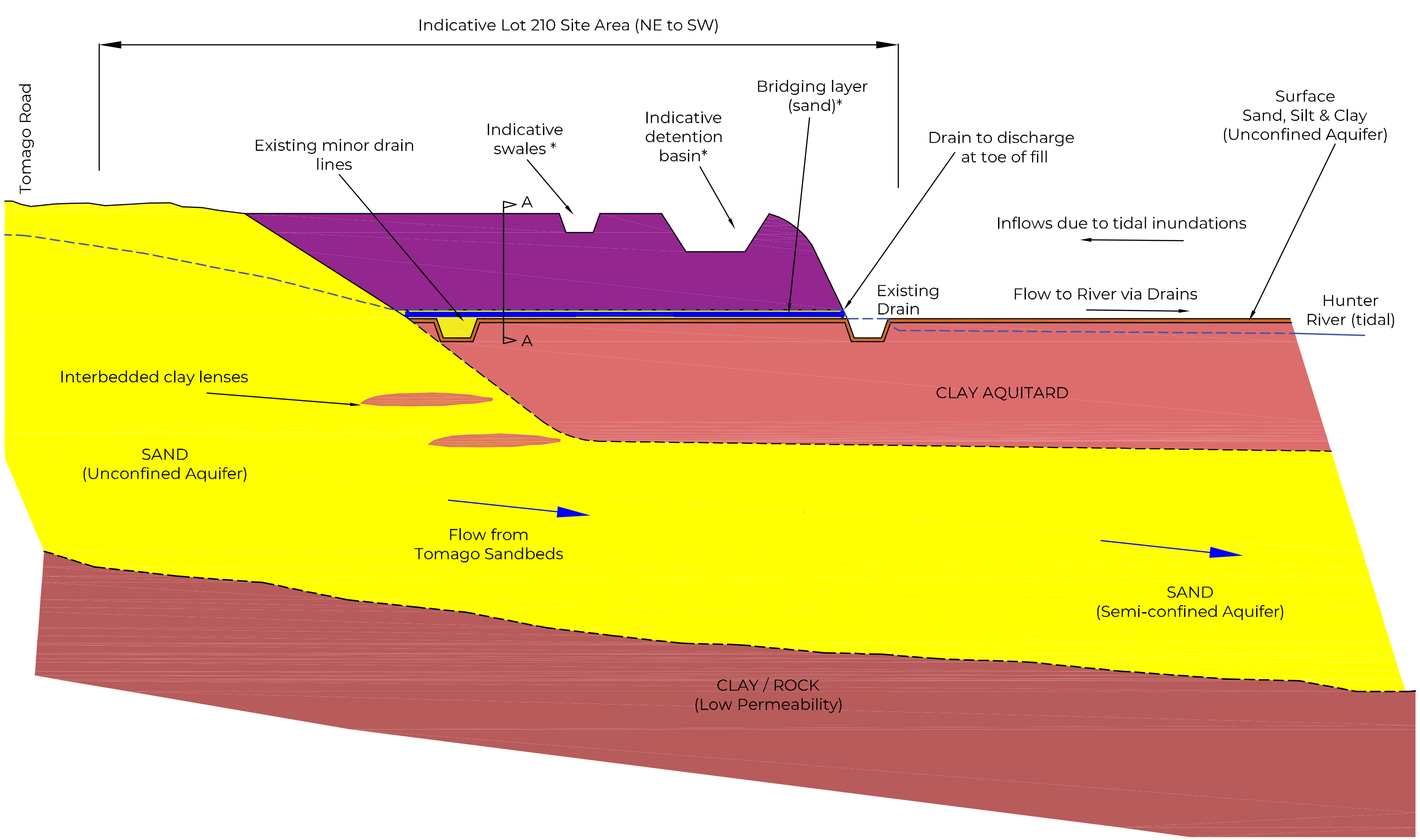
In accordance with Schedule 3 - Condition 8 of NSW Major Projects consent MP07_0086-Mod-3, Hunter Water requires the opportunity to review the updated Site Water Balance for the development, and in particular the engineering controls proposed for Stage 3 to address the interface between the Tomago Sandbeds and the adjacent estuarine mud and clay system.

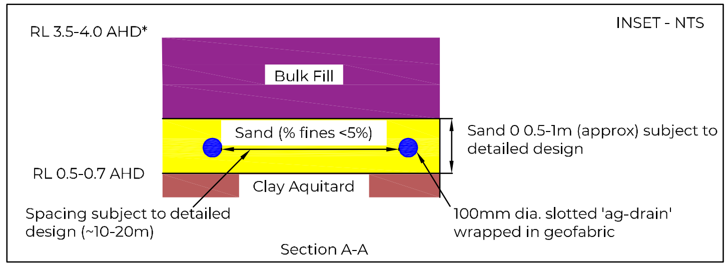
Refer to Subsoil Drain Concept Design by Douglas Partners attached.

We thank you for this consultation and trust the above additional information is satisfactory.

If you have any questions, please contact me on 0414 689 091 or scottd@torqueprojects.com
Yours Sincerely,

Scott Day
Torque Projects Pty Limited
Encl. Subsoil Drain Concept Design by Douglas Partners





LEGEND

Subsoil drains to direct groundwater flows in south-east direction towards catchment drains (invert level, grades and frequency subject to detailed design)

* Subject to detailed design

Douglas Partners — Geotechnics / Environment / Groundwater	CLIENT: Northbank Enterprise Hub Pty Ltd	
	OFFICE: Newcastle	DRAWN BY: PLH
	SCALE: Not to Scale	DATE: 15.12.2023

TITLE: Conceptual Cross Section of Bulk Filling and Subsoil Drains
Stage 3, Northbank Enterprise Hub
Lot 210 D.P 1174939, Westrac Drive, Tomago

PROJECT No:	39920.09
DRAWING No:	2
REVISION:	0

Appendix J - Hydraulic assessment of the Tomago Stage 3 development

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MEMORANDUM

Date	2 December 2024
Attention	Scott Day
Company	Torque Projects Pty Limited on behalf of Northbank Enterprise Hub Pty Ltd
WRM ref.	1918-02-G3
Subject	Hydraulic assessment of the Tomago Stage 3 development

Dear Scott,

1 SUMMARY OF FINDINGS

The capacity of the Existing Drainage Channel does not have an impact on the volume of flows that drain to the RAMSAR Wetlands. Flood modelling of the entire catchment, including the development site, has demonstrated approximately 7% reduction in flow volumes draining to the RAMSAR Wetlands under developed compared to existing conditions due to the redirection of Site runoff. The capacity of the entire drainage system, including the Existing Drainage Channel, is considered adequate to accommodate post-development flows under a range of tidal conditions.

2 INTRODUCTION

We understand Northbank Enterprise Hub Pty Ltd (NEH) is completing the Management Plan approvals to develop Lot 210 DP1174939 (Stage 3) in Tomago, NSW, into an industrial estate (the Site) as approved under Major Project Approval MP07_0086. The Site is located nearby to the estuarine section of the Hunter River adjacent to the RAMSAR[1] classified Hunter Estuary Wetlands (refer Figure 1), specifically the tidal wetlands restoration project east of the Site. The NSW Department of Planning, Housing and Infrastructure (DPHI) has requested further information in their email of 1 November 2024. You have requested we address the following comment from DPHI:

> *Regarding condition 12(e) – we understand from your response that the Existing Drainage Channel through Lot 1001 is 1.7 km long and up to 7m wide. However, it is unclear whether it has capacity to accommodate post-development flows under a range of tidal conditions. Could you please provide either measured data (our preference for pre-development condition) or modelled results to demonstrate it has capacity? Specifically, we would like to see the maximum volume of the drainage channel, the tidal conditions evaluated, rainfall amount/duration, and stored volumes for both pre-development and post-development scenarios.*

[1] The Convention on Wetlands was adopted in the Iranian city of Ramsar in 1971 and is the intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources.

