
**Groundwater Monitoring and
Management Plan
Revision 3**

**Stage 1 Northbank Enterprise Hub
(EPBC Approval 2007/3343)**

**Lot 212 and Part Lot 211 DP 1174939,
Westrac Drive, Tomago, NSW**

**Prepared for Northbank Enterprise Hub
Pty Ltd**

Project 39920.09

18 November 2025

Document History

Details

Project No.	39920.09
Document Title	Groundwater Monitoring and Management Plan Revision 3 Stage 1 Northbank Enterprise Hub (EPBC Approval 2007/3343)
Site Address	Lot 212 and Part Lot 211 DP 1174939, Westrac Drive, Tomago, NSW
Report Prepared For	Northbank Enterprise Hub Pty Ltd ABN 77 063 271 625
Filename	39920.09.R.016.Rev3.GMMP.Stage1

Status and Review

Status	Prepared by	Reviewed by	Date issued	Reason for change
Revision 0	Dana Wilson	Will Wright	27 February 2025	Contemporary plan to replace the approved GMP following review
Revision 1	Dana Wilson	Will Wright	3 March 2025	Client review
Revision 2	Dana Wilson	Will Wright	19 September 2025	Updated in response to DCCEEW review of Revision 1
Revision 3	Dana Wilson	Will Wright	18 November 2025	Updated to address minor typographical errors and responses to DCCEEW review of Revision 2

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

Signature

Date

Author	<i>Dana Wilson</i>	18 November 2025
Reviewer	<i>P W Wright</i>	18 November 2025



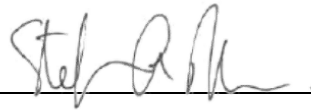
Douglas Partners acknowledges Australia's First Peoples as the Traditional Owners of the Land and Sea on which we operate. We pay our respects to Elders past and present and to all Aboriginal and Torres Strait Islander peoples across the many communities in which we live, visit and work. We recognise and respect their ongoing cultural and spiritual connection to Country.

Declaration of accuracy

In making this declaration, I:

- a) am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (EPBC Regulations). The offence is punishable on conviction imprisonment or a fine, or both.
- b) am authorised to bind Northbank Enterprise Hub Pty Ltd to this declaration and have no knowledge of that authorisation being revoked at the time of making this declaration.

Signature



Full name (please print)

Steve Robson

Organisation (please print)

Northbank Enterprise Hub Pty Ltd

Date

12 / 12 / 2025

Executive Summary

This groundwater monitoring and management plan (GMMP) has been prepared by Douglas Partners Pty Ltd (Douglas) for Stage 1 of the Northbank Enterprise Hub (NEH) at Lot 212 and Part Lot 211 DP 1174939, Westrac Drive, Tomago, NSW (the site).

Stage 1 and future stages of the industrial development, as defined on Drawing 1 in Appendix A, were approved under Environment Protection and Biodiversity Conservation Act (EPBC) approval 2007/3343. Stage 1 has been developed and WesTrac Pty Ltd (WesTrac) has operated a Caterpillar dealership and service centre on the site since 2012.

This GMMP includes a program for continued monitoring of groundwater conditions. The purpose of this GMMP is to monitor for potential impacts to groundwater level and quality that may arise from ongoing site use and implement appropriate management and mitigation strategies, where required. Improvements are based on a review of the results of available monitoring data, changes in site conditions and practices, and contemporary groundwater monitoring practices and provision for adaptive management.

This GMMP for Stage 1, incorporates groundwater monitoring and groundwater management measures, with reference to DCCEEW *Environmental Management Plan Guidelines* (DCCEEW, 2024). This GMMP replaces the Groundwater Monitoring Plan (GMP) approved by Department of Climate Change, Energy, the Environment and Water (DCCEEW) which listed a commitment to review and update the plan to ensure an effective monitoring program (“approved GMP (Douglas, 2010a)”).

This GMMP provides the following:

- A summary of the site and existing consent approvals, monitoring plan requirements and regulatory setting in the context of future stages of development ;
- Roles and responsibilities in relation to implementation of the GMMP;
- Updated environmental and condition assessment for the Stage 1 site and future stages of development;
- Conceptual hydrogeological model (CHM);
- Conceptual site model which identifies potential sources of contamination, main potential contaminants of concern (PCoC), environmental receptors and relevant potential pathways linkages;
- Summary of previous groundwater level and quality monitoring results and trends;
- Identification of potential impacts to groundwater for the Stage 1 developed site including risk evaluation of the mitigation measures which have been considered in the development of the revised monitoring network;
- Groundwater monitoring program comprising a nominated network of wells (new and existing) and nominated test parameters / PCoCs, field and QA/QC procedures, site specific trigger levels and a procedure for assessment of groundwater level and quality trends, review and reporting procedures, incident / pollution response and requirements for continuous improvement and adaptive management.

Douglas considers that implementation of this GMMP for Stage 1, along with the continued application of appropriate environmental management practices already in place, is expected to support the ongoing achievement of the GMMP objective to minimise potential groundwater and surface water impacts.

Table of Contents

	Page No
1. Introduction.....	1
2. Site identification	2
2.1 Site description.....	2
2.2 Consent approvals and staging.....	3
2.3 Monitoring plan requirements.....	4
2.4 Regulatory setting.....	6
2.5 Roles and responsibilities	6
3. Environmental Setting	8
3.1 Topography.....	8
3.2 Geology.....	8
3.3 Acid sulfate soils (ASS).....	9
3.4 Site vegetation	10
3.5 Climate.....	11
3.6 Aquifers.....	11
3.7 Surface water bodies	12
3.8 Groundwater receptors.....	12
3.8.1 Registered groundwater bores.....	12
3.8.2 Groundwater dependent ecosystems (GDEs)	13
3.8.3 Ramsar wetlands.....	14
4. Conceptual Hydrogeological Model (CHM)	15
5. Stage 1 Development.....	17
5.1 Pre-construction and following Stage 1 completion	17
5.2 Current Stage 1 Condition.....	18
5.3 Adjacent land uses.....	19
6. Review of previous monitoring and trends.....	21
6.1 Summary – 2024 review.....	21
6.2 Applicability of data set for derivation of site specific trigger levels.....	27
7. Preliminary conceptual site model and potential contaminants of concern	27
8. Potential groundwater impacts and management measures.....	30
9. Groundwater Monitoring Program	34
9.1 Monitoring Summary	34
9.2 Standards	35

9.3	Groundwater monitoring network.....	36
9.4	Maintenance or replacement of monitoring wells	38
9.5	Groundwater monitoring parameters and test frequency	38
9.6	Sampling and testing protocols.....	40
9.7	Assessment criteria.....	40
9.7.1	Groundwater levels.....	40
9.7.2	Groundwater quality.....	41
9.7.2.1	Overview	41
9.7.2.2	Adopted trigger levels.....	41
9.8	Assessment process and contingency measures.....	43
9.8.1	Groundwater levels.....	43
9.8.2	Groundwater quality.....	43
9.9	Environmental incidents / pollution events.....	46
9.10	Reporting.....	46
9.10.1	Exceedances or incidents.....	46
9.10.2	Annual reporting.....	47
9.11	Review and continuous improvement of the monitoring program and effectiveness	47
9.12	Summary of improvements to the GMMP.....	48
10.	Conclusions.....	49
11.	References	50
12.	Limitations.....	52

List of Appendices

- Appendix A:** Drawing 4 – Groundwater Monitoring Well Plan
- Appendix B:** About This Report
- Appendix C:** Consent Conditions:
- EPBC 2007/3343 - Tomago Road Industrial Development, Tomago, NSW
- Variation to Conditions attached to Approval EPBC 2007/3343
- Appendix D:** Sampling Methods
Soil Descriptions
Symbols and Abbreviations
Borehole Logs (Bores MW6 to MW11, MW8A, MW101 to MW107) – Douglas Partners
Borehole Logs (Bores MW1 to MW5) – Coffey
Table D1: Monitoring Well Summary
- Appendix E:** Table E1: Groundwater Quality Assessment Criteria for Bores in the Tomago Sandbeds (i.e. MW1A, MW6, MW10 to MW13)
Table E2: Groundwater Quality Assessment Criteria for Bores in the Clay Aquitard (i.e. MW02, MW04)
Figure E1: Groundwater Levels in Monitoring Wells (2007-2025)
- Appendix F:** Groundwater quality plots
Surface water quality plots
- Appendix G:** Site Photo Inspection Record

Abbreviations

AEMR	Annual Environmental Monitoring Report
AHD	Australian Height Datum
ASS	acid sulfate soils
BTEX	benzene, toluene, ethylbenzene, total xylenes
BOM	Bureau of Meteorology
CHM	conceptual hydrogeological model
CSM	conceptual site model
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DGV	default guideline value
DO	dissolved oxygen
Douglas	Douglas Partners Pty Ltd
D.P.	deposited plan
DPHI	Department of Planning, Housing and Infrastructure
EC	electrical conductivity
EPBC	Environment Protection and Biodiversity Conservation Act
HEPA	Heads of EPAs Australia and New Zealand and Australian Government Department of the Environment
HWC	Hunter Water Corporation
GDE	groundwater dependent ecosystem
GME	Groundwater monitoring event
GPT	gross pollutant trap
GMP	groundwater monitoring plan
LOSP	level of species protection
mg/L	milligrams per litre (or parts per million)
NATA	National Association of Testing Authorities
NEH	Northbank Enterprise Hub Pty Ltd
NEPM	<i>National Environment Protection Measure 1999 (as amended 2013)</i>
NEPC	National Environment Protection Council.
NPWS	National Parks and Wildlife Service
NSW	New South Wales
OCP	organochlorine pesticides
OPP	organophosphorus pesticides
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PCoC	potential contaminant of concern
PFAS	per- and poly-fluoroalkyl substances
ppm	parts per million
QA/QC	quality assurance / quality control
RFI	request for information
RL	reduced level
SGC	silica gel clean up
SWMP	Soil and Water Management Plan
TKN	Total Kjeldahl Nitrogen
TPH	total petroleum hydrocarbons
TRH	total recoverable hydrocarbons
TSS	total suspended solids
UCL	upper confidence limit

Groundwater Monitoring and Management Plan

Stage 1 Northbank Enterprise Hub

(EPBC Approval 2007/3343)

Lot 212 and Part Lot 211 DP 1174939, Westrac Drive, Tomago, NSW

1. Introduction

This groundwater monitoring and management plan (GMMP) has been prepared by Douglas Partners Pty Ltd (Douglas) for Stage 1 of the Northbank Enterprise Hub (NEH) at Lot 212 and Part Lot 211 DP 1174939, Westrac Drive, Tomago, NSW (the site). The GMMP was commissioned by Northbank Enterprise Hub Pty Ltd.

Stage 1 and future stages of the industrial development, as defined on Drawing 1 in Appendix A, were approved under Environment Protection and Biodiversity Conservation Act (EPBC) approval 2007/3343. Stage 1 has been developed and WesTrac Pty Ltd (WesTrac) has operated a Caterpillar dealership and service centre on the site since 2012.

An initial Groundwater Monitoring Plan (GMP) was prepared by Douglas (2010a) to cover the monitoring requirements for Stage 1 and future stages. The GMP was approved 2 February 2010 by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) (“approved GMP (Douglas, 2010a)”). The approved GMP (Douglas, 2010a) had a provision for review and update of the plan to ensure an effective monitoring program.

This GMMP for Stage 1, incorporates groundwater monitoring and groundwater management measures, with reference to DCCEEW *Environmental Management Plan Guidelines* (DCCEEW, 2024). This GMMP replaces the approved GMP (Douglas, 2010a).

The GMMP has been prepared for Stage 1 to document a procedure for continued monitoring and management of groundwater conditions (levels / quality). The purpose of this plan remains the same as the approved GMP (Douglas, 2010a); to monitor for potential impacts to groundwater that may arise from ongoing Stage 1 site use and implement appropriate management and mitigation strategies, where required. It is noted that this GMMP may be revised in future to meet the objectives of the plan and in consultation with relevant authorities as permitted in the EPBC Approval conditions.

This GMMP includes the following:

- A summary of the site and existing consent approvals, monitoring plan requirements and regulatory setting in the context of future stages of development;
- Roles and responsibilities in relation to implementation of the GMMP;
- Updated environmental and condition assessment for the Stage 1 site and future stages of development;
- Conceptual hydrogeological model (CHM);
- Summary of the current Stage 1 development and adjacent sites;

- Conceptual site model which identifies potential sources of contamination, main potential contaminants of concern (PCoC), environmental receptors and relevant potential pathways linkages;
- Summary of previous groundwater level and quality monitoring results and trends;
- Identification of potential impacts to groundwater for the Stage 1 developed site including risk evaluation of the mitigation measures which have been considered in the development of the revised monitoring network;
- Groundwater monitoring program comprising:
 - o Outline of the groundwater monitoring well network for level and quality monitoring, comprising eight monitoring wells;
 - o List of parameters/PCoC that must be monitored and the frequency of sampling and testing;
 - o Field sampling and quality assurance / quality control (QA/QC) protocols;
 - o Summary of site specific groundwater quality trigger levels developed from the historical data set monitoring;
 - o A procedure for the assessment of groundwater level and quality trends and contingencies measures in the event of exceedances;
 - o Reporting procedures, including a description of how to assess the effectiveness of the programme over time and the frequency of review;
 - o Requirements for review and continuous improvement of the monitoring program and effectiveness.

It is noted that the approved GMP (Douglas, 2010a) covered future stages of the development. This GMMP is now intended to cover Stage 1 only and not the other Stages, which will be subject to their own GMMP. The Stage 3 groundwater monitoring plan and groundwater management plan (Douglas, 2024a; 2024b) were approved by a delegate of the Minister on 12 July 2024. . A summary of the lots, stages and status of approvals are provided in Section 2.

This report must be read in conjunction with all appendices including the notes provided in Appendix B.

2. Site identification

2.1 Site description

The Northbank Enterprise Hub Estate comprises an industrial subdivision involving several stages of development) and is located south of Tomago Road, Tomago NSW, in the local government area of Port Stephens Council. The site is approximately 8 km south-west of Raymond Terrace and approximately 12 km north-west of Newcastle.

The Stage 1 site (WesTrac) is approximately 27 hectares as shown on Drawing 4 in Appendix A. The site is zoned IN1 General Industrial.

Stage 1 construction has occurred with:

- Earthworks for Stage 1 commenced in February 2010 and continued until November 2010;
- Stage 1 building works commenced in February 2011 and continued until July 2012;
- The Stage 1 industrial site is leased by WesTrac and was operational from July 2012.

Section 3 of this report provides an overview of the general environmental setting relative to the post construction environment. Section 5 provides further details on the Stage 1 development, current condition and activities, as well as a review of adjacent sites.

2.2 Consent approvals and staging

The Northbank Enterprise Hub Estate comprises an industrial subdivision site to be developed in stages. The industrial development was approved under bilateral agreement:

- Major Project Approval MP07_0086;
- Environment Protection and Biodiversity Conservation Act (EPBC) Approval 2007/3343.

Information on the lots, staging, status and monitoring requirements were provided by NEH as summarised in Table 1. The lot and stage boundaries are shown on Drawing 4 in Appendix A.

Table 1: Summary of site areas, approvals and monitoring requirements

Lot	Stage and current status	Requirements for monitoring	Revised GMMP
Lot 212 D.P. 1174939 and Part Lot 211 D.P. 1174939 by Major Project Approval MP07_0086.	<i>The ~27 hectare lot contains an industrial development.</i> The lot is owned by a third party and is leased/operated by WesTrac as its NSW / ACT headquarters. <i>Stage 1 Soil & Water Management Plan (SWMP) (ADWJ, 2010) and Groundwater Management Plan (Douglas, 2010a) approved by DCCEEW under EPBC 2007/3343.</i>	Pre-construction, during and post-construction as per the approved GMP (Douglas, 2010a).	Ongoing monitoring and management requirements outlined under this revised GMMP
Major portion of Lot 211 D.P. 1174939	The ~17.5 hectare lot is vacant. Regarded as Stage 2 and approved for future industrial development, however, remains undeveloped with no management plan approvals. The lot is owned by a third party and WesTrac has certain lease rights over the land for future expansion of its NSW / ACT headquarters.	No Stage 2 management plan approvals in place (or applied for yet).	Not covered by this revised GMMP

Lot	Stage and current status	Requirements for monitoring	Revised GMMP
Lot 210 D.P. 1174939 (construction pending)	The ~50 hectare lot is vacant. Stage 3 <i>Soil and Water Management Plan</i> and <i>Groundwater Management Plan</i> (Douglas, 2024b) approved by DCCEEW under EPBC 2007/3343. Baseline groundwater monitoring commenced in May 2023 prior to commencement of Stage 3 works. The monitoring forms part of the <i>Trigger Action Response Plan</i> .	Stage 3 management plans approved as described below. <ul style="list-style-type: none"> • <i>Groundwater Monitoring Program</i> (Douglas, 2025); • <i>Groundwater Management Plan</i> (Douglas, 2024b). Monitoring is required pre-construction (baseline), during and post-construction.	Not covered by this revised GMMP
Part Lot 1001 D.P. 1127780 Stage 4	The ~17 hectare portion of the lot is vacant. Regarded as Stages 4A and 4B and approved under EPBC 2007/3343 for future industrial development.	No Stage 4 management plan approval in place (or applied for yet).	Not covered by this GMMP

2.3 Monitoring plan requirements

The approved GMP (Douglas, 2010a) was prepared in consultation with Department of Water and Energy (DWE), now known as Department of Planning and Environment (DPE). The approved GMP (Douglas, 2010a) set out the agreed monitoring program, including the parameter types and the frequency of sampling and testing, the use of statistical analysis for setting trigger levels from where background concentrations were greater than default guideline value (DGV) criteria, assessment, reporting and review/update of the plan.

As noted in Section 6, annual environmental monitoring reports (AEMRs)/returns have been submitted to DCCEEW and Department of Planning, Housing and Infrastructure (DPHI) for review and assessment of compliance.

It is understood that in accordance with Condition 7 of EPBC Approval 2007/3343, a revised plan may be submitted to the Minister for approval. The approved GMP (Douglas, 2010a) listed a commitment to review and update the plan. This GMMP is a new document incorporating both monitoring and management measures to meet recommendations by Douglas to improve and refine the monitoring program. The GMMP is a contemporary document in line with current environmental guidelines and best practice and therefore it is appropriate in its replacement of the approved GMP (Douglas, 2010a).

The requirements of the EPBC approval and sections within this report are shown in Table 2.

Table 2: Sections addressing Conditions 2, 3 and 7 of EPBC approval

Requirements for Groundwater Monitoring Plan	Report Section
<p>2. In order to minimise potential significant impacts on the Hunter 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:</p> <p>a. documented industry best practice water sensitive design principles and practices;</p>	<p>N/A to this GMMP</p> <p>Included in approved GMP (Douglas, 2010a)</p>
<p>b. a review of the environmental values and water quality objectives for the Hunter Estuary Wetlands Ramsar site;</p>	<p>Section 3.8.3</p>
<p>c. replication of natural surface and groundwater flows and water quality;</p>	<p>Section 5.1 and 5.2</p>
<p>d. protection of the environmental values of receiving waters, including the Hunter Estuary Wetlands Ramsar site; and</p>	<p>Section 9.7</p>
<p>e. the principle of continuous improvement.</p>	<p>Section 9.11</p>
<p>The plan must include but not be limited to the following elements:</p> <p>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 Enterprises Pty Ltd -- Tomago Road, Tomago - Environmental Assessment Report dated 12 March 2008 "Concept Engineering, Servicing, Earthworks and Stormwater Management" Appendix F.</p>	<p>N/A to this GMMP</p> <p>Refer Surface Water Management Plan</p>
<p>b. how attainment of water quality objectives for these receiving waters will be supported by the action;</p>	<p>Section 9</p>
<p>c. how monitoring activities will be undertaken to track environmental performance of the action; and</p>	<p>Section 9</p>
<p>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</p>	<p>Section 9</p>
<p>3. If water quality measurements exceed the trigger levels set under the stormwater and groundwater management plan then works must stop immediately and the exceedance reported to the Minister within 7 days of detecting the exceedance. Failure to stop works and notify the Minister will be considered a breach of these conditions.</p>	<p>Refer Table 16 in Section 9.8.2 including modified timing for reporting</p>
<p>7. If the person taking the action wishes to carry out any activity otherwise than in accordance with the plans, reports or strategies referred to in this approval, the person taking the action may submit for the Minister's approval a revised version of any such plan, report or strategy. If the Minister approves such a revised plan, report or strategy, that plan, report or strategy must be implemented in place of the plan, report or strategy originally approved. Unless the Minister has approved the revised plan, report or strategy, then the person taking the action must continue to implement the plan, report or strategy originally approved under this approval.</p>	<p>Sections 9.1 and 9.11</p>

2.4 Regulatory setting

The legislation and guidelines that are considered most relevant for environmental management for the Stage 1 development are listed in Table 3.

Table 3: Environmental legislation and guidelines

Legislation / Guideline	Relevance / Applicability
Protection of the Environment Operations Act (1997) [POEO Act]	Key overarching legislation that enables the NSW Government to set out explicit policies for protection of the environment, including granting and administering Environmental Protection Licences (EPL).
Contaminated Land Management Act 1997 (as amended 2009) [CLM Act]	NSW Legislation for management of contaminated sites.
DECC Guidelines for the Assessment and Management of Groundwater (March 2007)	These guidelines are relevant for groundwater contamination in NSW. They stipulate the use of ANZECC (2000) guidelines which have since been superseded by ANZG (2018) and NEPC (2013) groundwater investigation levels (GILs) for 95% protection of aquatic ecosystems.
National Environment Protection Council, National Environment Protection Measure 1999 (as amended 2013) [NEPM 2013]	The NEPMs outline <i>national</i> objectives for protecting or managing aspects of the environment. These may be a combination of goals, guidelines, standards, or protocols.
NSW EPA Guidelines for Consultants Reporting on Contaminated Land, 2020	These guidelines provide a reporting framework for consultant reporting on the management of contaminated land.
Water Management Act 2000	Framework for the sustainable and integrated management of the water sources of the state for the benefit of both present and future generations.
NSW Aquifer Interference Policy	Policy that covers requirements for obtaining water licences for aquifer interference activities.
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The Act and regulations provide guidance to protect and manage nationally and internationally 'matters of national environmental significance' including plants, animals, habitats and places.

2.5 Roles and responsibilities

The identified roles and responsibilities in relation to the action are summarised in Table 4.

Table 4: Summary of roles and responsibilities for implementation of this GMMP

Role	Identification	Responsibility
Approval holder	Northbank Enterprise Hub Pty Ltd	<ul style="list-style-type: none"> Ensuring all conditions of the approval are met.
Environmental Manager	Torque Projects Pty Ltd	<ul style="list-style-type: none"> Overseeing implementation of the conditions of the approval; Preparation of Annual Compliance Reports.
Environmental Consultant	Douglas Partners Pty Ltd	<ul style="list-style-type: none"> Undertake monitoring requirements of the as per the GMMP Provide advice and recommendations arising from monitoring, inspections and/or incidents; Notify the Approval Holder and Environmental Manager with the results of assessments, non-conformances or actions required within the timeframes listed in the GMMP; Prepare monitoring reports; Update / revision of GMMP where required.
Person Taking the Action	WesTrac Pty Ltd	<ul style="list-style-type: none"> Undertaking all site activities in a manner that prevents environmental harm, consistent with the general environmental duty under the NSW Protection of the Environment Operations Act 1997, and to ensure compliance with all applicable statutory, regulatory obligations and conditions of the approval. Comply with all conditions of the approval. Incident and emergency response and notification of / environmental incidents to the Environmental Manager and Approval Holder to undertake appropriate actions.
Consent Authority	Minister	<ul style="list-style-type: none"> Setting and varying of consent conditions, approval of changes to management plans, monitoring compliance (thorough DCCEEW), enforcement of actions where required. Public reporting through the EPBC Act Public Portal.
	Department of Climate Change, Energy, the Environment and Water	<ul style="list-style-type: none"> Monitoring compliance with the approval conditions

3. Environmental Setting

3.1 Topography

The finished levels of the developed Stage 1 site is 2.5 metres Australian Height Datum (mAHD) around the perimeter road edges, with concrete floor levels for site buildings at RL 3.5 to 4 AHD. The Stage 1 surface water basin has an overflow weir at RL 1.34 AHD.

Based on 2 m mapped contours, elevations for future development sites are generally as follows:

- Predominantly 4 to 6 AHD to the north, comprising the vegetated areas of the Hunter Water Corporation borefield. Localised depressions < 4 AHD and rises up to 12 AHD are also mapped which are likely to be associated with dune formations and/or former mineral sand mining activities upgradient of NEH Estate;
- 0.5 and 2.0 AHD for the undeveloped Stage 2 area to the south and east of Stage 1 which generally comprises flat water-logged terrain;
- 3.5 to 4 AHD for the northern parts of the Stage 3 (Lot 210) to the west of Stage 1 which are dominated by low sand dune formations with elevations which are similar to levels along Tomago Road. The southern parts of Stage 3 and Stages 4A and 4B are similarly low lying RL 0.5 and 1.0 AHD;
- < 2 AHD for areas to the south of Stage 1, including the low-lying wetland areas which drain to the Hunter River.

3.2 Geology

Reference to the NSW Seamless Geology mapping indicates four mapped zones as shown in Figure 1:

- (1) QP-bd: Coastal deposits of marine-deposited and aeolian-reworked coastal sand dunes; partially consolidated, located on the elevated areas (i.e. sand dune formations).
- (2) QP_brs: Coastal deposits comprising fine to medium-grained quartz-lithic-carbonate (marine-deposited) sand, organic-rich mud, peat.
- (3) QH-es: Estuarine swamp comprising organic-rich mud, peat, clay, silt, very fine to fine-grained sand (marine-deposited), fine- to medium-grained sand (fluvially deposited).
- (4) QH_er: Estuarine shoreline ridge and dune deposits comprising fine- to medium-grained lithic-quartz sand (fluvially deposited), very fine- to fine-grained lithic-carbonate-quartz sand (marine deposited), polymictic gravel, silt, clay, shell material.

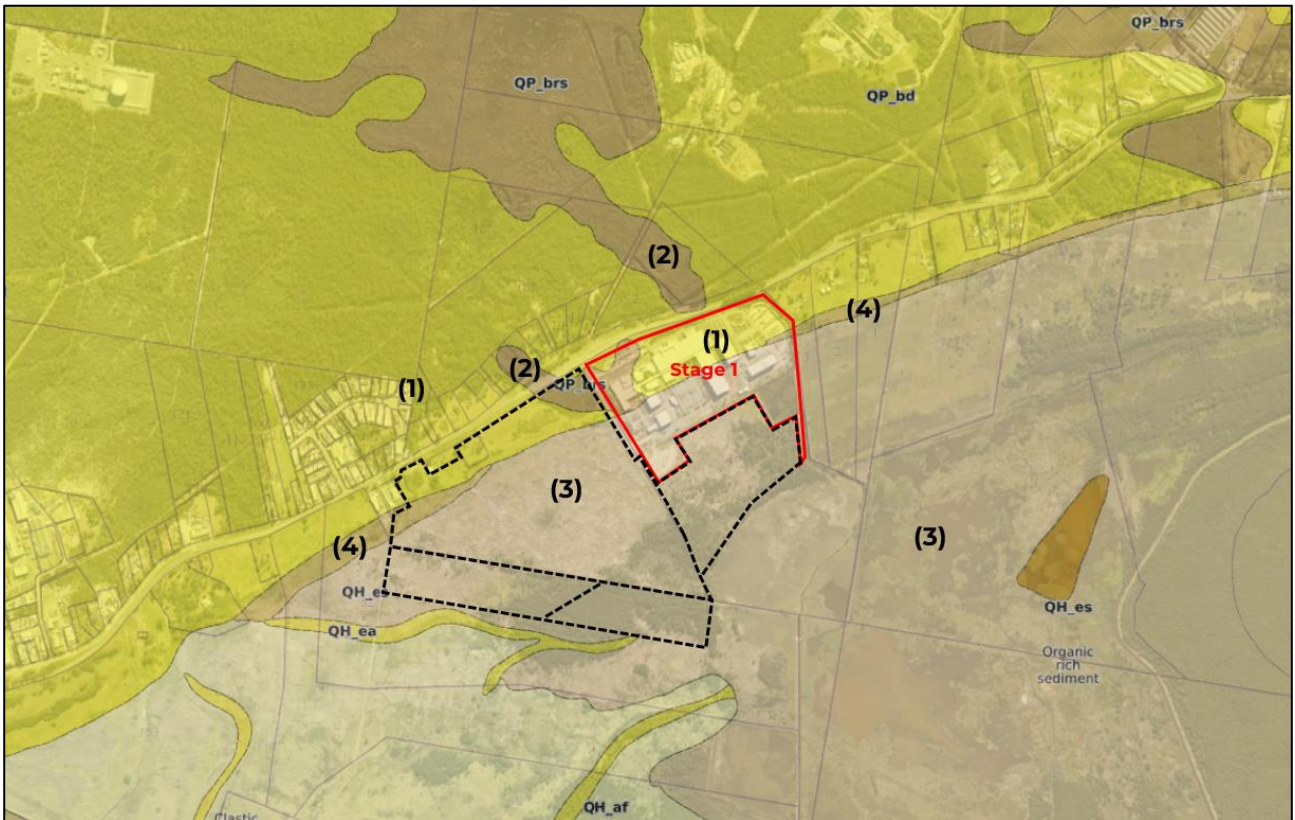


Figure 1: NSW Seamless Geology Map (Base Image source: MetroMap 2023)

3.3 Acid sulfate soils (ASS)

ASS typically occur at levels of approximately RL 5 AHD or below, but typically at elevations less than 1 AHD in coastal environments.

Most of the site lies within an area of high risk of ASS conditions, most likely to be present between 1 m to 3 m below the ground surface, corresponding to lower-lying areas. The northern portion of the site fronting Tomago Road and on higher ground lies within an area of low probability of ASS conditions, which if present is mostly likely at greater than 3 m below the ground surface, corresponding to the Aeolian sandplain, elevation >4 m).

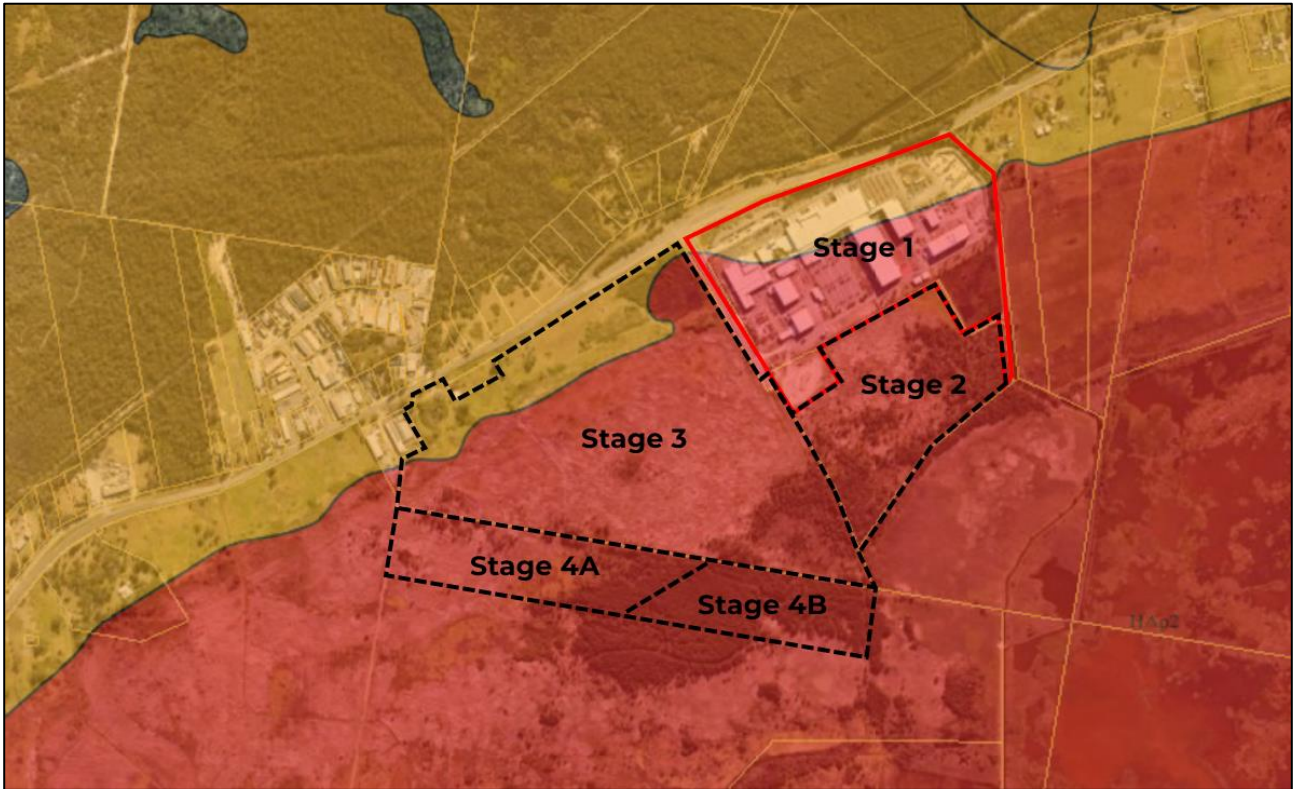


Figure 2: ASS Risk Map. Site boundary shown in red (Base Image source: MetroMap 2023)

Previous testing on the Stage 1 site indicated:

- The alluvial soils below RL 1.5 comprising clays and sands soils were potential ASS;
- The aeolian sands above RL 1.5 to 8.5 across the northern portion of the site were not ASS.

It is noted that ASS environments are often associated with low/ acidic pH conditions in soil and groundwater, which can be magnified where potential ASS are exposed to varying wet and dry conditions.

An ASS management plan was prepared for Stage 1 and implemented during construction. The review of long term groundwater data and trends in Section 6.1, noted that there were no obvious long term trends to suggest impacts from the Stage 1 development which includes ASS.

3.4 Site vegetation

Stage 1 vegetation generally comprises:

- Medium shrubs and trees within the landscaped areas of the developed site;
- Reeds and grasses within the drainage swales;
- Mature trees around the eastern and southern perimeter areas of the site the site which comprise the watercourse flow paths.

3.5 Climate

The regional climate of the project area is subtropical, characterised by with more rain in the summer and autumn.

The closest Bureau of Meteorology (BoM) station to the site is Williamtown (station 061078), where climate monitoring started in 1942. The mean annual rainfall is 1126.8 mm and the mean annual evaporation is 1734.2 mm (i.e. evaporation exceeds rainfall on an annual basis).

The highest rainfall typically occurs in March (126.9 mm on average) and the lowest in September (60.2 mm on average). Figure 3 compares the available mean monthly rainfall to the evaporation data. Evaporation exceeds rainfall for most months, except May and June.

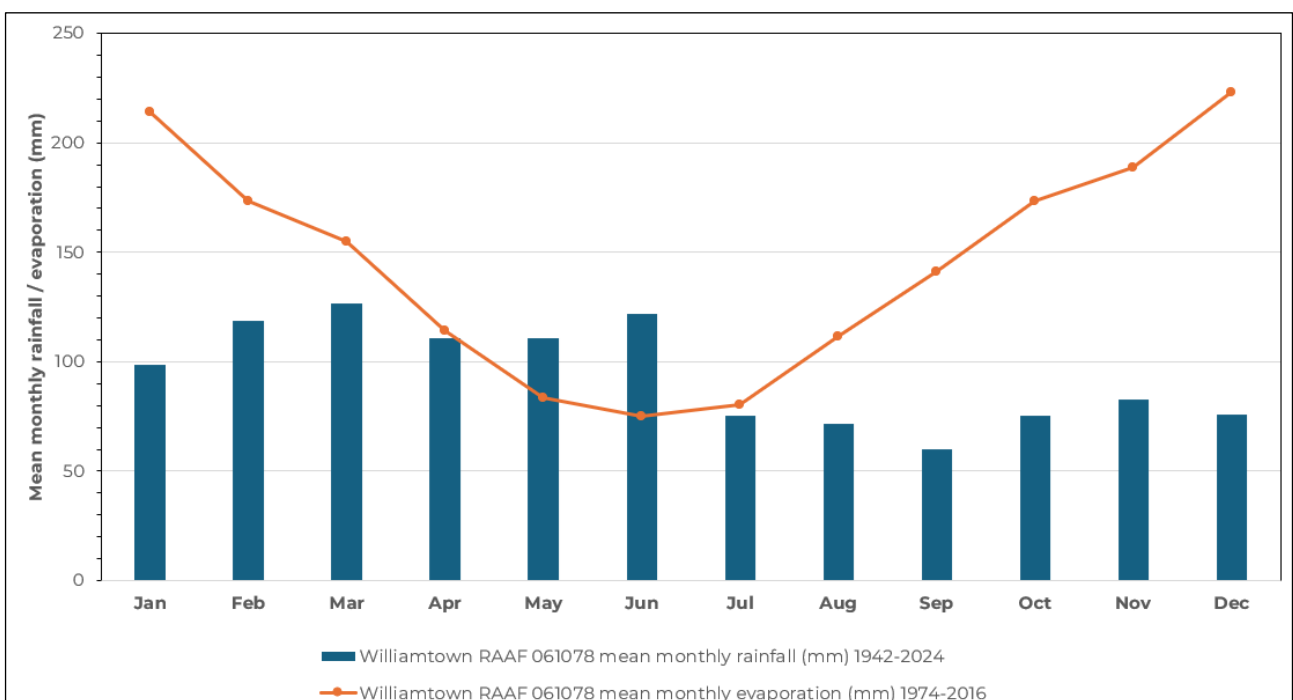


Figure 3: Mean monthly rainfall and evaporation

Average climate conditions at the site are expected to be similar to the Williamtown station located 8.3 km north-east. Higher variations can be expected for specific localised rainfall events.

3.6 Aquifers

Two groundwater systems are present within the site area:

- The aquifer within the Tomago Sandbeds daylight in the northern portion of Stage 1 and extends north to include an extensive water-extraction bore field operated by Hunter Water Corporation (HWC). The aquifer is unconfined north of the site and semi-confined where clay soils overlie the Tomago Sandbeds. As discussed below, groundwater flows from the bore field and towards the Stage 1 site.
- The aquitard within the Quaternary clay soils overlying the Tomago Sandbeds in most of the project area (refer (3) on Figure 1 NSW Seamless Geology). The aquitard acts as a semi-confining layer.

3.7 Surface water bodies

A drainage diversion swale/channel is located within and adjacent to the northern Stage 1 site boundary. The swale collects groundwater that daylights from the north and directs it east around the site toward and into the Stage 1 drainage basin. It is understood that the level of the northern diversion swale was designed to intercept groundwater in periods of elevated levels so as to not restrict flow volumes or flow paths by the constructed Stage 1 development and make groundwater available for downstream infiltration via the southern swales (i.e. mimicking pre-development conditions).

Drainage swales are also located on the southern side of the Stage 1 development which collect and treat surface water (post collection and gross pollutant trap (GPT) treatment). Overflows of surface water are directed into the drainage basin located in the south-eastern corner of Stage 1.

A number of caisson wells are also positioned along the swale alignments for infiltration of water into the Sandbeds aquifer. The caisson wells were installed to depths of about 1 m below ground level and infiltrate water into the upper parts of the Sandbed aquifer, just below the clay aquitard.

The low-lying areas on the adjacent sites to the east (rural), west (Stages 3, 4A and 4B) and south (Stage 2) regularly contain surface water at the surface, derived from groundwater flows from the north as well as surface water runoff. Surface water flows generally follow the topography in these areas, however, flows are also directed by existing manmade open channels (former farm drains) to convey surface waters further downstream and alleviate surface ponding. Stage 1 surface water flows are directed onto Lot 22 D.P. 1150980 for dispersal prior to entering the head of the North South Drain.

Surface water flows in low-lying areas to the west and east are complex and at times influenced by sediment build and vegetation build up which can reduce drainage conveyance in the manmade drains.

Ultimately, surface water flows towards the Hunter River (North Arm) which is located to the south-west and south of the site, varying in distance from about 2.7 km to 3.5 km. Fullerton Cove is located about 1.5 km east-south-east of the site.

3.8 Groundwater receptors

3.8.1 Registered groundwater bores

A search of the publicly available registered groundwater bore database indicates there is only one registered groundwater bore within 500 m of the site as shown in Figure 5. It is noted that the published records provided limited information only which is summarised in Table 5.



Figure 4: Registered groundwater bores relative to Stage 1 boundary. 500 m buffer shown in white

Table 5: Summary of registered landholder bores within 500 m of the site

GW ID	Purpose	Status	Location Relative to Site	Depth (m)	Drillers Log	Remarks
GW079563	Monitoring bore	Unknown	~230 m north-east, upgradient. North of Tomago Road	-	-	Hunter Water Corporation Tomago Bore SK350

3.8.2 Groundwater dependent ecosystems (GDEs)

Mapped GDEs in the vicinity of the site, based on the BoM GDE Atlas, primarily pertaining to groundwater dependent terrestrial vegetation, are shown in Figure 5.

A mapped area of a high potential GDE comprising Parramatta red gum/ fern-leaved banksia and Melaleuca sieberi swamp woodland is located to the south within Stage 2, however slightly extended into the south-eastern portions of Stage 1 downgradient of the basin. It is understood that ecological fieldwork mapping by others assessed this area to be Swamp Oak Forest. The GDEs within Stage 1 and future stages of development are approved for clearing, with offsets provided for in Lot 22.

More broadly, potential GDEs are also mapped:

- Upstream / north of the site within the Tomago Sandbeds including:

- o High probability and low to moderate potential terrestrial GDEs: smooth-barked apple/blackbutt/ old man banksia woodland on coastal sands;
- o High probability and high potential terrestrial GDEs: Parramatta red gum/ fern-leaved banksia and Melaleuca sieberi swamp woodland;
- Downstream / south of the site within for areas fronting the Hunter River including:
 - o High probability and low to high potential terrestrial GDEs: mangrove low closed forest (mangrove swamps);
 - o Moderate potential aquatic GDE from national assessment: wetlands (shown in blue in Figure 5).

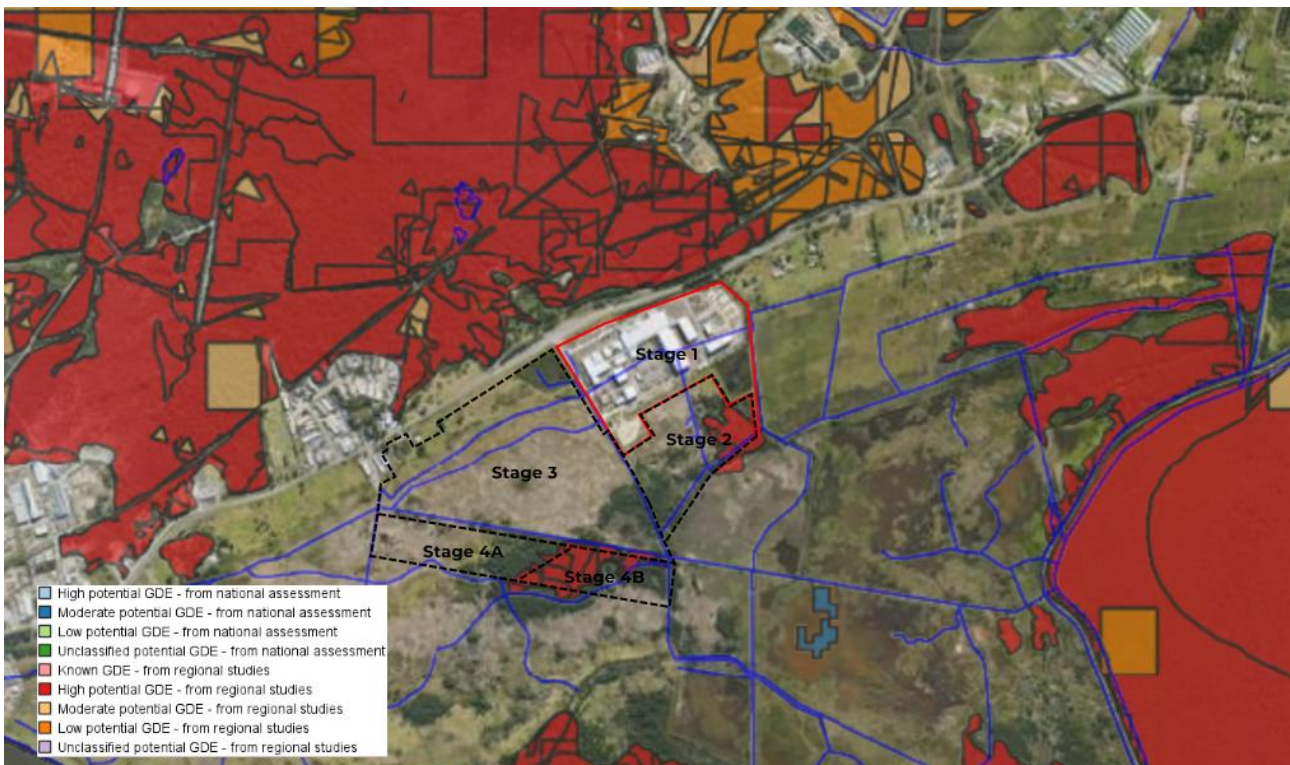


Figure 5: Mapped GDEs. Site boundary shown in red (Base Image source: MetroMap July, 2024)

3.8.3 Ramsar wetlands

The Hunter Wetlands National Park is located to the south and east of the Stage 1 site, varying in distance from about 200 m (south-east), 600 m (south) and 3 km south-west and makes up part of the Hunter Estuary Wetlands Ramsar site. The Ramsar site extends to the Hunter River (North Arm) and Fullerton Cove located about 2 km east-south-east of the site as shown in Figure 5 above. The wetlands are important for a number of species including migratory birds.