Whilst the federal environmental department (DCCEEW) as custodian of the RAMSAR Wetlands has already approved the WRM Stage 3 Stormwater Management Plan (Stage 3 SMP) and Douglas Partners Stage 3 Groundwater Management Plan in July 2024, detailed hydrological and hydraulic modelling has been undertaken to address the DPHI query. More specifically, modelling was undertaken to determine whether runoff volumes draining toward the RAMSAR Wetlands would increase as a result of the development through a range of tide cycles.

3 HYDROLOGIC CONSIDERATIONS

The Site has been historically heavily managed by farming, which included historical excavation of drains for commanding the drainage characteristics and the establishment of pasture grasses. Under existing conditions, most runoff from the Site drains eastwards towards the Wetlands. The catchment draining the Site and the ground level topography is shown in Figure 2.

The proposed development runoff will be diverted to an existing drainage easement via an Existing Drainage Channel (referred to by DPHI) across Lot 1001 and discharges to the Hunter River via a 1,500 mm diameter flood-gated pipe approximately 1.7 km downstream of the Site (refer to Figure 1). A photograph of the Existing Drainage Channel is provided in Figure 3.

The Existing Drainage Channel also receives runoff from the catchment to the west of the drain. Under existing conditions, the drain will either flow to the south to the Hunter River, or overflow in an easterly direction towards the RAMSAR Wetlands. It is not proposed to modify the Existing Drainage Channel as part of the Stage 3 SMP to prevent water from the western catchment or from the Site entering this drain and overflowing to the east. The characteristics of the Existing Drainage Channel will remain.

Figure 2 also shows that there is a substantial (larger) catchment area to the east of the drain, all of which would drain to the RAMSAR Wetlands, or pond and infiltrate into the groundwater irrespective of the development. The proposed drainage strategy for the Site will reduce the catchment area to the west of the drain that could drain to the RAMSAR Wetlands by diverting it to the Existing Drainage Channel. The outlet from Basin 2 has been moved as far as practical to the west to increase the travel time across this catchment where it will mostly pond and evaporate before reaching the RAMSAR Wetlands.

Given the above, the capacity of the Existing Drainage Channel forms only a small component of the total volume of water that would drain to the RAMSAR Wetlands under existing or proposed conditions. As a result, the DPHI query has been addressed by undertaking hydraulic investigations of the entire catchment including the Existing Drainage Channel. The extent of the hydraulic model configuration is shown in Figure 2.

The catchment and model extent are generally consistent with the Regional Flooding Assessment previously undertaken by BMT[2] for Lot 1001 and the associated Major Project Approval MP10_0185, also completed and owned by NEH. The catchment draining Lot 212 (Stage 1; the approved WesTrac Facility) was excluded, such that the investigations presented herein report the impact of the proposed development site only.

To evaluate the impact of tidal conditions and rainfall runoff volumes, a severe (1% annual exceedance probability (AEP)) long-duration storm (48 hours) has been adopted for the assessment. The 48-hour duration storm allows the volumes exiting the Site either through the pipes to the Hunter River or easterly flows draining towards the RAMSAR Wetlands to be calculated across four tide cycles (two high tides and two low tides each day). The model was run

[2] *Northbank Enterprise Hub Business and Industrial Park – Regional Flooding Assessment*, August 2012.

for existing conditions and for fully developed Stage 3 conditions to determine the differences in total catchment runoff that would drain to the wetlands.

4 HYDRAULIC MODELLING

A two-dimensional TUFLOW direct rainfall (rain-on-grid) hydraulic model was developed for this additional assessment, as shown in Figure 2, with rainfall applied over the full catchment. A 5 m grid resolution and 0.83 m sub-grid-sampling was adopted, and a level 3 quadtree domain corresponding to a 1.25 m grid was defined around the existing drains, which were enforced in the topography based on surveyed elevations. A cutoff depth of 0.01 m was adopted for mapping purposes. The latest TUFLOW solver 2023-03-AF-iSP-w64 was used for the assessment.

Rainfall depths were obtained from the BoM IFD datahub for the centroid of the catchment (Lat. -32.8309, Lon. 151.7430). The following information was derived for the 1% AEP design event, 48-hour storm duration:

- Rainfall depth = 376 mm;
- Areal reduction factor = 0.992 for a catchment of 6.2 km^2 in the East Coast South zone; and
- Applied rainfall = 327.9 mm.

Initial and continuing loss values were adopted in accordance with the previous report (WRM reference 1918-02-B11), refer also Section 4.3.

4.1 BOUNDARY CONFIGURATION

At the southern model boundary, two HT (water level versus time) tailwater boundaries were adopted at the culverts beneath the southern Hunter River levee, based on the tidal fluctuation recorded at Hexham Bridge (station number 210448) located approximately 4.5 km upstream of the Site (refer Figure 1). Over the modelled 48-hour storm duration, the boundaries are subjected to two full tidal cycles. The tidal cycle adopted at the boundary is shown in Figure 4.

No bathymetric data is available of the North South Drain, and no survey information is available for the North South Levee Trail and bund. The eastern model boundary was thus defined approximately 100 m west of these features, and a relatively steep flood slope of 0.1% was instead adopted for five QT (discharge versus time) outflow boundaries. The steep boundary would reduce flood storage and therefore represent the worst-case scenario of calculating flows draining to the Wetlands.

4.2 TOPOGRAPHY

4.2.1 LiDAR

LiDAR data was sourced from Geoscience Australia's *Elevation and Depth - Foundation Spatial Data* (ELVIS[3]) system. The topographic data was flown in June 2013 and September 2014, with a vertical/horizontal accuracy of 0.3 m/0.8 m and provided with a 1 m resolution. It covers the entire model domain and was adopted for this study.

[3] https://elevation.fsdf.org.au/

4.2.2 Survey

The elevations of drains and ridgelines were surveyed in 2007. This data is regarded as representative since no development works have occurred since then other than the maintenance work undertaken for the Existing Drainage Channel.

Photographs of the Site show the drains extend beyond the surveyed extent. The available information on drain elevations was extended beyond the survey extent based on aerial imagery and additional survey data collected in August 2024, post drain clearing.

Surveyed elevations of the drains and ridgelines were enforced in the hydraulic model to ensure adequate representation of these features.

4.3 ROUGHNESS AND LOSS VALUES

Aerial imagery and a site visit showed the modelling area to be covered in thick grass. Depth-varying roughness (Manning's) values were adopted as outlined in Table 4.1, where the shallow flows are impeded by the grass and that impedance would reduce as the water depth increases. The default initial and continuing loss values of the land use areas (existing and proposed) were adopted in accordance with the previous report (WRM reference 1918-02-B11).

The drains within the model domain were delineated based on the surveyed information, the available topographic data, and aerial imagery (refer Figure 2). A reduced Manning's n value was adopted for these domains, and the water surface was assumed to be free of losses.

Table 4.1 Adopted Manning's n and loss values

Landuse	Manning's n	Initial loss (mm)	Continuing loss (mm/hr)
Active channel with light vegetation	0.035	0	0
Dense vegetation (default)	0.10 (≤ 0.2m) 0.07 (≥ 0.4m)	3.4	1.1
Development Site	0.025	0.3	0.1

4.4 SOIL

Upstream (northwest) of the Tomago Road, the NSW SEED[4] database indicates the presence of soils with high infiltration rates, consisting chiefly of deep, well to excessively well-drained sands being the Tomago Sandbeds. These soils have a high rate of water transmission and have low water runoff potential.

Initial testing using a "sand" soil type indicated no runoff from the area in question. As anecdotal data suggests some runoff in rare events, the "loamy sand" soil type as predefined by the United States Department of Agriculture (USDA), outlined in Table 4.2, was instead adopted within the model domain upstream of Tomago Road. The initial moisture content, i.e. the fraction of the soil that is initially wet, was assumed to be 0.

[4] https://www.seed.nsw.gov.au/

Table 4.2 Green-Ampt infiltration parameters, USDA 'loamy sand' soil type

Suction (mm)	Hydraulic conductivity (mm/hr)	Porosity (fraction)
61.3	29.9	0.401

4.5 HYDRAULIC STRUCTURES

Culverts with flood gates are installed beneath the southern levee at the outlet to the Hunter River. Based on survey information, these structures have been included in the TUFLOW hydraulic model as outlined in Table 4.3. Culverts were also included beneath Tomago Road to the west based on aerial imagery and the available topographic information.