Surface water, comprising both surface water runoff and groundwater emanating as surface water from Stage 1, overflows on to Lot 22 for dispersal prior to overflowing into the head of the North South Drain. The North-South Drain is a deeply incised drain that conveys water to the Hunter River at low tide. The drain contains a flood gate at Lot 22 to protect the private upstream land from tidal inundation.

The Ramsar Wetlands comprise a mix of freshwater and estuarine wetlands that mostly receive water from rainfall, surface water bodies and tidal flows. The Ramsar Wetlands include Fullerton Cove located east which is a shallow, circular embayment. The fully tidal mangrove forest of Fullerton Cove and associated wetlands are bounded and separated by perimeter levees and drains.

The hydrology of the Tomago Wetlands has been significantly altered over the past two centuries through the construction of drainage and flood systems, dredging and reclamations to prevent flooding on private lands north and west of the wetlands.

Due to the effect of the perimeter levee and drainage system constructed in 1976, the Tomago Wetlands receive less direct saline water than prior to levee connection and regular tidal inundation.

It is understood that a rehabilitation project was designed by the NSW Department of Industry and Investment (DII) to restore tidal flooding of the Ramsar Wetlands (DII, 2011) to re-establish saltmarsh vegetation. The project included tidal structures to permit controlled inundation of river water to flood approximately 450 hectares of land inside and upstream of the Hunter River perimeter levee. The Kooragang Ramsar Wetland Ecological Character Description document (Brereton, 2010) indicates that tidal inflows account for about 90% of the inflows fluxes into the estuary, which suggests that fresh surface water inflows overall, may be a relatively minor contribution to the overall system.

It is understood that management of the Hunter Estuary Wetlands Ramsar site is a multi-faceted effort involving various plans, such as the Ecological Character Description document (Brereton, 2010) which provides a baseline for monitoring changes, the Hunter Wetlands National Park Plan of Management (NPWS, 2020), and the Hunter Estuary Coastal Management Program (MCC, 2023).

4. Conceptual Hydrogeological Model (CHM)

Groundwater beneath the site comprise four primary geological units (Units) (from shallowest to deepest):

1. Unconfined alluvial aquifers in the Hunter River alluvium;
2. A low permeability clay aquitard within the clay profile acting as a semi-confining layer to the underlying sand beds;
3. A sand aquifer within the underlying Tomago Sandbeds. This aquifer is unconfined in the northern part of the Stage 1 site where the clay layer is absent and semi-confined (leaky) where the clay aquitard overlies the sand beds; and
4. The underlying bedrock, which is interpreted to be mostly impermeable (aquiclude) and at significant depth below the site.

Groundwater monitoring wells have been installed at the site in Units 1, 2 and 3 (as described above). The underlying sand aquifer is interbedded with clay layers and there may be some vertical differences with depth. Site monitoring wells in Unit 3 are typically shallow within the profile for the assessment of potential development impacts.

Groundwater monitoring has typically encountered groundwater:

- At RLs typically > 1 AHD up to 1.7 AHD within the unconfined aquifer, which includes the fill placed below the Stage 1 development area;
- At RLs ranging from 0 to 0.9 AHD in lower lying areas (i.e. Stage 2 and eastern and southern areas of Stage 1) within the unconfined aquifer and clay aquitard profile. At times groundwater has been above ground surface representing overflows from the unconfined aquifer;
- At RLs ranging from 0.3 to 1.2 AHD for deeper screened wells in the Tomago Sandbeds.

The full record of groundwater level monitoring at the site, including the adjacent Stage 3 monitoring wells, is included in Figure E1 in Appendix E and discussed further in Section 6.

Groundwater flow on the Stage 1 site is to the south and south-east, with the main recharge coming from the Sandbeds to the north as evidenced by HWC monitoring bore SK3520 and monitoring wells within the northern boundary of Stage 1.

Rainfall infiltration in the main area of Stage 1 is expected to be minimal due to the impervious surfaces. Rainwater from buildings is collected in a 2 ML rainwater tank for re-use as grey water. Other surface water is directed to holding tanks and then via GPTs is directed towards the southern swales which assist with groundwater re-infiltration and are supplemented by re-infiltration wells screened in the underlying sand aquifer. Surface water overflows remain, and these are directed to the main surface water basin the southern part of Stage 1.

Rainfall infiltration is expected to be limited on the southern lower lying parts of Stage 2. This is partly due to the low permeability of the soil and partly due to the low-lying nature of the ground resulting in groundwater levels close to the surface and thereby inhibiting infiltration. As a result, water is predominantly evident in the existing surface drains at the southern downstream boundary of the site.

Evapotranspiration rates in the vegetated areas of Stage 1 (swales) and Stage 1 basin site are expected to be relatively high due the shallowness of the groundwater.

Groundwater flow is expected to be split vertically by the presence of the estuarine swamp deposits, with some flowing up over the swamp deposits and discharging as seepage from the toe of the aeolian sands on the northern parts of the site. It is expected that the seepage discharge to surface flows will be subject to a combination of flow into surface drains, re-infiltration to groundwater within the swamp deposits and evapotranspiration, the relative proportions of which will vary depend on prevailing climatic conditions.

Shallow groundwater flows downstream of the site are altered by the presence of the existing surface watercourses and drains excavated under previous land uses. These drains previously removed ponded surface water efficiently including near surface groundwater from the site draining the water in multiple directions including to the east and south-west and eventually discharge to the Hunter River.

It is noted that the downstream landscape of the wetlands has been altered by the introduction of tidal inundation via the North South Drain which is deeply incised below wetland ground levels. It is understood that the estuarine waters may have progressed over 1 km further in land than previously.

5. Stage 1 Development

5.1 Pre-construction and following Stage 1 completion

Initial investigations undertaken for development approval and prior to construction noted that the proposed development had the potential for the following impacts as noted in the approved GMP (Douglas, 2010a):

- Lowering of water table leading to oxidation of acid sulphate soils;
- Surface contamination from construction and site usage leaching into water table; and
- Leaching of contamination or suspended solids from filling. Douglas considers that this is an unlikely scenario.

The design of the now constructed Stage 1 development was undertaken to replicate the existing groundwater regime. Key aspects relevant to groundwater management that were enacted included the following:

- A swale on the northern side of the development to direct groundwater and surface water flows around the perimeter of the site in periods of elevated levels;
- On site surface water management features including drains, GPTs, swales and caisson infiltration wells to replicate infiltration of water into the groundwater table;
- A surface water basin for capture and management of final surface water runoff (i.e. that does not infiltrate via other means);
- Placement of appropriate bulk fill with appropriate drainage properties to facilitate groundwater flow through fill and beneath the site to replicate the pre-development conditions.

The following improvements have also been undertaken to the monitoring program since completion of Stage 1 and in addition to the requirements of the approved GMP (Douglas, 2010a):

- Installation of a refined hydrocarbon / oil sensor at the Stage 1 basin outlet for an increased level of monitoring of potential contaminant risks to the surface water basin. The sensor:
 - o Records level readings at 10 minute intervals;
 - o Contains an alarm which if triggered, notifies the operators for a response which may include inspection and/or an additional surface water quality monitoring event;
- Following recommendations by the Environmental Consultant, additional monitoring wells were installed to improve the monitoring network;
 - o MW1A for assessment of upgradient conditions and replacement for damaged well MW1;
 - o New upgradient well MW12 as an alternative to MW3 (located within Stage 3 area).
 - o New well MW13 installed downgradient of Stage 1 in November 2024;
- Commencement of PFAS testing groundwater monitoring wells (MW4, MW8A) from January 2024, and extending to all other wells and surface water in August 2024 (MW1A, MW2, MW6, MW10, MW11, MW12, SW1 to SW3).

The available monitoring data reviewed indicates variable results between sampling events, however, there are no obvious long term trends to suggest impacts from the Stage 1 development. A summary of the key trends in groundwater level and quality to date are discussed in Section 6.

5.2 Current Stage 1 Condition

The completed Stage 1 development comprises the WesTrac NSW/ACT headquarters.

An environmental inspection was undertaken by a senior environmental engineer from Douglas on 19 November 2024 to “review land uses and potential contamination sources” as per the approved GMP (Douglas, 2010a) requirement to monitor the effectiveness of the program. The inspection was also undertaken to assess the current site activities and condition of the site and inform a preliminary conceptual site model with sources, pathways and receptor linkages relevant to ecological receptors.

The inspection record and photographs are included in Appendix G. A chemical inventory was also provided by WesTrac pertaining to chemicals stored and used on the property.

The findings of the inspection and supplementary information for Stage 1 are summarised as follows:

- Site activities include:
 - o General office / support activities undertaken within dedicated buildings: WesTrac Institute (building A), administration (building B), cafeteria (building D), and connecting walkways (building H);
 - o Machinery repairs/rebuild, servicing, parts storage etc within dedicated site buildings (buildings F, G, J K, L);
 - o Storage of heavy machinery (new and servicing), machinery parts etc within buildings and hardstand / compacted pavement areas across most of the site;
 - o Remote operation testing of excavators and equipment in the demonstration bay located in the south-western corner of the Stage 1 site (part Lot 211). This included periodic digging within a dedicated soil stockpile for equipment trial;
 - o Wash down of equipment within dedicated wash bays (buildings N, M);
 - o Chemical storage including bulk oils provided within a bunded dedicated storage areas, minor volumes of diesel, hydraulic and coolants in self-bunded containers (building P);
 - o Minor chemical storage within dedicated interior areas of concrete floored workshop buildings including coolants, lubricants, paints, primers, solvents, silicon, silicon spray, degreasers, cleaning products, methylated spirits, aerosol spray cans;
 - o Disposal of all wastes in dedicated areas/bins for off-site disposal;
 - o Staff vehicle parking primarily on hardstand / compacted surfaces;
 - o Collection of rainwater in tanks for on-site re-use as grey water for amenities;
 - o Surface water management comprising kerbs/drains, underground holding tanks, GPTs and then discharge to swales and caisson wells;

- o Landscaping and maintenance of the general grounds, including vegetated swales (mowing, slashing and removal of excess vegetation);
- o Above ground LPG storage (south of building G) which is subject to inspections and testing. Upgrade of isolation valves was undertaken late 2024.
- o Sewer connection has been made to the HWC wastewater network;
- Surface water:
 - o Surface water was observed flowing in the northern and southern perimeter swales towards the Stage 1 basin. Vegetation varied within and near the perimeter of the swales, including small to medium trees, shrubs and grasses. Surface water was moderately turbid in some areas;
 - o The southern perimeter swales contained grasses, reeds and shrubs and varied in some parts. Vegetation die back was observed, mostly on the higher sides of the swales which did not routinely collect or contain ponded water. The surface water in swales contained some evidence of iron precipitation for stagnant water;
 - o The surface water basin contained a significant amount of water. The basin contained some perimeter vegetation, as well as floating vegetation and birdlife;
 - o There were no indications of hydrocarbon slicks or impact to the surface water in the swales or basin.

The inspection indicated that general site environmental practices were being undertaken with appropriate consideration of managing potential environmental risks, including appropriate storage of chemicals, management of wastes, potential spills and protection of drainage infrastructure.

It is understood that environmental inspections are routinely undertaken by WesTrac to maintain the facility, prevent environmental incidents and to make improvements where required.

5.3 Adjacent land uses

Adjacent sites were assessed in conjunction with the environmental inspection on 19 November 2024 as discussed above. The inspection was limited to areas available for viewing from the public areas of Tomago Road the Stage 1 site to assess the general land activities. The summary presented below has also included a preliminary review of aerial photographs and online resources.

Table 6: Summary of adjacent site uses and activities – November 2024

<p>North</p>	<p>This area is zoned at SP1 Special Activities and primarily comprises an extensive bushland area forming the drinking water bore field operated and managed by Hunter Water Corporation. The area also includes the Grahamstown Water Treatment Plant with facilities to treat 257 ML of water per day. The plant utilises conventional water treatment processes including coagulation/flocculation, sedimentation, filtration, pH correction, disinfection and fluoridation.</p> <p>The site also includes the electrical and mechanical maintenance (EMM) Depot which is also operated by HWC. It is presumed that the depot undertakes ancillary electrical and mechanical commercial/industrial works to support the main treatment plant.</p> <p>Parts of the HWC operated sites, located within the Tomago Sandbeds aquifer, were subject to sand mineral mining by RZM Pty Ltd (RZM) in the 1980s to mid-1990s. The process of the sand mining activities have indicated some impact to groundwater in the locality, including elevated iron, sulphate and low pH outside the default guideline values (DGV) for fresh water quality.</p> <p>The Sandbeds aquifer is also known to contain metals including cadmium, chromium, manganese and zinc at concentrations which regularly exceed DGVs. Treatment is also undertaken to meet drinking water criteria prior to water supply.</p>
<p>East</p>	<p>There are ten RU2 rural landscape allotments to the east of Stage 1 which contain rural residences and generally seem to be used for non-intensive agricultural activities (grazing, hobby farming etc). The properties contain residences, farm sheds, farming equipment/machinery. Most of the areas viewed from Tomago Road indicate the landscape is mostly grassed, with some mature trees and areas of overgrown vegetation and weeds. Wet ground conditions are expected for the southern areas mapping indicates contain farm drains to assist with surface water direction.</p> <p>Some amount of surface water would be expected to flow from these properties towards Stage 1 via the eastern swales and surface water overflows in the south-eastern corner of the Stage 1 site and into the head of the North South Drain and Ramsar restoration project.</p>
<p>South</p>	<p>Stage 2, located south of Stage 1, remains undeveloped.</p> <p>The low lying areas of Stage 2 and further south contains grassed areas and thick marshland vegetation which is typically waterlogged. Existing farm drains remain in place which have been periodically cleared of vegetation to assist with surface water flows.</p>
<p>West</p>	<p>The Stage 3 and Stage 4A and 4B sites are located to the west of Stage 1 . The area contains thick marshland vegetation which is typically waterlogged. Existing farm drains remain in place which have been periodically cleared of vegetation to assist with surface water flows.</p> <p>Further west, a number of industrial / commercial premises were present. These included mechanics, storage depot, scrap metal recyclers and chemical manufacturing. These properties are not considered upgradient of Stage 1.</p>

6. Review of previous monitoring and trends

6.1 Summary – 2024 review

A review of groundwater monitoring was conducted by Douglas (Douglas, 2024c) in connection with preparation of this GMMP. The review included the following:

- reviewing the approved GMP (Douglas, 2010a) requirements ;
- Compilation of the available monitoring data;
- Comments on groundwater level and groundwater / surface water quality trends based on plots of groundwater level (head) and quality for key parameters;
- Comments on exceedances of the default assessment criteria in the approved GMP (Douglas, 2010a) and the significance of exceedances;
- Overall assessment of the performance of monitoring conducted at the time of reporting;
- Recommendations regarding future monitoring.

Key information from the review is summarised as follows:

- Groundwater monitoring program:
 - o A review of the monitoring program in the approved GMP (Douglas, 2010a) identified opportunities for improvement in light of the fact construction of Stage 1 was completed in 2012 and the site has been operating as an industrial facility since 2012.
 - o Opportunities for improvement include establishment of trigger levels as well as changes to the monitoring network.
- Assessment criteria:
 - o In the absence of site specific trigger levels in the approved GMP (Douglas, 2010a), assessment of the available groundwater and surface water quality monitoring data was undertaken by comparison to standard guideline values which were generally those nominated in the approved GMP (Douglas, 2010a) and considered to be inherently conservative;
 - o Exceedances of the standard water quality guidelines occurred for most monitoring events, for example metals, which are known to regularly exceed guideline values for the locality and groundwater aquifer. The exceedances were noted in the groundwater monitoring event (GME) reports by the Environmental Consultant and typically included a comparison of the data against a spreadsheet of the minimum/maximum range and the previous GME results as standard protocol;
 - o Re-sampling events were instigated on five occasions to confirm the significance of the results and whether further action was required. The laboratory testing regime was also extended on a number of occasions;
 - o No significant increasing, adverse trends or concerns were identified from the investigations;

- Monitoring network:
 - The groundwater monitoring well network has been extended as follows:
 - MW1A for assessment of upgradient conditions and replacement for damaged well MW1 – installed August 2024;
 - New upgradient well MW12 as an alternative to MW3 (located within Stage 3 area) – installed August 2024;
 - New well MW13 was installed downgradient of Stage 1 in November 2024 to capture the Stage 1 activities. This well was installed as an outcome of the Douglas (2024c) review.
- Groundwater level trends:
 - Groundwater levels are consistently higher levels for wells located in the northern elevated areas fronting Tomago Road compared to wells in the low-lying areas which were often similar to surface levels;
 - Groundwater levels for wells in the low-lying areas (MW2, MW6, MW4) are substantially controlled by the low site levels and drainage channels and their effectiveness to direct flows further downstream;
 - For lower rainfall events, wells located in the low-lying areas, which are typically screened in the clay aquitard, showed lesser response to rainfall compared to those screened in the Tomago Sandbeds (MW8A, MW101, MW102, MW103, MW105);
 - HWC Bore SK3520 located 250 m north-east and upgradient of Stage 1 has indicated similar, but often higher groundwater levels, than MW3 and MW8/M8A indicative of groundwater flows coming from the Sandbeds to the north. The monthly groundwater levels at SK3520 range from as low as 1.1 AHD to as high as 3.4 AHD. Groundwater levels (head) at Bore SK3520 generally increase following rainfall, however, at times there are apparent delays to the response in groundwater levels. In some instances, such as 2015, there was no obvious correlation between high rainfall events and elevated groundwater levels. The results suggest that groundwater levels at HWC Bore SK3520, as well as upgradient groundwater conditions in the bore field extraction area and more generally, are likely to be affected by bore field pumping activities and/or delayed effects of recharge as noted above;
 - Overall the groundwater level monitoring data suggested a range within the expected bounds of natural variability, although the levels on the northern parts of the site may be influenced by upgradient pumping activities by third parties;
 - The dataset was considered to be normalised (controlled) for the set time of the annual monitoring (March/April) and assisted in the assessment of long term trends.
- Groundwater and surface water quality data trends:
 - The water quality data showed the two groundwater systems have different chemistry, and this was often reflected in the wide range of values reported both spatially and temporally. In some instances, there was a clear trend of higher or lower concentrations for a parameter at a particular location, both above and below the default guideline value;
 - Although the data set indicated variable water quality results between sampling events, there were no obvious long term trends which suggested impacts from the Stage 1 development;

- o It is considered that the variability could be expected due to the transient nature of groundwater and surface water. Variability may also have been influenced by construction impacts during the earlier monitoring period, differences in field sampling techniques, laboratory test methods and detection limits, upstream activities such as pumping and downstream activities which may influence the ability of groundwater / surface water to flow / drain;
- o The general observations regarding water quality trends for key parameters from Douglas (2024c) are presented in Table 7 below.

Table 7: Key pertinent observations from groundwater water level and groundwater quality plots

Item	Groundwater	Surface water
pH	<p>pH in groundwater has varied widely between monitoring events. Wells screened in the clay (MW2, MW4 and MW6) have generally been at higher pH ranges and mostly within the 6.8-8.5 ANZG DGV. Wells screened in the Tomago Sandbeds generally indicated lower pH values. Low pH is common for the area regionally and could be due to a number of reasons including former sand mining within the broader Tomago Sandbeds (upgradient); podzol soils in coastal dunes; and acid sulfate soils. pH at the site would be affected by rainfall events. The range of values identified are not considered uncommon.</p>	<p>Similar to groundwater, pH in surface water has varied widely between monitoring events. This has included pH for upgradient monitoring locations (SW3 and Graham Drive). Overall pH for surface water is slightly higher than groundwater. Fewer upgradient surface water monitoring locations were sampled due to dry conditions.</p>
EC	<p>EC has been relatively consistent between monitoring events. The notably low values reported in 2013 are considered likely to be erroneous as they are inconsistent with rainfall data. Similar to pH, higher EC is evident for wells screened in the clay aquitard. Wells screened in the Tomago Sandbeds were generally lower in EC and fresher owing to the freshwater catchment of the Tomago Sandbeds. The data suggests a reasonably consistent EC profile for each well, and a clear difference between well strata. The values are considered representative of the general site locality, and therefore exceedances of the ANZG and ADWG criteria are not of concern.</p>	<p>EC has been relatively consistent for between monitoring events and indicates low EC and fresh conditions which is consistent with rainfall and runoff.</p>
Nutrients	<p>Ammonia, nitrate, nitrite and total Kjeldahl nitrogen (TKN) are test methods to report forms of nitrogen. Concentrations have varied over the monitoring period. The nitrogen state can be dependent on pH and temperature and in mangrove / low lying areas can change with periods of wetting and drying. MW4 has indicated higher concentrations of ammonia which are typically greater than the ANZG criteria. MW6 was also elevated periodically and there was a single spike in MW2 in 2021 which subsequently returned to more typical concentrations. There is no ANZG (2022) criteria for total phosphorus (TP) and so the ANZECC (2000) value for NSW & Victorian east flowing coastal rivers in a marine setting has been adopted. TP is notably variable over the monitoring period, with similar variability to ammonia. Overall, higher nutrients are apparent for wells in the clay aquitard which is likely to be attributed to the organic rich clay soils rather than runoff impacts from site activities.</p>	<p>Lower ammonia, nitrate and TP concentrations were apparent for surface water. TKN concentrations in surface water concentrations were similar overall, but spikes in concentrations were typically higher. As noted for groundwater, nitrogen states can be dependent on pH and temperature and fluctuations may influenced by the variable pH for surface water. Nutrient concentrations may also be influenced by animal/bird populations that inhabit the basin. Overall, the nutrients indicate periodic spikes but do not suggest increasing trends that could adversely affect downstream water quality.</p>

Item	Groundwater	Surface water
Metals	<p>Most metals concentrations were below the ANZG and NHRMC criteria for most events.</p> <p>Occasional exceedances occurred for dissolved arsenic and nickel, however, concentrations have typically been below the guideline value for the subsequent monitoring event. Monitoring during the initial period suggest possible elevated results which may be due to sampling or filtration methods.</p> <p>Manganese, iron, copper, chromium, were regularly above the current ANZG criteria, with most exceedances for wells screened in the clay aquitard. Exceedance of ANZG criteria for such metals is a common occurrence in groundwater in the region and is often due to naturally occurring processes. Iron and manganese concentrations in the Tomago Sandbeds have been influenced by past sand mining activities.</p> <p>It is noted that metals are often more soluble in groundwater at lower pHs. The variable pHs in groundwater identified may therefore contribute to the variability of dissolved metals between monitoring events.</p> <p>Limited data for aluminium and iron are available, however, they are included in this GMMP for ongoing monitoring. Overall, metals results do not suggest an increasing trend and appear to show values within a typical range of natural variability.</p>	<p>The metals testing has comprised dissolved metals (filtered) and total metals (non-filtered), however, this has not been consistent between monitoring events.</p> <p>Dissolved metals allow a comparison with groundwater results, whereas, total metals concentrations are more representative of actual conditions reflecting metals which may be suspended in surface water due to soil-bound particulates. Future monitoring would benefit from testing of both metal states.</p> <p>The variability in metals may be influenced by sample handling and the presence/absence of particulates for the particular sampling event.</p> <p>In most instances, metals concentrations were higher for downgradient locations (SW1, SW2) which are located in vegetated drains/basins and as such these results are not unexpected or significantly different to groundwater conditions.</p>
Pesticides	<p>The detection limits for pesticides have varied over the period of monitoring, and have been lower for recent monitoring. OCP and OPP pesticides have not been detected above the laboratory PQL.</p> <p>Unless land use changes alter, it is considered that pesticides could be removed from the Stage 1 approved GMP (Douglas, 2010a).</p>	<p>Similar to groundwater, OCP and OPP pesticides have not been detected above the laboratory PQL for surface water.</p>
Hydrocarbons, phenols	<p>Hydrocarbon as TRH, fractions of BTEX and phenols have been identified at times. Phenols were identified at MW2 in 2010 and 2021. Resampling was not recommended by the Environmental Consultant, but subsequent well clean out was completed at the time. Subsequent annual events from 2016 to 2020 did not identify phenols. An elevated result in 2021 was re-tested and indicated concentrations below the laboratory PQL. Phenol has not been identified in 2022, 2023 or 2024.</p> <p>Low level hydrocarbons have been identified periodically. In most instances, silica gel clean up testing was undertaken which indicated the hydrocarbons were from a natural/organic source rather than a petroleum based source and were attributed to organics present in the clay aquitard.</p> <p>The monitoring has not indicated the presence of increasing hydrocarbon trends or a contaminant plume.</p>	<p>Similar to groundwater, hydrocarbons have been detected periodically above the laboratory PQL for surface water. Silica gel clean up testing has indicated the hydrocarbons were from a natural/organic source rather than a petroleum based source.</p>

Item	Groundwater	Surface water
PFAS	<p>PFAS were not included in the approved GMP (Douglas, 2010a), however, some wells were subject to testing from January 2024. Trace levels have been identified at most of the locations tested. Based on the limited data available, there are no obvious spatial trends (i.e. upgradient / downgradient and clay/Sandbeds wells are comparable).</p> <p>Based on the trace concentrations of PFAS identified and recent experience in the local area, the concentrations of PFAS identified in groundwater at the site are likely to be indicative of urban conditions which contain PFAS in the environment at trace concentrations.</p>	<p>PFAS testing in surface water was undertaken in August 2024 and indicated trace concentrations which were similar to groundwater and considered representative of urban background conditions.</p>

It is noted that where groundwater quality results were suggested to be elevated above the DGV, or previous range of results, further assessment was generally undertaken and documented in each monitoring report. At times, elevated results were attributed to high suspended sediments, particularly in the instance of surface water monitoring locations.

Updated water quality plots for groundwater and surface water to January 2025 are included in Appendix F.

6.2 **Applicability of data set for derivation of site specific trigger levels**

The monitoring data from 2013 captures long term groundwater and surface water conditions based on the March/April annual sampling events. From 2015, field sampling methods, laboratory test methods and detection limits detailed in monitoring reports were reasonably consistent, which is aligned with a period of lesser variability between each monitoring event.

Based on the dataset available, Douglas considers that the monitoring data from 2015 to January 2025 (inclusive) is suitable for the adoption of site specific trigger levels. This approach recognises that groundwater in the region can have background levels of various parameters, in particular metals, with concentrations higher than the ANZG (2018) DGVs. Therefore the groundwater monitoring data available will be used to provide a statistical assessment of the background levels to allow adoption of appropriate assessment criteria, for relevant parameters.

Discussion on the process of trigger level adoption is detailed in Section 9.7.2.

7. **Preliminary conceptual site model and potential contaminants of concern**

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM provides the framework for identifying potential contamination sources (S), receptors (R) and potential exposure pathways either in the present or the future. It enables an assessment of the potential source – pathway – receptor linkages which are considered as “complete pathways”.

Based on the environmental inspection, previous testing to date and relevant other site information, the potential sources of contamination and associated contaminants of potential concern (CoPC) are summarised in Table 8.

Table 8: Summary of potential sources

Potential sources and associated CoPC
<p>On site sources</p> <p>S1: Chemical use, storage, spills, wash down, machining, general industrial/commercial activities as noted in Section 5.2 and 5.3 CoPC include TRH, BTEX, PAH, metals, VOC, solvents, PFAS, PCB</p> <p>S2: Landscaping maintenance, weed spraying etc CoPC: glyphosate, Round Up</p>
<p>Off-site sources</p> <p>S3: Rural agricultural land use activities east and upgradient (cropping, maintenance, farming) CoPC: microbiological contaminants, nutrients, pesticides (OCP/OPP)</p> <p>S4: Drinking water treatment works to the north associated with HWC borefield (treatment, depot etc) CoPC: flocculants (aluminium), acids/alkalis for pH adjustment, fluoride, chlorine, hydrocarbons, PFAS, nutrients, metals</p> <p>S5: Former sand mining activities within the extensive upgradient catchment CoPC: metals, sulphates, low pH</p> <p>S6: Runoff from Tomago Road, and upgradient reserves CoPC: TRH, BTEX</p>

The assessment of pathways has considered the environmental receptors and relevant potential pathways in Table 9. Human health receptors on site have not been considered as groundwater/surface water are not utilised on site, nor within the downgradient environmental areas.

Table 9: Summary of potential environmental receptors and pathways

Potential environmental receptors
<p>ER1: Surface water – on site [Stage 1 swales, Stage 1 basin]</p> <p>ER2: Surface water – downgradient / off site [surface water drains, Hunter River estuary (estuarine environmental) and Hunter River (estuarine / saline)]</p> <p>ER3: Groundwater (on site and off site)</p> <p>ER4: Terrestrial ecosystems (on site and off site)</p>
<p>Potential pathways to environmental receptors</p> <p>EP1: Surface water run-off</p> <p>EP2: Leaching of contaminants and vertical migration into groundwater</p> <p>EP3: Vertical migration into groundwater via caisson wells and swales</p> <p>EP4: Lateral migration of groundwater providing base flow to water bodies</p>

The following potential environmental receptors, along with relevant potential pathways, have been identified and summarised in Table 10.

Table 10: Summary of potentially complete exposure pathways to environmental receptors

Source and CoPC	Exposure pathway	Receptor
<p>S1: Chemical use, storage, spills, wash down, machining, general industrial/commercial activities as noted in Section 5.2 and 5.3. CoPC include TRH, BTEX, PAH, VOC, solvents, PFAS, metals, PCB</p> <p>S2: Landscaping maintenance, weed spraying etc CoPC: glyphosate, Round Up</p>	<p>EP1: Surface water run-off</p> <p>EP4: Lateral migration of groundwater providing base flow to water bodies</p>	<p>ER1: Surface water – on site [Stage 1 swales, Stage 1 basin]</p> <p>ER2: Surface water – downgradient / off site [surface water drains, Hunter River estuary]</p> <p>ER4: Terrestrial ecosystems (on site and off site)</p>
<p>S3: Rural agricultural land use activities east and upgradient (cropping, maintenance, farming) CoPC: nutrients, pesticides (OCP/OPP)</p> <p>S4: Drinking water treatment works to the north associated with HWC borefield (treatment, depot etc) CoPC: flocculants (aluminium / sulfate), acids/alkalis for pH adjustment, fluoride, hydrocarbons, PFAS, nutrients, metals within groundwater</p> <p>S5: Former sand mining activities within the extensive upgradient catchment CoPC: metals (iron, cadmium, chromium, manganese, zinc), sulphates, low pH</p> <p>S6: Runoff from Tomago Road, and upgradient reserves CoPC: TRH, BTEX</p>	<p>EP2: Leaching of contaminants and vertical migration into groundwater</p> <p>EP3: Vertical migration into groundwater via caisson wells and swales</p>	<p>ER3: Groundwater (on site and off site)</p>

Although OCP/OPP are noted as potential PCoC, as discussed in Section 6, OCP/OPP have not been identified above LOR in the previous ten years of monitoring. OCP/OPP are legacy contaminants typically associated with intensive agriculture/farming activities and are not regulated for use in Australia (i.e. are not expected to be in current use). Removal of OCP/OPP from the monitoring test parameters is considered appropriate on this basis.

PFAS has been included in the monitoring program going forward considering the current site activities, and potential for PFAS to migrate from other sites. PFAS has been identified in upgradient and downgradient wells at trace / low concentrations in groundwater (and surface water) based on the limited testing to date. The PFAS concentrations identified are considered to be indicative of concentrations present in the urban environment. It is also understood that PFAS has been identified as a key CoPC for the Hunter Estuary Ramsar site and agencies are undergoing assessment and action planning regarding potential changes to estuary character from PFAS (DCCEEW, 2025). It is anticipated that PFAS testing as part of this GMMP could assist in the broader Ramsar studies by DCCEEW and other agencies. On the basis of the site inspection and information presented above, Douglas considers the main potential contaminants of concern for inclusion in the monitoring program to be as follows:

- Total recoverable hydrocarbons (TRH);
- Polycyclic aromatic hydrocarbons (PAH);
- Benzene, toluene, ethyl benzene, xylene (BTEX);
- Polychlorinated biphenyl (PCB);
- Heavy metals – Al, As, Cd, Cr, Pb, Mn, Hg, Mo, Ni, Zn, Fe;
- Per- and polyfluoroalkyl substances (PFAS);
- Nutrients.

Chlorinated hydrocarbons or solvents could be considered for addition to the monitoring program if other indicator contaminants are identified, for example TRH/BTEX, or if field observations during sampling suggest the potential for impact to groundwater.

As per the contingency plans following, additional CoPC must be added to the program at the advice of the Environmental Consultant, such as in the event of a spill, relevant to the incident.

8. Potential groundwater impacts and management measures

The Stage 1 development was designed and constructed to replicate the natural groundwater conditions and flow regime. The approved GMP (Douglas, 2010a) identified potential impacts to groundwater associated with both construction and longer term site use. Management and mitigation measures were implemented during construction and included subsurface drains, swales, infiltration wells, in addition to use of appropriate fill materials to meet environmental and geotechnical requirements.

For the developed Stage 1 site, impacts associated with construction are no longer considered relevant. Long term monitoring conducted post construction has indicated variable results between monitoring events, however, there are no obvious long term trends to suggest impacts from the Stage 1 development (refer Section 6.1). Continued mitigation of potential groundwater impacts, however, are required long term for Stage 1.

With reference to the DCCEEW EMP guidelines (DCCEEW, 2024), the identified potential effects of the Stage 1 development on groundwater and identified management measures are summarised in Table 11. The assigned risk rating is based on the tables following.

Table 11: Summary of Identified Potential Effects on Groundwater and Risk Evaluation (refer accompanying tables)

Potential effects	Description	Groundwater Management Measures	Risk Assessment - Post-Development and Ongoing		
			Likelihood	Consequence	Risk rating
Reduction of the groundwater table due to reduced infiltration (identified in approved GMP (Douglas, 2010a))	Lowering of water table leading to oxidation of ASS because of reduced infiltration into the site and increased hardstand areas. Douglas considers that this scenario is unlikely given that swales surface water basins will more likely allow for increased infiltration at recharge locations. Historical monitoring has not shown impacts and the as constructed design is performing as predicted.	<ul style="list-style-type: none"> • Stage 1 was designed and constructed to replicate the existing flow regimes, which included a northern swale to manage groundwater flows in high flow conditions and redirect downstream; • Stage 1 included design of subsoil drains to an invert level that replicated groundwater levels; • Use of appropriate drainage material; • Swales, infiltration wells and basin pond implement return of runoff of to the groundwater table and surface watercourses. • Routine inspection and maintenance of swales, infiltration wells, surface water management ponds to confirm appropriate functioning; • Appropriate design and implementation of the groundwater quality monitoring program, assessment of level trends against historical data set, adoption of contingency measures (Section 9.8 of this GMMP). 	Unlikely	Minor	Low
Leaching of contamination or suspended solids from filling	Leaching of contamination or suspended solids from filling.	<ul style="list-style-type: none"> • Stage 1 has been constructed with placement of appropriate fill with low contaminant levels. Historical monitoring has not shown impacts. Appropriate design and implementation of the groundwater quality monitoring program, assessment of trends against historical data set, adoption of contingency measures (Section 9.8 of this GMMP) will continue assessment of potential impacts; • Future importation of fill (if any), would require confirmation of low contaminant concentrations and demonstration of “fit for purpose” from a contamination and geotechnical perspective. 	Unlikely	Moderate	Low
Changes to downgradient groundwater (level/flows)	Changes to downgradient groundwater level, and to a lesser extent, flow directions due to construction of impervious surfaces and redistribution of runoff from the stormwater management system on site.	<ul style="list-style-type: none"> • Implementation of surface water management measures as per approved SWMP; • Routine inspection and maintenance of swales, infiltration wells, surface water management ponds to confirm appropriate functioning; • Appropriate design and implementation of the groundwater quality monitoring program, assessment of level trends against historical data set, adoption of contingency measures (Section 9.8 of this GMMP); • Review and continuous improvement of the monitoring program and effectiveness (Section 9.12). 	Possible	Minor	Low
Contamination of groundwater and surface water post development	Contamination from site activities reaching the groundwater tables and/or surface water.	<ul style="list-style-type: none"> • Implementation of surface water management measures as per approved SWMP; • Implementation of environmental management practices for site operation such as appropriate storage of chemicals, bunding, spills prevention, detection devices and waste management (refer current conditions in Sections 5.1 and 5.2); • Implementation of incident management procedures for environmental incidents / pollution events and notification to the Environmental Manager and/or Environmental Consultant to assess the event, review the suitability of measures and advise of any additional actions, reporting and notifications as per Section 9.9; • Monitoring using refined hydrocarbon / oil sensor at the Stage 1 basin outlet; • Appropriate design and implementation of the groundwater quality monitoring program, assessment of trends against historical data set, adoption of contingency measures (Section 9.8 of this GMMP); • Review and continuous improvement of the monitoring program and effectiveness (Section 9.11). 	Unlikely	Moderate	Low

Potential effects	Description	Groundwater Management Measures	Risk Assessment - Post-Development and Ongoing		
			Likelihood	Consequence	Risk rating
Leaching of contamination or suspended solids from filling	Leaching of contamination or suspended solids from filling.	<ul style="list-style-type: none"> Stage 1 has been constructed with placement of appropriate fill with low contaminant levels. Historical monitoring has not shown impacts. Appropriate design and implementation of the groundwater quality monitoring program, assessment of trends against historical data set, adoption of contingency measures (Section 9.8 of this GMMP) will continue assessment of potential impacts; Future importation of fill (if any), would require confirmation of low contaminant concentrations and demonstration of "fit for purpose" from a contamination and geotechnical perspective. 	Unlikely	Moderate	Low
Changes to downgradient groundwater (level/flows)	Changes to downgradient groundwater level, and to a lesser extent, flow directions due to construction of impervious surfaces and redistribution of runoff from the stormwater management system on site.	<ul style="list-style-type: none"> Implementation of surface water management measures as per approved SWMP. Routine inspection and maintenance of swales, infiltration wells, surface water management ponds to confirm appropriate functioning; Appropriate design and implementation of the groundwater quality monitoring program, assessment of level trends against historical data set, adoption of contingency measures (Section 9.8 of the GMMP); Review and continuous improvement of the monitoring program and effectiveness (Section 9.11). 	Possible	Minor	Low

Table 11A: Environmental Risk Likelihood (adapted from DCCEEW (2024))

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 project
Possible	Might occur during the life of the project
Unlikely	Could occur but considered unlikely or doubtful
Rare	May occur in exceptional circumstances

Table 11B: Environmental Risk Consequence (adapted from DCCEEW (2024))

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 11C: Environmental Risk Rating (adapted from DCCEEW (2024))

	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

In summary, the potential risks and impacts as a result of the ongoing Stage 1 site use are expected to be low and managed by implementation of this overall GMMP.

9. Groundwater Monitoring Program

9.1 Monitoring Summary

The groundwater monitoring program is summarised in Table 12 with the nominated monitoring wells shown on Drawing 4 in Appendix A and discussed in the following sections.

The revised monitoring program focusses on 'ongoing monitoring' as defined in the approved GMP (Douglas, 2010a) given that Stage 1 construction is complete.

The approved GMP (Douglas, 2010a) included monitoring for Category 1 (field parameters, pH, EC, TSS) and Category 2 parameters (cations and anions) at three monthly (quarterly) and 6 monthly (biannual) intervals and proposed periodic review of the plan with the potential to relax these requirements based on the results of the ongoing monitoring.

The review of monitoring results indicates that the monitoring at an annual interval provides a reasonable characterisation of site conditions, provided the testing is undertaken at a similar time each year, that being April/May. No adverse trends have been identified in them to date. The Category 1 and 2 parameters are considered to be of limited value on their own for standalone monitoring events as they assist to inform general conditions and interpretation of laboratory testing data, rather than identifying potential impacts due to site practices.

Monitoring at an annual frequency is therefore proposed. The Category 3 parameters have been combined with the former Category 2 parameters to provide a comprehensive laboratory suite.

Table 12: Summary of monitoring program for Stage 1

Parameters	Ongoing monitoring (Stage 1 complete)
Wells to be monitored	MW1A, MW02, MW04, MW06, MW10, MW11, MW12, MW13 as per Table 11 in Section 9.3
Category 1 (field parameters)	12 Monthly
Category 2 (laboratory parameters)	12 Monthly
Water levels	12 monthly in conjunction with groundwater quality monitoring events
Notification of exceedances	As per Table 13 in Section 9.8.2 for actions prompted by monitoring results
Reporting	12 Monthly
Monitoring program review	12 Monthly in routine monitoring reports
	Formal review and update five yearly as per Section 9.11

It is understood that development of future stages, will require preparation of stage specific monitoring and management plans for approval by the Minister. As several monitoring wells for Stage 1 monitoring (MW4 and MW6) are located within Stage 2 and Stage 3, a review and update of this monitoring program would be required if the wells cannot be retained and/or no longer meet the intended monitoring rationale (refer Table 14 in Section 9.3). Re-establishment of quarterly (three monthly) monitoring for these wells would be recommended during construction of Stage 2 or Stage 3 as such works have the potential to impact the groundwater being monitored under this GMMP.

9.2 Standards

The standards in Table 13 have been identified for groundwater monitoring.

Table 13: Summary of relevant standards

Item	Reference Standard
Groundwater monitoring installation well	<ul style="list-style-type: none"> • <i>Minimum Construction Requirements for Water Bores in Australia</i> (NUDLC, 2020).
Groundwater level and quality monitoring procedures	<ul style="list-style-type: none"> • Monitoring sampling, testing and assessment of groundwater shall be undertaken by appropriately qualified hydrogeologists or environmental scientists. • NEPC. (2013). <i>National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM]</i>. 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Appropriately qualified hydrogeologists or environmental scientists.

9.3 Groundwater monitoring network

Groundwater level and quality for the current Stage 1 development must be monitored using the nominated network of eight wells as shown on Drawing 4 in Appendix A and summarised in Table 14.

The nominated wells are located to assess groundwater conditions spatially as follows:

- Upgradient – groundwater flowing towards the site from adjacent / upgradient sites (two wells);
- Mid-site – i.e. downgradient of the developed Stage 1 area, and upgradient of Stage 2 (three wells);
- Downgradient – groundwater from both the developed Stage 1 and undeveloped Stage 2 areas (three wells).

Table 14: Summary of monitoring network

Well ID	Stage location	General target rationale	Comments	Screened aquifer
MW1A	Stage 1	Upgradient	Upgradient of Stage 1 near boundary. Installed in 2024. Replacement for MW1.	Tomago Sandbeds / Aeolian Sands
MW02	Stage 1	Downgradient of Stage 1 developed area and basin	Downgradient of Stage 1 near boundary. Subject to previous long term monitoring .	Clay aquitard
MW04	Stage 3 (off site)	Downgradient of Stage 1 developed area	Downgradient of Stage 1 and 2. On boundary of Stage 2-3. Subject to previous long term monitoring.	Clay aquitard
MW06	Stage 2	Downgradient of Stage 1 developed area	Downgradient of Stage 1. Near Stage 2 boundary. Subject to previous long term monitoring.	Clay aquitard
MW10	Stage 2	Downgradient of Stage 1 developed area	Downgradient of Stage 1 and screened at a depth to assess reinfiltration wells. Subject to previous long term monitoring.	Tomago Sandbeds (semi-confined)
MW11	Stage 1	Downgradient of Stage 1 developed area	Downgradient of Stage 1 and screened at a depth to assess reinfiltration wells. Subject to previous long term monitoring.	Tomago Sandbeds (semi-confined)
MW12	Stage 1	Upgradient	Upgradient of Stage 1 near boundary. Installed in 2024 Alternative upgradient location for MW3 located in Stage 3 and no longer operational	Tomago Sandbeds / Aeolian Sands (unconfined)
MW13	Stage 1	Downgradient of Stage 1 developed area	Downgradient location for Stage 1 (Demonstration Area). Installed in 2024 as recommended by Douglas.	Tomago Sandbeds (semi-confined)

The location of the eight wells, together with the long term data set, allows for assessment of trends in groundwater level and quality and potential impacts from on-going site use.

Well logs are included in Appendix D and are to be read in conjunction with the preceding notes. A summary of the monitoring wells strata and installation depths is provided in Table D1, also in Appendix D.