Table 4.3 Hydraulic structures, existing conditions

ID	Configuration	US/DS invert (mAHD)	Floodgate
Hunter River (northern)	1 x 0.9 m	-0.82 / -0.82	Yes
Hunter River (southern)	1 x 1.5 m	-0.86 / -0.86	Yes
Tomago Road	2 x 0.9 m	2.55 / 2.50	No

4.6 PROPOSED DEVELOPMENT

The proposed development fill on Lot 210, including the proposed drains and the eastern (Basin 2) and western (Basin 3) basins, was incorporated into the existing conditions hydraulic model. The proposed drains and embankments were enforced in the hydraulic model to ensure adequate representation.

The proposed culvert beneath the internal road, the multi-staged outlet pipes (refer Table 4.4) as well as the basin spillways were incorporated in accordance with the Stage 3 SMP.

The developed surface was assumed as 90% impervious (general industrial zone) consistent with the Stage 3 SMP. For consistency with the previous assessment, the parameters outlined in Table 4.1 were adopted for the Site.

No drainage works are proposed on Lot 1001. However, the Existing Drainage Channel will be monitored and managed in accordance with Section 11.4 and Appendix H of the Stage 3 SMP. Lot 1001 was modelled as the existing, unchanged landform and associated existing drains.

Table 4.4 Hydraulic structures, developed conditions

ID	Piped outlet configuration	US/DS invert (mAHD)
Basin 2	1 x 0.225 m	0.70 / 0.70
	4 x 0.45 m	1.20 / 1.20
Basin 3	1 x 0.225 m	1.20 / 1.20
	3 x 0.45 m	1.70 / 1.70
Crossing 3	5 x 1.2 m x 0.9 m	0.62 / 0.59

5 RESULTS

5.1 CATCHMENT FLOW CHARACTERISTICS

5.1.1 Existing conditions

Figure 5 shows the predicted flood depths, extent and the flow direction for the 1% AEP design event, 48-hour storm duration under existing conditions. As discussed in Section 2:

- Runoff from the existing undeveloped Site drains in a southeasterly and then easterly direction towards the RAMSAR Wetlands.
- Catchment runoff to the west of the Existing Drainage Channel drains into the channel. The Existing Drainage Channel drains southwards across the drainage easement on Lot 1001 where it:
  - overflows and drains along another historical drainage channel and overland across Lot 1001 and the proposed development Site eastward towards the Wetlands; or
  - continues southward into the remnant flood channel of the Hunter River (see Figure 2).
- The existing bund across the remnant flood channel contains these flows and prevents it from draining to the RAMSAR Wetlands. The flood volume stored within the remnant flood channel behind the bund eventually drains via a deeply incised channel to the Hunter River during the low tide.

5.1.2 Proposed conditions

Figure 6 shows the predicted flood depths, extent and the flow direction for the 1% AEP design event, 48-hour storm duration under proposed conditions. The flood level impact associated with the development across the model area is shown in Figure 7. Under this scenario, all outflows from the development site occur at the southwestern corner into the Existing Drainage Channel. The flows then take the circuitous route as described for existing conditions.

Figure 7 shows that there is a reduction in peak flood levels immediately to the west of the proposed development Site on Lot 22 at the head of the North South Drain due to the redirection of the Site runoff. Conversely, there is a minor increase in flood levels along the Existing Drainage Channel and surrounds due to the discharges from the development site.

5.2 RUNOFF VOLUME AT WETLANDS

Modelling results were investigated to assess whether the rate of discharge/volumes from the entire catchment including the Site would not exceed pre-development flows draining towards the Wetlands.

Reporting locations were established in the model at the location of interest, west of the North South Levee Trail adjacent to the North South Drain of the RAMSAR Wetlands. Analysis was undertaken over approximately 2 km, subdivided into six representative sections (“East 1” to East 6”). The peak discharges and total volumes draining to the North South Drain through each of the subsections were compared for existing and developed model conditions. The comparison is summarised in Table 5.1 and graphically represented in Figure 8.

A decrease in total flow volume toward the Wetlands of approximately 7% is predicted as a result of the proposed development. Outflows from the Site at its southwestern corner into or near the Existing Drainage Channel discharge into the Hunter River or follow the circuitous route as described for existing conditions, activating additional storage across the floodplain. Of particular note is the significant reduction in volume through reporting location “East 1”, draining the conservation Lot 22 transferred by NEH to NPWS, which fully reports to the head of the North South Drain and the RAMSAR Wetlands.

Table 5.1 Discharge and volume comparison draining to North-South Drain

ID (refer Figure 2)	Peak discharge (m^3/s)		Total volume (ML)		Difference
	Existing	Developed	Existing	Developed	
East 1	1.5	0.9	114	69	-39.7%
East 2	1.5	1.3	141	132	-6.4%
East 3	2.5	2.4	245	239	-2.2%
East 4	0.1	0.1	7	7	-0.2%
East 5	2.3	2.3	220	223	1.1%
East 6	0.8	0.8	76	77	0.8%
TOTAL	**8.6**	**7.6**	**803**	**746**	**-7.1%**

5.3 IMPACTS FOR MORE FREQUENT STORM EVENTS

This analysis has focused on a long duration, high volume design storm event, to replicate a worst-case scenario of freshwater flows draining to the RAMSAR Wetlands. Given there was a reduction in flow draining to the wetland for this scenario, modelling of smaller events was not undertaken.

However, the oversized detention basins and the stormwater strategy to divert runoff from the developed Site, away from the southeast corner of Lot 210 adjacent to Lot 22, to the southwest corner into Existing Drainage Channel would be more significant for reducing flows toward the RAMSAR Wetlands and North South Drain during every day rainfall runoff events. These minor volume runoff events will drain along the Existing Drainage Channel toward the Hunter River and away from the RAMSAR Wetlands.

6 CONCLUSIONS

The capacity of the Existing Drainage Channel does not have an impact on the volume of flows that drain to the RAMSAR Wetlands. However, flood modelling of the entire catchment, including the development site, (in line with Project Approval and requests made through consultation) has demonstrated that there will be a reduction in flow volumes draining to the RAMSAR Wetlands due to the redirection of Site runoff further to the west.

That is, the capacity of the entire drainage system, including the Existing Drainage Channel, is considered adequate to accommodate post-development flows under a range of tidal conditions.

Notwithstanding, surface flow is subject to monitoring and annual reporting to DPHI, and contingencies have been considered in the Trigger Action Response Plan to take action if monitoring results are unfavourable (refer WRM report 1918-02-B11).

Regards,

Greg Roads

Director/Senior Principal Engineer

APPENDIX A FIGURES

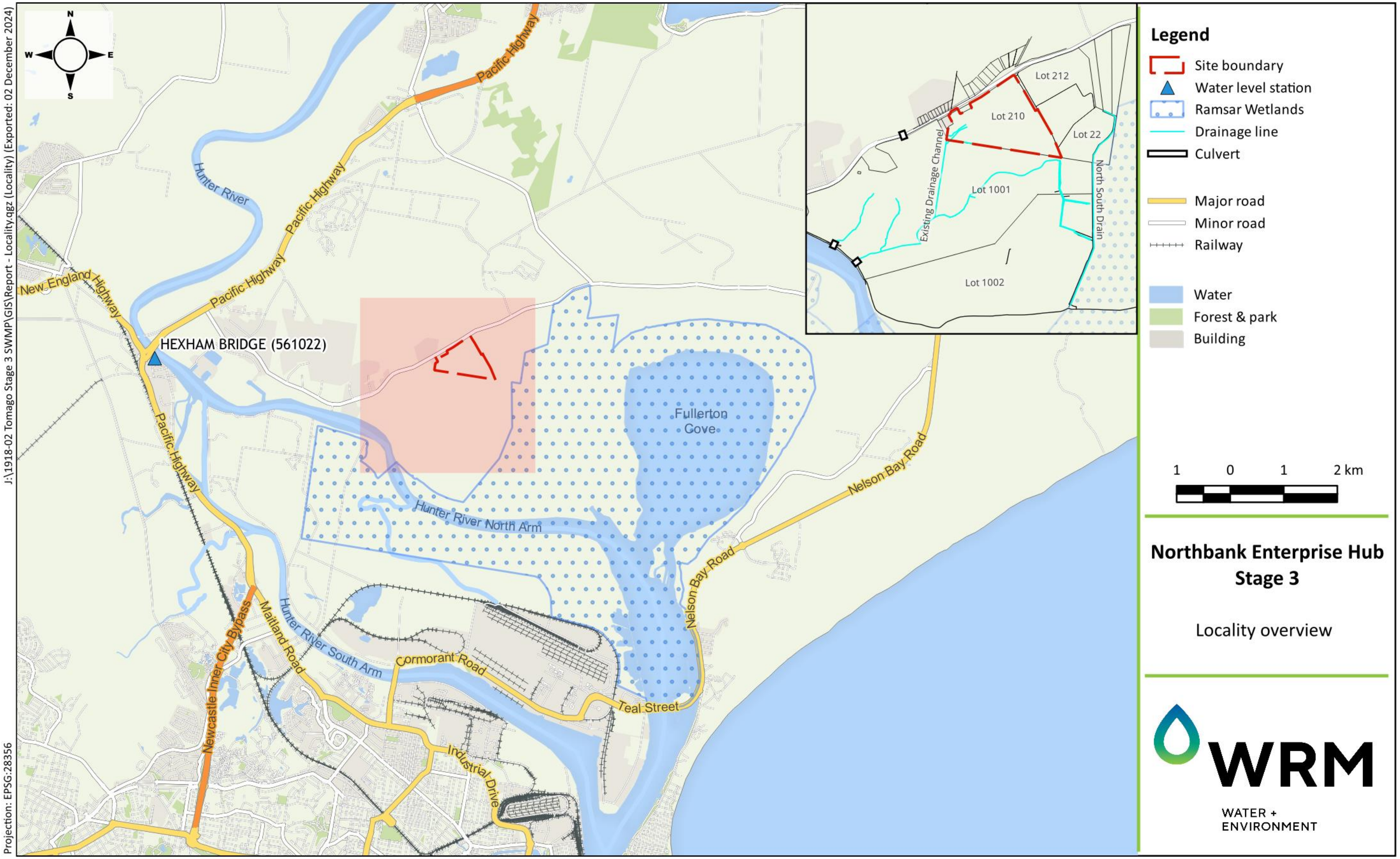

Figure 1 Site locality

WRM

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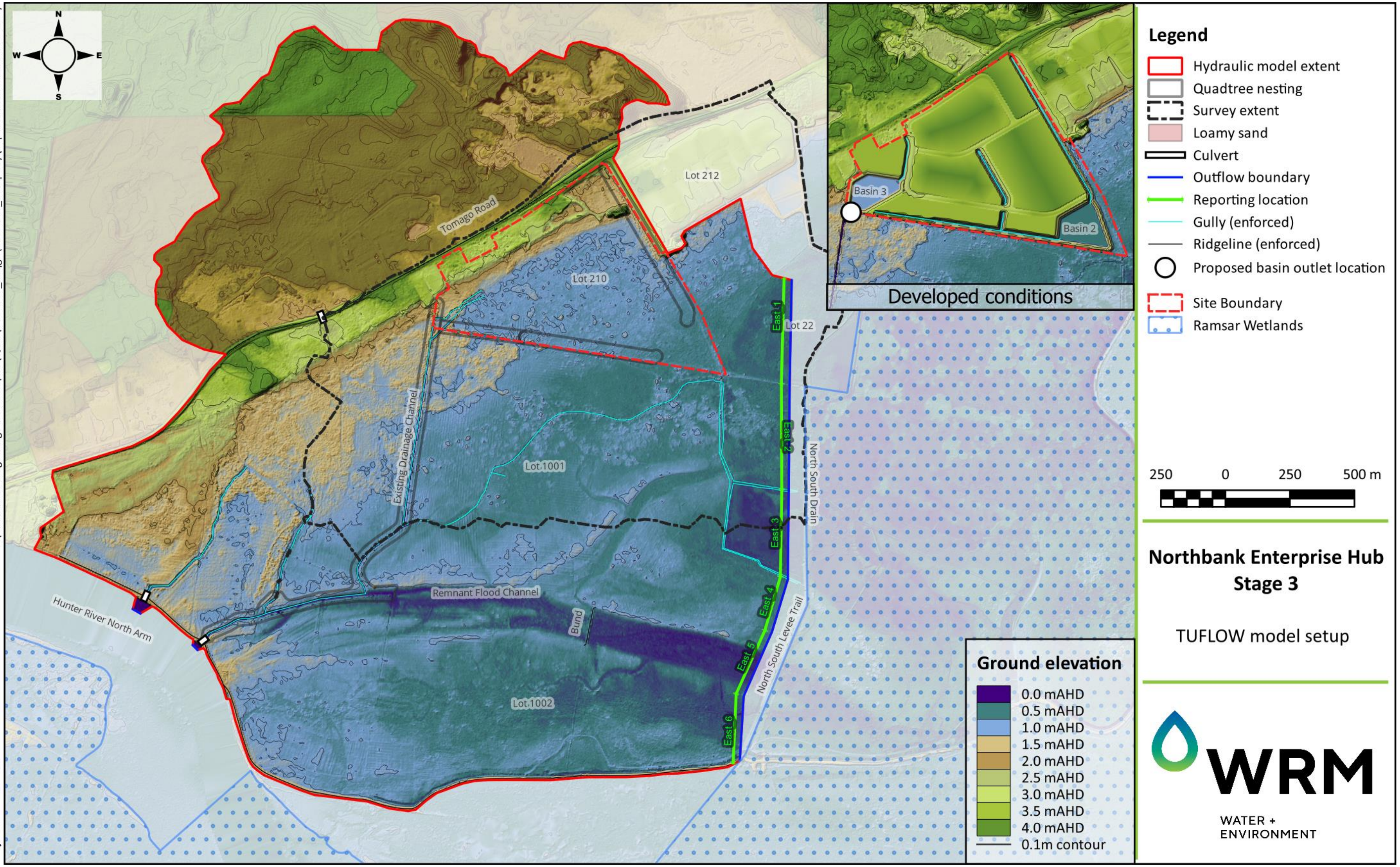