9.4 **Maintenance or replacement of monitoring wells**

Periodic maintenance of groundwater monitoring wells can at times be required to remove tree root / organics from the well screens or sediment build up. Assessment of the requirement for such maintenance will be undertaken during the scheduled monitoring. The general procedure for well maintenance / clean-out, if required, includes removal of obstructions using a suitable method (i.e. down hole pressure jet) followed by and redevelopment of the wells to remove introduced tap water to re-establish a connection between the well and the aquifer. Details of any well maintenance should be detailed in the monitoring report.

If wells are damaged or not performing as intended, reinstallation/replacement will be required as soon as practicable and within three months. Alternative locations for long term monitoring will be at the advice of a suitably qualified groundwater consultant and will require revision and approval the GMMP.

9.5 **Groundwater monitoring parameters and test frequency**

The groundwater quality parameters to be monitored capture a range of general water quality indicators and PCoC based on the results of previous monitoring of current and continued use for commercial / industrial activities.

Table 15: Summary of groundwater level, field, laboratory testing and frequency

Wells to be monitored	As per Table 13 in Section 9.3
Frequency of monitoring	12 monthly (except during any construction phases as per Table 12 in Section 9.1)
Category 1 Parameters (Field parameters)	<ul style="list-style-type: none"> • Temperature (T) • pH • Electrical Conductivity (EC) • Dissolved oxygen (DO); • Oxidation-reduction potential (ORP) • Turbidity.
Category 2 Parameters (laboratory)	<ul style="list-style-type: none"> • Total Suspended Solids (TSS) • Cations: <ul style="list-style-type: none"> – Calcium (Ca) – Potassium (K) – Sodium (Na) – Magnesium (Mg) • Anions as general water quality indicators <ul style="list-style-type: none"> – Chloride (Cl) – Sulphate (SO₄) – Bicarbonate (HCO₃⁻) – Carbonate (CO₃²⁻) – Total alkalinity – Fluoride (F) • Nutrients: <ul style="list-style-type: none"> – Nitrate (NO₃) – Nitrite (NO₂) – Ammonia (NH₃) – Total Kjeldahl Nitrogen (TKN) – Total Phosphorous (PO₄⁻) • Heavy metals (dissolved): <ul style="list-style-type: none"> – Aluminium (Al) – Arsenic (As) – Cadmium (Cd) – Chromium (Cr) – Copper (Cu) – Iron (Fe) – Lead (Pb) – Manganese (Mn) – Mercury (Hg) – Molybdenum (Mo) – Nickel (Ni) – Zinc (Zn)
	<ul style="list-style-type: none"> • Total recoverable hydrocarbons (TRH) • Polycyclic aromatic hydrocarbons (PAH) • Benzene, toluene, ethyl benzene, xylene (BTEX) • Polychlorinated biphenyl (PCB) • Phenols • Per- and polyfluoroalkyl substances (PFAS)
Groundwater levels	12 monthly in conjunction with groundwater quality monitoring event

If the results of field observations or initial laboratory testing indicate exceedances of the adopted criteria or results which warrant further consideration, additional laboratory testing and further review may be required such as:

- Hydrocarbon detection:
 - o Speciation testing via the total petroleum hydrocarbon (TPH) silica gel clean up method to assess for the presence of petroleum and/or non-petroleum based hydrocarbons;
 - o Review of laboratory chromatograms for assessment of the possible hydrocarbon source/type.

- Metals:
 - Speciation testing to further assess the significance of the result e.g. Cr (III), Cr (VI);
- Re-testing of the sample where elevated suspended solids are present;
- Comparison of total and dissolved metals where elevated suspended solids may have influenced the result.

The assessment criteria are shown on Table E1 and E2 in Appendix E and discussed in Section 9.7. It is noted that not all parameters have an assigned criterion.

9.6 Sampling and testing protocols

The recommended sampling protocol is low-flow sampling which is consistent with the most recent monitoring and is in line with standard industry practice. The sampling must comprise:

- Low flow purging 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;
- Reporting (NSW EPA, 2020).

Laboratory testing will be undertaken at a NATA-accredited chemical laboratory. Testing will be undertaken to LORs which allow for comparison against the assessment criteria, where possible, noting that guideline values at times can be updated to levels that are below reporting limits. In situations where testing is undertaken at higher LORs (e.g. due to low water sample volume, high suspended sediments, dilution by the laboratory due to matrix interferences from analytes etc) or guideline values change to impractical test levels, the results of the water quality will be reviewed for adequacy (including past results) to determine if additional sampling, testing or assessment is required.

The assessment criteria are shown on Table E1 and E2 in Appendix E.

9.7 Assessment criteria

9.7.1 Groundwater levels

Groundwater levels will fluctuate with variations in climatic conditions. Assessment of groundwater level trends will therefore require:

- General comparison with the long term data set;
- Consideration of climatic conditions measured at Williamtown Meteorological Station;
- Consideration of groundwater levels for upgradient wells which will influence groundwater levels and conditions flowing onto the site, including pumping and release of water as part of the HWC operations;
- Consideration of possible downstream influences, such as changes to tidal inundation, flooding, levee bank failure etc which may affect drainage and surface water conveyance for Stage 1.

Variations in groundwater levels which are inconsistent with rainfall trends and/or outside the range of measured historical fluctuations may prompt further review or action, where considered appropriate.

9.7.2 Groundwater quality

9.7.2.1 Overview

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, could be adopted however 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 20th/80th percentile calculations from the baseline data.

It is proposed that unit specific trigger levels be used for monitoring bores screened in the Tomago Sandbeds aquifer and those in the overlying clay soils, given the difference in water chemistry of the two groundwater systems.

Typically, the guidelines (ANZG 2018) recommend the 80th 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 20th percentile of the baseline data (i.e. pH which is expressed as an upper range by the 80th percentile and lower range by the 20th percentile to provide a trigger level range, commensurate with the generic ANZG pH criteria).

ANZG (2023) notes that the beneficial use of groundwater should be considered in adopting site specific criteria. However, in the absence of identified downgradient drinking water users, beneficial re-use of groundwater for drinking water purposes has not been considered.

9.7.2.2 Adopted trigger levels

As summarised in Section 6.2, based on the dataset available, Douglas considers that the monitoring data from 2015 to January 2025 (inclusive) is suitable for the adoption of site specific trigger levels which were not established in the approved GMP (Douglas, 2010a).

Groundwater flowing towards the site from the Tomago Sandbeds is low in salinity and is considered to be a fresh water environment. The downgradient receiving environment and GDEs are considered to be an estuarine environment, receiving saline/marine tidal surface water flows which inundate the low-lying land areas of the Ramsar wetlands.

In the absence of estuarine criteria, ANZG (2018) marine water guidelines are considered appropriate in the development of water quality objectives, and considering the most sensitive receptor (wetlands).

A level of species protection (LOSP) of 95% has been considered in the review of ANZG default guidelines and marine waters in the absence of estuarine specific criteria. This level is consistent with the previous consent approvals and assessment of water quality to date and applies to 'slightly to moderately disturbed systems. As noted in Section 3.8.3, the downstream wetland are subject to tidal inflows from the Hunter River which contribute about 90% of the overall flux. Hunter River stormwater quality monitoring by Office of Environment and Heritage in 2015 indicated elevated contaminants from industrial, agricultural and urban discharges (Swanson, et al 2017). In periods of rainfall, the river quality has exceeded the 80% LOSP criteria. Adopting a LOSP higher than 95% is therefore not considered appropriate.

The assessment criteria for PFAS has considered the HEPA (2025) 95% LOSP. It is noted that the 99% LOSP is notably stringent and below the current LOR for most laboratories. The limited testing to date has indicated some wells, including upgradient wells, have identified PFAS above the 99% LOSP criteria, present at concentrations indicative of urban the environment. Therefore the 95% LOSP is considered appropriate.

It is also noted that an exceedance of a guideline value at a monitoring well upstream of the receptors does not imply exceedance at the receptors, as fate and transport mechanisms can result in significant dilution, retardation and attenuation of solutes. Such factors must be considered in the assessment of the significance of monitoring results.

It is also recognised that groundwater in the region has background levels of various parameters at concentrations higher than the ANZG (2018) criteria. As outlined in the preliminary CSM in Section 7, iron, cadmium chromium, manganese, zinc, and sulphate in groundwater are regionally known to exceed the ANZG (2018) DGVs possibly associated with former mineral sand mining in the area. Groundwater pH is also routinely below the ANZG (2018) pH range. Therefore the groundwater monitoring from 2015-2025 has been used to provide a statistical assessment of the background levels to allow adoption of appropriate assessment criteria, for relevant parameters.

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

The site specific trigger levels for groundwater have been adopted as follows:

- The ANZG (2018) marine water criteria at 95% LOSP is adopted as the DGV;
- Unless the 80th percentile of the data set (2015-2025) is higher, then the 80th percentile value is appropriate for adoption. The 20th percentile will also be considered for pH;
- Where no criteria or site based data exists, the trigger level has generally been adopted as the laboratory limit of reporting (LOR) for parameters which are not expected to be naturally occurring in the environment (e.g. hydrocarbons etc);
- For PFAS, the trigger level is based on HEPA (2025) 95% LOSP;
- For other general water quality indicator parameters (e.g. hardness, alkalinity), a trigger value has not been set.

The criteria for each analyte and aquifer are provided in Table E1 and E2 in Appendix E.

It is noted that periodic exceedances of the groundwater quality trigger levels can be expected to occur, particularly where values are based on 80th percentile data set (i.e. values have historically been above these levels).

It is noted that it may be appropriate to undertake further statistical analysis and review of associated trigger levels regularly:

- As additional water quality data become available;
- As guidelines are updated;
- If it is deemed necessary to undertake site-specific modifications to criteria that can be made (e.g. adjustment for aquatic ecological DGVs based on hardness, pH, dissolved organic carbon, salinity etc).

The site specific trigger levels for groundwater are not applicable to surface water quality and the DGVs at LOSP must be adopted as indicated on Tables E1 and E2 in Appendix E.

9.8 **Assessment process and contingency measures**

9.8.1 **Groundwater levels**

If a consistent trend in variations in groundwater level are recorded, then the potential implications of the long-term variation should be assessed. The management strategy will depend on the nature of the groundwater variation and its expected effects.

9.8.2 **Groundwater quality**

The trigger levels have been developed based on consideration of the long term data set and assessment against relevant water quality guidelines as per Section 9.7.2 and these represent the main groundwater quality assessment criteria.

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/mean. Exceedance of the adopted trigger levels would prompt further assessment. This procedure is summarised in Table 16 below.

Table 16: Actions prompted by monitoring results

Event	Action	Documentation	Requirements to Notify Agencies ⁽¹⁾
Consecutive results exceed UCL ₉₅ -mean value	<ul style="list-style-type: none"> Review trend in parameter(s) concerned and note in monitoring report. 	Environmental Consultant to include the result in monitoring report to be issued to Approval Holder, person taking the Action and Environmental Manager.	Not required
Result exceed adopted trigger level (Tables E1 and E2 in Appendix E)	<ul style="list-style-type: none"> Assessment of the significance of the exceedance including, but not limited to: <ul style="list-style-type: none"> Comparison with previous/historic site monitoring data used in preparation of trigger levels, full data series as shown on concentration vs time plots (i.e. is the result within data range for the historic data set for the well and/or all monitoring wells); Review the basis for the trigger level criteria (i.e. reliability of the guideline value, or 20th /80th percentile site derived); Review of groundwater flow directions (i.e. representative of groundwater up-gradient, within site, and/or downgradient) and risk to receptors; Review groundwater levels and preceding climatic conditions for possible influence (e.g. rainfall effects prior to event, abnormally dry/wet conditions etc); Assess possible source of impacts. Undertake additional speciation laboratory testing, if suitable (e.g. hydrocarbons or metals). 		
	<ul style="list-style-type: none"> If the result is considered potentially significant in terms of potential impacts (on site or downgradient), undertake additional sampling at the relevant location(s) and analysis for parameter(s) concerned. A timeline of up to 28 days from confirmation of the initial results is considered a practicable timeframe for re-sampling. Person taking the action to review procedures, maintenance and incident records and notify Environmental Manager, Approval holder and Environmental Consultant of relevant findings. If the re-sampled result confirms the initial value, note the occurrence in the in monitoring report for additional review at next annual monitoring event. Additional actions would be prompted if the exceedance is attributed to an incident or by further consecutive exceedance events as below. If the re-sampled result is within the trigger level, suggesting the prior result was spurious or an aberration, then a note is to be made of the re-test in annual reporting. 	The Person taking the action to review their procedures, maintenance and incident records and notify Environmental Manager, Approval holder and Environmental Consultant of their relevant findings. Environmental Consultant to include result in monitoring report (as above).	Not required, unless the exceedance is attributable to an incident as per the Approval conditions which requires notification the Approval Holder or person taking the action to notify to DCCEEW, DPPI and NPWS within five (5) business days of receiving notification from the Environmental Manager and/or Environmental Consultant of the incident.

Event	Action	Documentation	Requirements to Notify Agencies ⁽¹⁾
<p>Three consecutive results exceed the trigger level (including re-testing, if undertaken) and/or in the event two consecutive annual sample results exceed the trigger value (Tables E1 and E2 in Appendix E)</p>	<ul style="list-style-type: none"> • Investigate the possibility of adverse changes to the groundwater quality/flow regime and/or contaminant plume; • Implement appropriate actions to investigate and/or mitigate contamination risks. Actions may include: <ul style="list-style-type: none"> ○ A detailed site inspection of the site and adjacent sites to identify possible source(s); ○ The possible need to temporarily increase the frequency of monitoring until results have returned to below the trigger levels or within the historical range; ○ The possible need to for installation of additional monitoring wells or surface water locations; ○ Consideration of fate and transport mechanisms for potential impacts at receptors and/or specific risk assessment for GDEs; • The Approval holder or person taking the action is to notify DCCEEW, DPHI and NPWS within five (5) business days of receiving notification from the Environmental Manager and/or Environmental Consultant of the third consecutive exceedance and/or in the event two consecutive annual samples for the parameter of concern that exceeds the trigger value where the result is considered potentially related to site impacts. 	<p>Environmental Consultant to include investigation and mitigation actions in monitoring report (as above).</p>	<p>Approval holder or person taking the action is to notify DCCEEW, DPHI and NPWS within five (5) business days of receiving notification from the Environmental Manager and/or Environmental Consultant.</p>

Notes:

(1) In addition to reporting required under AEMRs

It is noted that the laboratory results do not provide a direct indication of an exceedance, the determination of which requires data collation, quality control checking, data analyses and interpretation. The five business day notification period is intended to apply once the Approval holder or person taking the action becomes aware of exceedances.

9.9 Environmental incidents / pollution events

In the event of an on-site environmental or pollution incident, the person taking the action is to implement appropriate incident management procedures and actions relevant for the type of event. Immediate / short term actions measures may include spill containment/bunding, prevention of discharges of waters and/or sediments to drains, swales, surface water, and unsealed surfaces.

Where an environmental incident or pollution event occurs that has the potential to impact groundwater and/or surface water quality, the person taking the action is to notify the Environmental Manager and/or Environmental Consultant as soon as possible to assess the event, review the suitability of initial measures and advise of further actions or notifications that may be required. Actions could include, but are not limited to:

- Visual inspection, assessment and documentation;
- Soil, sediment or water sampling and testing, for example, at the spill location and downgradient;
- Soil remediation/removal and validation sampling of the affected area(s);
- Groundwater and/or surface water sampling to monitor for impacts and/or confirm appropriate measures have been undertaken to mitigate potential environmental harm, including installation of additional groundwater wells if appropriate;
- Notification to authorities as per the approval, if required;
- Notification to regulatory bodies under the POEO Act, if required.

9.10 Reporting

9.10.1 Exceedances or incidents

The approval holder or person taking the action is to notify DCCEE, DPHI and NPWS within five (5) business days of receiving notification from the Environmental Manager and/or Environmental Consultant if monitoring result(s) exceeds the adopted trigger level for consecutive events as per Table 16 in Section 9.8.2 above.

In the event of an uncontrolled spill or potential environmental incident, the Environmental Consultant is to notify the Approval Holder and Environmental Manager with the results of assessments, non-conformances or actions required within the timeframes listed in the GMMP to determine if the incident needs to be reported to relevant agencies.

9.10.2 Annual reporting

An annual report must include the following:

- Details of any well maintenance / clean out if undertaken;
- Time and date of sampling;
- Sampling methods, including well purging records;
- Sample chain of custody documentation;
- Results of quality assurance / quality control (QA/QC) protocols;
- Laboratory test methods and laboratory limit of reporting (LOR);
- Tabulated results of field testing (Category 1 parameters);
- Tabulated results of laboratory testing (Category 2 parameters and any other testing);
- Plot of laboratory testing results over time for key parameters to allow assessment of trends;
- Groundwater levels plotted against rainfall records;
- Comparison with groundwater quality trigger levels, UCL-mean values and assessment of trends in groundwater quality noting any exceedances of criteria and actions taken;
- Details of environmental incidents / pollution events occurring during the monitoring period, including actions taken;
- Comments on groundwater level trends and any obvious adverse changes to the groundwater quality/flow regime.

9.11 Review and continuous improvement of the monitoring program and effectiveness

Potential improvements to the monitoring program or site practices are to be included in the annual reports.

A revision of the monitoring program is an important aspect of continuous improvement and adaptive management. Review must be undertaken by the Environmental Consultant or a suitably qualified groundwater consultant:

- Following significant environmental incidents;
- When material improvements to performance have been recommended by the Environmental Consultant in annual reports or as directed by the environmental authority;
- When new stages of construction are proposed that have the potential to modify the current GMMP (e.g. Stage 2 development which contains wells for Stage 1 monitoring);
- Otherwise, every five years to:
 - o Review changes in land uses within the site and for adjacent sites which may increase potential contamination sources and/or potential contaminants of concern;
 - o Review changes in the landscape downstream or management practices for adaptive management of the Groundwater Monitoring Program. Information from wider monitoring may require evaluation as part of the iterative process of continuous improvement;

- o Analyse trends in groundwater levels and quality for comparison against the long term data set;
- o Review trigger levels and update, if warranted;
- o Assess the effectiveness of existing monitoring program and whether the objectives/intention of the GMMP are being met; and
- o Recommend any changes to provide an efficient and effective monitoring programme, such as changes to the monitoring well network, frequency of testing and nominated test parameters.

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.

In cases where a review results in revision of the GMMP, the revised GMMP will be submitted to DCCEE for approval in accordance with the requirements of EPBC Approval 2007/3343.

9.12 **Summary of improvements to the GMMP**

This GMMP has been revised based on improvements identified from review of the monitoring to date, changes in site conditions and practices, and contemporary groundwater monitoring practices. Table 17 below provides a summary of the key improvements to this GMMP.

Table 17: Summary of key improvements

Attribute	Summary of improvements
Monitoring well locations	A number of redundant monitoring wells have been removed from the program (MW3, MW5, MW7, MW8, MW9) and replaced with more effective locations (MW12, MW13).
Monitoring parameters and analytes	The results of site monitoring and site usage indicates that monitoring for OCP/OPP is no longer warranted. Phenols have been formally added to GMP and have been routinely tested Monitoring for PFAS compounds has been added.
Monitoring frequency	The monitoring frequency for the long term site conditions has been standardised to annually. Quarterly monitoring is still recommended for any construction periods.
Establishment of baseline data and trigger levels	Adoption of current / updated guideline values. Statistical analyses of historical monitoring results to determine representative 80 th percentile and 95 th UCL means. Adoption of different trigger levels in the clay and Sandbeds aquifers to better represent the differing background conditions.
Actions prompted by monitoring results	The actions have been updated to represent contemporary practices and allow for considered investigation of potential exceedances. Additional clarity has been provided with regards to timing of notifications.
Environmental incidents / pollution events	Requirements for the Environmental Consultant to review and advise of appropriate actions in the instance of environmental incidents and pollution events
Review of monitoring effectiveness and continuous improvement	Additional guidance has been provided on applying the principal of continuous improvement to improving both site practices and the monitoring methodology. This includes review of the relevant site assessment criteria for water quality and update if required (Section 9.7.2).

10. Conclusions

The implementation of this GMMP for Stage 1, along with the continued application of appropriate environmental management practices already in place, is expected to support the ongoing achievement of objectives aimed at minimising potential groundwater and surface water impacts.

11. References

- ADWJ. (2010). *Soil and Water Management Report including Stormwater Management Scheme, Site Water Balance and Erosion and Sediment Control for WesTrac Facility at Tomago Road, Tomago*. Ref 11886_Soil and Water Version C, January 2010: ADW Johnson Pty Ltd (ADWJ).
- Ahern, C. R., McElnea, A. E., & Sullivan, L. A. (2004). *Acid Sulfate Soils Laboratory Methods Guidelines*. In *Queensland Acid Sulfate Soils Manual 2004*. (QASSIT) Indooroopilly, Queensland, Australia: Department of Natural Resources, Mines and Energy.
- ANZECC. (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australia and New Zealand Environment and Conservation Council.
- ANZG. (2018). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Canberra, ACT: Australian and New Zealand Governments and Australian state and territory governments.
- ANZG. (2023). *Using monitoring data to derive and assess against guideline values*. Retrieved from Australian and New Zealand Guidelines for Fresh & Marine Water Quality: <https://www.waterquality.gov.au/anz-guidelines/monitoring/data-analysis/derivation-assessment>
- Brereton, R. a.-W. (2010). *Ecological Character Description of the Kooragang Component of the Hunter Estuary Wetlands Ramsar Site*. Canberra: Report to the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC).
- Coffey. (2007). *Preliminary Acid Sulfate Soils Assessment, Proposed WesTrac Industrial Development, Tomago Road, Tomago*. Document No. Ref GEOTSGTE20301AA-AF, 25 June 2007.: Coffey Geotechnics.
- DCCEEW. (2024). *Environmental Management Plan Guidelines*. Version 1.2 (2024): Department of Climate Change, Energy, the Environment and Water, Canberra.
- DCCEEW. (2025, June 20). *Per- and poly-fluoroalkyl substances (PFASs)*. Retrieved from Department of Climate Change, Energy, the Environment and Water: https://www.dcceew.gov.au/environment/protection/chemicals-management/pfas#frequently-asked-questions_2
- Dear, S., Ahern, C., O'Brien, L., Dobos, S., McElnea, A., Moore, N., & Watling, K. (2014). *Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines*. Brisbane: Department of Science: Department of Science, Information, Technology, Innovation and the Arts, Queensland Government.
- DII. (2011). *Review of Environmental Factors - Tomago East Wetland Rehabilitation Project*. NSW Department of Industry and Investment.
- Douglas. (2010a). *Groundwater Monitoring Plan, Proposed Industrial Subdivision, Tomago Road, Tomago*. Document No. 39920.02-GMP Rev1: Douglas Partners Pty Ltd.

Douglas. (2010b). *Acid Sulphate Soil Management Plan, Proposed Industrial Subdivision, Tomago Road, Tomago*. Document No. 39920.02-ASSMP Rev1: Douglas Partners Pty Ltd.

Douglas. (2024b). *Groundwater Management Plan EPBC 2007/3343, Proposed Industrial Subdivision, Stage 3, Lot 210 D.P.1174939, 2 Westrac Drive, Tomago*. Ref 39920.09.R.004.Rev4.GW Mngt plan: Douglas Partners Pty Ltd.

Douglas. (2024c). *Report on Summary of Groundwater and Surface Water Monitoring - 2010 to 2024, Stages 1-3 Northbank Enterprise Hub, WesTrac Drive, Tomago NSW*. Ref 39920.09.R.013.Rev1: Douglas Partners Pty Ltd.

Douglas. (2025). *Groundwater Monitoring Program, Proposed Industrial Subdivision, Stage 3, Lot 210 D.P.1174939, 2 Westrac Drive, Tomago*. Ref 39920.09.R.001.Rev5.GMP: Douglas Partners Pty Ltd.

HEPA. (2025). *PFAS National Environmental Management Plan (NEMP)*. Version 3.0: Heads of EPAs Australia and New Zealand.

MCC. (2023, July 5). *Hunter Estuary Coastal Management Program*. Retrieved from Maitland City Council (MCC): <https://www.maitland.nsw.gov.au/projects/hunter-estuary-coastal-management-program>

NHMRC, NRMCC. (2021). *Australian Drinking Water Guidelines 6 2011, Version 3.6*. Canberra: National Health and Medical Research Council, National Resource Management Ministerial Council.

NPWS. (2020). *Hunter Wetlands National Park Plan of Management*. 23 March 2020: NSW National Parks & Wildlife Service (NPWS); Environment, Energy and Science - Department of Planning, Industry and Environment (DPIE).

NSW EPA. (2020). *Guidelines for Consultants Reporting on Contaminated Land*. Contaminated Land Guidelines: NSW Environment Protection Authority.

Ramboll. (2022). *2022 GROUNDWATER AND SURFACE WATER MONITORING 318001414*. Document No. 318001414, Final Report, Version 1 : Ramboll.

Stone, Y., Ahern, C. R., & Blunden, B. (1998). *Acid Sulfate Soil Manual*. Acid Sulfate Soil Management Committee (ASSMAC).

Sullivan, L., Ward, N., Toppler, N., & Lancaster, G. (2018). *National Acid Sulfate Soils Guidance: National Acid Sulfate Soils Sampling and Identification Methods Manual*. Canberra ACT CC BY 4.0: Department of Agriculture and Water Resources.

Swanson et al. (2017). *Lower Hunter River Health Monitoring Program: Legacies of a century of industrial pollution and its impact on the current condition of the lower Hunter River estuary*. Sydney: Swanson RL, Potts JD & Scanes PR. Office of Environment and Heritage.

Torque. (2022). *Annual Report EPBC/2007/3343, Reporting Period: 1 May 2021 – 30 April 2022*. Project No. TP100 Version A: Torque Projects.

WRM. (2024). *Industrial Estate at Lot 210 DP1174939 (Stage 3), Tomago, Stormwater Management Plan*. Doc ref 1918-02-B10: WRM Water & Environment Pty Ltd (WRM).

12. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report for this project at Lot 211-Lot 212 D.P.1174939, WesTrac Drive, Tomago with reference to Douglas' proposal 39920.09.P.011.Rev1 dated 7 November 2024 and acceptance received from Northbank Enterprise Hub Pty Ltd. The work was carried out under agreed terms between Douglas Partners Pty Ltd and Northbank Enterprise Hub Pty Ltd (Contract 20230206 ACE-LEG-005A executed 23 February 2023). This report is provided for the exclusive use of Northbank Enterprise Hub Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out, as reported by Douglas and others. Sub-surface and groundwater conditions can change abruptly due to variable geological processes and also as a result of human influences.

Douglas' advice is based upon the conditions encountered during previous investigations as reported by others. The accuracy of the advice provided by Douglas in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

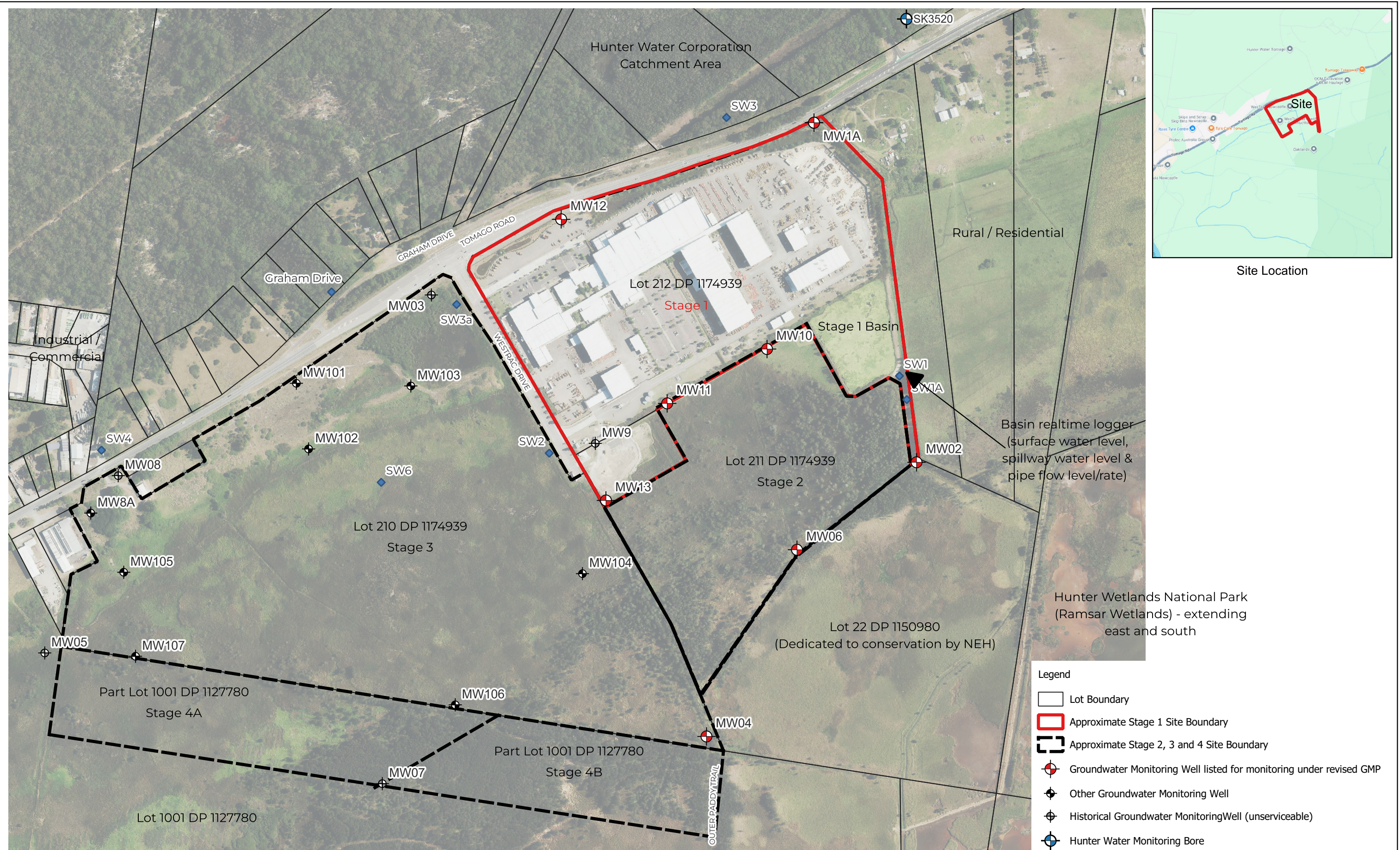
The assessment of atypical safety hazards arising from this advice is restricted to the environmental / groundwater components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. Douglas cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by Douglas. This is because this report has been written as advice and opinion rather than instructions for construction.

Appendix A

Drawing 4 – Groundwater Monitoring Well Plan

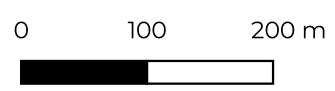


Site Location

Basin realtime logger (surface water level, spillway water level & pipe flow level/rate)

Hunter Wetlands National Park (Ramsar Wetlands) - extending east and south

- Legend**
- Lot Boundary
 - Approximate Stage 1 Site Boundary
 - Approximate Stage 2, 3 and 4 Site Boundary
 - Groundwater Monitoring Well listed for monitoring under revised GMP
 - Other Groundwater Monitoring Well
 - Historical Groundwater Monitoring Well (unserviceable)
 - Hunter Water Monitoring Bore
 - Surface Water Monitoring Location



Drawing adapted from Metromap Image dated 12.02.2023.
 Test locations are approximate only. MW8A and MW100 series wells located using differential GPS.
 MW1A & MW12 - Groundwater monitoring well (installed August 2024).



CLIENT: Northbank Enterprise Hub Pty Ltd	
OFFICE: Newcastle	DRAWN BY: PLH
SCALE: 1:6000 @ A3	DATE: 17.09.2025

TITLE: Groundwater Monitoring Well Network
 Stage 1, Northbank Enterprise Hub
 Westrac Drive, Tomago



PROJECT No:39920.09
DRAWING No: 4
REVISION: 3

Appendix B

About this Report

Introduction

These notes have been provided to amplify Douglas' report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

Douglas' reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Engagement Terms for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather

changes. They may not be the same at the time of construction as are indicated in the report; and

- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, Douglas will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, Douglas cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, Douglas will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, Douglas requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. Douglas would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

intentionally blank

Appendix C

Consent Conditions

- EPBC 2007/3343 – Tomago Road Industrial Development, Tomago, NSW
- Variation to Conditions attached to Approval EPBC 2007/3343



Australian Government

Department of the Environment, Water, Heritage and the Arts

Approval

Tomago Road Industrial Development, Tomago, NSW, (EPBC 2007/3343)

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999*.

Proposed action

person to whom the approval is granted WEPL Investments Pty Ltd

proponent's ACN and ABN (if applicable) ACN 093 498 116

proposed action The proposed action is to develop an 111ha site on Tomago Road at Tomago, NSW, for industrial use and as described in the referral received on 12 March 2007 and final New South Wales Environment Assessment Report received on 15 September 2009.

Approval

Controlling Provision	Decision
Wetlands of international importance (sections 16 & 17B)	Approved
Listed threatened species and communities (sections 18 & 18A)	Approved
Listed migratory species (sections 20 & 20A)	Approved

conditions of approval

This approval is subject to the conditions specified below.

expiry date of approval

This approval has effect until 19 November 2039

Decision-maker

name and position Michelle Wicks
Acting Assistant Secretary
Environment Assessment Branch

signature

date of decision 18 November 2009

Conditions attached to the approval

1. In order to minimise potential impacts on the Hunter Estuary Ramsar Wetland site, prior to any works commencing the person taking the action must establish the 22 hectare area (at Annexure 1) as a conservation area by transferring title of the area to the state of New South Wales (Department of Environment, Climate Change and Water).
2. In order to minimise potential significant impacts on the Hunter 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;
 - b. a review of the environmental values and water quality objectives for the Hunter Estuary Wetlands Ramsar site;
 - c. replication of natural surface and groundwater flows and water quality;
 - d. protection of the environmental values of receiving waters, including the Hunter Estuary Wetlands Ramsar site; and
 - e. the principle of continuous improvement.

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 Enterprises Pty Ltd – Tomago Road, Tomago – Environmental Assessment Report dated 12 March 2008 “Concept Engineering, Servicing, Earthworks and Stormwater Management” Appendix F.
 - 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
 - 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.
3. If water quality measurements exceed the trigger levels set under the stormwater and groundwater management plan then works must stop immediately and the exceedance reported to the Minister within 7 days of detecting the exceedance. Failure to stop works and notify the Minister will be considered a breach of these conditions.
 4. Within 10 days of works, the person taking the action must advise the department of the actual date of commencement.
 5. If, at any time after 3 years from the date of this approval, the person taking the action has not reached substantial commencement, then the person taking the action must not substantially commence the action without the written consent of the Minister.

6. Upon the direction of the Minister, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.
7. If the person taking the action wishes to carry out any activity otherwise than in accordance with the plans, reports or strategies referred to in this approval, the person taking the action may submit for the Minister's approval a revised version of any such plan, report or strategy. If the Minister approves such a revised plan, report or strategy, that plan, report or strategy must be implemented in place of the plan, report or strategy originally approved. Unless the Minister has approved the revised plan, report or strategy, then the person taking the action must continue to implement the plan, report or strategy originally approved under this approval.
8. If the Minister believes that it is necessary or desirable for the better protection of listed threatened species and ecological communities to do so, the Minister may request that the person taking the action make specified revisions to the plans, reports or strategies approved pursuant to the conditions of this approval and submit the revised plan, report or strategy for the Minister's approval. The person taking the action must comply with any such request. The revised approved plan, report or strategy must be implemented.
9. Within three months of every 12 month anniversary after the commencement of the action, the person taking the action must provide a report to the department addressing compliance with each of the conditions of this approval over the previous 12 months. These reports must be provided to the department each year until the Minister advises that the proponent has complied with all conditions of the approval.
10. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, and make them available upon request to the department. Such records may be subject to audit by the department, and used to verify compliance with the conditions of approval. Summaries of audits will be posted on the department's website. The results of audits may also be publicised through the general media.

Definitions:

Department: The Australian Government Department responsible for the *Environment Protection and Biodiversity Conservation Act 1999*.

Minister: The minister responsible for the *Environment Protection and Biodiversity Conservation Act 1999*.

Commencement of Works: Undertaking of any activity identified below under the definition of works.

Works: Include any preparatory works required to be undertaken including clearing vegetation, the erection of any on-site temporary structures and the use of heavy duty equipment for the purpose of breaking the ground for buildings or infrastructure.

Significant Impact(s): An impact that is important, notable or of consequence having regard to its context or intensity.

Substantial Commencement: The commencement of fill works on the site of Stage 1.

Plan of: Proposed Subdivision of Lot 1001
 DP.1127780, Lot 161 DP.774440,
 Lot 1 DP.1003492, Lot 1 DP.597372
 and Lot 513 DP.585256

Location: Tomago Road
 Tomago
 Council: Port Stephens

Datum: AHD
 Origin: PM 27766
 Projection: MGA Zone 56
 Origin: PM 27766
 North Direction: Grid
 Contour Interval: N/A

Date: 18th September 2009
 Sheet: 1 of 2
 Plan by: MS/RC
 Project Manager: CM
 Office: Hunter
 Plan Purpose: DA

Version: F (04/11/2009)
 Client: WEPL Investments Pty Ltd
 Survey: Z-CAD6 (small:11886dp
 AutoCad: N/A (11886-008-006-F
 Our Ref: 11886

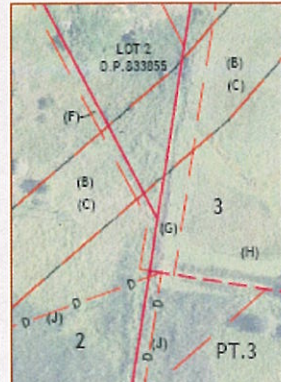
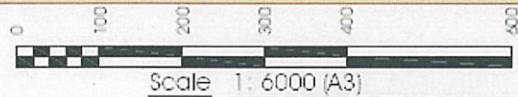
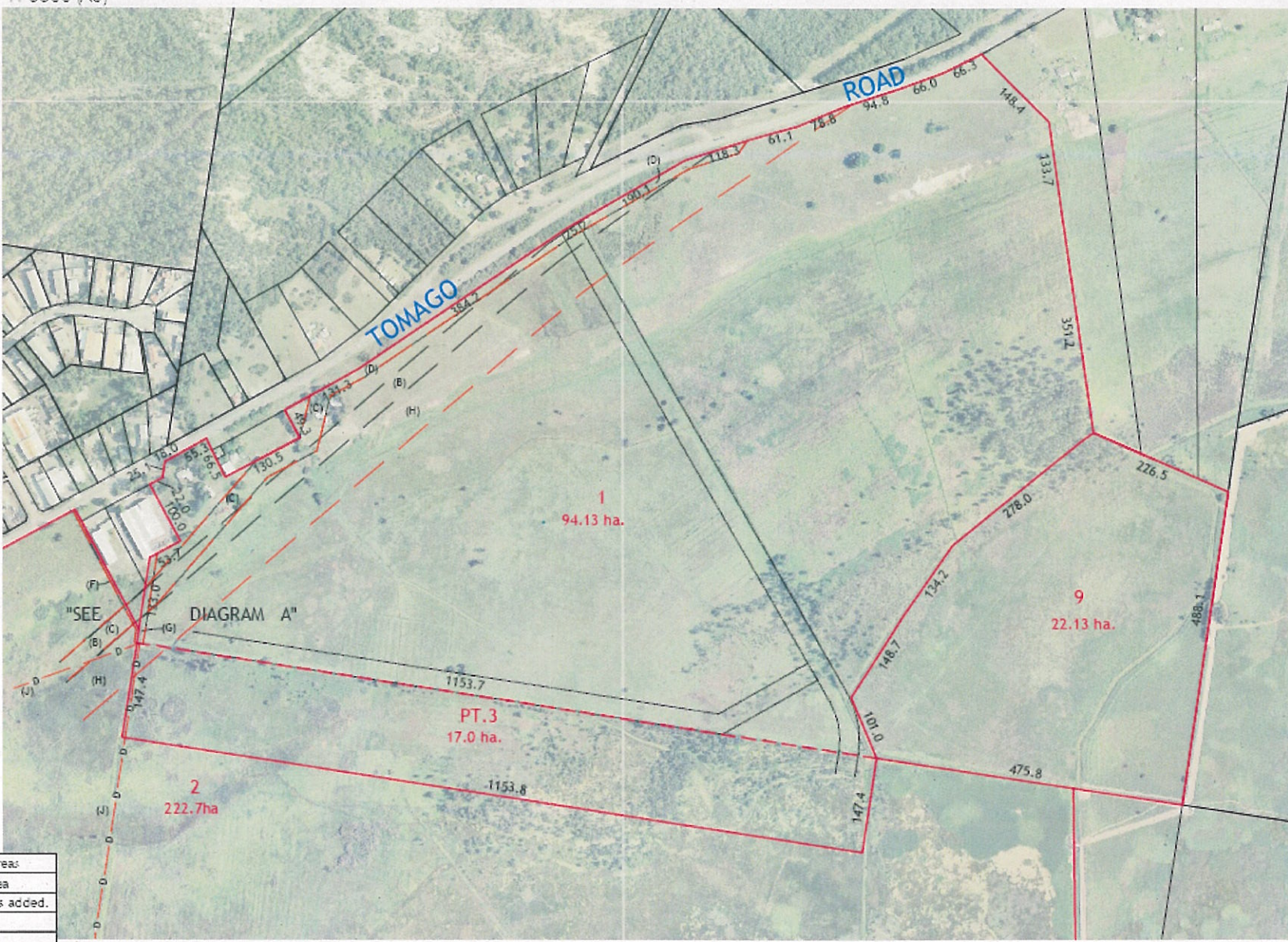


DIAGRAM "A"

- (B) EXISTING EASEMENT FOR OVERHEAD ELECTRICITY AND OTHER PURPOSES 30.48m WIDE (G.G. 13/03/1964 No.29 FOLIO 561) TO BE EXTINGUISHED.
- (C) PROPOSED EASEMENT FOR ELECTRICITY AND OTHER PURPOSES 30 WIDE.
- (D) PROPOSED EASEMENT FOR ELECTRICITY AND OTHER PURPOSES 15 WIDE.
- (F) EASEMENT TO DRAIN WATER 4 WIDE (DP.577334)
- (G) EASEMENT TO DRAIN WATER 10 WIDE (BK.3887 No.834)
- (H) PROPOSED EASEMENT FOR TRANSMISSION LINE 60.96m WIDE (SHOWN IN D.P.557695) - NOT REQUIRED.
- (J) EASEMENT CREATED FOR DRAINAGE. (SEE D.P.1127780).

COPYRIGHT NOTICE
 THIS PLAN AND THE INFORMATION IT CONTAINS ARE COPYRIGHT AND REMAIN THE PROPERTY OF adw johnson Pty Ltd.
 adw johnson Pty Ltd GRANTS TO THE CLIENT NAMED ON THIS PLAN A LICENSE TO USE THE INFORMATION HEREON FOR THE PURPOSE FOR WHICH WE WERE ENGAGED TO PERFORM THE WORK.
 USE OF THE PLAN AND INFORMATION IT CONTAINS FOR ANY OTHER PURPOSE IS NOT PERMITTED UNLESS PRIOR WRITTEN APPROVAL HAS BEEN OBTAINED FROM adw johnson Pty Ltd.

Ver.	Date	Comment
E	9/10/2009	Combine Lots, Update Areas
D	1/10/2009	Adjust Boundary to Area
C	28/09/2009	Boundary adjusted, easements added.
B	24/09/2009	Amended Layout





VARIATION TO CONDITIONS ATTACHED TO APPROVAL

Tomago Road Industrial Development, Tomago, NSW, (EPBC 2007/3343)

This decision to vary a condition of approval is made under section 143 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Proposed action

Person to whom the approval is granted WEPL Investments Pty Ltd
ACN 093 498 116

Proposed action The proposed action is to develop an 111ha site on Tomago Road at Tomago, NSW, for industrial use and as described in the referral received on 12 March 2007 and final New South Wales Environment Assessment Report received on 15 September 2009.

Variation

Variation of conditions of approval The variation is:

1. (a) In order to minimise potential impacts on the Hunter Estuary Ramsar Wetland site, the person taking the action must **establish**¹ a conservation area of at least 22 hectares (Identified as "9" at Annexure 1) prior to any **works**² commencing.
- (b) The title to the area referred to in condition 1a) must be transferred to the state of New South Wales (Department of Environment, Climate Change and Water) within 6 months from the commencement of **works**² associated with stage 1 (Within this 6 month period only works associated with Stage 1 can be carried out).

¹ **Establish:** Taking measures to define the conservation area (identified under Condition 1) on site. For Example: Survey Pegs, Fencing, and Exclusion Zone Signage.