Projection: EPSG:28356

Figure 2 TUFLOW hydraulic model setup

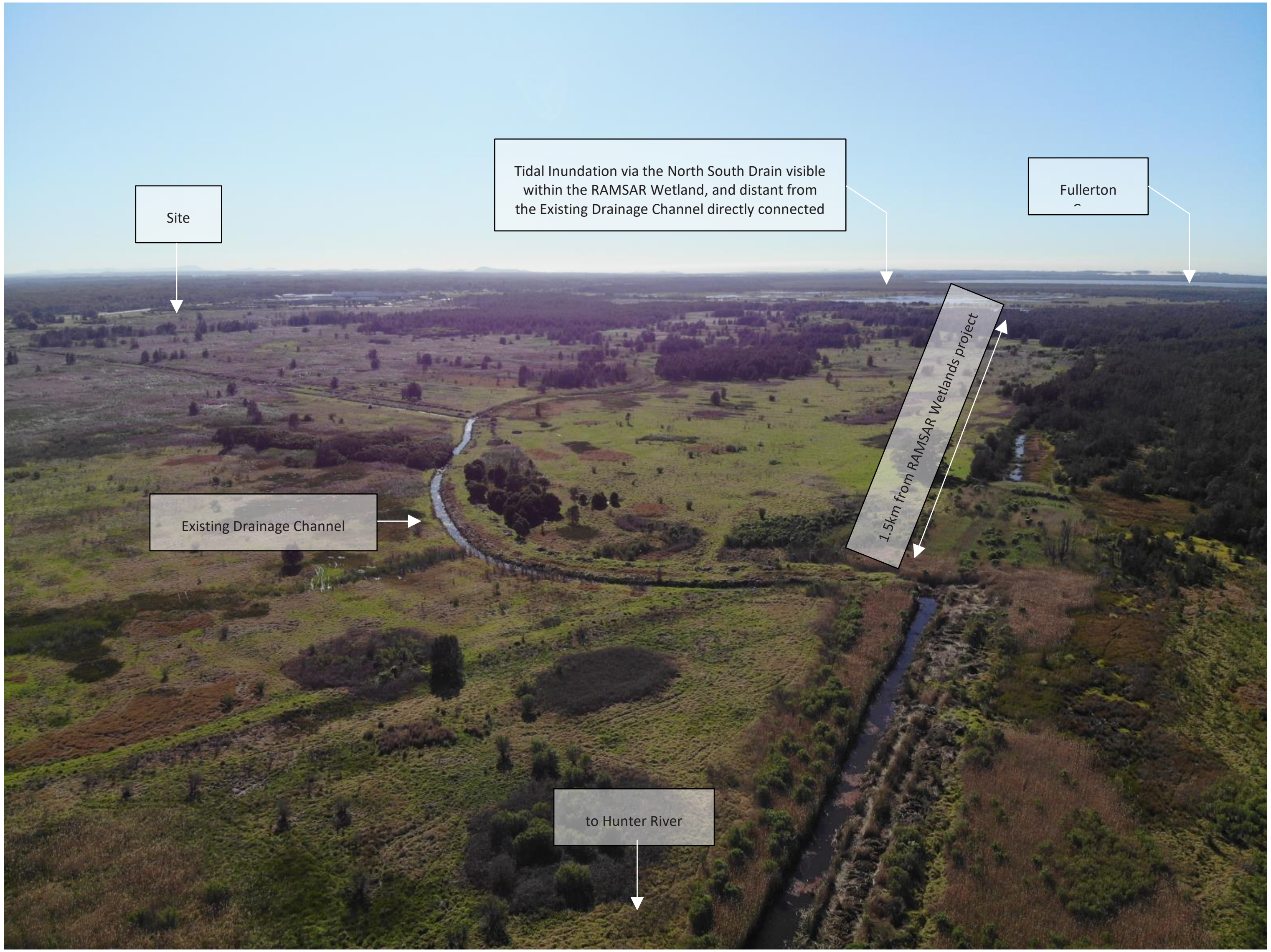

Figure 3 Photograph of the cleared Existing Drainage Channel

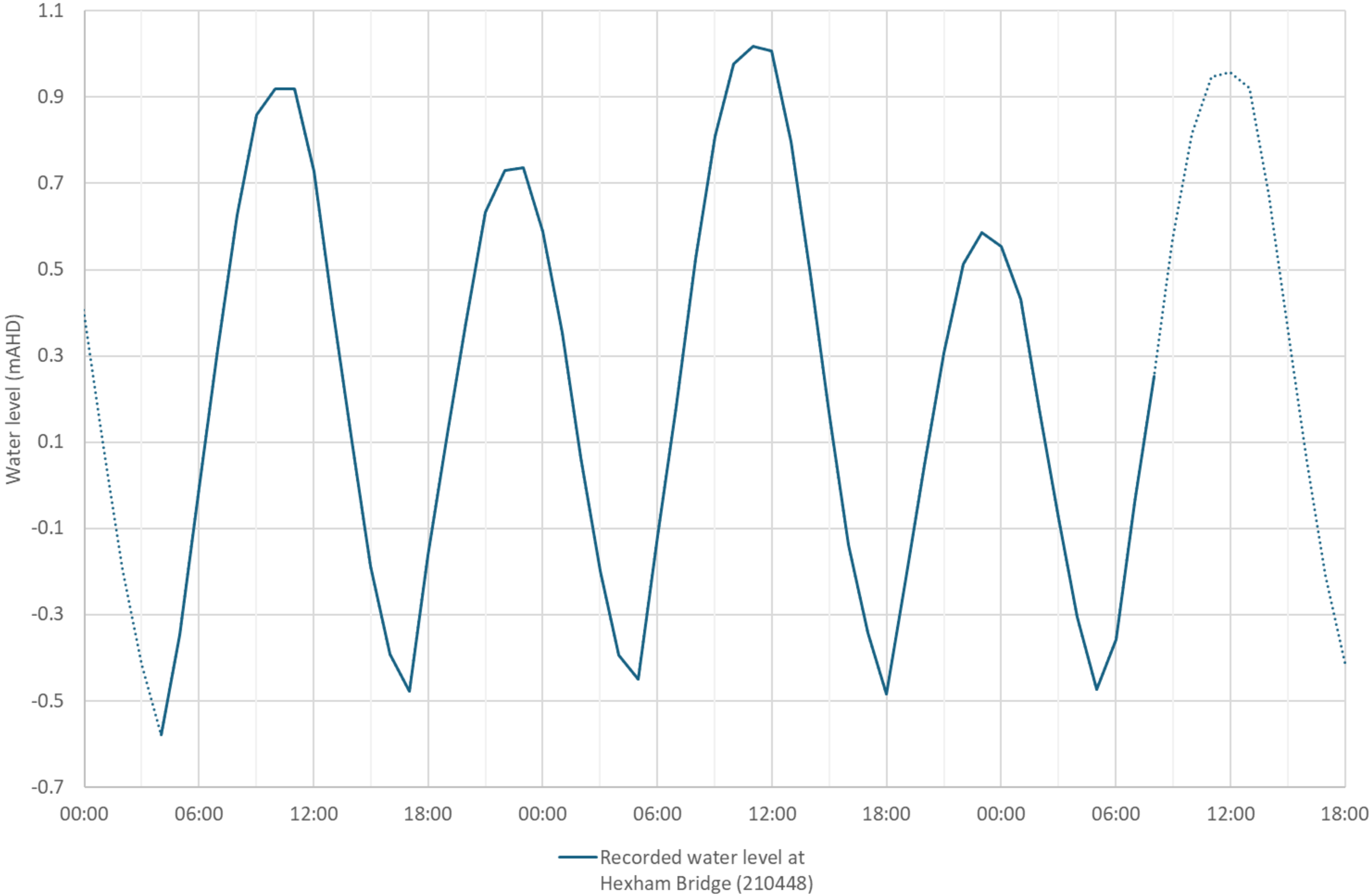

Figure 4 Tidal cycle adopted at Hunter River outflow boundaries

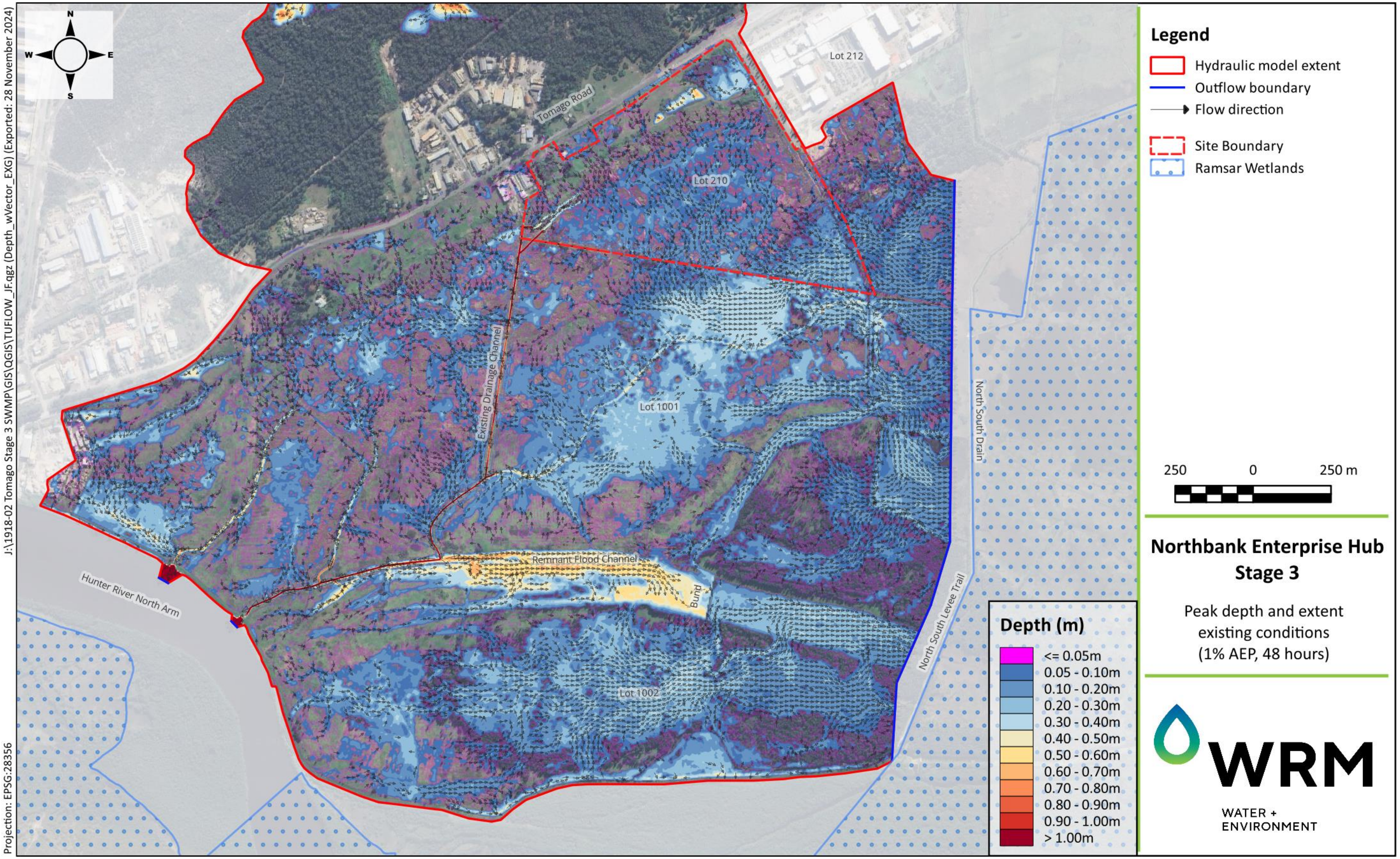

Figure 5 Existing conditions 1% AEP flood extent

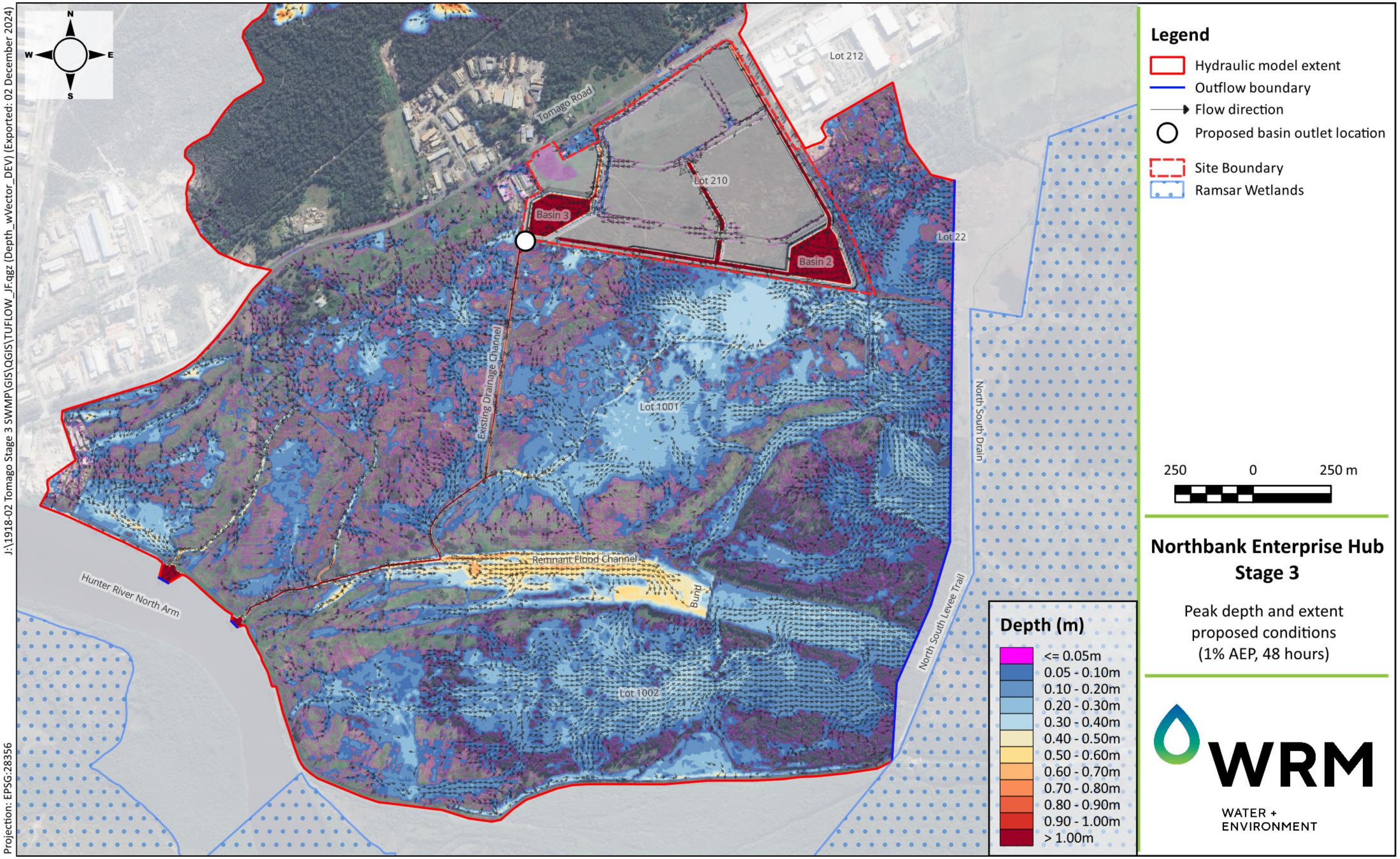

Figure 6 Proposed conditions 1% AEP flood extent

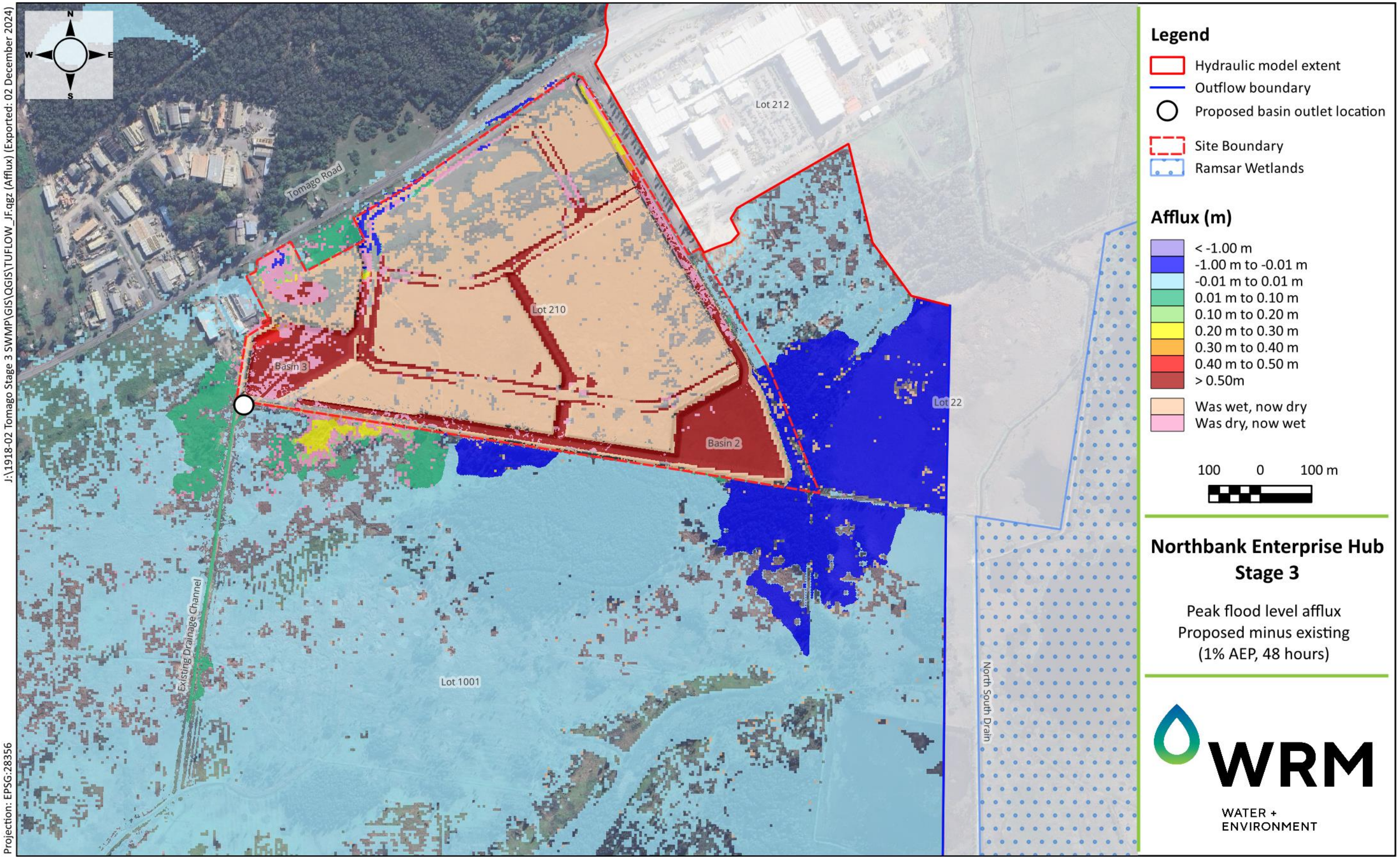

Figure 7 Predicted 1% AEP peak flood level afflux, proposed minus existing conditions