² **Works:** Include any preparatory works required to be undertaken including clearing vegetation, the erection of any on-site temporary structures and the use of heavy duty equipment for the purpose of breaking the ground for buildings or infrastructure.

Date of effect This variation has effect on 15 January 2010

Person authorised to make decision

Name and position Tim Kahn
Acting Assistant Secretary
Environment Assessment Branch

Signature

Date of decision 12 January 2010

Plan of: Proposed Subdivision of Lot 1001
 DP.1127780, Lot 161 DP.774440,
 Lot 1 DP.1003492, Lot 1 DP.597372
 and Lot 513 DP.585256

Location: Tomago Road
 Tomago
 Council: Port Stephens

Datum: AHD
 Origin: PM 27766
 Projection: MGA Zone 56
 Origin: PM 27766
 North Direction: Grid
 Contour Interval: N/A

Date: 18th September 2009
 Sheet: 1 of 2
 Plan by: MS/RC
 Project Manager: CM
 Office: Hunter
 Plan Purpose: DA

Version: F (04/11/2009)
 Client: WEPL Investments Pty Ltd
 Survey: Z:\CAD6\small\11886.dwg
 AutoCad: N/A, 11886-GUE-006-F
 Our Ref: 11886

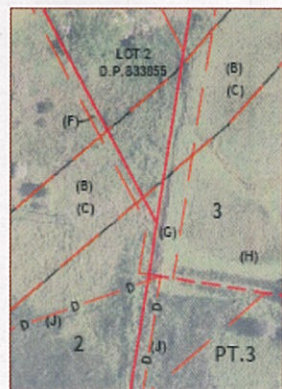
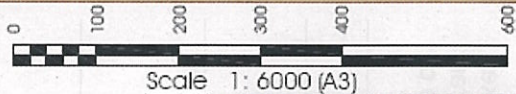


DIAGRAM "A"

- (B) EXISTING EASEMENT FOR OVERHEAD ELECTRICITY AND OTHER PURPOSES 30.48m WIDE (G.G. 13/03/1964 No.29 FOLIO 561) TO BE EXTINGUISHED.
- (C) PROPOSED EASEMENT FOR ELECTRICITY AND OTHER PURPOSES 30 WIDE.
- (D) PROPOSED EASEMENT FOR ELECTRICITY AND OTHER PURPOSES 15 WIDE.
- (F) EASEMENT TO DRAIN WATER 4 WIDE (DP.577334)
- (G) EASEMENT TO DRAIN WATER 10 WIDE (BK.3887 No.834)
- (H) PROPOSED EASEMENT FOR TRANSMISSION LINE 60.96m WIDE (SHOWN IN D.P.557695) - NOT REQUIRED.
- (J) EASEMENT CREATED FOR DRAINAGE. (SEE D.P.1127780).

COPYRIGHT NOTICE
 THIS PLAN AND THE INFORMATION IT CONTAINS ARE COPYRIGHT AND REMAIN THE PROPERTY OF ADW JOHNSON PTY LTD. ADW JOHNSON PTY LTD GRANTS TO THE CLIENT NAMED ON THIS PLAN A LICENCE TO USE THE INFORMATION HEREON FOR THE PURPOSE FOR WHICH WE WERE ENGAGED TO PERFORM THE WORK. USE OF THE PLAN AND INFORMATION IT CONTAINS FOR ANY OTHER PURPOSE IS NOT PERMITTED UNLESS PRIOR WRITTEN APPROVAL HAS BEEN OBTAINED FROM ADW JOHNSON PTY LTD.

Ver.	Date	Comment
E	9/10/2009	Combine Lots, Update Areas
D	1/10/2009	Adjust Boundary to Area
C	28/09/2009	Boundary adjusted, easements added.
B	24/09/2009	Amended Layout



Appendix D

Sampling Methods

Soil Descriptions

Symbols and Abbreviations

Borehole Logs (Bores MW6 to MW11, MW8A, MW101 to MW107) – Douglas Partners

Borehole Logs (Bores MW1 to MW5) – Coffey

Table D1: Monitoring Well Summary



Introduction to Terminology, Symbols and Abbreviations

Douglas Partners' reports, investigation logs, and other correspondence may use terminology which has quantitative or qualitative connotations. To remove ambiguity or uncertainty surrounding the use of such terms, the following sets of notes pages may be attached Douglas Partners' reports, depending on the work performed and conditions encountered:

- Soil Descriptions;
- Rock Descriptions; and
- Sampling, insitu testing, and drilling methodologies

In addition to these pages, the following notes generally apply to most documents.

Abbreviation Codes

Site conditions may also be presented in a number of different formats, such as investigation logs, field mapping, or as a written summary. In some of these formats textual or symbolic terminology may be presented using textual abbreviation codes or graphic symbols, and, where commonly used, these are listed alongside the terminology definition. For ease of identification in these note pages, textual codes are presented in these notes in the following style **XW**. Code usage conforms with the following guidelines:

- Textual codes are case insensitive, although herein they are generally presented in upper case; and
- Textual codes are contextual (i.e. the same or similar combinations of characters may be used in different contexts with different meanings (for example `PL` is used for plastic limit in the context of soil moisture condition, as well as in `PL(A)` for point load test result in the testing results column)).

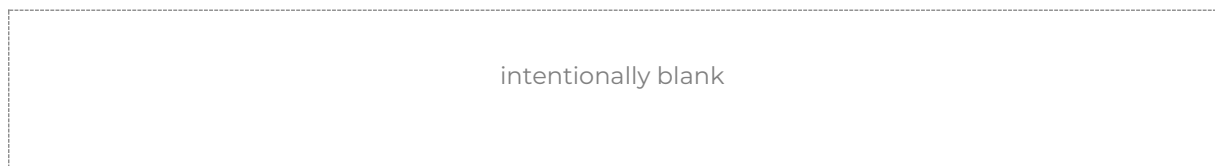
Data Integrity Codes

Subsurface investigation data recorded by Douglas Partners is generally managed in a highly structured database environment, where records "span" between a top and bottom depth interval. Depth interval "gaps" between records are considered to introduce ambiguity, and, where appropriate, our practice guidelines may require contiguous data sets. Recording meaningful data is not always appropriate (for example assigning a "strength" to a concrete pavement) and the following codes may be used to maintain contiguity in such circumstances.

Term	Description	Abbreviation Code
Core loss	No core recovery	KL
Unknown	Information was not available to allow classification of the property. For example, when auguring in loose, saturated sand auger cuttings may not be returned.	UK
No data	Information required to allow classification of the property was not available. For example if drilling is commenced from the base of a hole predrilled by others	ND
Not Applicable	Derivation of the properties not appropriate or beyond the scope of the investigation. For example providing a description of the strength of a concrete pavement	NA

Graphic Symbols

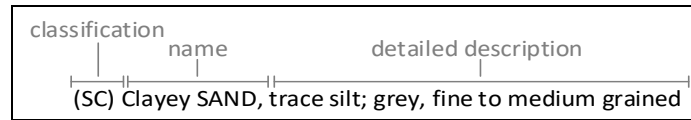
Douglas Partners' logs contain a "graphic" column which provides a pictorial representation of the basic composition of the material. The symbols used are directly representing the material name stated in the adjacent "Description of Strata" column, and as such no specific graphic symbology legend has been provided in these notes.





Introduction

All materials which are not considered to be “in-situ rock” are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:



The “classification” comprises a two character “group symbol” providing a general summary of dominant soil characteristics. The “name” summarises the particle sizes within the soil which most influence its behaviour. The detailed description presents more information about composition, condition, structure, and origin of the soil.

Classification, naming and description of soils require the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either “fine grained” (also known as “cohesive” behaviour) or “coarse grained” (“non cohesive” behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

Particle Size Designation	Particle Size (mm)	Behaviour Model	
		Behaviour	Approximate Dry Mass
Boulder	>200	Excluded from particle behaviour model as “oversize”	
Cobble	63 - 200		
Gravel ¹	2.36 - 63	Coarse	>65%
Sand ¹	0.075 - 2.36		
Silt	0.002 - 0.075	Fine	>35%
Clay	<0.002		

¹ – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer “component proportions” below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a “Sandy CLAY”, this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a “primary”, “secondary”, or “minor” component of the soil mixture, depending on its influence over the soil behaviour.

Component Proportion Designation	Definition ¹	Relative Proportion	
		In Fine Grained Soil	In Coarse Grained Soil
Primary	The component (particle size designation, refer above) which dominates the engineering behaviour of the soil	The clay/silt component with the greater proportion	The sand/gravel component with the greater proportion
Secondary	Any component which is not the primary, but is significant to the engineering properties of the soil	Any component with greater than 30% proportion	Any granular component with greater than 30%; or Any fine component with greater than 12%
Minor ²	Present in the soil, but not significant to its engineering properties	All other components	All other components

¹ As defined in AS1726-2017 6.1.4.4

² In the detailed material description, minor components are split into two further sub-categories. Refer “identification of minor components” below.

Composite Materials

In certain situations, a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example, “INTERBEDDED Silty CLAY AND SAND”.

Classification

The soil classification comprises a two character group symbol. The first character identifies the primary component. The second character identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

Soil Name

For most soils, the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way, the soil name also describes the general composition and indicates the dominant behaviour of the material.

Component ¹	Prominence in Soil Name
Primary	Noun (eg "CLAY")
Secondary	Adjective modifier (eg "Sandy")
Minor	No influence

¹ – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters (?), with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description).

Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

Minor Component Proportion Term	Relative Proportion	
	In Fine Grained Soil	In Coarse Grained Soil
With	All fractions: 15-30%	Clay/silt: 5-12% sand/gravel: 15-30%
Trace	All fractions: 0-15%	Clay/silt: 0-5% sand/gravel: 0-15%

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterise due to the relative size of the particles and the investigation methods.

Soil Composition

Plasticity

Descriptive Term	Laboratory liquid limit range	
	Silt	Clay
Non-plastic materials	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

Type	Particle size (mm)	
	Gravel	Coarse	19 - 63
	Medium	6.7 - 19
	Fine	2.36 - 6.7
Sand	Coarse	0.6 - 2.36
	Medium	0.21 - 0.6
	Fine	0.075 - 0.21

Grading

Grading Term	Particle size (mm)
Well	A good representation of all particle sizes
Poorly	An excess or deficiency of particular sizes within the specified range
Uniformly	Essentially of one size
Gap	A deficiency of a particular size or size range within the total range

Note, AS1726-2017 provides terminology for additional attributes not listed here.

Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

Applicability	Term	Tactile Assessment	Abbreviation code
Fine	Dry of plastic limit	Hard and friable or powdery	w<PL
	Near plastic limit	Can be moulded	w=PL
	Wet of plastic limit	Water residue remains on hands when handling	w>PL
	Near liquid limit	"oozes" when agitated	w=LL
	Wet of liquid limit	"oozes"	w>LL
Coarse	Dry	Non-cohesive and free running	D
	Moist	Feels cool, darkened in colour, particles may stick together	M
	Wet	Feels cool, darkened in colour, particles may stick together, free water forms when handling	W

The abbreviation code **NDF**, meaning "not-assessable due to drilling fluid use" may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Material

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the "consistency" describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials, the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented "strength" is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered material origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description.

Quantitative engineering performance of these materials may be determined by laboratory testing or estimated by correlated field tests (for example penetration or shear vane testing). In some cases, performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example **(VS)**.

Consistency (fine grained soils)

Consistency Term	Tactile Assessment	Undrained Shear Strength (kPa)	Abbreviation Code
Very soft	Extrudes between fingers when squeezed	<12	VS
Soft	Mouldable with light finger pressure	>12 - ≤25	S
Firm	Mouldable with strong finger pressure	>25 - ≤50	F
Stiff	Cannot be moulded by fingers	>50 - ≤100	St
Very stiff	Indented by thumbnail	>100 - ≤200	VSt
Hard	Indented by thumbnail with difficulty	>200	H
Friable	Easily crumbled or broken into small pieces by hand	-	Fr

Relative Density (coarse grained soils)

Relative Density Term	Density Index	Abbreviation Code
Very loose	<15	VL
Loose	>15 - ≤35	L
Medium dense	>35 - ≤65	MD
Dense	>65 - ≤85	D
Very dense	>85	VD

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Compaction (anthropogenically modified soil)

Compaction Term	Abbreviation Code
Well compacted	WC
Poorly compacted	PC
Moderately compacted	MC
Variably compacted	VC

Cementation (natural and anthropogenic)

Cementation Term	Abbreviation Code
Moderately cemented	MOD
Weakly cemented	WEK

Extremely Weathered Material

AS1726-2017 considers weathered material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. less than very low strength rock). These materials may be identified as “extremely weathered material” in reports and by the abbreviation code **XWM** on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

Soil Origin

Term	Description	Abbreviation Code
Residual	Derived from in-situ weathering of the underlying rock	RS
Extremely weathered material	Formed from in-situ weathering of geological formations. Has strength of less than ‘very low’ as per as1726 but retains the structure or fabric of the parent rock.	XWM
Alluvial	Deposited by streams and rivers	ALV
Fluvial	Deposited by channel fill and overbank (natural levee, crevasse splay or flood basin)	FLV
Estuarine	Deposited in coastal estuaries	EST
Marine	Deposited in a marine environment	MAR
Lacustrine	Deposited in freshwater lakes	LAC
Aeolian	Carried and deposited by wind	AEO
Colluvial	Soil and rock debris transported down slopes by gravity	COL
Slopewash	Thin layers of soil and rock debris gradually and slowly deposited by gravity and possibly water	SW
Topsoil	Mantle of surface soil, often with high levels of organic material	TOP
Fill	Any material which has been moved by man	FILL
Littoral	Deposited on the lake or seashore	LIT
Unidentifiable	Not able to be identified	UID

Cobbles and Boulders

The presence of particles considered to be “oversize” may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with “MIXTURE OF”.

intentionally blank



Sampling and Testing

A record of samples retained, and field testing performed is usually shown on a Douglas Partners' log with samples appearing to the left of a depth scale, and selected field and laboratory testing appearing to the right of the scale, as illustrated below:

SAMPLE			DEPTH (m)	TESTING	
SAMPLE REMARKS	TYPE	INTERVAL		TEST TYPE	RESULTS AND REMARKS
	SPT		1.0 1.45	SPT	4,9,11 N=20

Sampling

The type or intended purpose for which a sample was taken is indicated by the following abbreviation codes.

Sample Type	Code
Auger sample	A
Acid Sulfate sample	ASS
Bulk sample	B
Core sample	C
Disturbed sample	D
Environmental sample	ES
Driven Tube sample	DT
Gas sample	G
Piston sample	P
Sample from SPT test	SPT
Undisturbed tube sample	U ¹
Water sample	W
Material Sample	MT
Core sample for unconfined compressive strength testing	UCS

¹ – numeric suffixes indicate tube diameter/width in mm

The above codes only indicate that a sample was retained, and not that testing was scheduled or performed.

Field and Laboratory Testing

A record that field and laboratory testing was performed is indicated by the following abbreviation codes.

Test Type	Code
Pocket penetrometer (kPa)	PP
Photo ionisation detector (ppm)	PID
Standard Penetration Test x/y = x blows for y mm penetration HB = hammer bouncing HW = fell under weight of hammer	SPT
Shear vane (kPa)	V

Unconfined compressive strength, (MPa)	UCS
----------------------------------------	-----

Field and laboratory testing (continued)

Test Type	Code
Point load test, (MPa), axial (A), diametric (D), irregular (I)	PLT(L)
Dynamic cone penetrometer, followed by blow count penetration increment in mm (cone tip, generally in accordance with AS1289.6.3.2)	DCP9/150
Perth sand penetrometer, followed by blow count penetration increment in mm (flat tip, generally in accordance with AS1289.6.3.3)	PSP/150

Groundwater Observations

▷	seepage/inflow
▽	standing or observed water level
NFGWO	no free groundwater observed
OBS	observations obscured by drilling fluids

Drilling or Excavation Methods/Tools

The drilling/excavation methods used to perform the investigation may be shown either in a dedicated column down the left-hand edge of the log, or stated in the log footer. In some circumstances abbreviation codes may be used.

Method	Abbreviation Code
Direct Push	DP
Solid flight auger. Suffixes: /T = tungsten carbide tip, /V = v-shaped tip	AD ¹
Air Track	AT
Diatube	DT ¹
Hand auger	HA ¹
Hand tools (unspecified)	HAND
Existing exposure	X
Hollow flight auger	HSA ¹
HQ coring	HQ3
HMLC series coring	HMLC
NMLC series coring	NMLC
NQ coring	NQ3
PQ coring	PQ3
Predrilled	PD
Push tube	PT ¹
Ripping tyne/ripper	R
Rock roller	RR ¹
Rock breaker/hydraulic hammer	EH
Sonic drilling	SON ¹
Mud/blade bucket	MB ¹
Toothed bucket	TB ¹
Vibrocore	VC ¹
Vacuum excavation	VE
Wash bore (unspecified bit type)	WB ¹

¹ – numeric suffixes indicate tool diameter/width in mm

BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: --
EASTING: 383518
NORTHING: 6367336
DIP/AZIMUTH: 90°/-

BORE No: MW6
PROJECT No: 39920.03
DATE: 7/10/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments		Stickup = 0.7m	
	0.23	SILTY CLAY - Dark grey silty clay, M>Wp	[Diagonal Hatching]						From 0m to 0.5m, Concrete	
		SILTY CLAY - Grey silty clay, M>>Wp							From 0.5m to 2m, Backfill	
	1									
	2									
	3									
	4									
	5									
	6.0	SAND - Grey/brown fine to medium grained sand with some silt and clay, trace shell fragments, saturated	[Dotted Pattern]						From 2m to 4.5m, Bentonite plug	
	7									
	8									
	9.0	Bore discontinued at 9.0m, limit of investigation							From 4.5m to 6m, 2.5mm washed gravel screen	
									From 6m to 9m, Collapsed strata From 6m to 9m, 50mm diameter Class 18 machine slotted PVC screen	
									End cap	

RIG: 4WD Truck Mounted Drill Rig **DRILLER:** **LOGGED:** Prowse **CASING:** Nil

TYPE OF BORING: 130mm hollow flight auger

WATER OBSERVATIONS: Free groundwater encountered at 0.3m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U _s	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W _s	Water seep
E	Environmental sample	W _l	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: --
EASTING: 382801
NORTHING: 6366934
DIP/AZIMUTH: 90°/-

BORE No: MW7
PROJECT No: 39920.03
DATE: 26/10/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing			Water	Well Construction Details	
				Type	Depth	Sample		Results & Comments	
	0	SILTY CLAY - Dark grey silty clay, M>Wp	[Diagonal Hatching]					Stickup - 0.85m	[Stickup Symbol]
	1							From 0.0m to 0.2m, concrete	[Concrete Symbol]
	1	From 1.4m, trace sand and shell fragments						From 0.0m to 0.6m, 50mm diameter Class 18 PVC blank	[PVC Blank Symbol]
	2							From 0.2m to 0.5m, bentonite	[Bentonite Symbol]
	2	From 2.6m, collapsing						From 0.5m to 2.6m, 5/2mm gravel filter	[Gravel Filter Symbol]
	2							From 0.6m to 2.6m, 50mm diameter machine slotted Class 18 PVC screen	[PVC Screen Symbol]
	3	From 2.6m, collapsing						End cap	[End Cap Symbol]
	3.0	Bore discontinued at 3.0m, limit of investigation							
	4								
	5								
	6								
	7								
	8								
	9								

RIG: Hand Tools **DRILLER:** Parkinson **LOGGED:** Prowse **CASING:** Uncased
TYPE OF BORING: 75mm diameter Hand Auger
WATER OBSERVATIONS: Free groundwater observed at 1.2m during drilling
REMARKS:

A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)
B Bulk sample	P Piston sample	PL(A) Point load axial test Is(50) (MPa)
BLK Block sample	U _t Tube sample (x mm dia.)	PL(D) Point load diametral test Is(50) (MPa)
C Core drilling	W Water sample	pp Pocket penetrometer (kPa)
D Disturbed sample	W _s Water seep	S Standard penetration test
E Environmental sample	W _l Water level	V Shear vane (kPa)

BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: --
EASTING: 382353
NORTHING: 6367461
DIP/AZIMUTH: 90°/--

BORE No: MW8
PROJECT No: 39920.03
DATE: 4/8/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing			Water	Well Construction Details
				Type	Depth	Sample			Results & Comments
	0.2	FILLING - Brown fine to medium grained sand filling, with trace to some silt and abundant organics to 0.05m, moist						
	0.4	SAND - (Loose) light brown fine to medium grained sand, trace organics, moist		A	0.5			
		SAND (Loose) grey fine to medium grained sand, moist						
	1	From 1.0m, loose		S	1.0		1,1,2 N=3	From 0m to 1.8m, bentonite
		From 1.3m, saturated			1.45			
	2							From 1.8m to 5.5m, gravel
		From 2.5m, brown, fine to coarse grained sand		S	2.5		1,2,4 N=6	
	3				2.95			
	4			S	4.0		3,10,-	From 2.5m to 5.5m, machine slotted PVC screen
		From 4.0m, medium dense			4.3			
	5							
				S	5.5		6,12,- (No Sample)	End cap
	5.8	Bore discontinued at 5.8m, limit of investigation			5.8			
	6							
	7							
	8							
	9							

RIG: 4WD

DRILLER: Atkins

LOGGED: Harris

CASING: Uncased

TYPE OF BORING: Hollow flight auger

WATER OBSERVATIONS: Free groundwater observed at 1.3m during drilling

REMARKS: Class 18 piezometer PVC installed to 5.5m depth. Machine slotted from 2.5m to 5.5m

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test ts(50) (MPa)
		PL(D)	Point load diametral test ts(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Northbank Enterprise Hub Pty Ltd
PROJECT: Stage 3 Northbank Enterprise Hub
LOCATION: Lot 210 Westrac Drive, Tomago

SURFACE LEVEL: 3.1 AHD
EASTING: 382303.7
NORTHING: 6367395.9
DIP/AZIMUTH: 90°/--

BORE No: MW8A
PROJECT No: 39920.09
DATE: 12/4/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
3.0	0.25	SILTY SAND - fine to medium grained, dark grey, trace rootlets, moist	| | | |	D	0.01				Stickup = 0.76 From 0m to 0.1m, concrete	| |
		SAND - fine to medium grained, dark grey, trace rootlets, moist at 0.7m - colour change to brown	. . . .	D	0.5				From 0.1m to 0.3m, bentonite From 0m to 0.5m, 50mm diameter Class 18 PVC Casing	. . . .
1.0	1.2	SAND - fine to medium grained, pale brown, trace sub-angular to sub-rounded gravel, moist at approximately 1.8m, wet	. . . .	D	1.5					. . . .
2.0			. . . .	D	2.5					. . . .
3.0			. . . .	D	3.5					. . . .
4.0			. . . .	D	4.5				From 0.3m to 7.0m, 2mm sand From 0.5m to 7.0m, 50mm diameter Class 18 Machine Slotted PVC Screen	. . . .
5.0			. . . .	D	5.5					. . . .
6.0			. . . .	D	6.5					. . . .
7.0	7.0	Bore discontinued at 7.0m Limit of investigation							End cap	| |
8.0										
9.0										

RIG: Geoprobe Dual Tube **DRILLER:** Tucker **LOGGED:** Krebs **CASING:** None
TYPE OF BORING: Push tube with disposable liners
WATER OBSERVATIONS: Free groundwater observed at 1.9m during drilling
REMARKS: Top of PVC casing level 3.86 AHD

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)



BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: 0.78 AHD
EASTING: 383467
NORTHING: 6367675
DIP/AZIMUTH: 90°/-

BORE No: MW9
PROJECT No: 39920.03
DATE: 2-3/8/10
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing			Water	Well Construction Details
				Type	Depth	Sample			Results & Comments
	0.1	TOPSOIL - Grey silty clay/clayey silt with abundant organics, saturated SILTY CLAY - (soft to firm), grey silty clay, M>Wp	[Hatched Pattern]					From 0.0m to 4.6m, bentonite
	1.0		[Hatched Pattern]	A	1.0			
	2.5	From 2.5m, (soft) with some fine to medium grained sand	[Hatched Pattern]	S	2.5		0,0,0 N = 0 (No Sample)	
	2.95		[Hatched Pattern]		2.95			
	4.0	SAND - Very loose, grey fine to medium grained sand, with trace to some clay and with trace organics, saturated	[Dotted Pattern]	S	4.05		1,0,0 N = 0	
	4.5		[Dotted Pattern]		4.5			
	5.75	SAND - Medium dense, grey, fine to medium grained gravel sand, saturated	[Dotted Pattern]	S	5.75		1,1,2 N = 3	From 4.6m to 8.3m, machine slotted screen
	6.2		[Dotted Pattern]		6.2			
	7.1	From 7.1m, loose	[Dotted Pattern]	S	7.1		4,7,10 N = 17	
	7.55		[Dotted Pattern]		7.55			
	9.8	From 9.8m, medium dense	[Dotted Pattern]	S	9.8		4,12,13	From 8.3m to 10.6m, PVC damaged

RIG: 4WD

DRILLER: Atkins

LOGGED: Harris

CASING: Uncased

TYPE OF BORING: Hollow flight auger

WATER OBSERVATIONS: Free groundwater obscured due to drilling water added

REMARKS: Class 18 piezometer PVC installed to 8.3m depth. Machine slotted from 4.6m to 8.3m

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U ₂	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	▷	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



Douglas Partners

Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: 0.78 AHD
EASTING: 383467
NORTHING: 6367675
DIP/AZIMUTH: 90°/-

BORE No: MW10
PROJECT No: 39920.03
DATE: 2-3/8/10
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing			Water	Well Construction Details
				Type	Depth	Sample			Results & Comments
	0.1	TOPSOIL - Grey silty clay/clayey silt with abundant organics, saturated	▽					From 0.0m to 4.6m, bentonite
		SILTY CLAY - (soft to firm), grey silty clay, M>Wp	/ / / / /	A	1.0			
		From 2.5m, (soft) with some fine to medium grained sand	/ / / / /		2.5		0,0,0 N = 0 (No Sample)	
			/ / / / /		2.95			
	4.0	SAND - Very loose, grey fine to medium grained sand, with trace to some clay and with trace organics, saturated	. . . . .	S	4.05		1,0,0 N = 0
			. . . . .		4.5		
	5.75	SAND - Medium dense, grey, fine to medium grained gravel sand, saturated	. . . . .	S	5.75		1,1,2 N = 3
			. . . . .		6.2		
		From 7.1m, loose	. . . . .	S	7.1		4,7,10 N = 17
			. . . . .		7.55		
		From 9.8m, medium dense	. . . . .	S	9.8		4,12,13

RIG: 4WD **DRILLER:** Atkins **LOGGED:** Harris **CASING:** Uncased

TYPE OF BORING: Hollow flight auger

WATER OBSERVATIONS: Free groundwater obscured due to drilling water added

REMARKS: Class 18 piezometer PVC installed to 8.3m depth. Machine slotted from 4.6m to 8.3m

SAMPLING & IN SITU TESTING LEGEND	
A Auger sample	pp Pocket penetrometer (kPa)
D Disturbed sample	PID Photo ionisation detector
B Bulk sample	S Standard penetration test
U Tube sample (x mm dia.)	PL Point load strength Is(50) MPa
W Water sample	V Shear Vane (kPa)
C Core drilling	▷ Water seep ¶ Water level

CHECKED
Initials: <i>JW</i>
Date: 9/8/10



BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: 0.78 AHD
EASTING: 383467
NORTHING: 6367675
DIP/AZIMUTH: 90°/--

BORE No: MW10
PROJECT No: 39920.03
DATE: 2-3/8/10
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing			Water	Well Construction Details
				Type	Depth	Sample			Results & Comments
		SAND - Medium dense, grey, fine to medium grained gravel sand, saturated <i>(continued)</i>	[Dotted pattern]	s	10.25		N = 25	End cap
-11								
-12	S			11.6		3, 8, 5/75mm		
-13				11.98				
-13.35		Bore discontinued at 13.35m, limit of investigation	[Dotted pattern]	S	13.1		3, 6/100mm	
-14								
-15								
-16								
-17								
-18								
-19								

RIG: 4WD **DRILLER:** Atkins **LOGGED:** Harris **CASING:** Uncased

TYPE OF BORING: Hollow flight auger

WATER OBSERVATIONS: Free groundwater obscured due to drilling water added

REMARKS: Class 18 piezometer PVC installed to 8.3m depth. Machine slotted from 4.6m to 8.3m

SAMPLING & IN SITU TESTING LEGEND			
A Auger sample	pp Pocket penetrometer (kPa)	PID Photo ionisation detector	☼ Water level
D Disturbed sample	S Standard penetration test	PL Point load strength Is(50) MPa	
B Bulk sample	V Shear Vane (kPa)	▷ Water seep	
U ₁ Tube sample (x mm dia.)			
W Water sample			
C Core drilling			

CHECKED
Initials: <i>AW</i>
Date: 4/9/10



BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: 1.2 AHD
EASTING: 383294
NORTHING: 6367675
DIP/AZIMUTH: 90°/-

BORE No: MW11
PROJECT No: 39920.03
DATE: 04 Aug 10
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing			Water	Well Construction Details
				Type	Depth	Sample			Results & Comments
	0.3	FILLING - Sand filling (for drilling access)	[Cross-hatch pattern]					
	0.4	TOPSOIL - Brown silty clay/clayey silt with abundant organics, saturated	[Diagonal lines]					
	1.0	SILTY CLAY - (Soft to firm), grey silty clay, M>Wp	[Diagonal lines]					
		From 1.0m, (soft)						
	2.5			S	2.5		0,0,0 N = 0 (No Sample)	
	2.95				2.95			
	3.5	SAND (Very loose), grey fine to medium grained sand with trace clay, saturated	[Dotted pattern]					
	4.05			S	4.05		0,0,0 N = 0	
	4.5				4.5			
	5.5	SAND - Medium dense, grey fine to medium grained sand with trace shell fragments, saturated	[Dotted pattern]					
	5.95			S	5.5		1,2,3 N = 5	
	5.95				5.95			
	8.5			S	8.5		3,10,0 N = 10	
	8.8				8.8			
		From 8.5m, (medium dense)						
								From 0m to 3.7m, bentonite From 3.7m to 4.6m, gravel
								From 4.6m to 10.6m, machine slotted PVC screen

RIG: 4WD **DRILLER:** Atkins **LOGGED:** Harris **CASING:** Uncased

TYPE OF BORING: Hollow flight auger to 11.5m depth

WATER OBSERVATIONS: Free groundwater obscured due to drilling fluids

REMARKS: Class 18 piezometer PVC installed to 10.6m depth. Machine slotted from 4.6m to 8.3m

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	Δ	Water seep
		☐	Water level

CHECKED
Initials: <i>PHW</i>
Date: <i>04/10</i>



Douglas Partners
 Geotechnics • Environment • Groundwater

BOREHOLE LOG

CLIENT: WEPL Investments Pty Ltd
PROJECT: Tomago Industrial Estate
LOCATION: Tomago Road, Tomago

SURFACE LEVEL: 1.2 AHD
EASTING: 383294
NORTHING: 6367675
DIP/AZIMUTH: 90°/--

BORE No: MW11
PROJECT No: 39920.03
DATE: 04 Aug 10
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
-9		SAND - Medium dense, grey fine to medium grained sand with trace shell fragments, saturated (continued)	[Dotted pattern]						End cap	[Symbol]
-11										
-11.8	11.8	Bore discontinued at 11.8m, limit of investigation		S	11.5		6,17,0 N = 17			
-12										
-13										
-14										
-15										
-16										
-17										
-18										
-19										

RIG: 4WD **DRILLER:** Atkins **LOGGED:** Harris **CASING:** Uncased
TYPE OF BORING: Hollow flight auger to 11.5m depth
WATER OBSERVATIONS: Free groundwater obscured due to drilling fluids
REMARKS: Class 18 piezometer PVC installed to 10.6m depth. Machine slotted from 4.6m to 8.3m

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep
		¶	Water level

CHECKED
Initials: <i>AW</i>
Date: <i>7/9/10</i>



BOREHOLE LOG

CLIENT: Northbank Enterprise Hub Pty Ltd
PROJECT: Northbank Enterprise Hub
LOCATION: Lot 211 DP 1174939 Westrac Drive, Tomago, NSW

SURFACE LEVEL: 3.1 AHD
COORDINATE: E:383187.9, N:6367418.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: MW13
PROJECT No: 39920.09
DATE: 18/11/24
SHEET: 1 of 2

GROUNDWATER		CONDITIONS ENCOUNTERED					SAMPLE			TESTING AND REMARKS				
RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN (#)	CONSIS. (%) DENSITY. (%)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE
3.00	0.70	FILL / Silty CLAY (CI), with gravel: brown; medium plasticity; fine to medium, sub-angular to sub-rounded gravel.		FILL	NA	w<PL		D/ES	0.50	PID	<1ppm		Concrete	50mm Class 18 PVC Casing
1.00	2.10	FILL / Silty CLAY (CI), trace gravel: grey; medium plasticity; fine to medium, sub-angular to sub-rounded gravel.		FILL	NA	w<PL		D/ES	1.00	PID	<1ppm			
2.10	2.90	FILL / Silty CLAY (CH): grey; high plasticity.		FILL	NA	w>PL		D/ES	2.50	PID	<1ppm			
3.20	3.20	FILL / Silty SAND (SM): dark brown; fine to medium; possible old topsoil layer, trace organics, rootlets.		FILL	SS	M		D/ES	3.00	PID	<1ppm			
3.20	8.60	Silty Sandy CLAY (CH): brown; high plasticity; fine to medium sand.		ALV	SS	w=PL w>PL		D/ES	5.00	PID	<1ppm			
8.60	9.00	SAND: grey; fine to medium.		ALV	L	M								

NOTES: [®]Soil origin is "probable" unless otherwise stated. [©]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Geoprobe
METHOD: Hollow Flight Auger
REMARKS: Top of PVC casing level 3.63 AHD. Stickup = 0.53

OPERATOR: Tuck Environmental (Tucker) **LOGGED:** Krebs
CASING: Uncased

Gravel - 2mm graded gravels/sand

Refer to explanatory notes for symbol and abbreviation definitions



BOREHOLE LOG

CLIENT: Northbank Enterprise Hub Pty Ltd
PROJECT: Northbank Enterprise Hub
LOCATION: Lot 211 DP 1174939 Westrac Drive, Tomago, NSW

SURFACE LEVEL: 3.1 AHD
COORDINATE: E:383187.9, N:6367418.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: MW13
PROJECT No: 39920.09
DATE: 18/11/24
SHEET: 2 of 2

CONDITIONS ENCOUNTERED				SAMPLE			TESTING AND REMARKS								
GROUNDWATER	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN (#)	CONSIS. (%)	DENSITY (%)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS	BACKFILL	WELL PIPE
	-7	[CONT] SAND: grey; fine to medium.							D/ES		10.00	PID	<1ppm		
	-11			ALV	L		M								
	-12														
	-13														
	-14														
	-14.5	Borehole discontinued at 14.50m depth.													
	-15														
	-16														
	-17														
	-18														
	-19														

NOTES: [#]Soil origin is "probable" unless otherwise stated. ^oConsistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Geoprobe
METHOD: Hollow Flight Auger
REMARKS: Top of PVC casing level 3.63 AHD. Stickup = 0.53

OPERATOR: Tuck Environmental (Tucker) **LOGGED:** Krebs
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions



Borehole No. **MW 1**

Engineering Log - Piezometer

Sheet 1 of 1

Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **16.8.2007**

Principal:

Date completed: **16.8.2007**

Project: **PROPOSED INDUSTRIAL DEVELOPMENT, TOMAGO**

Logged by: **CW**

Borehole Location: **REFER TO FIGURE 1**

Checked by:

drill model & mounting: Truck Mounted		Easting: 383658		slope: -90°		R.L. Surface: 2.31			
hole diameter: 200mm		Northing: 6367969		bearing:		datum: AHD			
drilling information				material substance					
method	penetration 1 2 3	support water	notes samples, tests, etc	well details	depth metres	material	structure and additional observations		
HF		C			RL	SM SC Silty SAND: fine to coarse grained, black. Clayey SAND: grey.	ALLUVIAL		
					2.0				
					0.5				
					1.5				
					1.0				
					1.0				
					1.5				
					0.5				
					2.0				
					0.0				
					2.5				
					0.5				
					3.0				
					1.0				
					3.5				
					1.5				
					4.0				
Borehole terminated at 3.85m									
method AS auger screwing* AD auger drilling* RR roller/incone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT		support C casing N nil penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow		notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test		classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit		consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense	

PIEZOMETER 20301AA LOGS MW1-5 GPJ COFFEY GDT 17 08

Borehole No. **MW 2**

Engineering Log - Piezometer

Sheet 1 of 1
Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **17.8.2007**

Principal:

Date completed: **17.8.2007**

Project: **PROPOSED INDUSTRIAL DEVELOPMENT, TOMAGO**

Logged by: **CW**

Borehole Location: **REFER TO FIGURE 1**

Checked by:

drill model & mounting: Truck Mounted Easting: 383725 slope: -90° R.L. Surface: 0.74
hole diameter: 200mm Northing: 6367488 bearing: datum: AHD

drilling information				material substance								
method	penetration	support	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
1 2 3									soil type: plasticity or particle characteristics, colour, secondary and minor components			
HF		C			0.5	0.5		CI	Silty CLAY: medium plasticity, dark brown-black, with rootlets.	M>Wp		TOPSOIL Root affected
						0.5		CI	CLAY: medium plasticity, grey.			ALLUVIAL / ESTUARINE
						1.0						
						1.5						
						2.0						
						2.5						
						3.0						
						3.5						
						4.0						
Borehole terminated at 3.5m												

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VS _t very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

PIEZOMETER 20301AA LOGS MW1-5.GPJ COFFEY.GDT 17 08

Form GEO 5.10 Issue 3 Rev 0

Borehole No. **MW 3**
 Sheet 1 of 1
 Project No: **GEOTSGTE20301AA**
 Date started: **17.8.2007**
 Date completed: **17.8.2007**
 Logged by: **CW**
 Checked by: *[Signature]*

Engineering Log - Piezometer

Client: **ASQUITH & de WITT PTY LTD**
 Principal:
 Project: **PROPOSED INDUSTRIAL DEVELOPMENT, TOMAGO**
 Borehole Location: **REFER TO FIGURE 1**

drill model & mounting: Truck Mounted		Easting: 382895		slope: -90°		R.L. Surface: 2.91			
hole diameter: 200mm		Northing: 6367789		bearing		datum: AHD			
drilling information				material substance					
method	penetration 1 2 3	support water	notes samples, tests, etc	well details	depth metres	material soil type: plasticity or particle characteristics, colour, secondary and minor components	structure and additional observations		
HF		C		▲	0.0	SM Silty SAND: fine to coarse grained, black mottled white, with rootlets	TOPSOIL		
				▲	0.5	SM Silty SAND: fine to coarse grained, dark grey	AEOLIAN		
				▼	1.0	Becoming dark brown			
					1.5				
					2.0	Trace of fine grained rounded gravel.	Alluvial?		
					2.5				
					3.0				
					3.5				
					4.0	Borehole terminated at 3.8m			
method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT		support C casing N nil penetration 1 2 3 4 no resistance ranging to refusal water ▼ 10/1/98 water level on date shown ▲ water inflow ▲ water outflow		notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test		classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit		consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense	

PIEZOMETER 20301AA LOGS MW1-5 GPJ COFFEY GDT 17 08

Form GEO 5.10 Issue 3 Rev.0

Borehole No. **MW 4**

Engineering Log - Piezometer

Sheet 1 of 1
Project No: **GEOTSGTE20301AA**

Client: **ASQUITH & de WITT PTY LTD**

Date started: **17.8.2007**

Principal:

Date completed: **17.8.2007**

Project: **PROPOSED INDUSTRIAL DEVELOPMENT, TOMAGO**

Logged by: **CW**

Borehole Location: **REFER TO FIGURE 1**

Checked by:

drill model & mounting: Truck Mounted	Easting: 383345	slope: -90°	R.L. Surface: 0.35
hole diameter: 200mm	Northing: 6366996	bearing:	datum: AHD

drilling information					material substance						
method	penetration	support	notes samples, tests, etc	well details	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
1 2 3				RL				soil type: plasticity or particle characteristics, colour, secondary and minor components.			
HF		C			0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0		CH	CLAY: high plasticity, grey-brown some orange mottled, with rootlets. Becoming grey.	M>Wp		ALLUVIAL
Borehole terminated at 3.9m											

PIEZOMETER 20301AA LOGS MW1-5 GPJ COFFEY GDT 17 08

method AS auger screwing* AO auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4 water ▼ 10/1/98 water level on date shown ▲ water inflow ▲ water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VS _t very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Form GEO 5.10 Issue 3 Rev 0

Table D1: Monitoring Well Summary

Bore ID	Easting	Northing	Elevation Ground Level (AHD)	Elevation top of PVC Casing Level (AHD)	Depth (m bgl)	Screened interval (m bgl)	Screened lithology	Proposed for monitoring in revised GMP for Stage 1-2	Comment
MW1	383552	6368062	2.0	2.84	3.8	0.8-3.8	Sand, clayey	No	Damaged/lost
MW1A	383545	6368065	2.8	3.31	4.0	0.5 - 4.0	Sand, fine to med	Yes	Installed Aug 2024 as replacement for MW1 and upgradient well
MW2	383721	6367483	0.7	1.25	3.5	0.5-3.5	Clay, silty	Yes	Damaged/lost
MW3	382900	6367780	2.9	3.56	3.0	0.5-3.0	Sand, fine to coarse, silt	No	Damaged/lost
MW4	383360	6367013	0.5	1.28	3.7	0.7-3.8	Clay	Yes	High EC readings assumed to be associated with elevated suspended solids (clay particles)
MW5	382225	6367156			3.8	0.8-3.8	Clay and sand	No	Damaged/lost
MW6	383516	6367333	0.6	1.26	9.0	6.0-9.0	Sand, fine to med	Yes	
MW7	382804	6366932	0.4	1.41	2.6	0.6-2.6	Clay, silty	No	Collapsed strata 6-9m - no gravel pack High EC readings assumed to be associated with elevated suspended solids (fine sand due to absence of gravel pack).
MW8	382351	6367460	3.4	4.72	5.5	2.5-5.5	Sand, fine to med	No	Damaged/lost
MW8A	382304	6367396	3.1	3.86	7.0	0.5-7.0	Sand, fine to med	No	Replacement for MW8
MW9	383165	6367492	0.6	1.54	10.6	4.6-8.3	Sand, fine to med	No	Damaged/lost
MW10	383467	6367675	0.8	2.11	10.6	4.6-8.3	Sand, fine to med	Yes	
MW11	383293	6367584	1.2	2.27	10.6		Sand, fine to med	Yes	
MW12	383111	6367900	3.0	3.57	4.0	0.5 - 4.0	Sand, fine to med	Yes	Installed Aug 2024 as new upgradient well
MW13	383188	6367418	3.1	3.63	14.5	9.5 - 12.6	Sand, fine to med	Yes	Installed Nov 2024
MW101	382657	6367619	3.2	4.09	7.0	0.3-7.0	Sand, fine to med	No	Stage 3 monitoring location
MW102	382678	6367506	1.8	2.52	4.0	0.3-4.0	Sand, fine to med	No	Stage 3 monitoring location
MW103	382853	6367614	2.3	3.31	7.0	0.3-7.0	Sand, fine to med	No	Stage 3 monitoring location
MW104	383148	6367292	0.7	1.16	1.5	0.5-1.5	Clay	No	High EC readings assumed to be associated with elevated suspended solids (clay particles). Stage 3 monitoring location
MW105	382360	6367294	1.5	2.05	6.0	0.3-6.0	Sand, fine to med	No	Stage 3 monitoring location
MW106	382929	6367067	0.7	1.35	2.0	0.5-2.0	Clay	No	High EC readings assumed to be associated with elevated suspended solids (clay particles). Stage 3 monitoring location
MW107	382381	6367150	0.72	1.52	2.2	0.5-2.2	Clay	No	Stage 3 monitoring location

Notes:

AHD = metres Australian Height Datum

EC = electrical conductivity

m bgl = metres below ground level

Borehole No. **MW 5**
 Sheet 1 of 1
 Project No. **GEOTSGTE20301AA**
 Date started: **18.8.2007**
 Date completed: **18.8.2007**
 Logged by: **CW**
 Checked by:

Engineering Log - Piezometer

Client: **ASQUITH & de WITT PTY LTD**
 Principal:
 Project: **PROPOSED INDUSTRIAL DEVELOPMENT, TOMAGO**
 Borehole Location: **REFER TO FIGURE 1**

drill model & mounting: Truck Mounted Easting: 382251 slope: -90° R.L. Surface: 0.71
 hole diameter: 200mm Northing: 6367165 bearing: datum: AHD

drilling information				material substance			
method	penetration	support	notes samples, tests, etc	well details	depth metres	material	structure and additional observations
1 2 3				RL		soil type: plasticity or particle characteristics, colour, secondary and minor components	
HF		C			0.5	Silty CLAY: medium plasticity, dark brown	ALLUVIAL
					0.5		
					1.0	Becoming dark grey-grey	
					1.5		
					2.0	Clayey SAND / Sandy CLAY: fine to medium grained.	
					2.5		
					3.0		
					3.5		
					4.0	Borehole terminated at 3.8m	

method AS auger screwing* AD auger drilling* RR roller/incone W washbore CT cable tool OT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g ADT	support C casing N nil penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