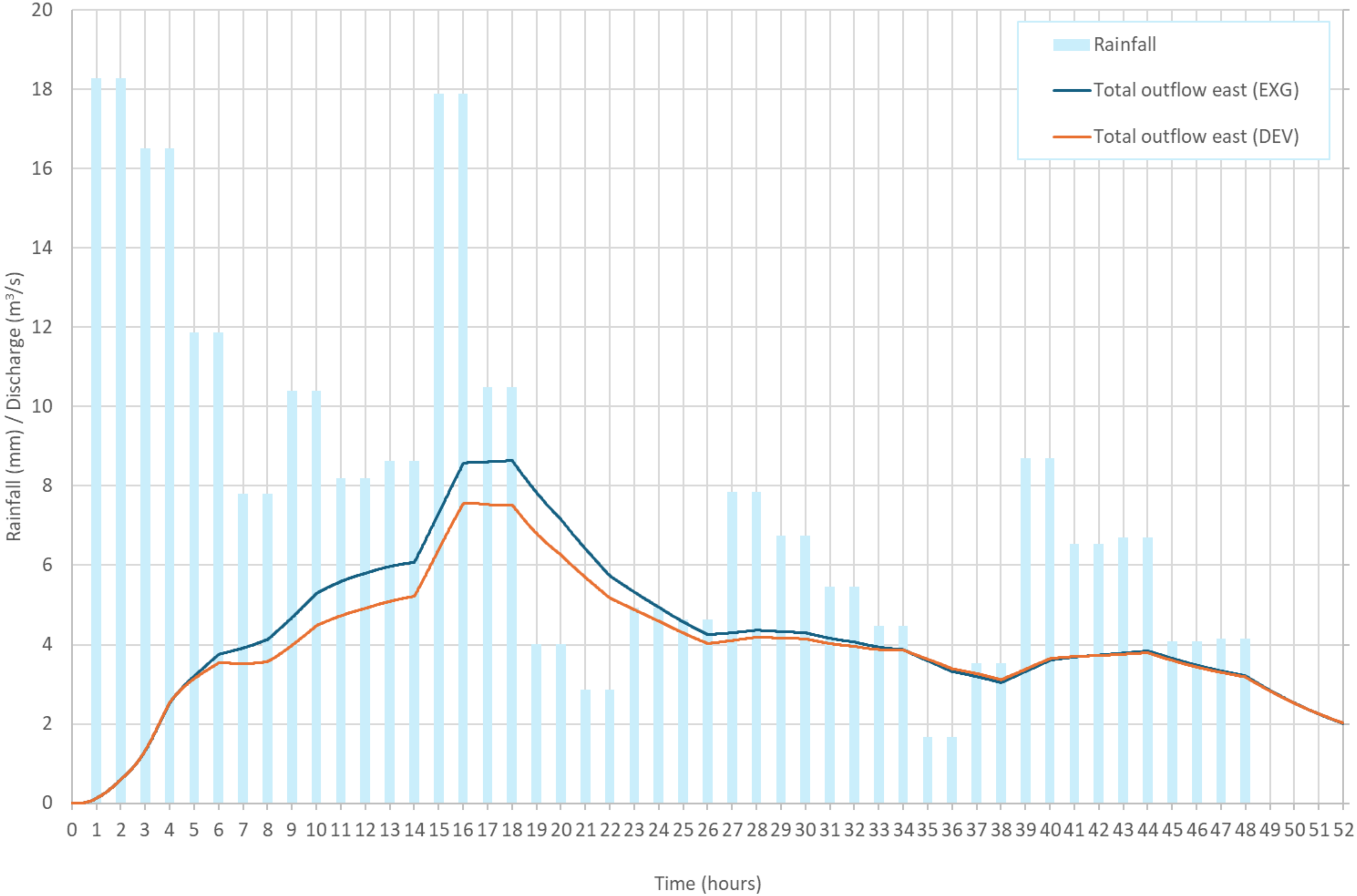

Figure 8 Rainfall hyetograph and total discharge hydrographs at eastern boundary

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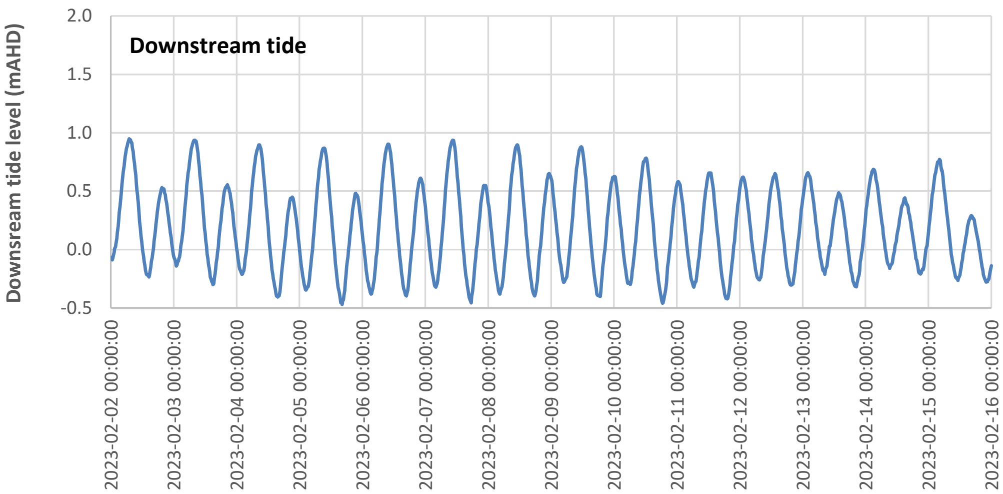
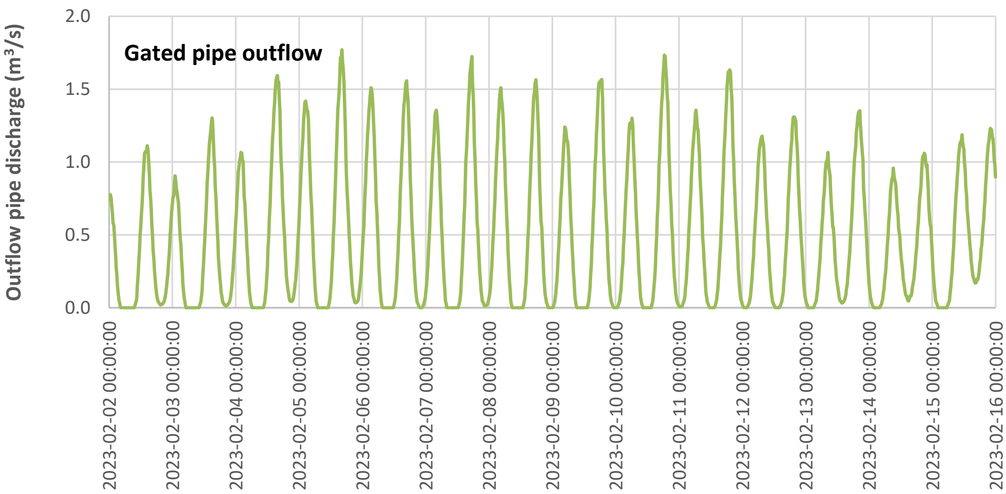
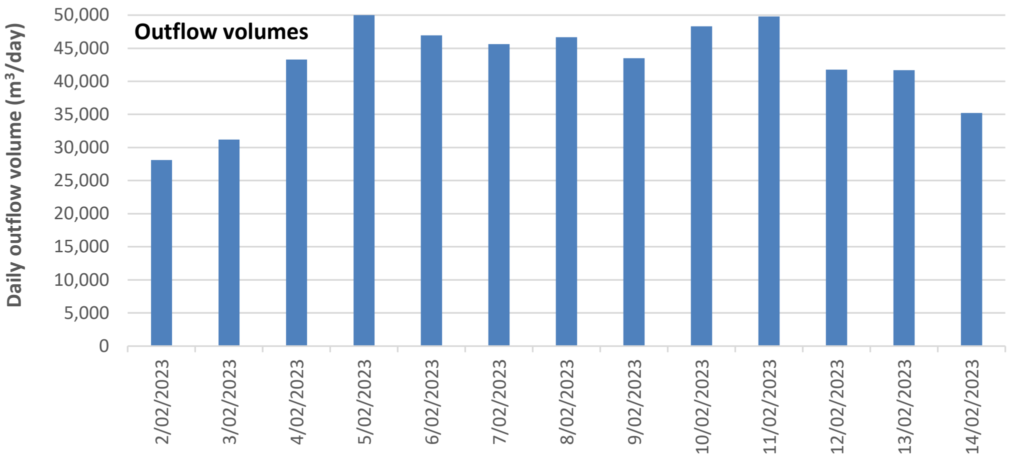