PIEZOMETER 20301AA LOGS MW1-5 GPJ COFFEY GDT 17 08

Form GEO 5.10 Issue 3 Rev 0

Appendix E

Table E1: Groundwater Quality Assessment Criteria for Bores in the Tomago

Sandbeds (i.e. MW1A, MW6, MW10 to MW13)

Table E2: Groundwater Quality Assessment Criteria for Bores in the Clay Aquitard (i.e. MW02, MW04)

Figure E1: Groundwater Levels in Monitoring Wells (2007-2025)

Table E1: Groundwater Quality Assessment Criteria for Bores in the Tomago Sandbeds (i.e. MW1A, MW6, MW10 to MW13)

	Unit	LOR	Monitoring data 2015-Jan 2025					ANZG Marine Water Toxicant DGVs 95% LOSP	Notes to ANZG	HEPA (2025) NEMP 3.0 Interim Marine 95% LOSP for protection of aquatic ecosystems	Adopted Trigger level - Wells Screened in Sand aquifer	Comments
			No of readings	Minimum	Maximum	UCL ₉₅ -mean	80 th Percentile					
Physio chemical parameters (field)												
pH (Field)	pH	0.1	73	4.7	7.7	6.08	5.2 / 6.6 (20th/80th)	7.0-8.0	#14		5.2-8.0	Lower bound based on 20th percentile, upper bound based on ANZG
Electrical Conductivity (field)	µS/cm	1	73	79	16140	4870	3780	125-2200	#15		3780	General indicator water quality value for groundwater rather than contaminants of concern
DO (Field)	mg/L	0.1	72	0.01	5.5	2.3	3.47				-	
DO (Field)	%	1	-	-	-	-	-	80-110%	#14		-	
Turbidity (Field)	NTU	1	-	-	-	-	-	0.5-10	#14		-	
Temperature (Field)	°C	-	-	-	-	-	-				-	
Physio chemical parameters												
Total Suspended Solids	mg/L	5	42	2.5	1000	99.7	71.9				-	TSS in groundwater can vary per monitoring event and based on well condition. General indicator water quality value for groundwater rather than contaminants of concern
Anions												
Chloride	mg/L	1	61	8	5960	1980	1390				1390	General indicator water quality value for groundwater rather than contamin
Sulphate	mg/L	1	61	0.5	896	288	310				310	
Fluoride	mg/L	0.1	61	0.05	0.6	0.22	0.27				0.27	
Alkalinity (Hydroxide) as CaCO ₃	mg/L	5	60	0.5	2.5	1.55	2.2				-	
Alkalinity (Carbonate as CaCO ₃)	mg/L	5	60	0.5	338	17.2	8.2				-	
Alkalinity (total) as CaCO ₃	mg/L	5	60	2.5	400	154	217				-	
Alkalinity (Bicarbonate as CaCO ₃)	mg/L	5	61	0.5	400	135	186				-	
Hardness (filtered)	mg/L	3	25	11	1000	336	204				-	
Nutrients												
Ammonia as N (filtered)	mg/L	0.005	61	<0.005	1.05	0.44	0.61	0.91	#1		0.91	
Total Kjeldahl Nitrogen	mg/L	0.1	56	<0.1	1.8	0.817	1.05				1.05	TKN, nitrate, nitrite etc are all measures of nitrogen species. The trigger level for ammonia is generally considered most applicable to assessing nitrogen concentrations in groundwater.
Nitrate (as N) (filtered)	mg/L	0.005	40	<0.005	0.57	0.014	0.012				0.012	
Nitrite (as N) (filtered)	mg/L	0.005	40	<0.005	0.68	0.038	0.022				0.022	
Nitrogen (Total Oxidised)	mg/L	0.005	52	<0.005	1.7	0.10	0.059	0.015	#15		0.059	
Nitrogen (Total)	mg/L	0.1	24	0.3	1.8	0.95	1.1	0.3	#15		1.1	
Total Phosphorus (Organic Phosphate)	mg/L	0.05	60	<0.005	1.76	0.186	0.13	0.03	#15		0.13	
Reactive Phosphorus as P (Orthophosphate as P) (filtered)	mg/L	0.005	21	<0.005	0.064	0.004	0.005	0.005	#15		0.005	
Cations												
Calcium (filtered)	mg/L	0.5	61	<0.5	297	92.7	113				-	General indicator water quality value for groundwater rather than contaminants of concern
Magnesium (filtered)	mg/L	0.5	61	<0.5	439	141	102				-	
Potassium (filtered)	mg/L	0.5	61	<0.5	90	31.4	31.3				-	
Sodium (filtered)	mg/L	0.5	61	6.8	2790	955	733				-	
Metals (filtered)												
Aluminium (filtered)	mg/L	0.01	13	0.05	0.41	0.28	0.31	0.0005	#4		0.31	
Arsenic (filtered)	mg/L	0.001	57	<0.001	0.005	0.001	0.001	0.0023 (As V)	#16		0.0023 (As V)	
Cadmium (filtered)	mg/L	0.0001	57	<0.0001	0.0005	N/A	N/A	0.0055	#2		0.0055	
Chromium (III+VI) (filtered)	mg/L	0.001	57	<0.001	0.003	0.001	0.002	0.0044 (Cr VI)	#17		0.0044 (Cr VI)	
Copper (filtered)	mg/L	0.001	57	<0.001	0.015	0.001	0.002	0.0013	#3		0.002	
Iron (filtered)	mg/L	0.01	54	<0.01	7	2.2	2.8				2.8	
Lead (filtered)	mg/L	0.001	57	<0.001	0.007	0.001	0.001	0.0044	#4		0.0044	
Manganese (filtered)	mg/L	0.005	56	<0.005	2.0	0.70	0.76		#9		0.76	
Mercury (filtered)	mg/L	0.00005	57	<0.00005	<0.00005	N/A	N/A	0.0004	#3		0.0004	
Molybdenum (filtered)	mg/L	0.001	56	<0.001	0.002	N/A	N/A	0.023	#18		0.023	
Nickel (filtered)	mg/L	0.001	57	<0.001	0.006	0.001	0.001	0.07	#3		0.07	
Zinc (filtered)	mg/L	0.001	57	<0.001	0.035	0.008	0.009	0.008	#6		0.009	
TRH												
C6-C10 Fraction (F1)	mg/L	0.01	56	<0.01	0.01	N/A	N/A				0.01	
C6-C10 (F1 minus BTEX)	mg/L	0.01	56	<0.01	0.01	N/A	N/A				0.01	
>C10-C16 Fraction (F2)	mg/L	0.05	56	<0.05	0.079	N/A	N/A				0.05	
>C10-C16 Fraction (F2 minus Naphthalene)	mg/L	0.05	48	<0.05	0.05	N/A	N/A				0.05	
>C16-C34 Fraction (F3)	mg/L	0.1	56	<0.1	0.5	N/A	N/A				0.1	
>C34-C40 Fraction (F4)	mg/L	0.1	56	<0.1	0.05	N/A	N/A				0.1	
>C10-C40 Fraction (Sum)	mg/L	0.05	56	<0.05	0.19	N/A	N/A				0.05	
C6-C9 Fraction	mg/L	0.01	53	<0.01	0.01	N/A	N/A				0.01	
C10-C14 Fraction	mg/L	0.05	53	<0.05	0.067	N/A	N/A				0.05	
C15-C28 Fraction	mg/L	0.1	53	<0.1	0.37	N/A	N/A				0.1	
C29-C36 Fraction	mg/L	0.1	53	<0.1	0.2	N/A	N/A				0.1	
C10-C36 Fraction (Sum)	mg/L	0.05	49	25	0.64	N/A	N/A				0.05	
TPH (Silica-Gel Cleanup)												
C10-C14 Fraction (SG)	mg/L	0.05	-	-	-	N/A	N/A				0.05	
C15-C28 Fraction (SG)	mg/L	0.1	-	-	-	N/A	N/A				0.1	
C29-C36 Fraction (SG)	mg/L	0.1	-	-	-	N/A	N/A				0.1	
>C10-C16 Fraction (SG)	mg/L	0.05	-	-	-	N/A	N/A				0.05	
>C16-C34 Fraction (SG)	mg/L	0.1	-	-	-	N/A	N/A				0.1	
>C34-C40 Fraction (SG)	mg/L	0.1	-	-	-	N/A	N/A				0.1	
BTEX												
Benzene	mg/L	0.001	56	<0.001	<0.001	N/A	N/A	0.7	#7		0.7	
Toluene	mg/L	0.001	56	<0.001	<0.001	N/A	N/A	0.18	#8		0.18	
Ethylbenzene	mg/L	0.001	56	<0.001	<0.001	N/A	N/A	0.08	#8		0.08	
Xylene (m & p)	mg/L	0.001	56	<0.002	<0.002	N/A	N/A					
Xylene (m)	mg/L	0.001	56	<0.002	<0.002	N/A	N/A	0.075	#7		0.075	
Xylene (o)	mg/L	0.001	56	<0.002	<0.002	N/A	N/A	0.35	#8		0.35	
Xylene (p)	mg/L	0.001	56	<0.002	<0.002	N/A	N/A	0.2	#8		0.2	
PAH												
Acenaphthene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A					
Acenaphthylene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A					
Anthracene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A	0.0004	#9		0.0004	
Benzo(a)anthracene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A					
Benzo(b)fluoranthene	mg/L	0.0002	57	<0.0002	<0.0002	N/A	N/A					
Benzo(a)pyrene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A	0.0002	#9		0.0002	
Benzo(g,h,i)perylene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A					
Chrysene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A					
Dibenz(a,h)anthracene	mg/L	0.0001	56	<0.0001	<0.0001	N/A	N/A					
Fluoranthene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A	0.0014	#9		0.0014	
Fluorene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A					
Indeno(1,2,3-c,d)pyrene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A					
Naphthalene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A	0.07	#7		0.07	
Phenanthrene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A	0.002	#9		0.002	
Pyrene	mg/L	0.0001	57	<0.0001	<0.0001	N/A	N/A					
PAHs (Sum of positives)	mg/L	0.0001	56	<0.0001	<0.0001	N/A	N/A					
PCBs												
Aroclor 1016	mg/L	0.00001	-	-	-	N/A	N/A					
Aroclor 1221	mg/L	0.00001	-	-	-	N/A	N/A					
Aroclor 1232	mg/L	0.00001	-	-	-	N/A	N/A					
Aroclor 1242	mg/L	0.00001	24	<0.0001	<0.0001	N/A	N/A	0.0003	#9		0.0003	
Aroclor 1248	mg/L	0.00001	-	-	-	N/A	N/A					
Aroclor 1254	mg/L	0.00001	24	<0.0001	<0.0001	N/A	N/A	0.00001	#9		0.00001	
Sum PCBs	mg/L	0.00001	51	<0.0001	<0.0001	N/A	N/A					
PFAS												
Sum of PFHxS and PFOS	µg/L	0.0002	16	<0.0002	0.027	0.016	0.014					
Perfluorooctane sulfonic acid (PFOS)	µg/L	0.0002	16	<0.0002	0.013	0.0091	0.0073			0.13	0.13	
Perfluorooctanoic acid (PFOA)	µg/L	0.0002	16	<0.0002	0.005	0.0022	0.0028			220	220	
Sum of positive PFAS	µg/L	0.0001	16	<0.0001	0.12	0.059	0.070					

Comments
 LOSP - level of species protection
 UCL - upper confidence limit
 DGV - default guideline value
 #1 Moderate reliability. Ammonia as total ammonia, measured as [NH₃-N] at pH 8.
 #2 High reliability. DGV may not protect key test species from chronic toxicity (this refers to experimental chronic values or geometric mean for species). Check toxicant DGV technical brief for spread of data and its significance.
 #3 Very high reliability
 #4 Low reliability guideline value
 #4 Low reliability guideline value - "indicative interim working level". Criteria not pH dependent and may be based on waters > pH 6.5
 #5 High reliability
 #6 Very high reliability. Recommended for application for slightly to moderately disturbed ecosystems. However, this DGV may be under-protective for key sensitive species (e.g. bivalve molluscs, cnidarians)
 #7 Moderate reliability. DGV may not protect key test species from chronic toxicity (this refers to experimental chronic values or geometric mean for species). Check toxicant DGV technical brief for spread of data and its significance.
 #8 Unknown reliability. Recommended for application for slightly to moderately disturbed ecosystems.
 #9 Low reliability freshwater criteria for OCP
 #10 Moderate reliability
 #11 Unknown reliability. To account for the bioaccumulating nature of this toxicant, it is recommended that the 99% species protection level DGV is used for slightly to moderately disturbed systems. Also see General comments.
 #12 To account for the bioaccumulating nature of this toxicant, it is recommended that the 99% species protection level DGV is used for slightly to moderately disturbed systems. Refer to Warne et al. (2017) for details.
 #14 ANZECC 2000 DTVs for physical and chemical stressors for SE Aust for slightly disturbed ecosystems - Low land rivers (Table 3.3.3)
 #15 ANZECC 2000 DTVs for physical and chemical stressors for SE Aust for slightly disturbed ecosystems - Estuaries (Table 3.3.2)
 #16 An Environmental Concern Level (ECL) of 2.3 µg/L was derived for As (III) in marine waters, using an assessment factor (AF) of 100. Refer Section 8.3.4.5 of the ANZECC & ARMCANZ (2000). This figure has been adopted as a marine low reliability trigger value, to be used only as an indicative interim working level. Further review
 #17 Chromium VI levels adopted as initial screen for total chromium. Very high reliability.
 #18 An environmental concern level (ECL) (refer to Section 8.3.4.5 of the ANZECC & ARMCANZ 2000 guidelines) of 23 µg/L is derived from an AF of 200 (as Mo is an essential element) and this was adopted as a low reliability trigger value. Both of these figures should only be used as indicative interim working levels.

Environmental Standards
 ANZG, July 2023, ANZG Marine Water Toxicant DGVs LOSP 95% (July 2023)
 HEPA (2025) NEMP 3.0 Interim Marine 95% LOSP for protection of aquatic ecosystems

Table E2: Groundwater Quality Assessment Criteria for Bores in the Clay Aquitard (i.e. MW02, MW04)

	Unit	LOR	Monitoring data 2015-Jan 2025					ANZG Marine Water Toxicant DGVs 95% LOSP	Notes to DGV	HEPA (2026) NEMP 3.0 Interim Marine 95% LOSP for protection of aquatic ecosystems	Adopted Trigger level	Comments
			No of readings	Minimum	Maximum	UCL ₉₅ -mean	80 th Percentile					
Physio chemical parameters (field)												
pH (Field)	pH	0.1	35	6.39	8.0	7.17	6.7 / 7.4 (20th/80th)	7.0-8.0	#14		6.7-8.0	Lower bound based on 20th percentile, upper bound based on ANZG
Electrical Conductivity (field)	µS/cm	1	35	305	45300	22400	15900	125-2200	#15		15900	General indicator water quality value for groundwater rather than
DO (Field)	mg/L	0.1	34	0	6.64	2.7	3.81				-	contaminants of concern
DO (Field)	%	1	-	-	-	-	-	80-110%	#14		-	
Turbidity (Field)	NTU	1	-	-	-	-	-	0.5-10	#14		-	
Temperature (Field)	°C	-	-	-	-	-	-				-	
Physio chemical parameters												
Total Suspended Solids	mg/L	5	22	30	1800	348	314				-	TSS in groundwater can vary per monitoring event and based on well condition. General indicator water quality value for groundwater rather than
Anions												
Chloride	mg/L	1	32	31	11000	7330	4720				4720	General indicator water quality value for groundwater rather than
Sulphate	mg/L	1	32	0.5	5200	3500	2560				2560	contaminants of concern
Fluoride	mg/L	0.1	32	0.05	1	0.62	0.74				0.74	
Alkalinity (Hydroxide) as CaCO3	mg/L	5	32	0.5	2.5	1.75	2.3				-	
Alkalinity (Carbonate as CaCO3)	mg/L	5	32	0.5	1140	247	19.3				-	
Alkalinity (total) as CaCO3	mg/L	5	32	86	1230	743	928				-	
Alkalinity (Bicarbonate as CaCO3)	mg/L	5	32	0.5	1230	676	887				-	
Hardness (filtered)	mg/L	3	15	68	7600	4770	2770				-	
Nutrients												
Ammonia as N (filtered)	mg/L	0.005	32	<0.01	55.6	3	1.81	0.91	#1		1.81	TKN, nitrate, nitrite etc are all measures of nitrogen species. The trigger level
Total Kjeldahl Nitrogen	mg/L	0.1	29	0.4	56	4.53	4.51				4.51	for ammonia is generally considered most applicable to assessing nitrogen
Nitrate (as N) (filtered)	mg/L	0.005	22	<0.005	0.3	0.08	0.04				0.04	concentrations in groundwater.
Nitrite (as N) (filtered)	mg/L	0.005	22	<0.005	0.088	0.020	0.07				0.07	TKN is a measure of ammonia, and more broadly nitrogen. Trigger level
Nitrogen (Total Oxidised)	mg/L	0.005	28	<0.005	1.9	0.20	0.11	0.015	#15		0.11	covered by ammonia.
Nitrogen (Total)	mg/L	0.1	15	0.4	56.3	11.8	6.7	0.3	#15		6.7	
Total Phosphorus (Organic Phosphate)	mg/L	0.05	32	<0.05	6.05	1.62	2.3	0.03	#15		2.3	
Reactive Phosphorus as P (Orthophosphate as P) (filtered)	mg/L	0.005	15	<0.005	0.079	0.0186	0.013	0.005	#15		0.013	
Cations												
Calcium (filtered)	mg/L	0.5	32	21	582	291	416				-	General indicator water quality value for groundwater rather than
Magnesium (filtered)	mg/L	0.5	32	3	1500	842	574				-	contaminants of concern
Potassium (filtered)	mg/L	0.5	32	3	310	131	191				-	
Sodium (filtered)	mg/L	0.5	32	7.8	8700	4660	3780				-	
Metals (filtered)												
Aluminium (filtered)	mg/L	0.01	9	<0.01	0.030	0.015	0.016	0.0005	#4		0.016	
Arsenic (filtered)	mg/L	0.001	30	<0.001	0.03	0.005	0.004	0.0023 (As V)	#16		0.004 (total As)	
Cadmium (filtered)	mg/L	0.0001	30	<0.0001	0.0005	0.0005	N/A	0.0055	#2		0.0055	
Chromium (III+VI) (filtered)	mg/L	0.001	30	<0.001	0.005	0.001	0.002	0.0044 (Cr VI)	#17		0.0044 (Cr VI)	
Copper (filtered)	mg/L	0.001	30	<0.001	0.007	0.003	0.004	0.0013	#3		0.004	
Iron (filtered)	mg/L	0.01	29	0.08	200	60	45				45	
Lead (filtered)	mg/L	0.001	30	<0.001	0.005	0.001	0.001	0.0044	#4		0.0044	
Manganese (filtered)	mg/L	0.005	30	0.01	16	9.2	7.5	0.08	#9		7.5	
Mercury (filtered)	mg/L	0.00005	30	<0.00005	<0.00005	N/A	N/A	0.0004	#3		0.0004	
Molybdenum (filtered)	mg/L	0.001	30	<0.001	0.026	0.003	0.003	0.023	#18		0.023	
Nickel (filtered)	mg/L	0.001	30	<0.001	0.045	0.00998	0.007	0.07	#3		0.07	
Zinc (filtered)	mg/L	0.001	30	0.002	2.01	0.313	0.070	0.008	#6		0.070	
TRH												
C6-C10 Fraction (F1)	mg/L	0.01	31	0.005	0.12	N/A	N/A				0.01	Laboratory LOR adopted
C6-C10 (F1 minus BTEX)	mg/L	0.01	31	0.005	0.04	N/A	N/A				0.01	
>C10-C16 Fraction (F2)	mg/L	0.05	31	0.025	2.75	N/A	N/A				0.05	
>C10-C16 Fraction (F2 minus Naphthalene)	mg/L	0.05	15	0.025	0.05	N/A	N/A				0.05	
>C16-C34 Fraction (F3)	mg/L	0.1	31	0.05	3.56	N/A	N/A				0.1	
>C34-C40 Fraction (F4)	mg/L	0.1	31	0.05	0.34	N/A	N/A				0.1	
>C10-C40 Fraction (Sum)	mg/L	0.05	31	0.025	6.65	N/A	N/A				0.05	
C6-C9 Fraction	mg/L	0.01	28	0.005	0.12	N/A	N/A				0.01	
C10-C14 Fraction	mg/L	0.05	27	0.025	2.48	N/A	N/A				0.05	
C15-C28 Fraction	mg/L	0.1	27	0.05	3.02	N/A	N/A				0.1	
C29-C36 Fraction	mg/L	0.1	27	0.025	1.24	N/A	N/A				0.1	
C10-C36 Fraction (Sum)	mg/L	0.05	23	0.025	6.74	N/A	N/A				0.05	
TPH (Silica-Gel Cleanup)												
C10-C14 Fraction (SG)	mg/L	0.05	-	-	-	N/A	N/A				0.05	
C15-C28 Fraction (SG)	mg/L	0.1	-	-	-	N/A	N/A				0.1	
C29-C36 Fraction (SG)	mg/L	0.1	-	-	-	N/A	N/A				0.1	
>C10-C16 Fraction (SG)	mg/L	0.05	-	-	-	N/A	N/A				0.05	
>C16-C34 Fraction (SG)	mg/L	0.1	-	-	-	N/A	N/A				0.1	
>C34-C40 Fraction (SG)	mg/L	0.1	-	-	-	N/A	N/A				0.1	
BTEX												
Benzene	mg/L	0.001	31	<0.001	<0.001	N/A	N/A	0.7	#7		0.7	
Toluene	mg/L	0.001	31	<0.001	<0.001	N/A	N/A	0.18	#8		0.18	
Ethylbenzene	mg/L	0.001	31	<0.001	<0.001	N/A	N/A	0.08	#8		0.08	
Xylene (m & p)	mg/L	0.001	31	<0.002	<0.002	N/A	N/A					
Xylene (m)	mg/L	0.001	31	<0.002	<0.002	N/A	N/A	0.075	#7		0.075	
Xylene (o)	mg/L	0.001	31	<0.002	<0.002	N/A	N/A	0.35	#8		0.35	
Xylene (p)	mg/L	0.001	31	<0.002	<0.002	N/A	N/A	0.2	#8		0.2	
PAH												
Acenaphthene	mg/L	0.0001	31	<0.0001	<0.0001	N/A	N/A					
Acenaphthylene	mg/L	0.0001	31	<0.0001	<0.0001	N/A	N/A					
Anthracene	mg/L	0.0001	31	<0.0001	<0.0001	N/A	N/A	0.0004	#9		0.0004	
Benzo(a)anthracene	mg/L	0.0001	31	<0.0001	<0.0001	N/A	N/A					
Benzo(b+j+k)fluoranthene	mg/L	0.0002	31	<0.0002	<0.0002	N/A	N/A					
Benzo(a) pyrene	mg/L	0.0001	31	<0.0001	<0.0001	N/A	N/A	0.0002	#9		0.0002	
Benzo(g,h,i)perylene	mg/L	0.0001	31	<0.0001	<0.0001	N/A	N/A					
Chrysene	mg/L	0.0001	31	<0.0001	<0.0001	N/A	N/A					
Dibenz(a,h)anthracene	mg/L	0.0001	31	<0.0001	<0.0001	N/A	N/A					
Fluoranthene	mg/L	0.0001	31	<0.0001	<0.0001	N/A	N/A	0.0014	#9		0.0014	
Fluorene	mg/L	0.0001	31	<0.0001	<0.0001	N/A	N/A					
Indeno(1,2,3-c,d)pyrene	mg/L	0.0001	31	<0.0001	<0.0001	N/A	N/A					
Naphthalene	mg/L	0.0001	31	<0.0001	<0.005	N/A	N/A	0.07	#7		0.07	
Phenanthrene	mg/L	0.0001	31	<0.0001	<0.001	N/A	N/A	0.002	#9		0.002	
Pyrene	mg/L	0.0001	31	<0.0001	<0.001	N/A	N/A					
PAHs (Sum of positives)	mg/L	0.0001	27	<0.0001	<0.005	N/A	N/A					
PCBs												
Aroclor 1016	mg/L	0.00001	-	-	-	N/A	N/A					
Aroclor 1221	mg/L	0.00001	-	-	-	N/A	N/A					
Aroclor 1232	mg/L	0.00001	-	-	-	N/A	N/A					
Aroclor 1242	mg/L	0.00001	15	<0.0001	<0.0001	N/A	N/A	0.0003	#9		0.0003	
Aroclor 1248	mg/L	0.00001	-	-	-	N/A	N/A					
Aroclor 1254	mg/L	0.00001	15	<0.0001	<0.0001	N/A	N/A	0.00001	#9		0.00001	
Sum PCBs	mg/L	0.00001	28	<0.0001	<0.0001	N/A	N/A					
Phenols												
2,4,6-Trichlorophenol	mg/L	0.001	31	<0.001	<0.005	N/A	N/A					
2,4-Dichlorophenol	mg/L	0.001	31	<0.001	<0.005	N/A	N/A					
2-Chlorophenol	mg/L	0.001	31	<0.001	<0.005	N/A	N/A					
Pentachlorophenol	mg/L	0.005	31	<0.001	<0.005	N/A	N/A	0.022			0.022	
Phenol	mg/L	0.001	29	<0.001	0.10	N/A	N/A	0.4	#4		0.4	
PFAS												
Sum of PFHxS and PFOS	µg/L	0.0002	10	<0.0002	0.098	0.084	0.075					
Perfluorooctane sulfonic acid (PFOS)	µg/L	0.0002	10	<0.0002	0.086	N/A	N/A			0.13	0.13	
Perfluorooctanoic acid (PFOA)	µg/L	0.0002	10	<0.0002	0.006	N/A	N/A			220	220	
Sum of positive PFAS	µg/L	0.0001	10	<0.0001	0.120	N/A	N/A					

Comments

LOSP - level of species protection
 UCL - upper confidence limit
 DGV - default guideline value

#1 Moderate reliability. Ammonia as total ammonia, measured as [NH3-N] at pH 8.
 #2 High reliability. DGV may not protect key test species from chronic toxicity (this refers to experimental chronic values or geometric mean for species). Check toxicant DGV technical brief for spread of data and its significance.
 #3 Very high reliability
 #4 Low reliability guideline value
 #5 High reliability
 #6 Very high reliability. Recommended for application for slightly to moderately disturbed ecosystems. However, this DGV may be under-protective for key sensitive species (e.g. bivalve molluscs, cnidarians)
 #7 Moderate reliability. DGV may not protect key test species from chronic toxicity (this refers to experimental chronic values or geometric mean for species). Check toxicant DGV technical brief for spread of data and its significance.
 #8 Unknown reliability. Recommended for application for slightly to moderately disturbed ecosystems.
 #9 Low reliability freshwater criteria for OCP
 #10 Moderate reliability
 #11 Unknown reliability. To account for the bioaccumulating nature of this toxicant, it is recommended that the 99% species protection level DGV is used for slightly to moderately disturbed systems. Also see General comments.
 #12 To account for the bioaccumulating nature of this toxicant, it is recommended that the 99% species protection level DGV is used for slightly to moderately disturbed systems. Refer to Warne et al. (2017) for details.
 #14 ANZECC 2000 DTVs for physical and chemical stressors for SE Aust for slightly disturbed ecosystems - Low land rivers (Table 3.3.3)
 #

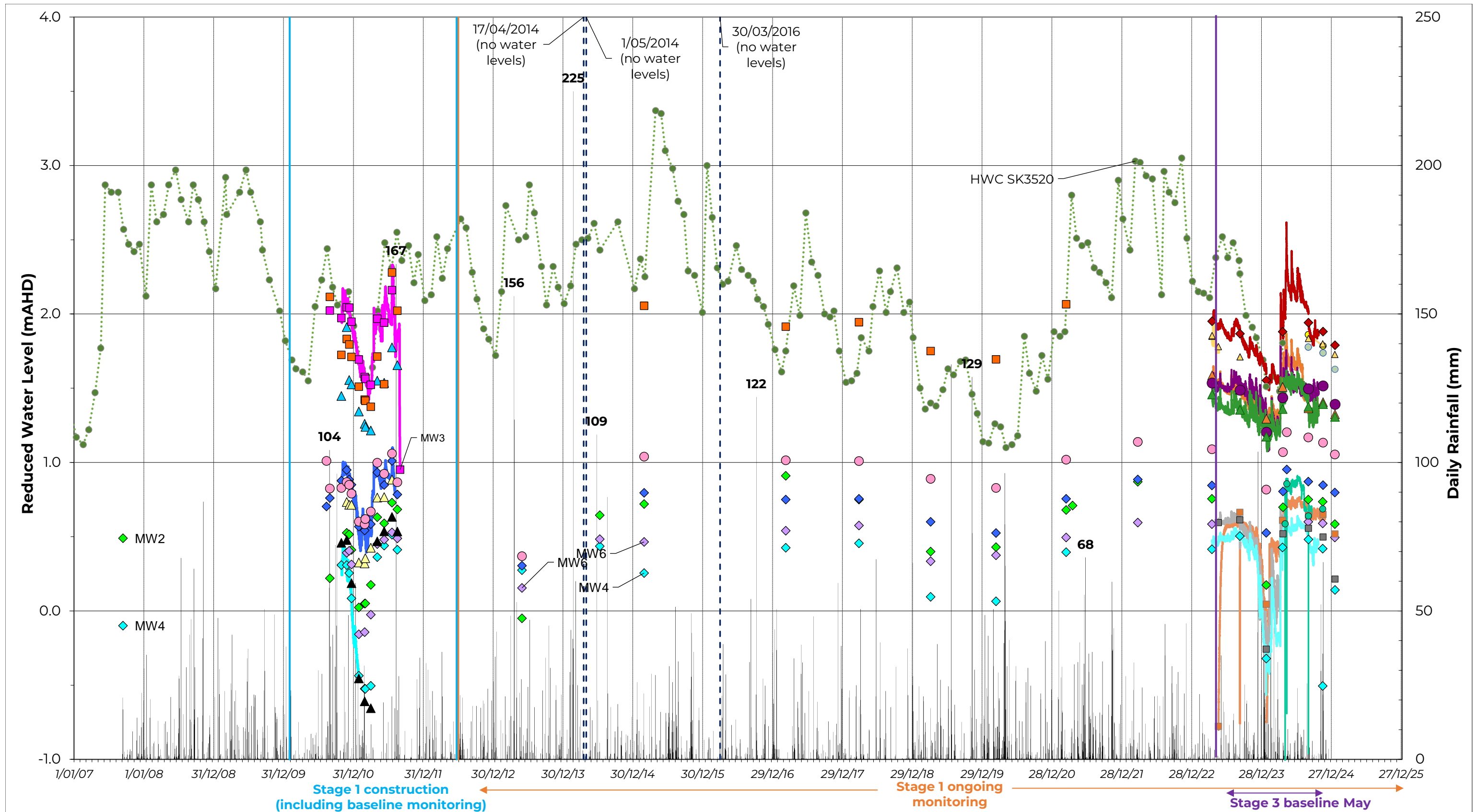


Figure E1: Groundwater Levels in Monitoring Wells (2007-2025)

Revision: Rev0



- | | | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> ■ Daily Rainfall (mm) - Williamtown RAAF ■ MW3 ■ MW8 ○ MW11 ● MW103 ● MW107 — MW101 Datalogger — MW104 Logger — MW8A Logger | <ul style="list-style-type: none"> ▲ MW1 ◆ MW4 ▲ MW8A ○ MW12 ■ MW104 ● SK3520 — MW101 Logger — MW105 Logger — MW107 Logger | <ul style="list-style-type: none"> — MW1A ◆ MW6 ▲ MW9 ▲ MW101 ▲ MW105 — MW3 Datalogger — MW102 Logger — MW106 Logger | <ul style="list-style-type: none"> ◆ MW2 ▲ MW7 ▲ MW10 ▲ MW102 ■ MW106 — MW4 Datalogger — MW103 Logger — MW104 Logger |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
- - - - - No water levels
 — Stage 1 - construction start

Appendix F

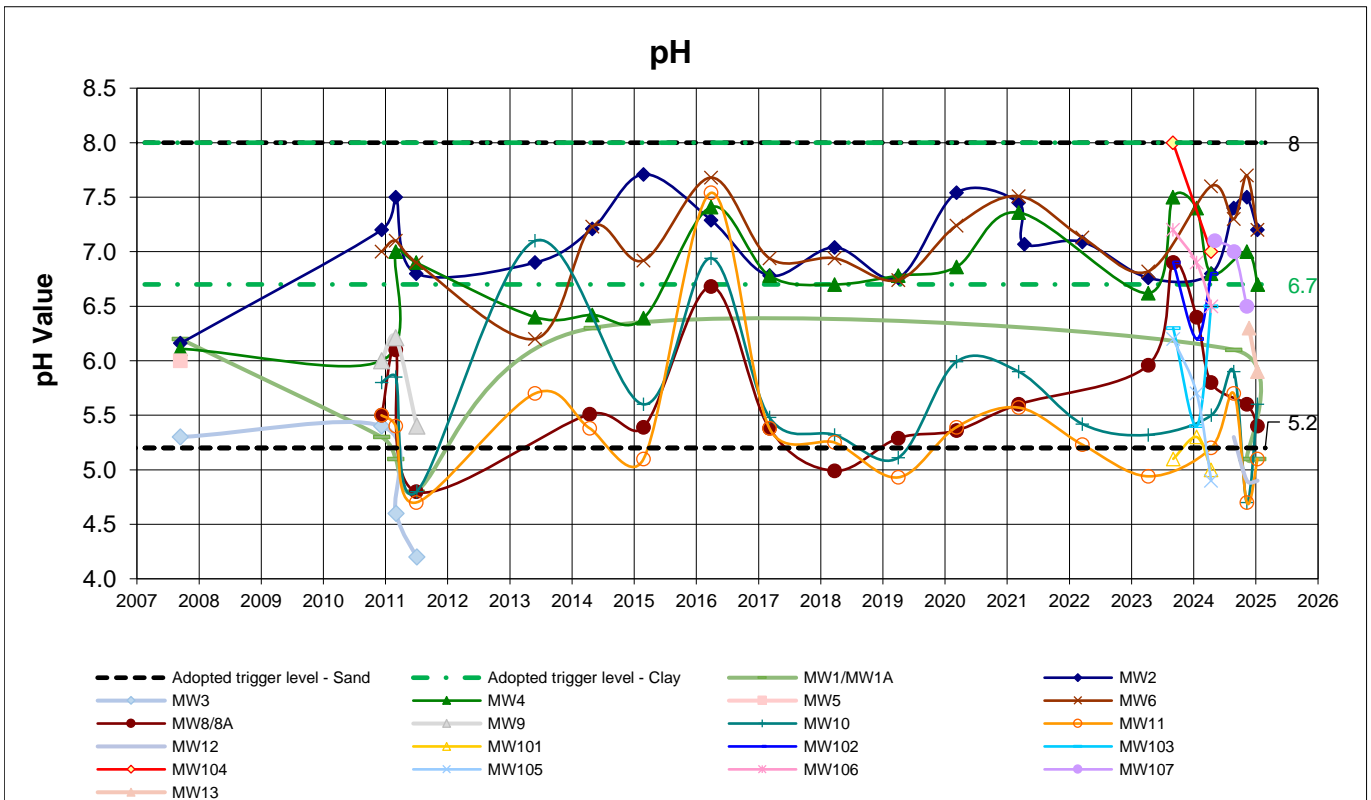
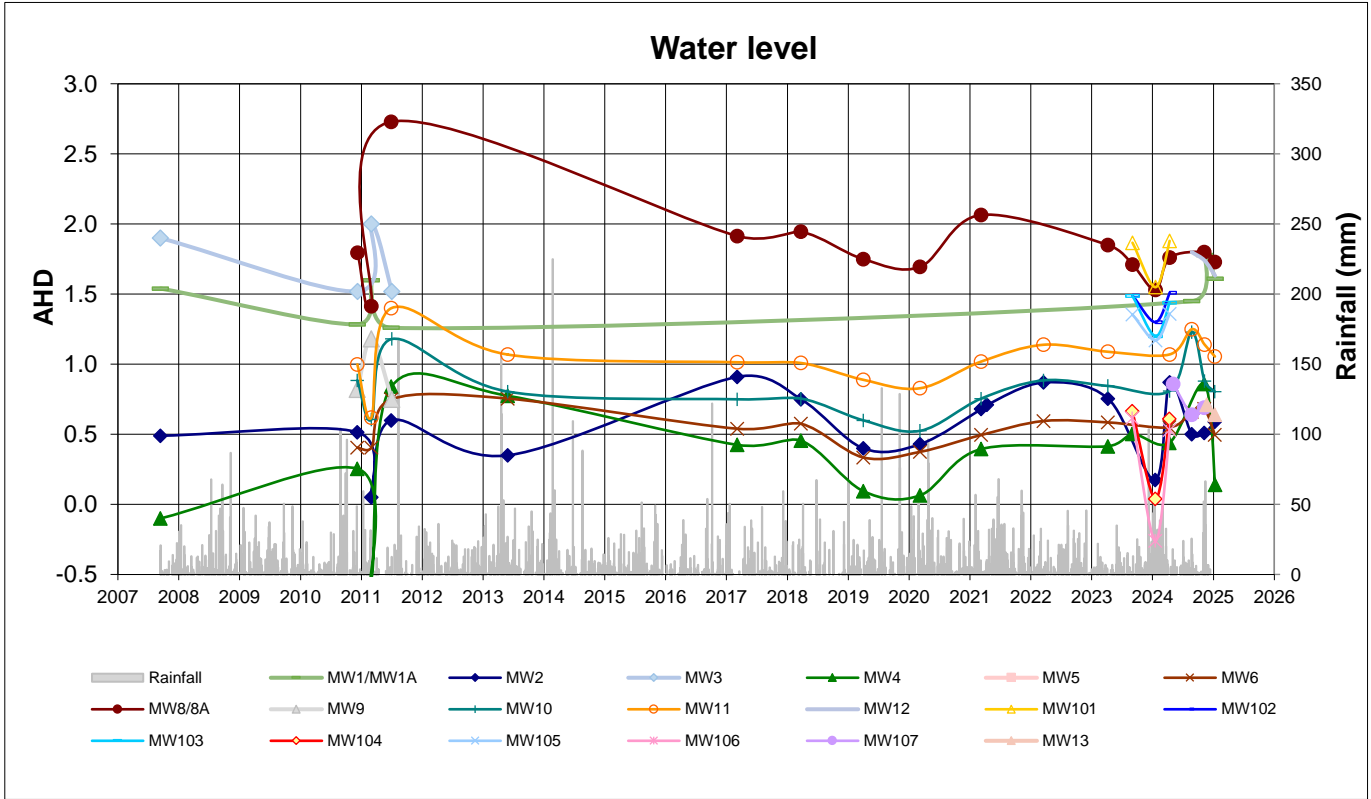
Groundwater Quality Plots

Surface water Quality Plots

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

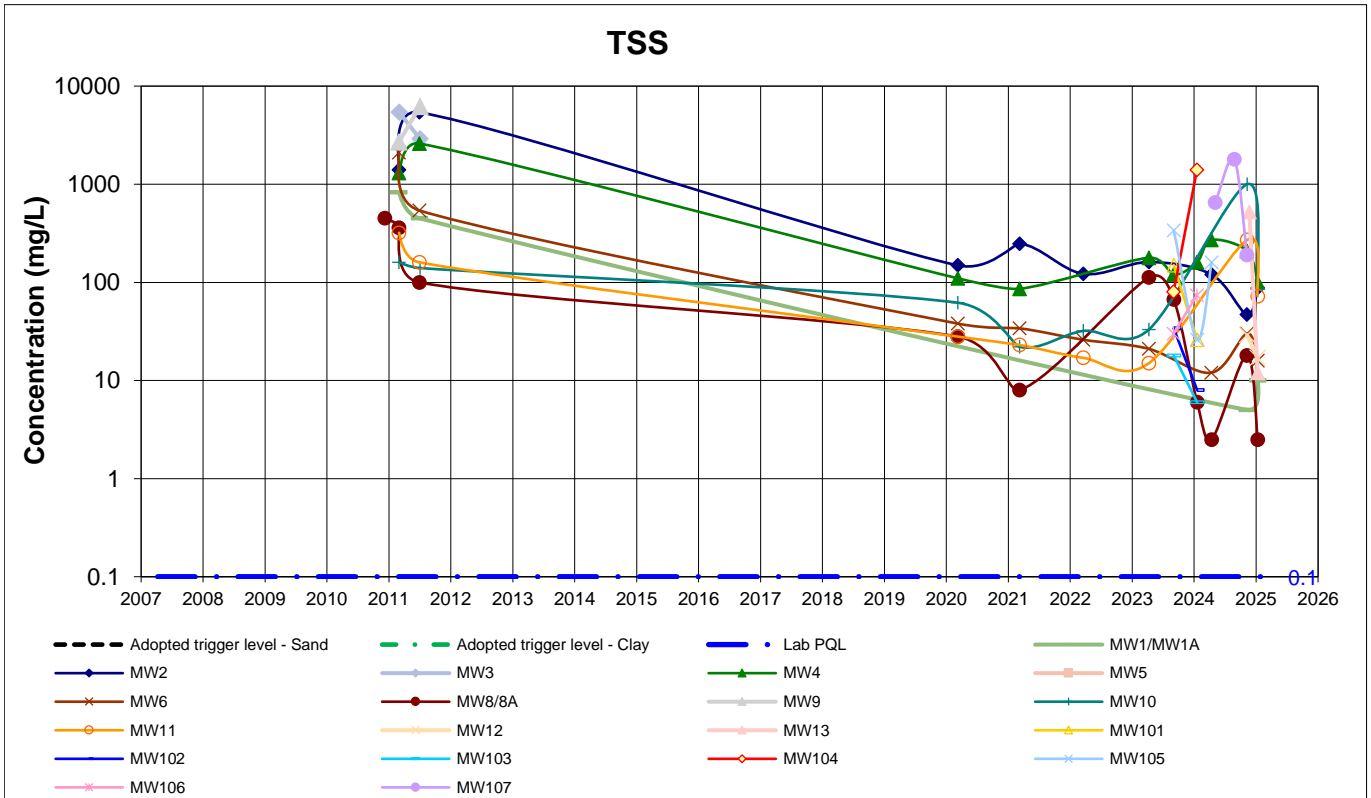
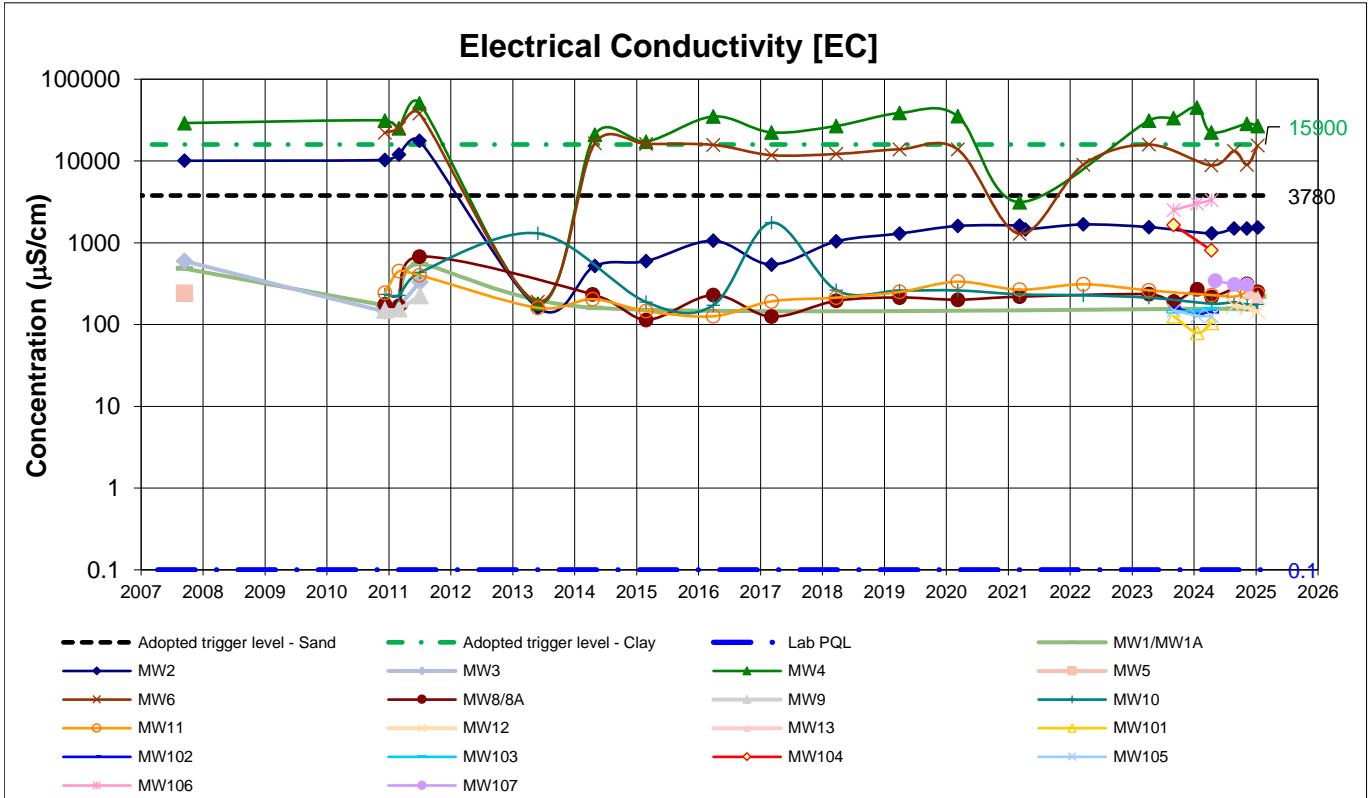


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

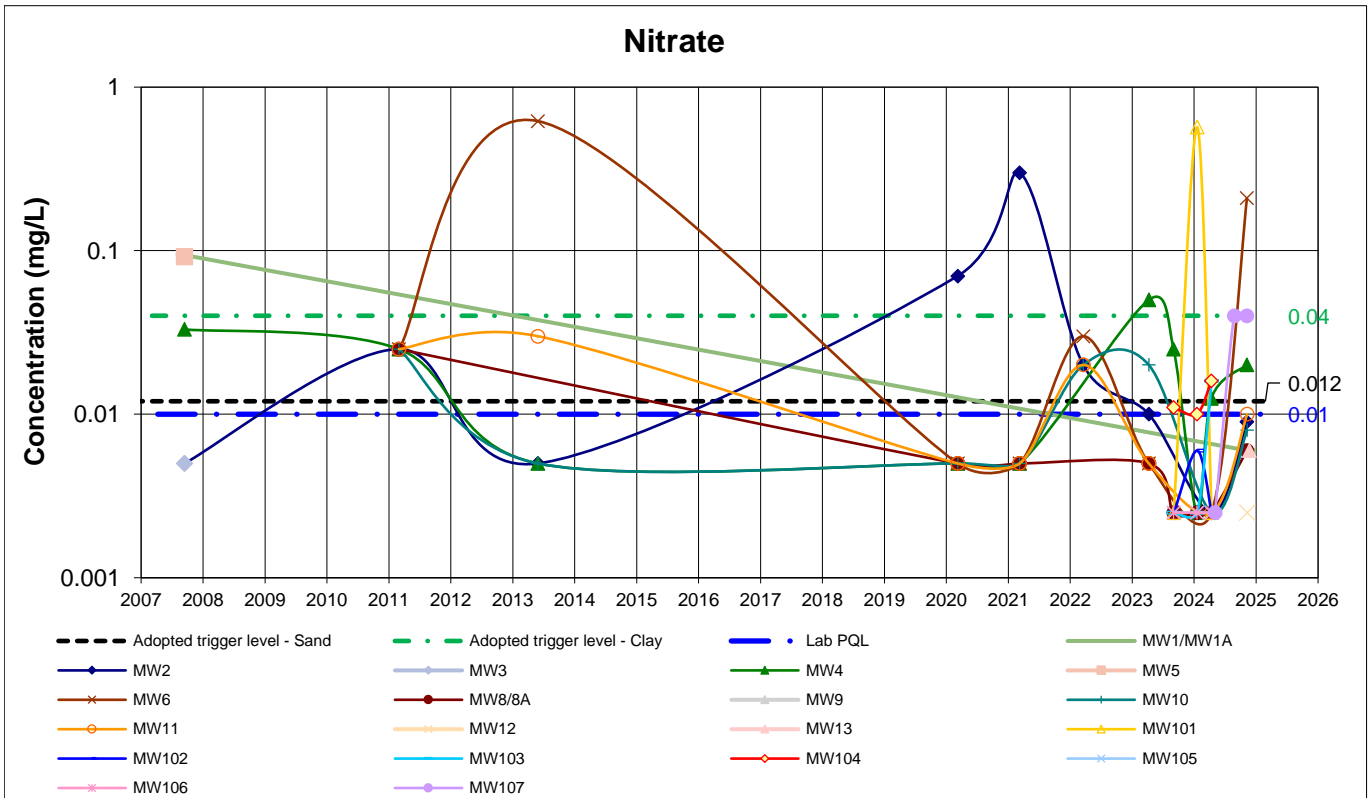
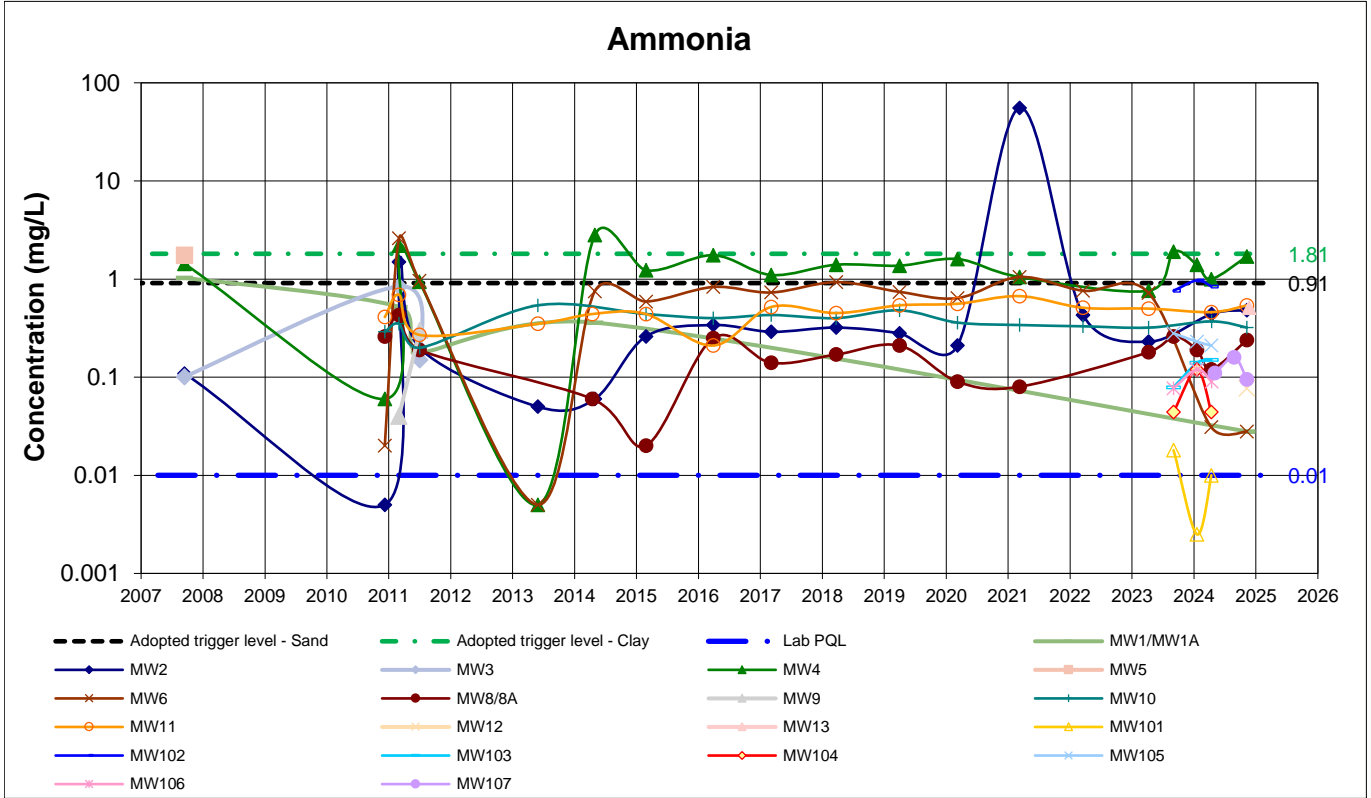


1. Values reported below PQL are plotted as half PQL
 2. If a Criterion line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

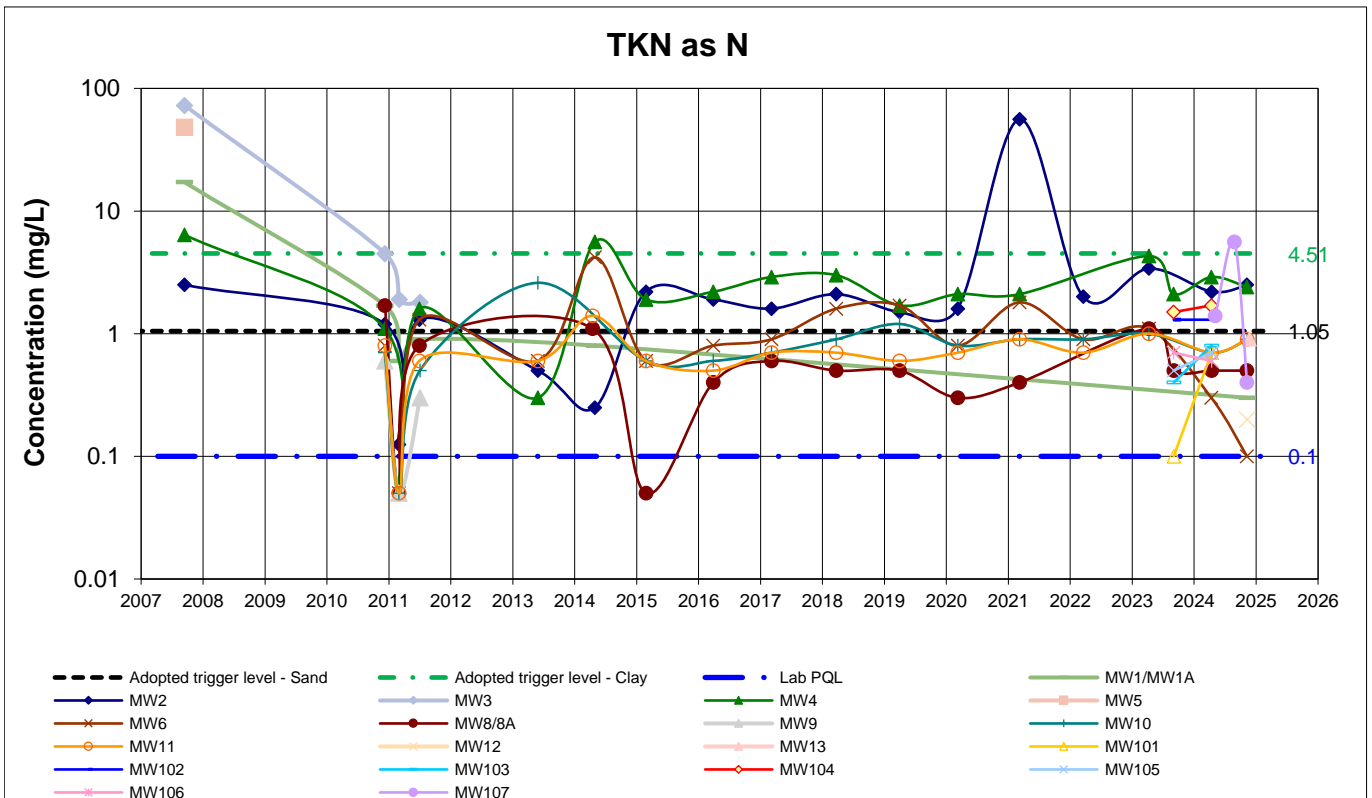
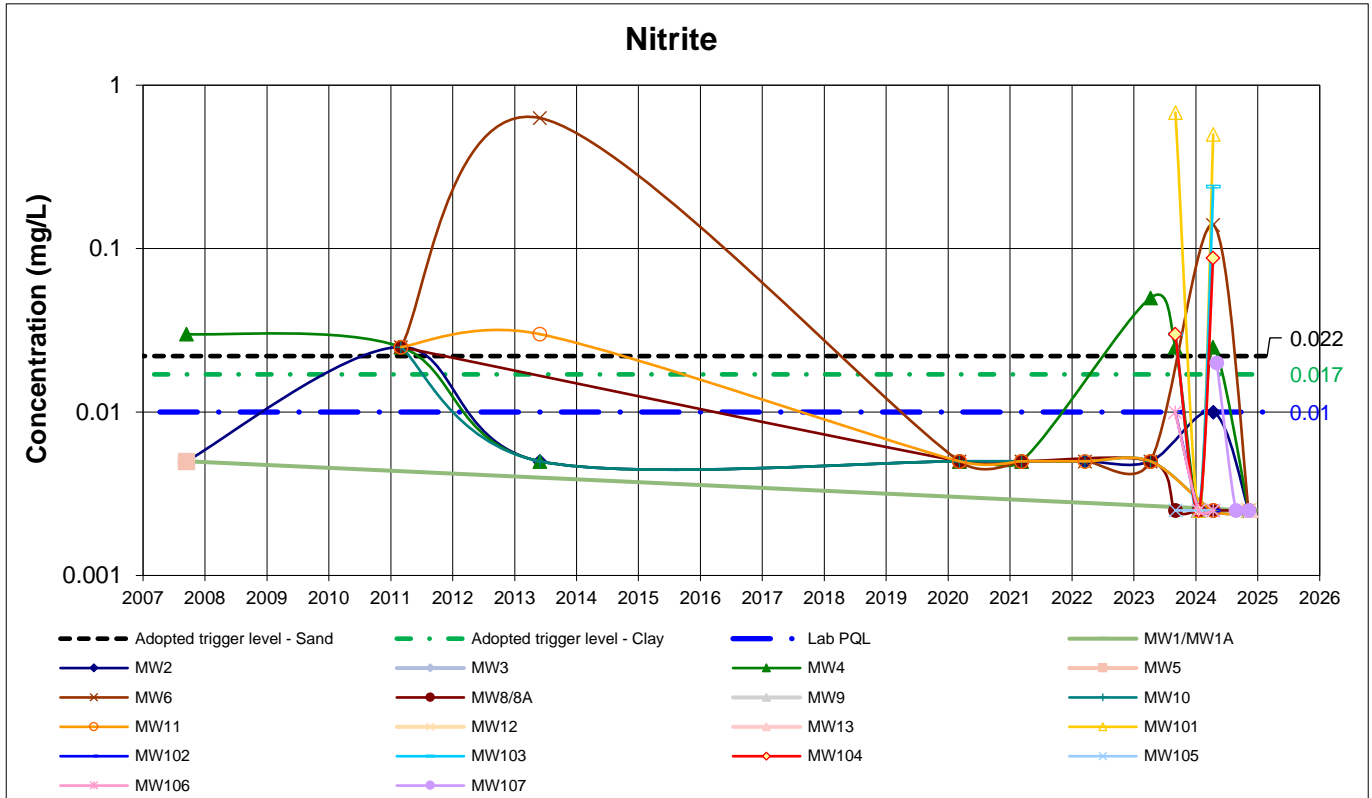


1. Values reported below PQL are plotted as half PQL
 2. If a Criterion line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

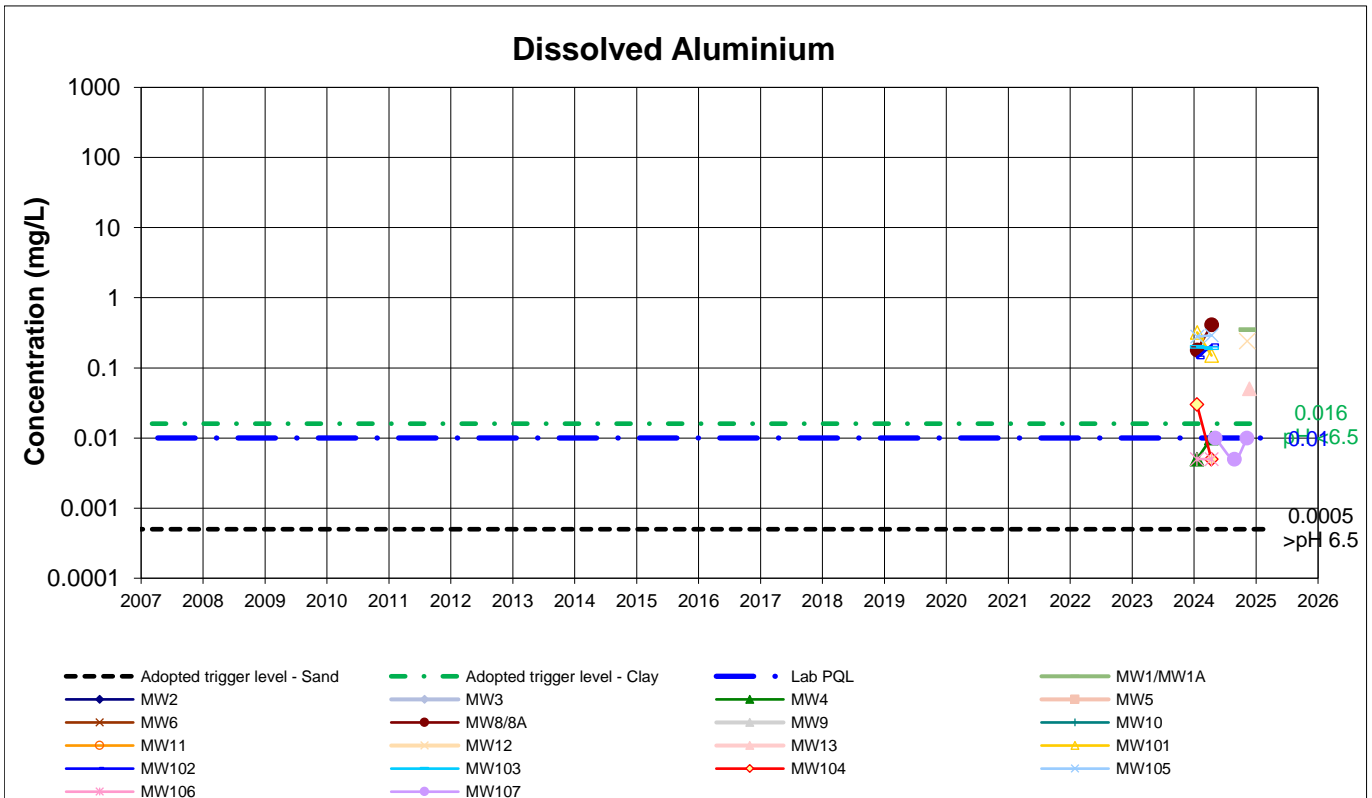
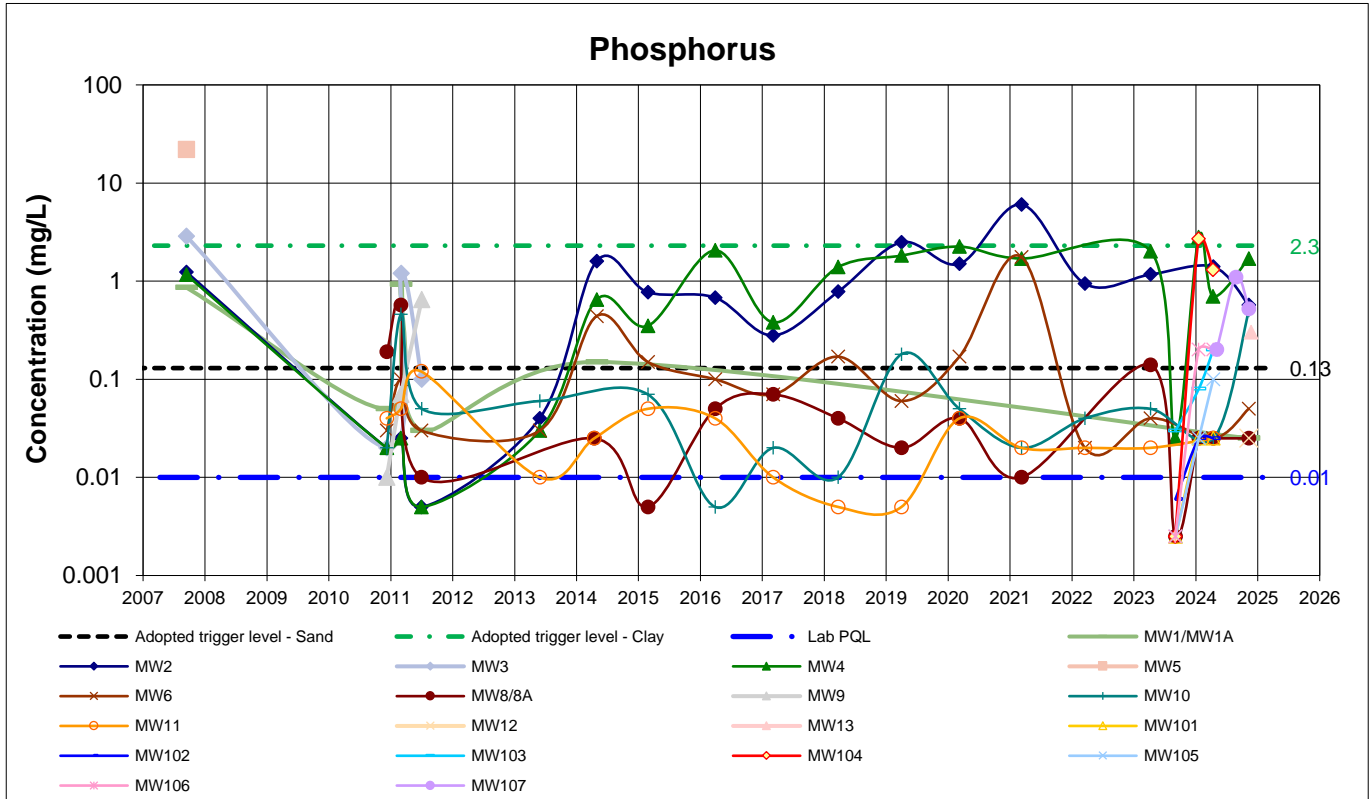


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

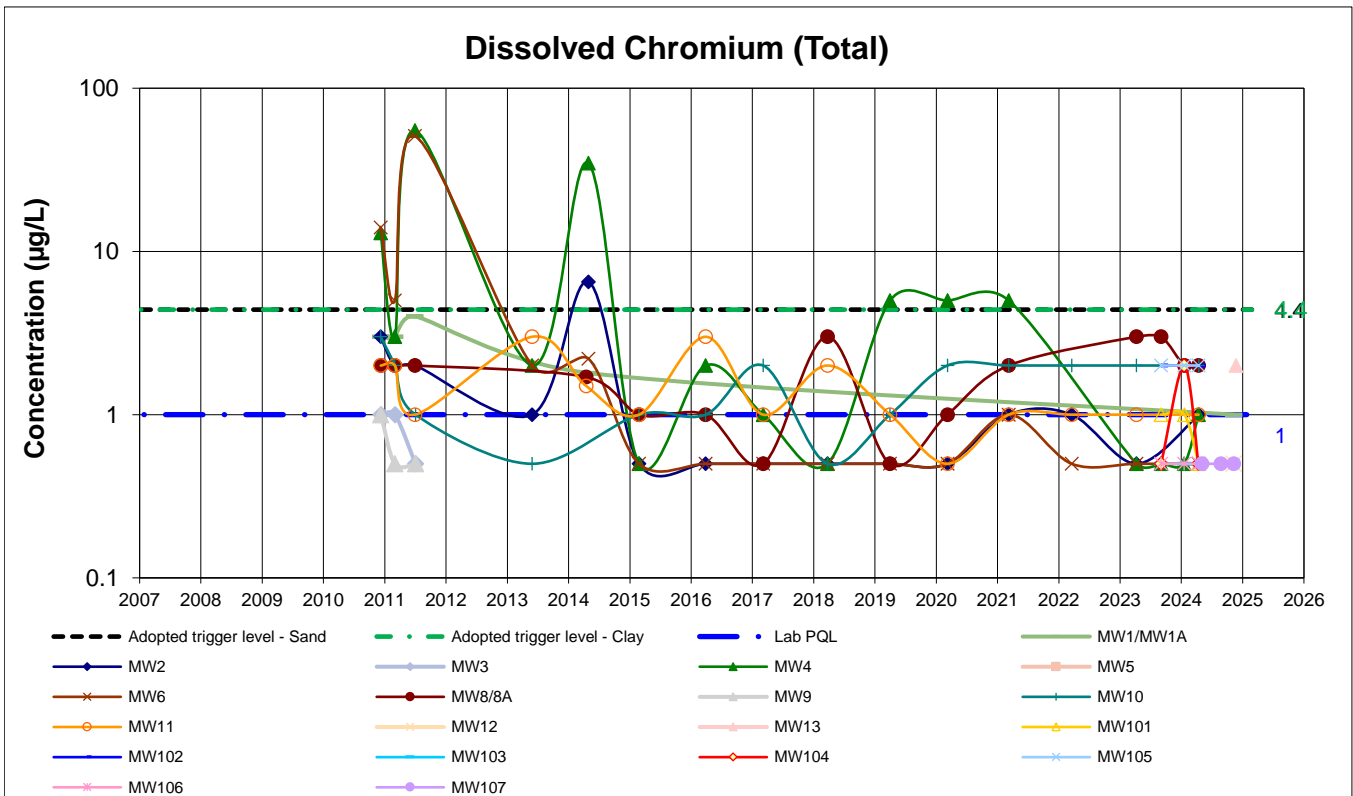
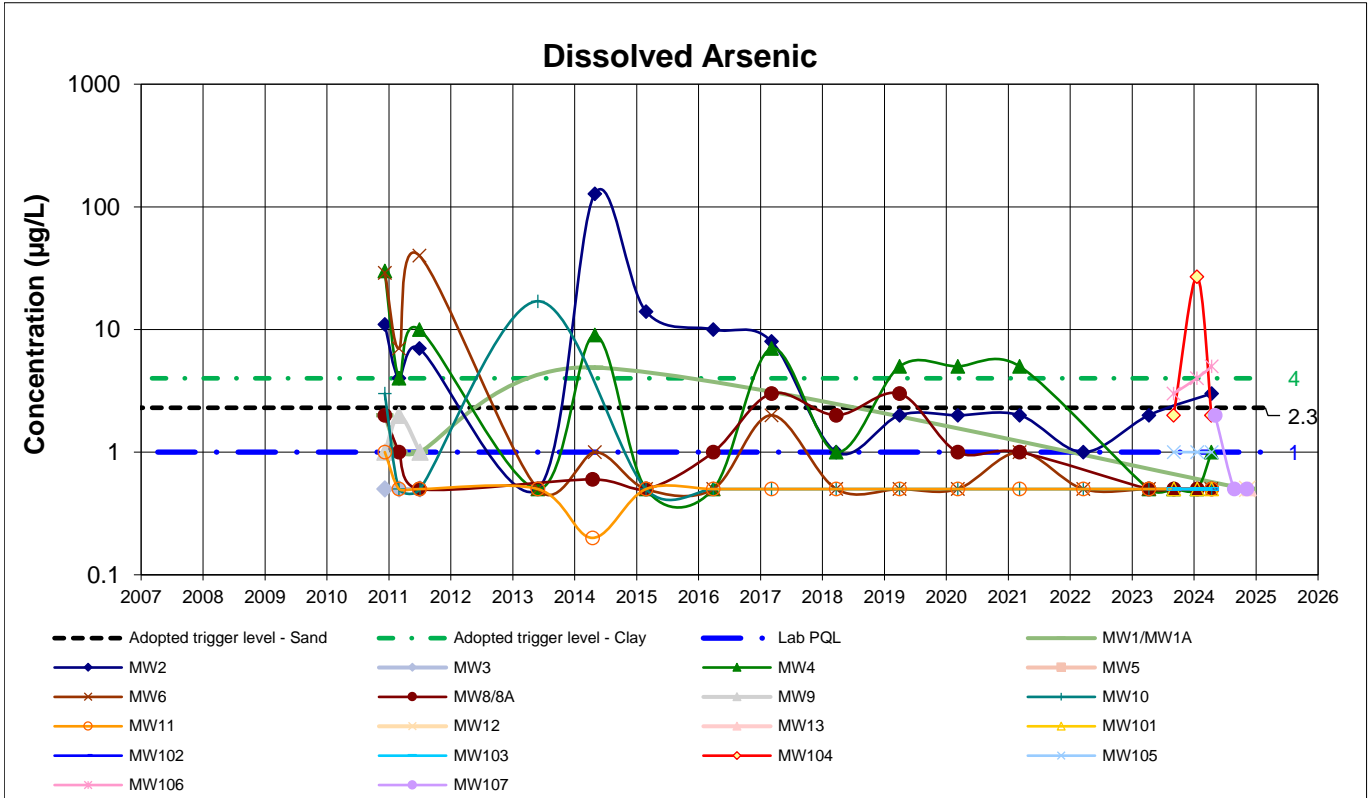


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

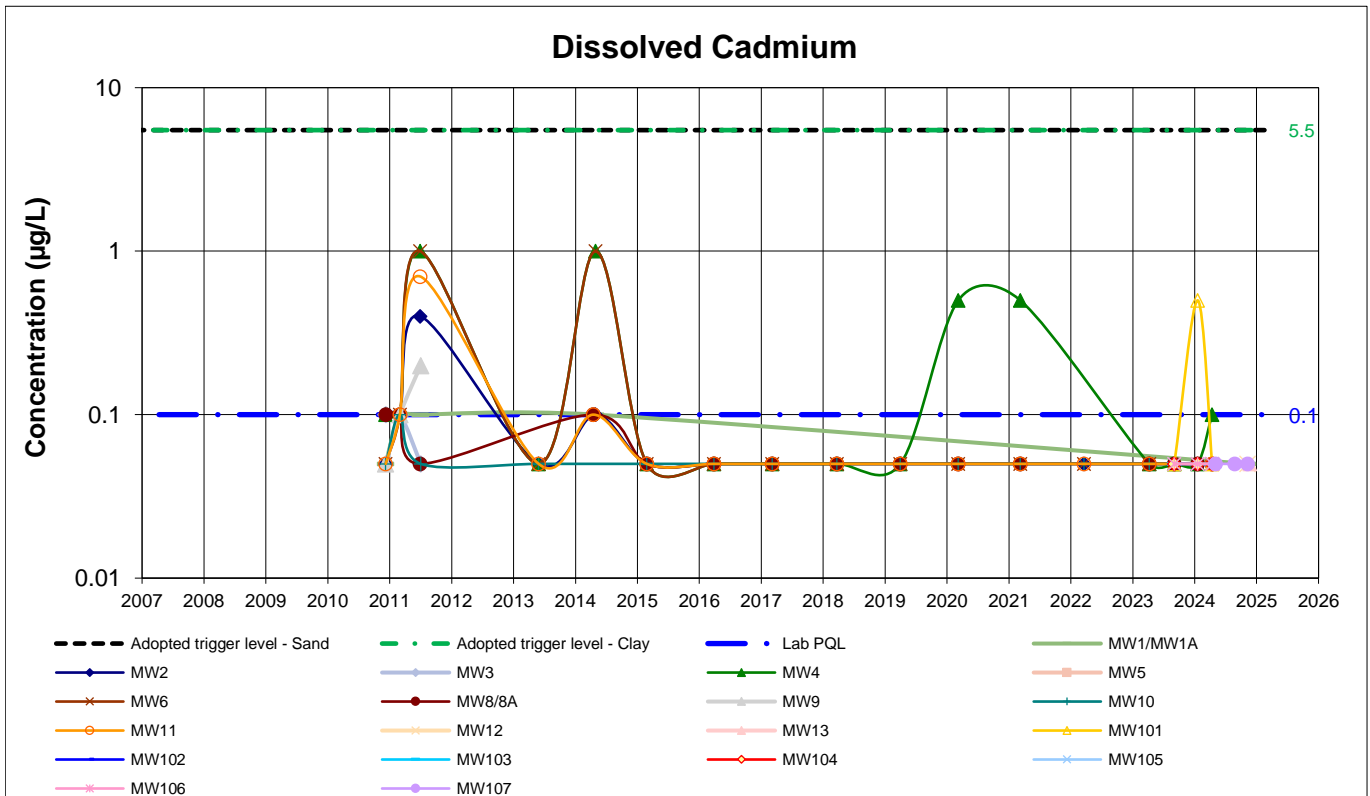
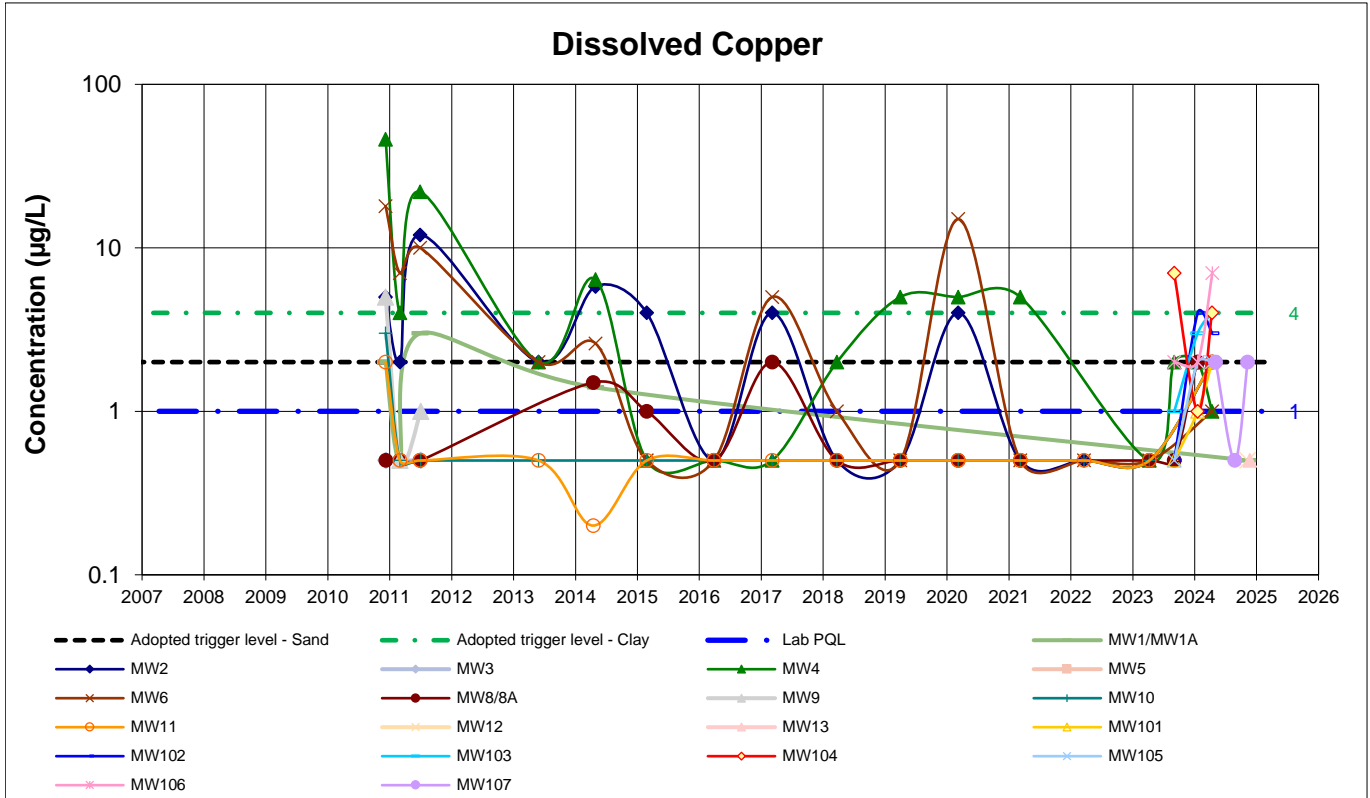


1. Values reported below PQL are plotted as half PQL
 2. If a Criterion line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

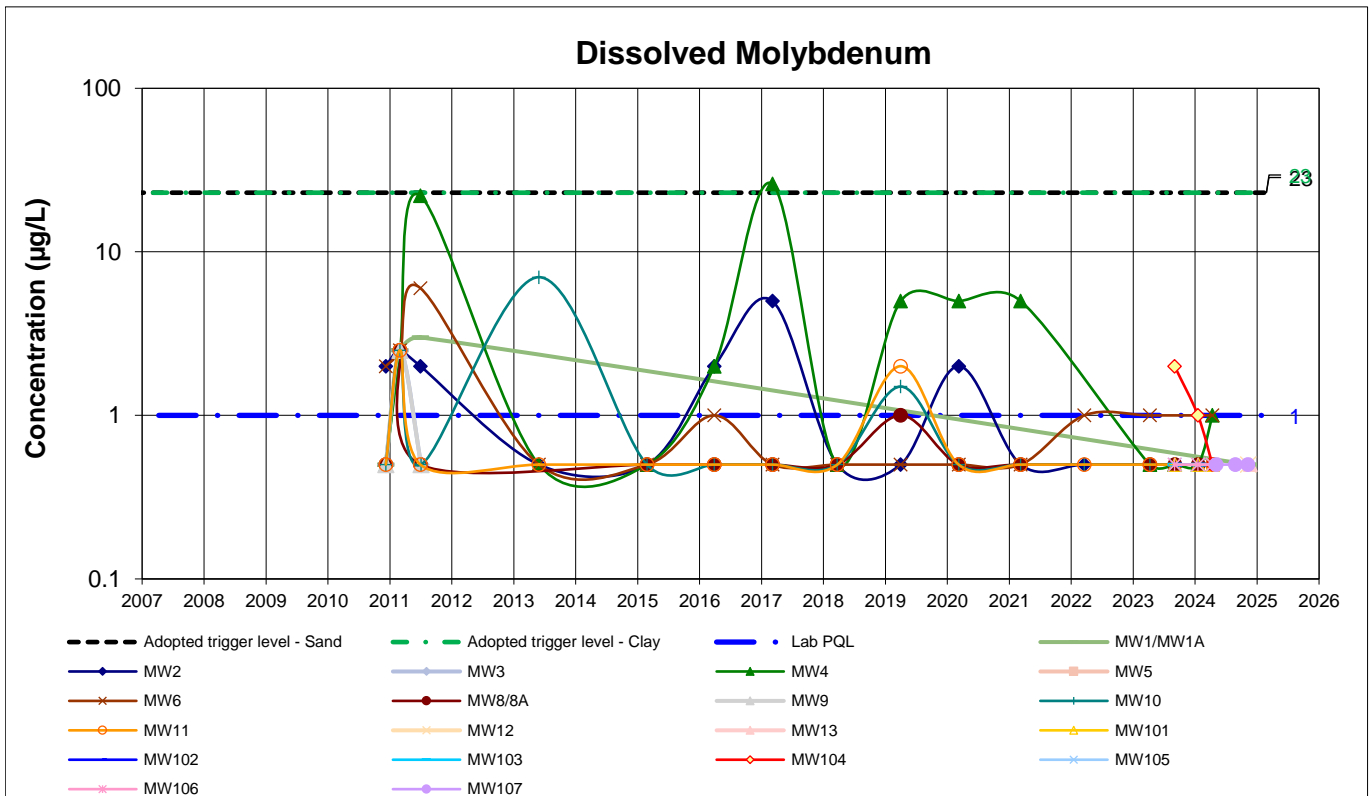
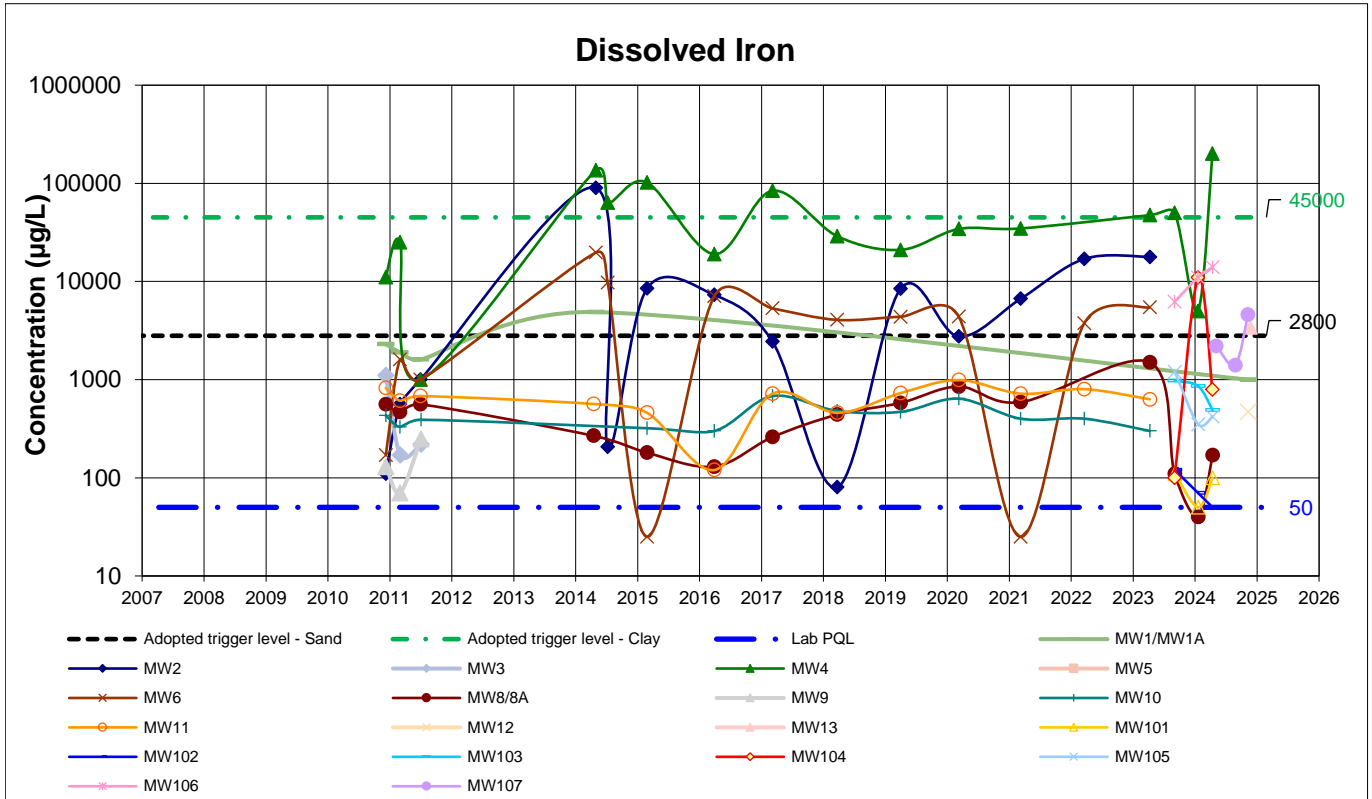


1. Values reported below PQL are plotted as half PQL
2. If a Criteria line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