Appendix K - Downstream drainage capacity analysis

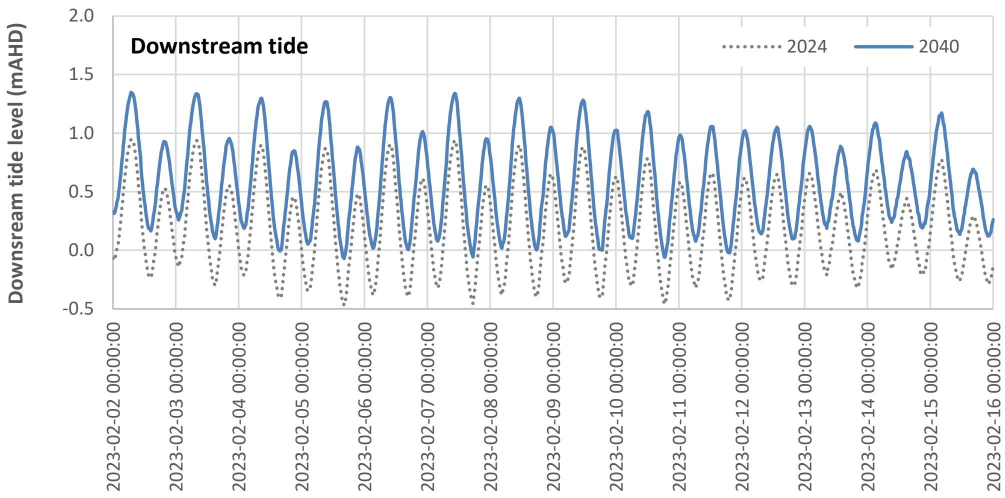
Current climate conditions

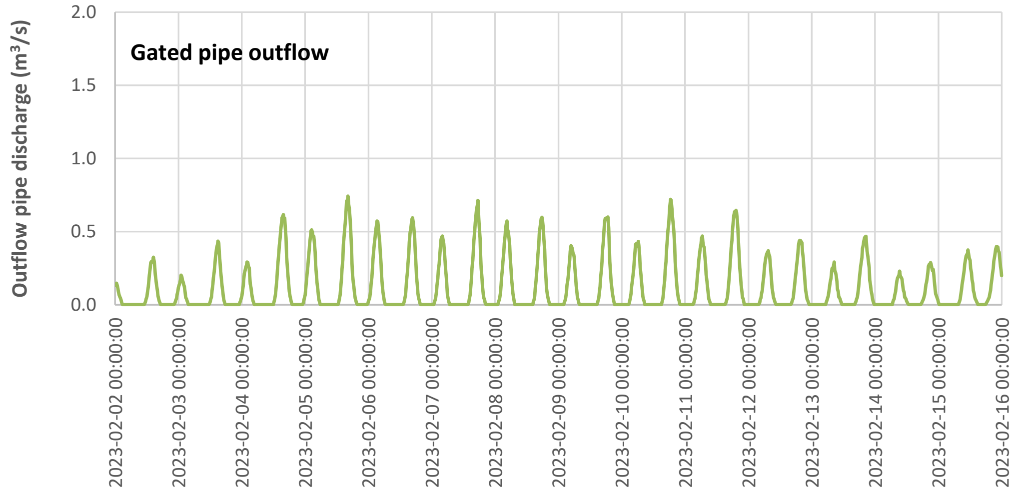


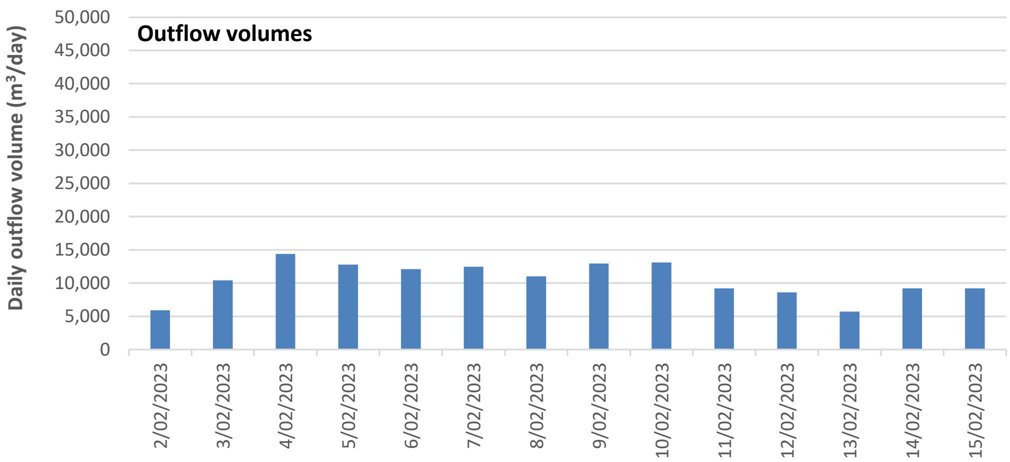




Year 2040 (future climate conditions)







Year 2100 (future climate conditions)