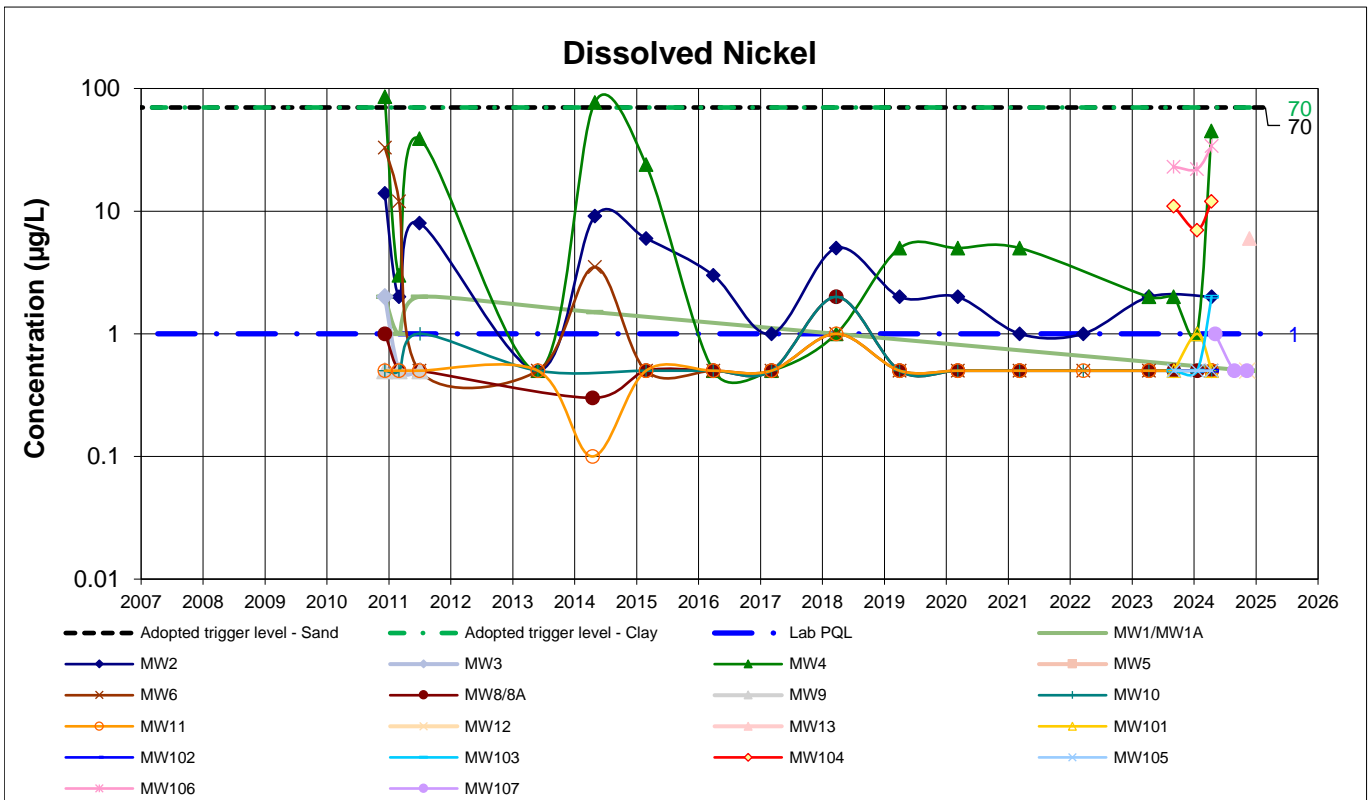
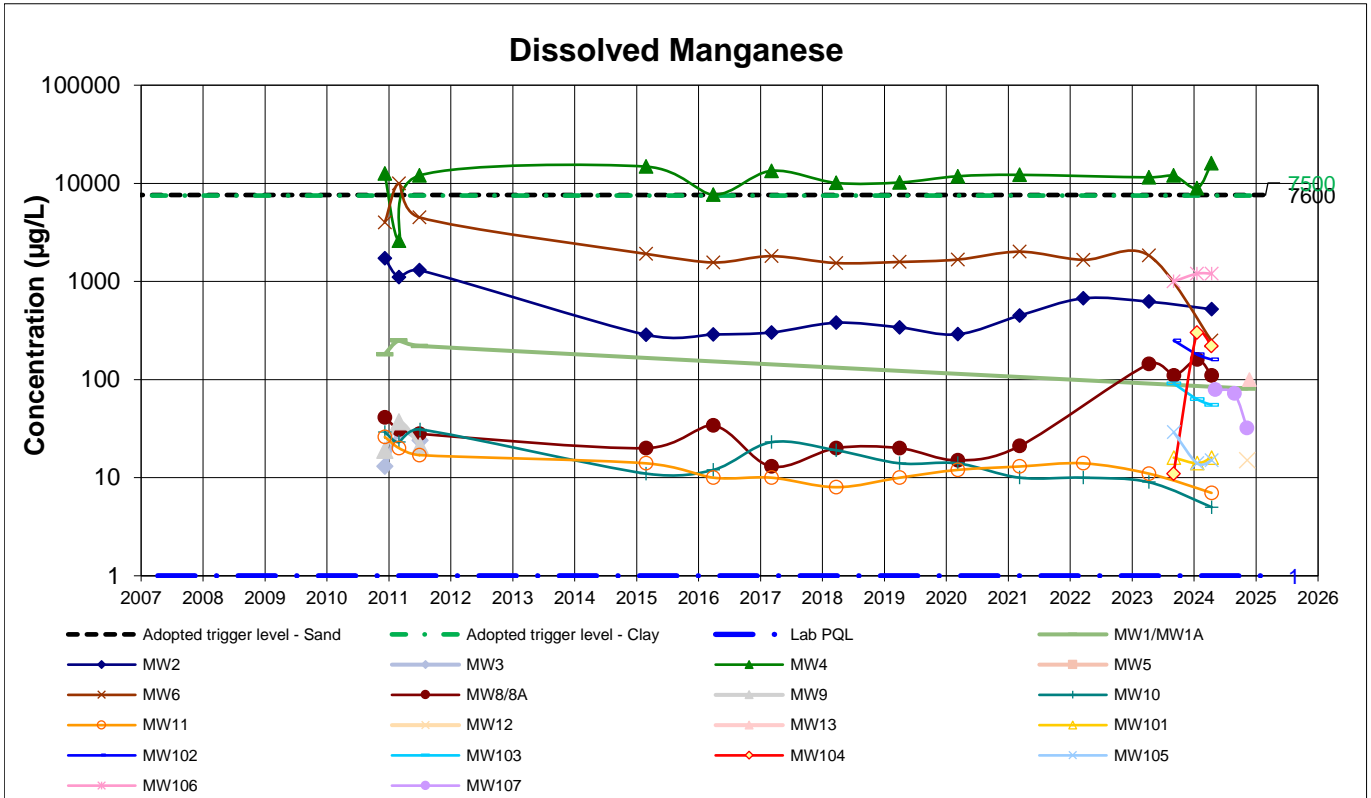


1. Values reported below PQL are plotted as half PQL
 2. If a Criterion line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

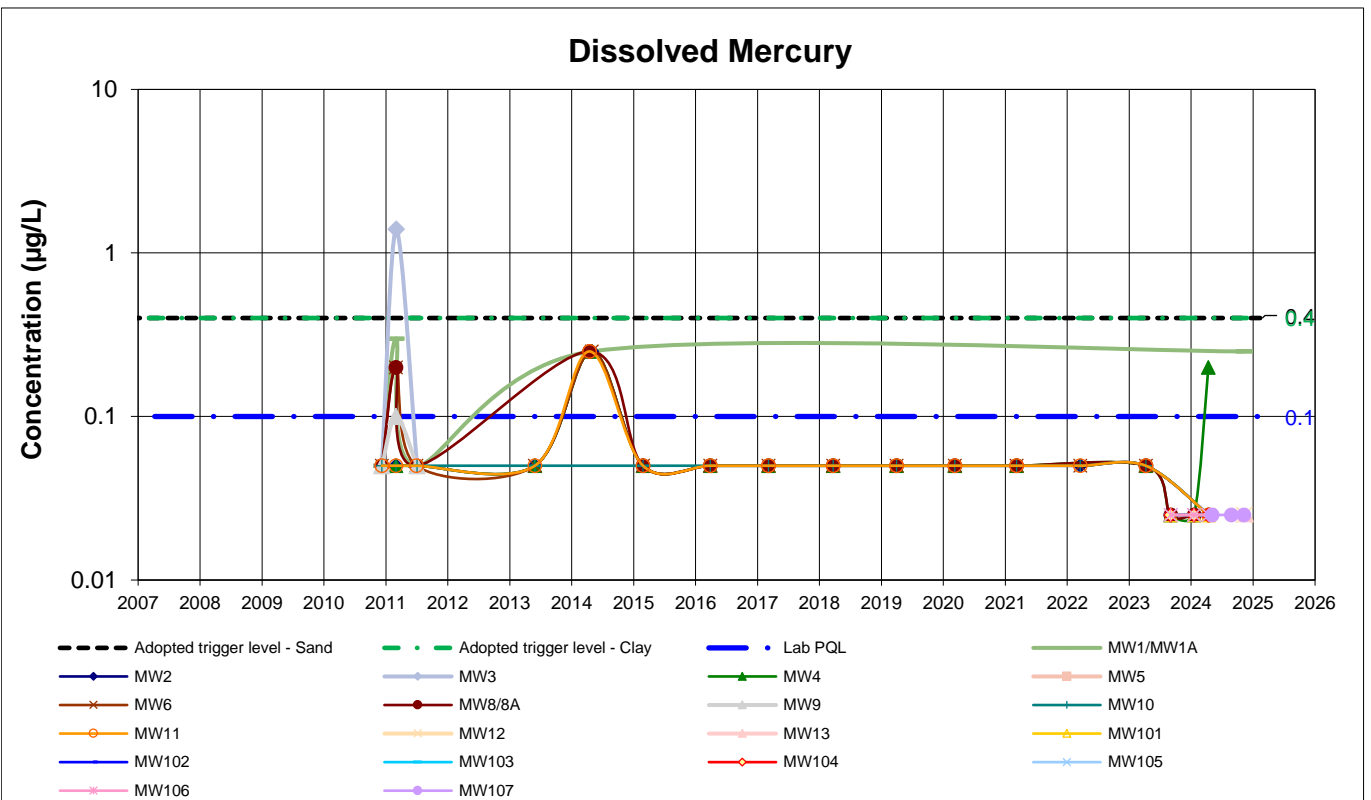
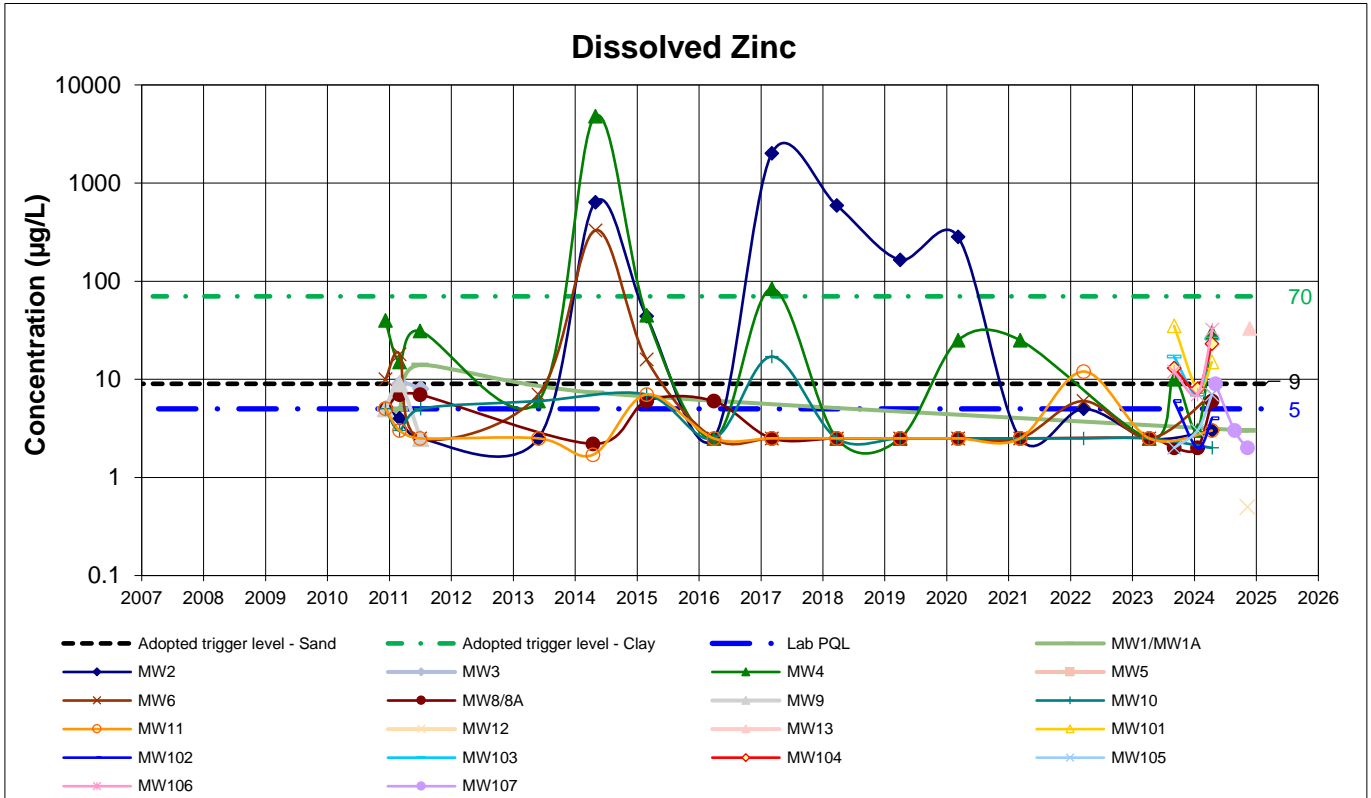


1. Values reported below PQL are plotted as half PQL
 2. If a Criterion line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

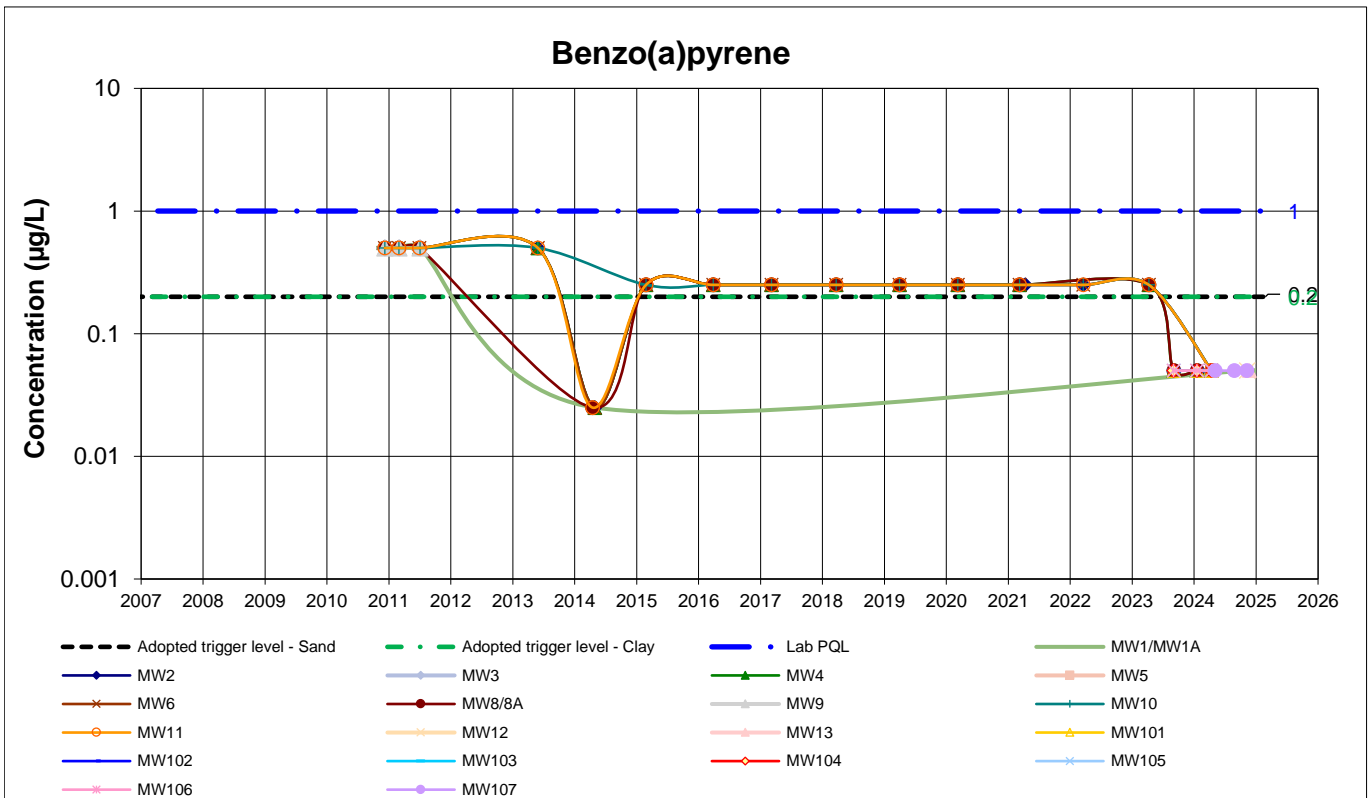
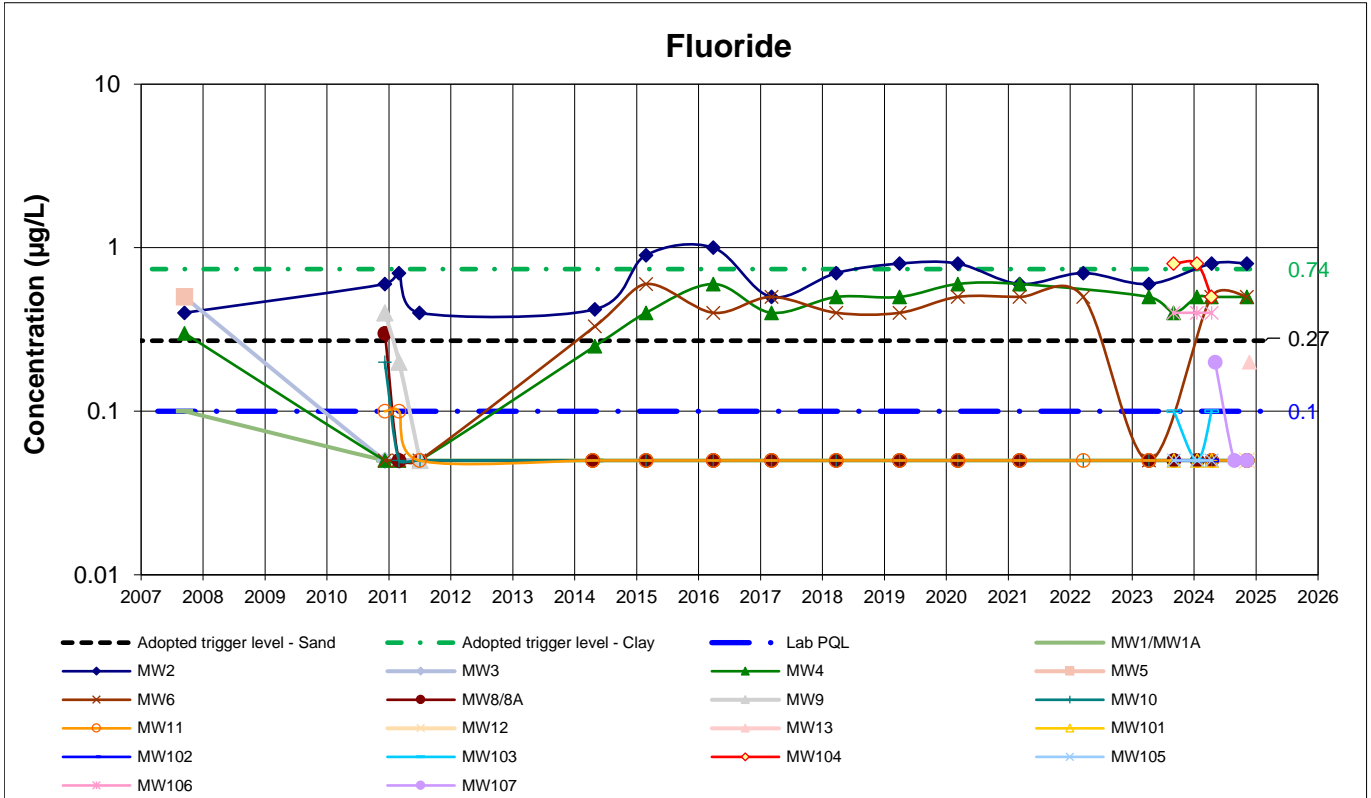


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

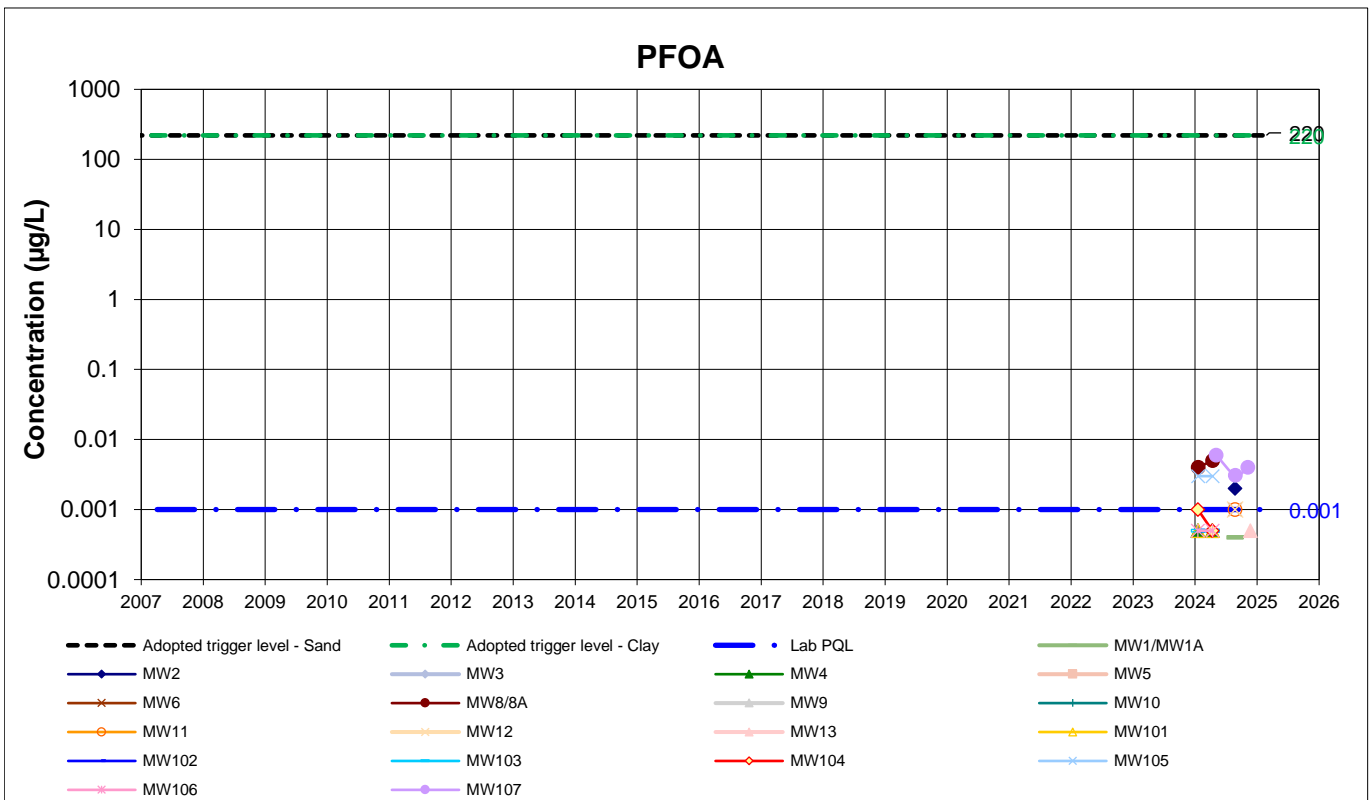
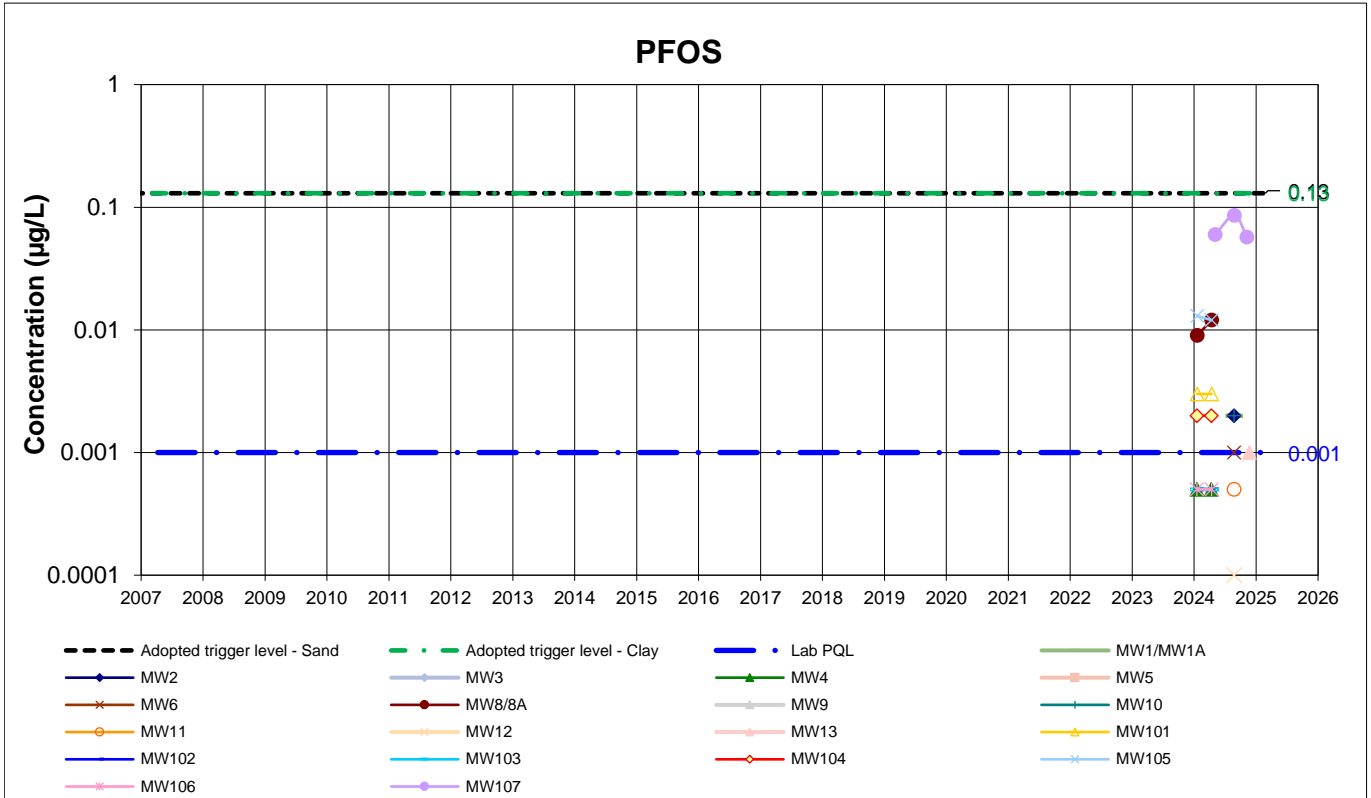


1. Values reported below PQL are plotted as half PQL
 2. If a Criterion line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

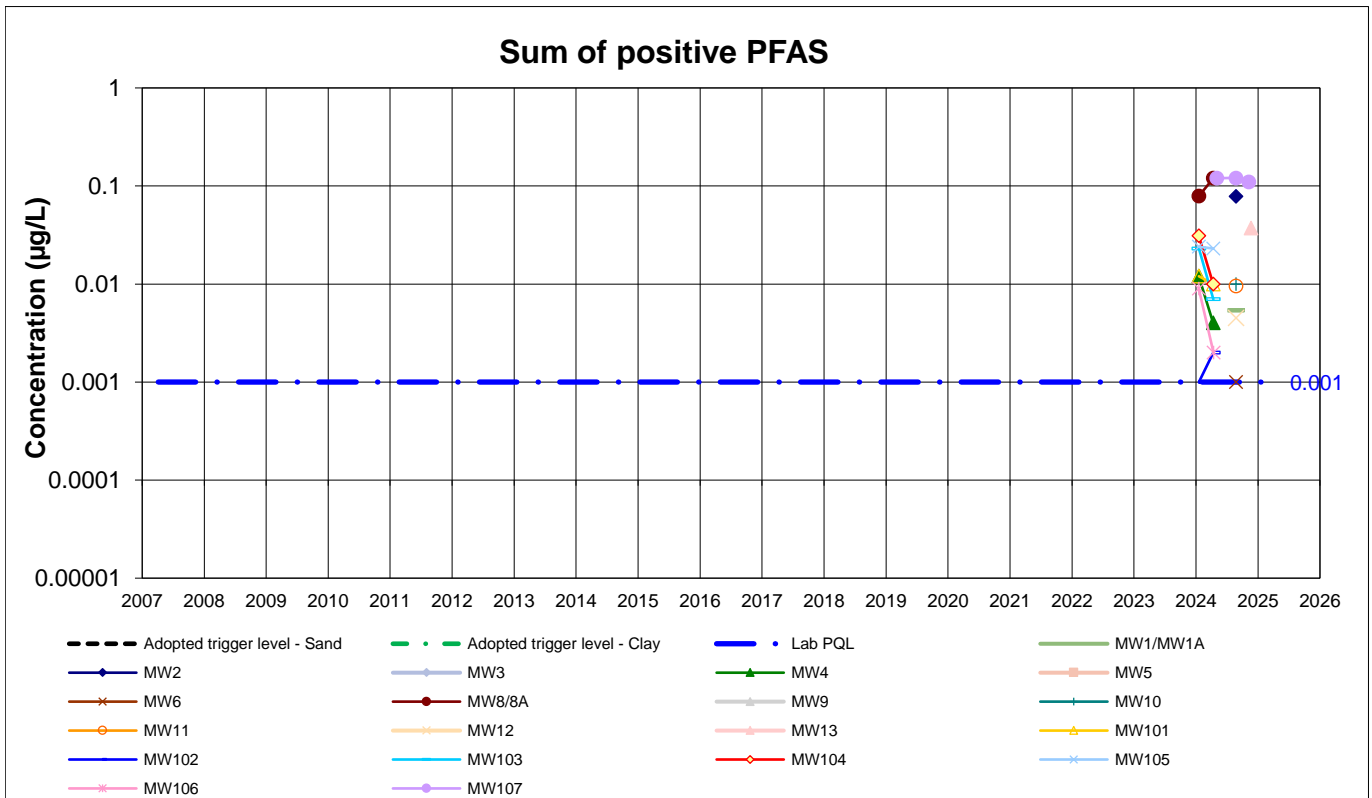
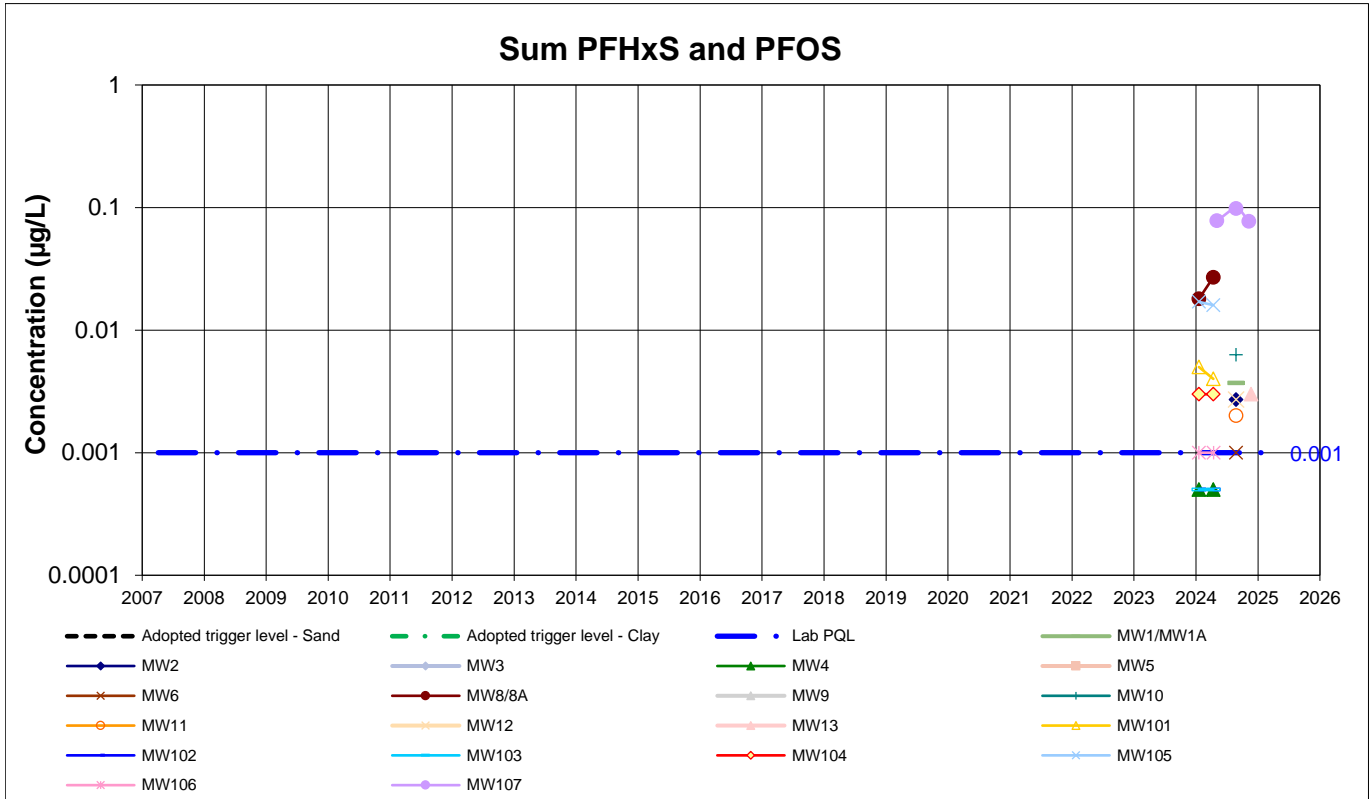


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

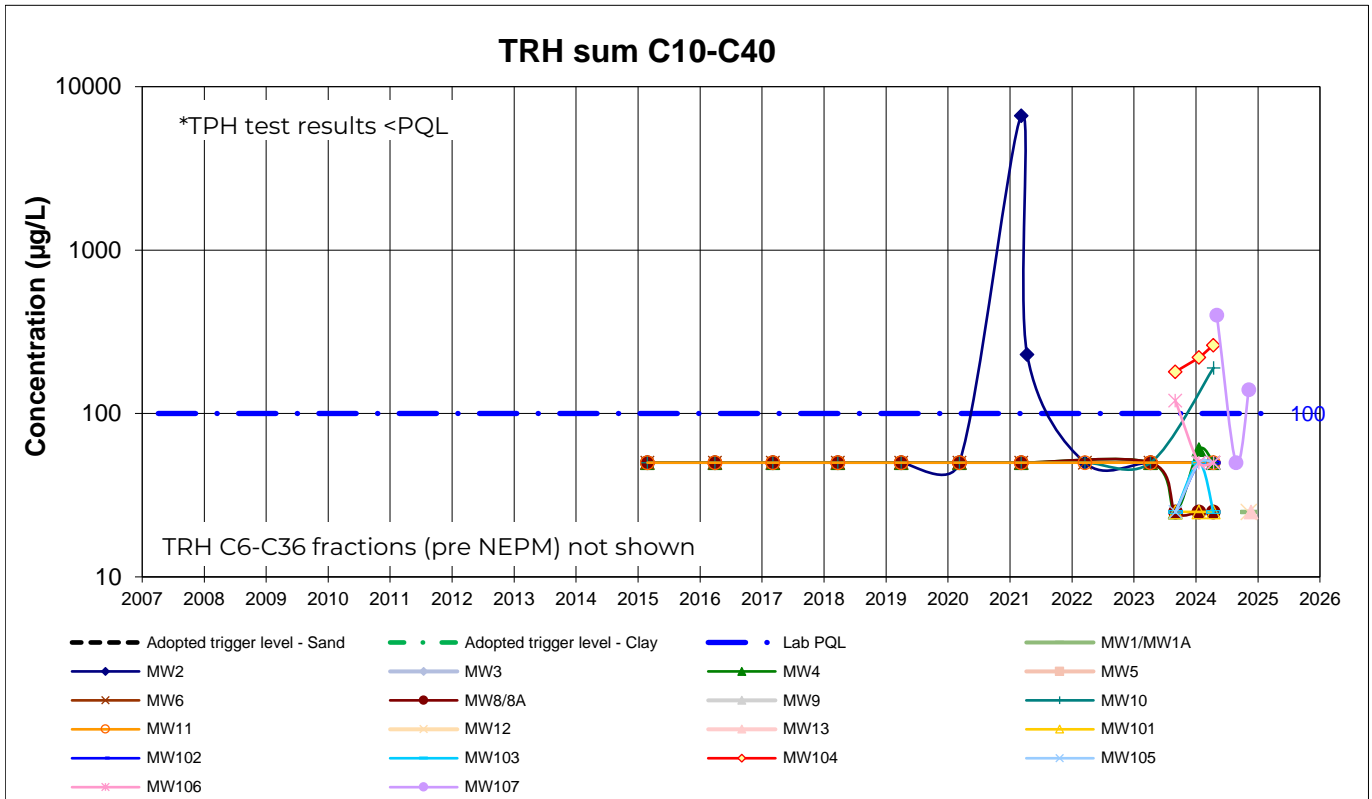


1. Values reported below PQL are plotted as half PQL
2. If a Criteria line is not plotted, there is no criteria

GROUNDWATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

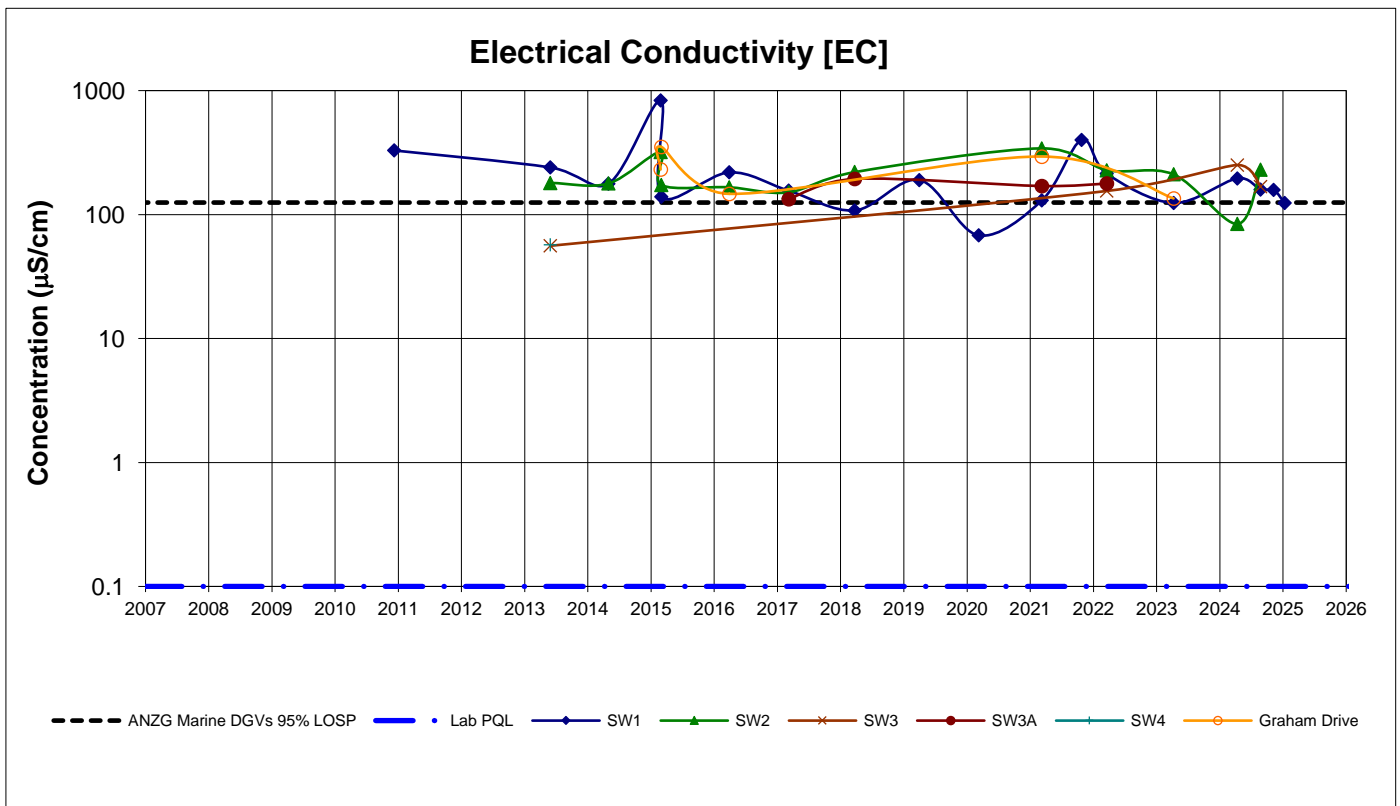
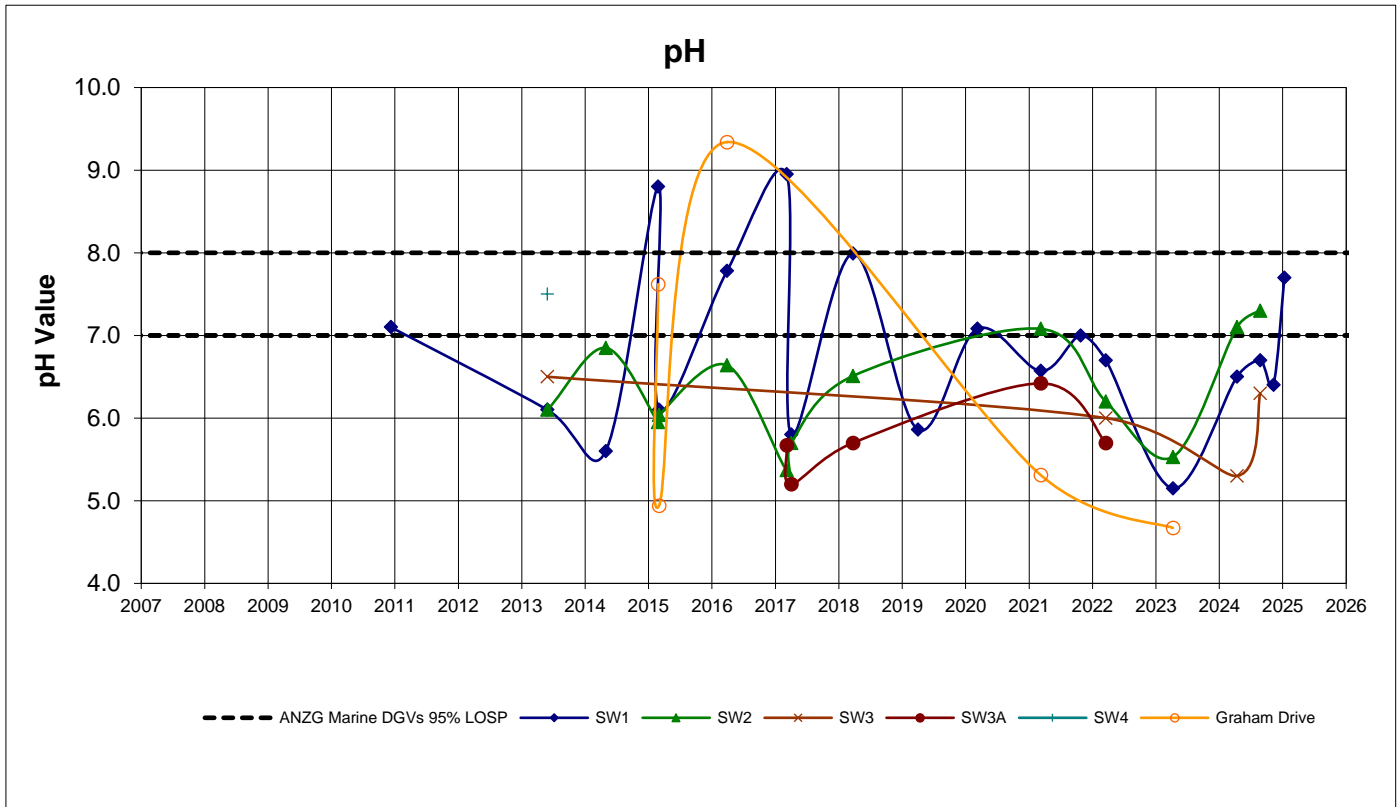


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no criteria

SURFACE WATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

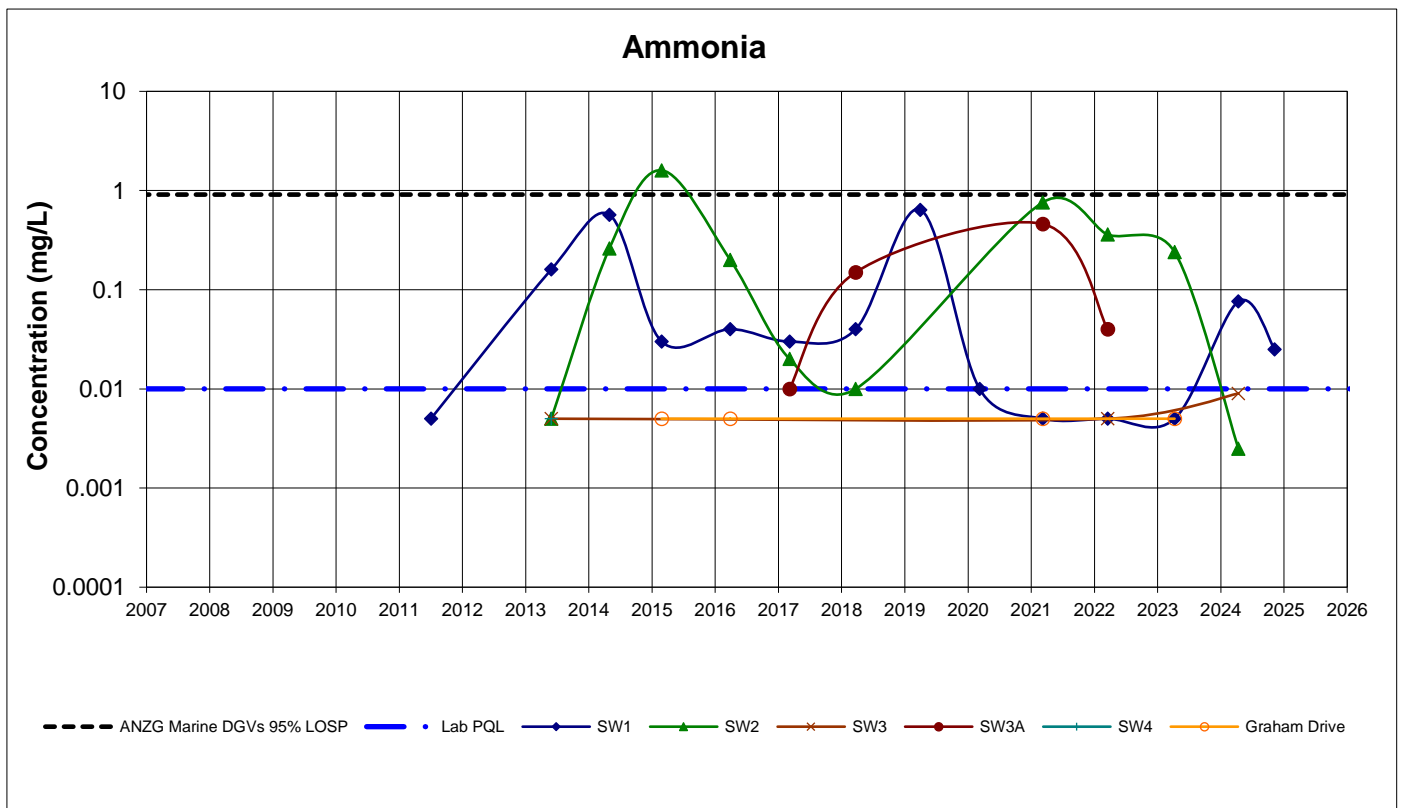
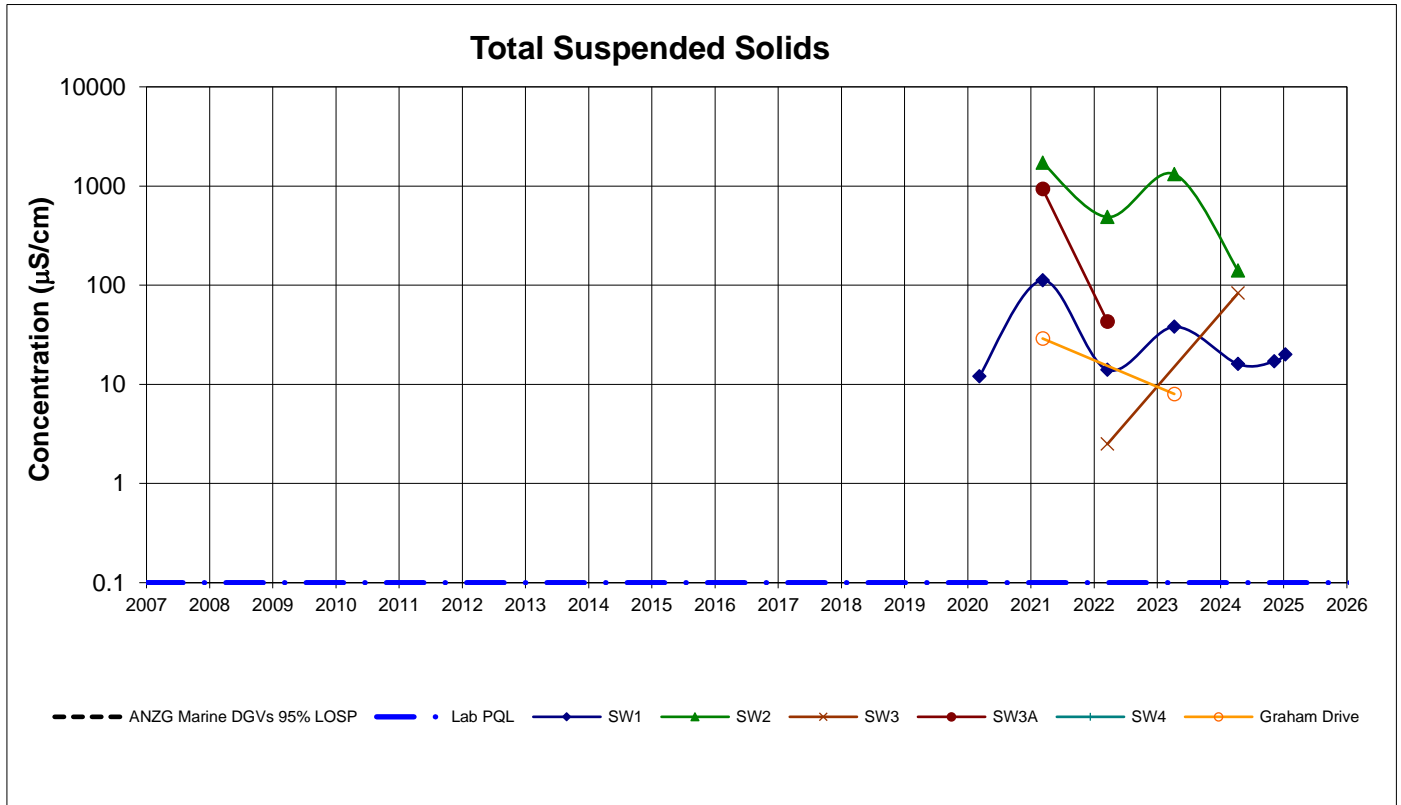


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no published criteria
3. ANZG - Marine water guideline values

SURFACE WATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

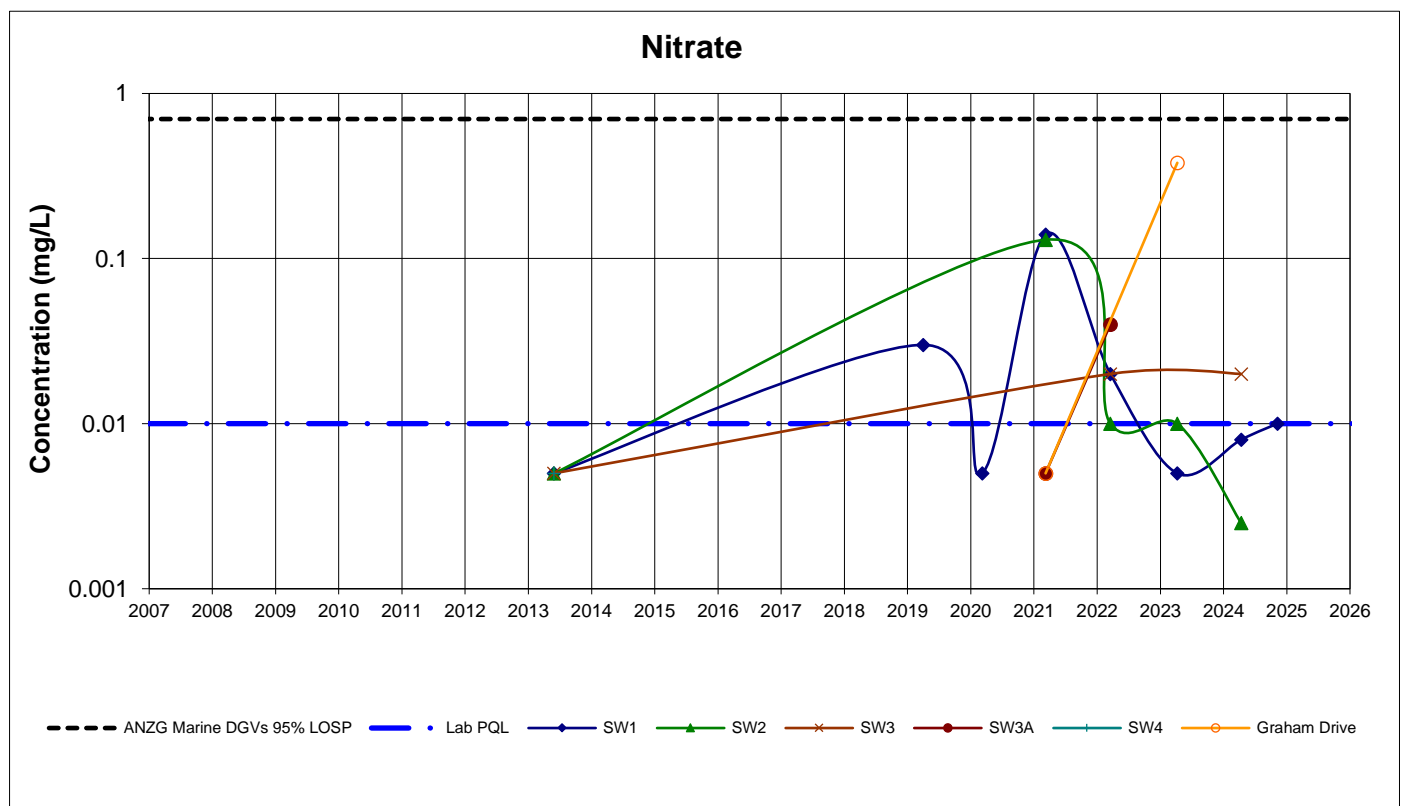
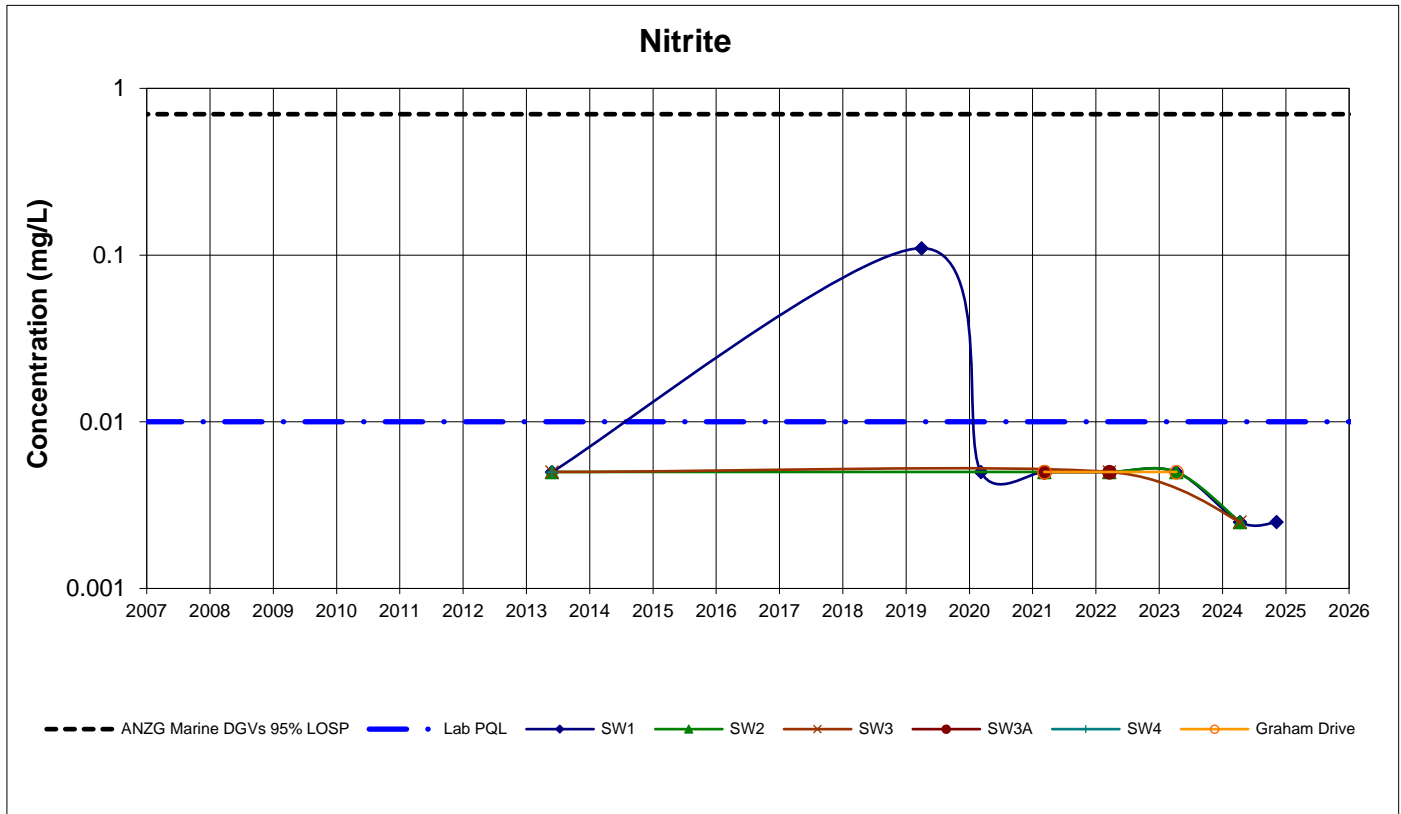


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no published criteria
3. ANZG - Marine water guideline values

SURFACE WATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

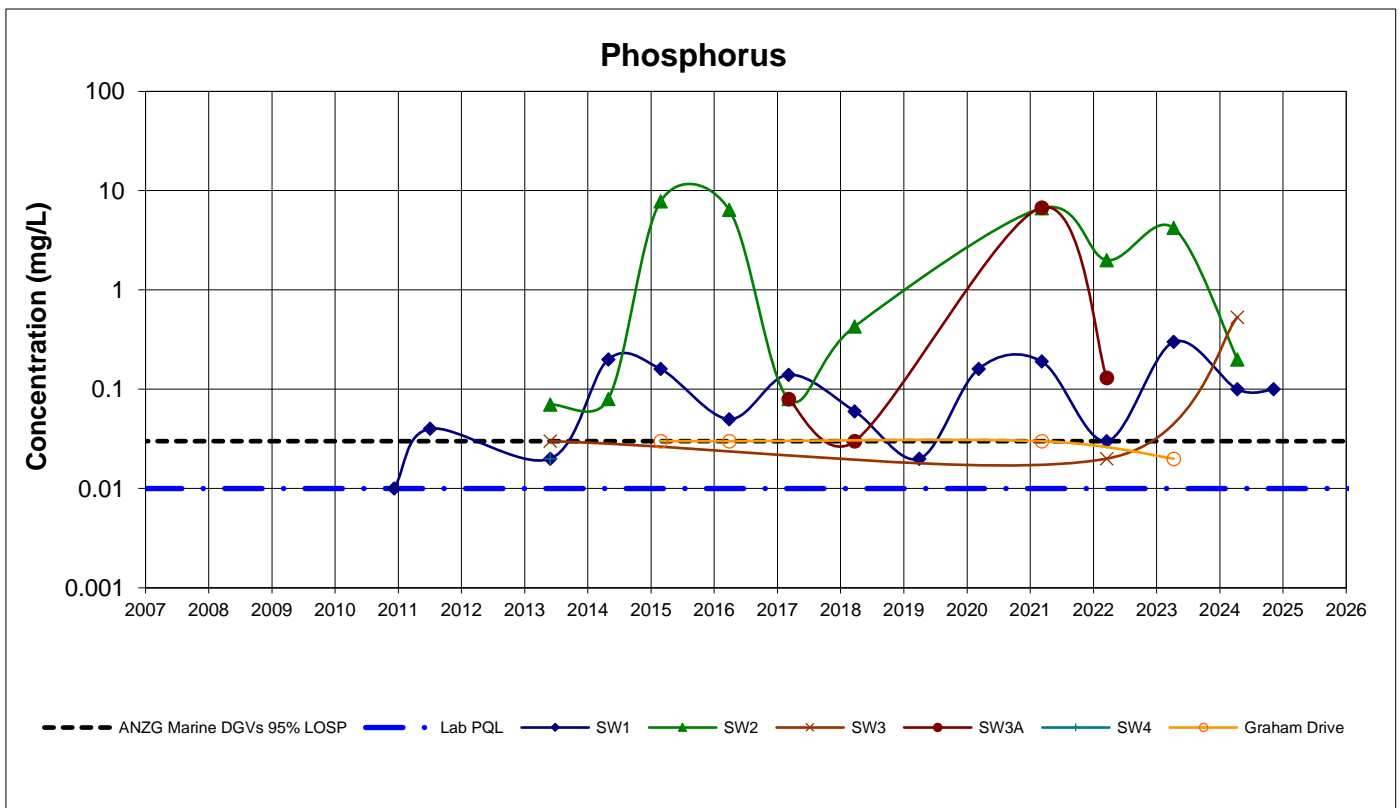
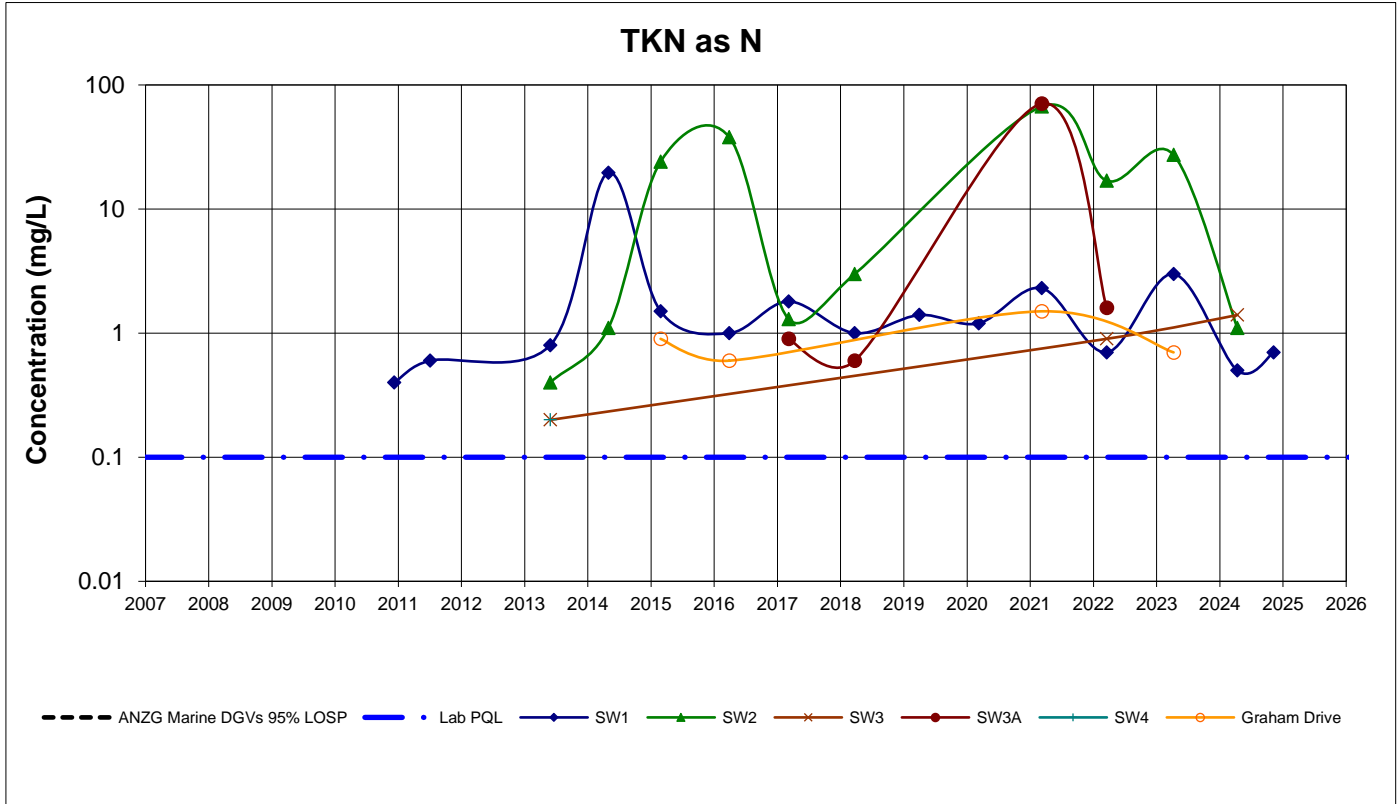


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no published criteria
3. ANZG - Marine water guideline values

SURFACE WATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

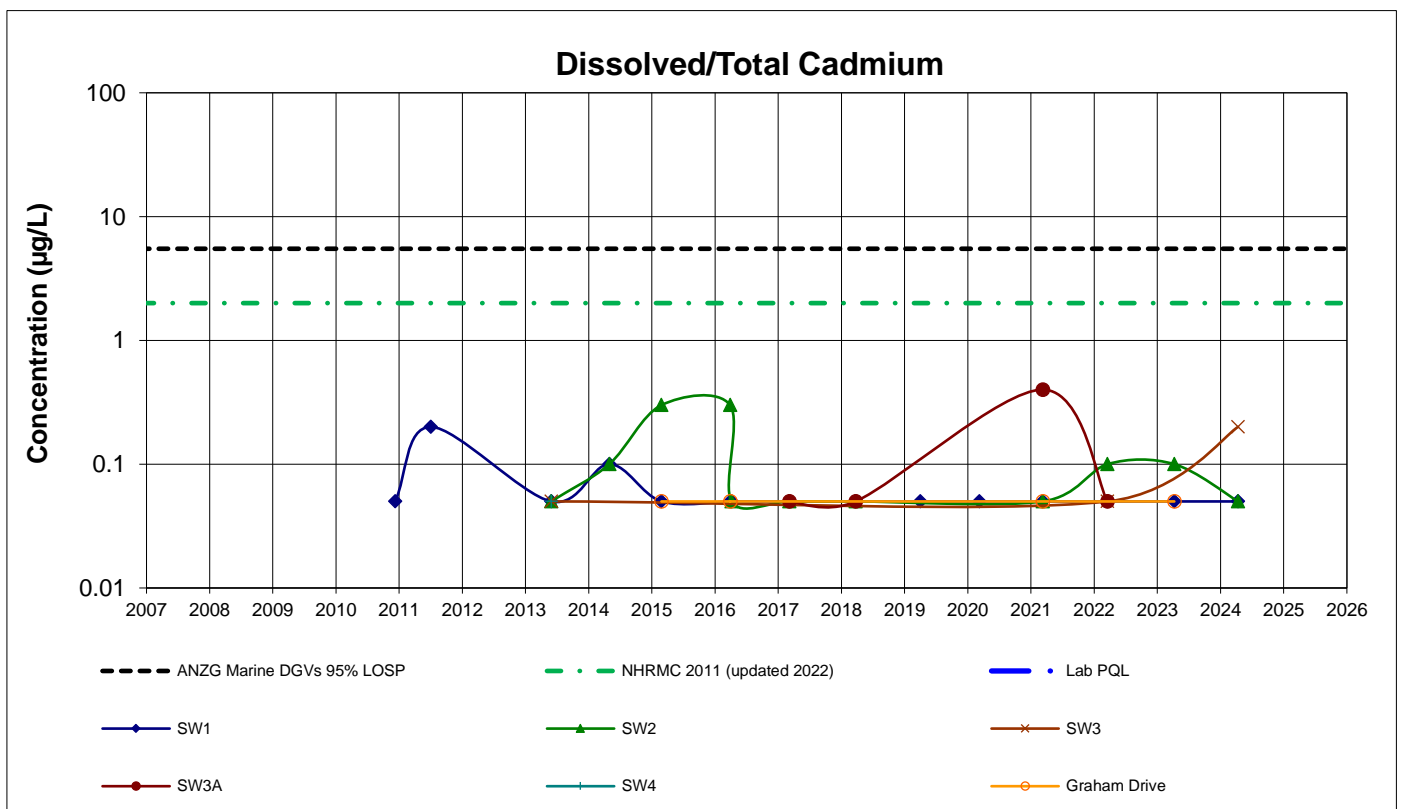
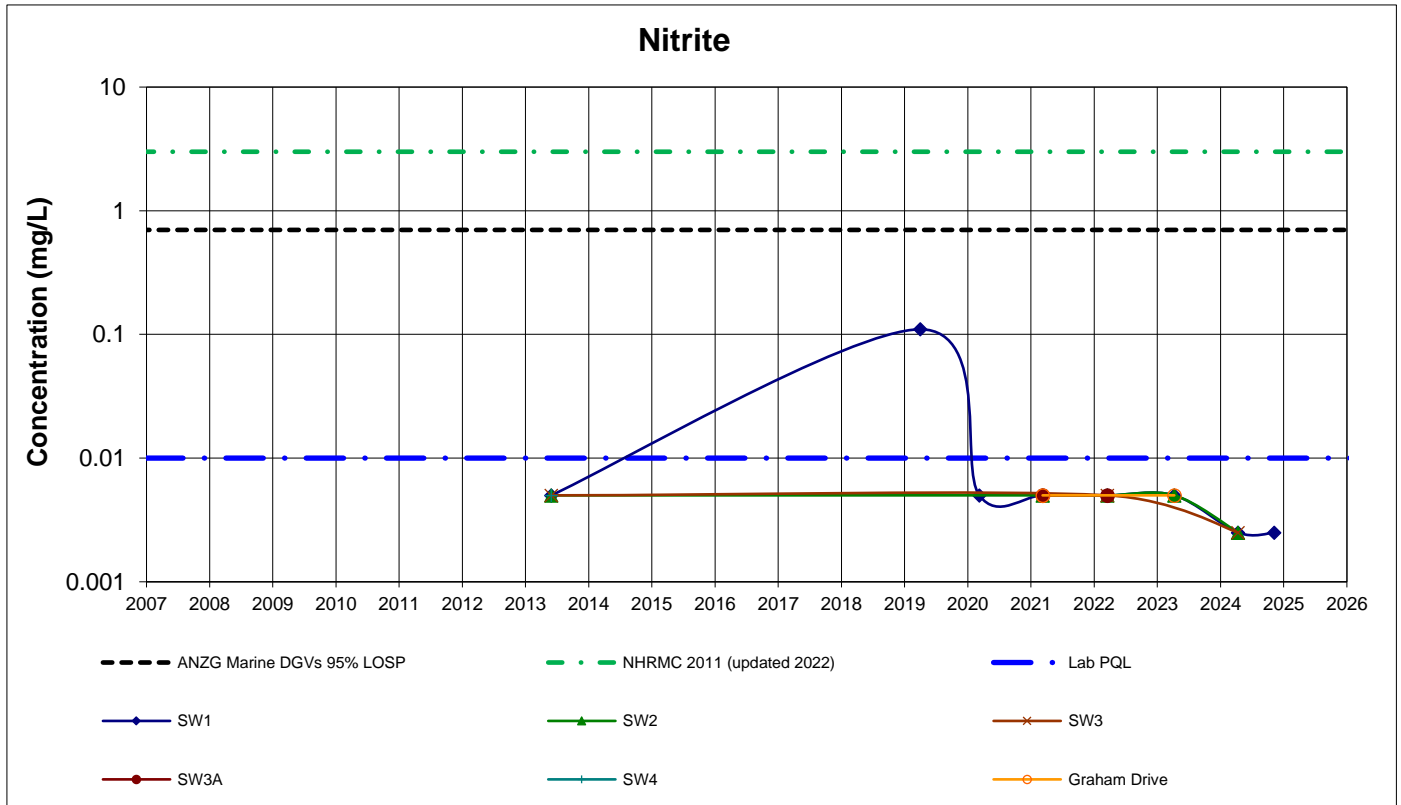


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no published criteria
3. ANZG - Marine water guideline values

SURFACE WATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

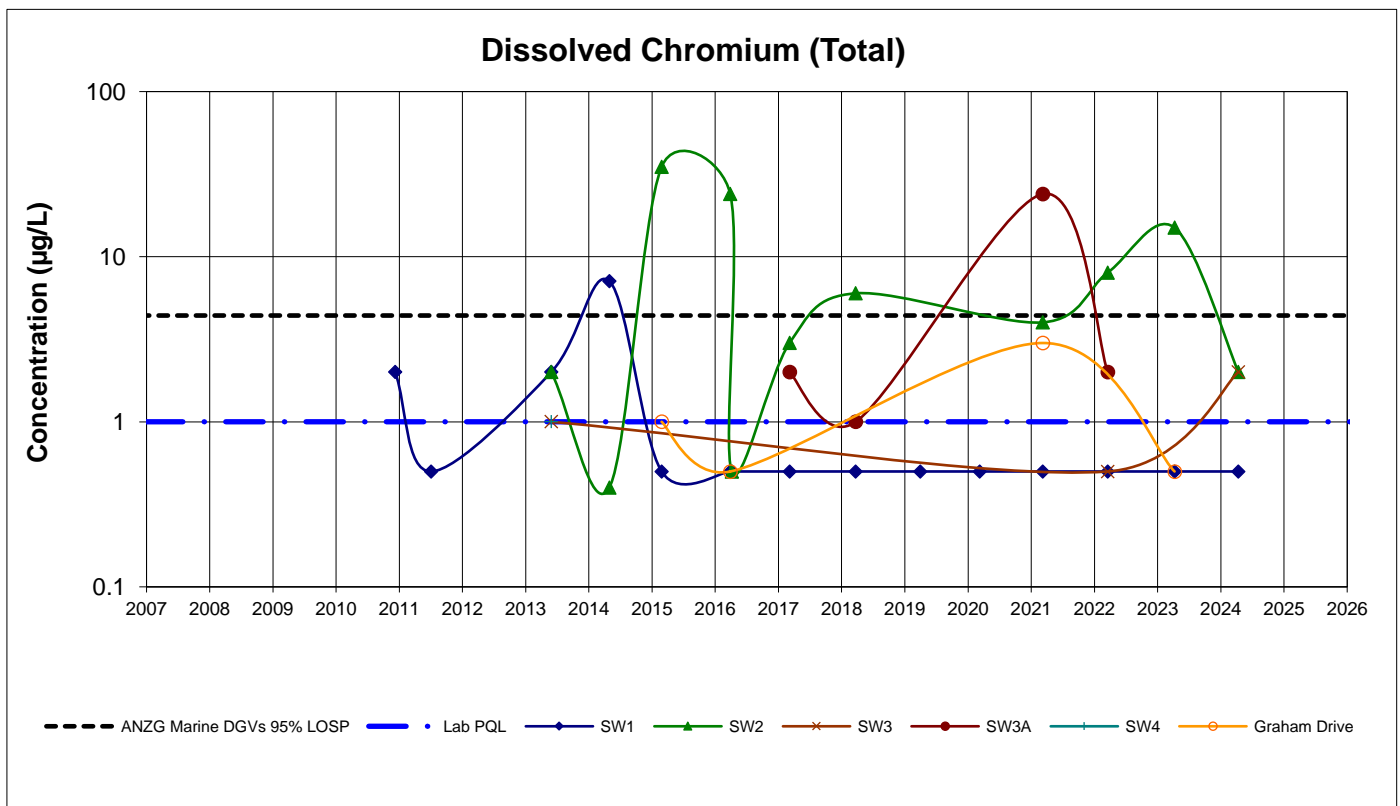
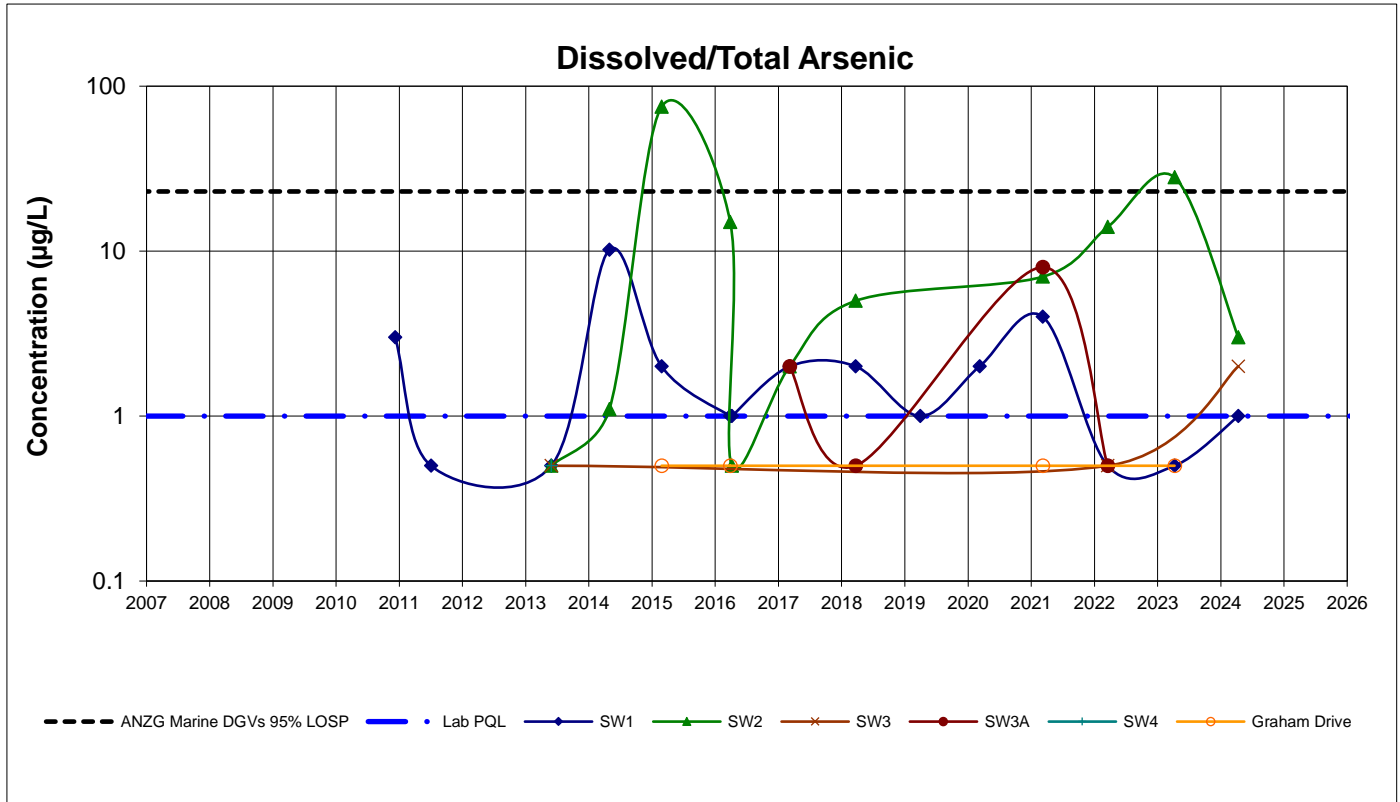


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no published criteria
3. ANZG - Marine water guideline values

SURFACE WATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

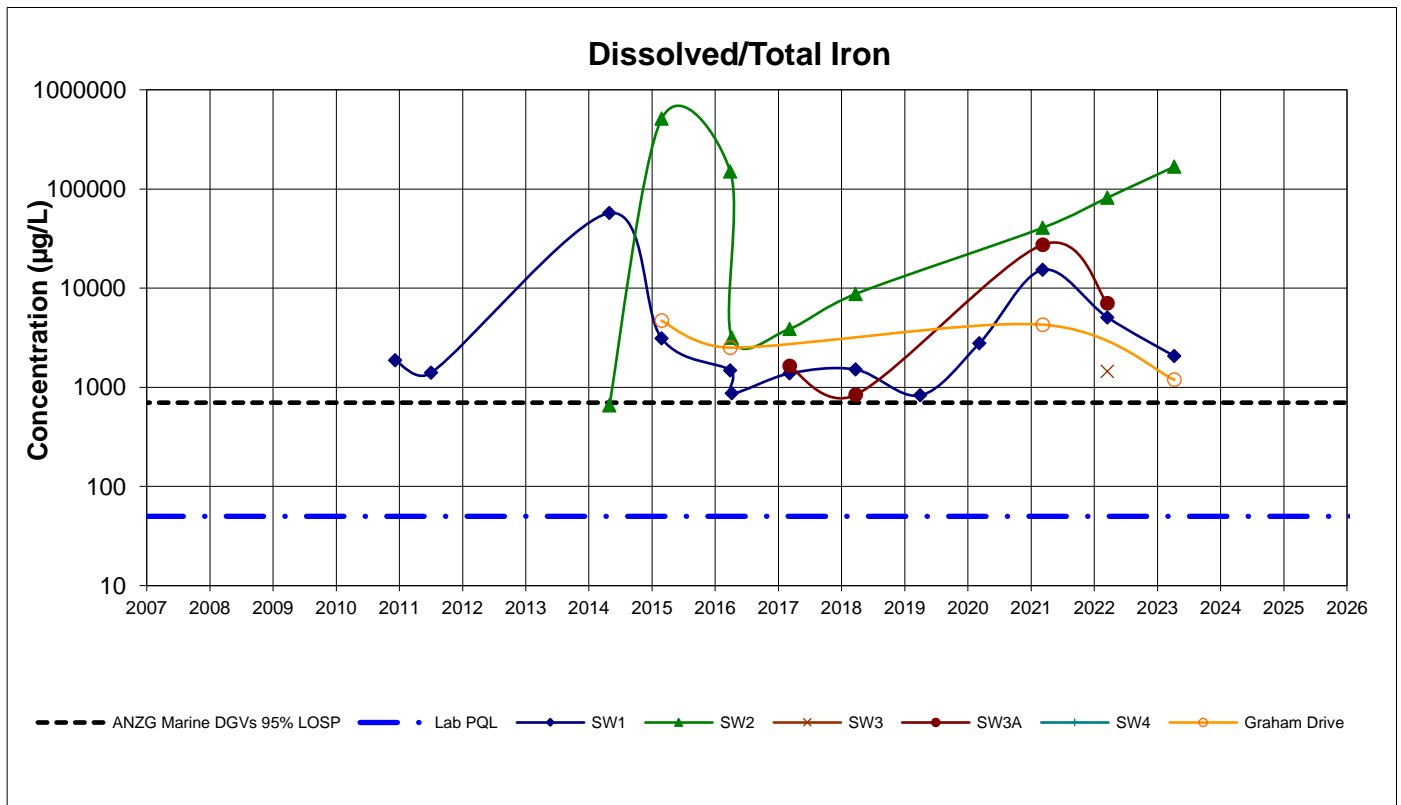
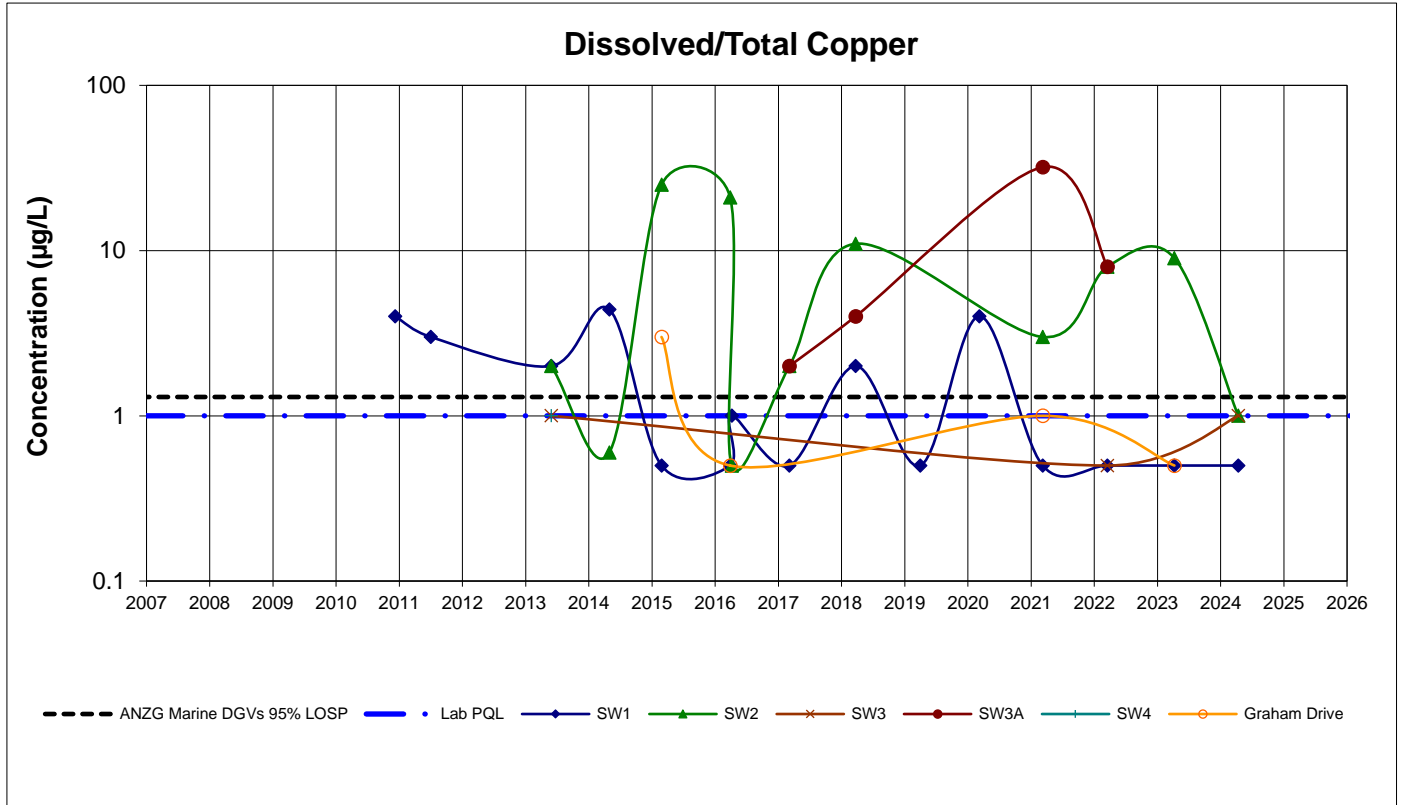


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no published criteria
3. ANZG - Marine water guideline values

SURFACE WATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

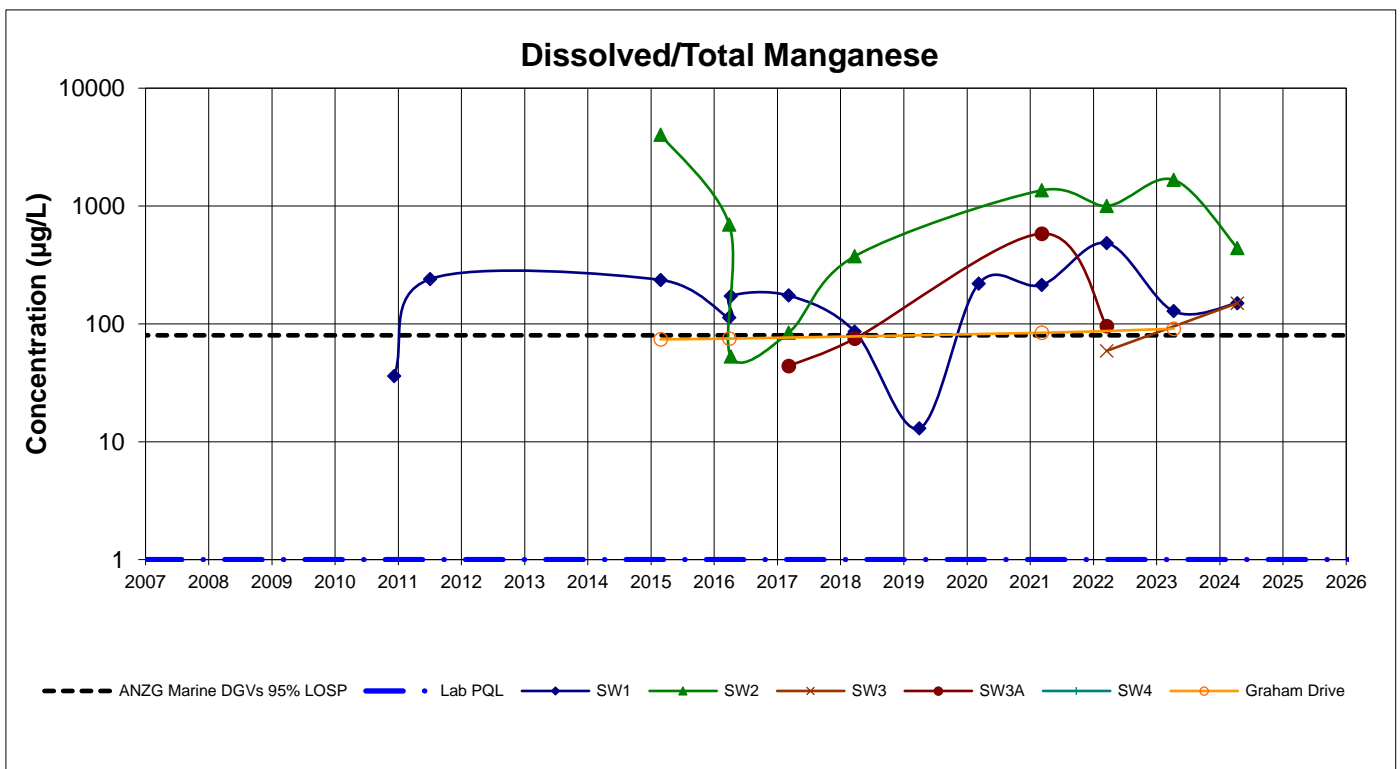
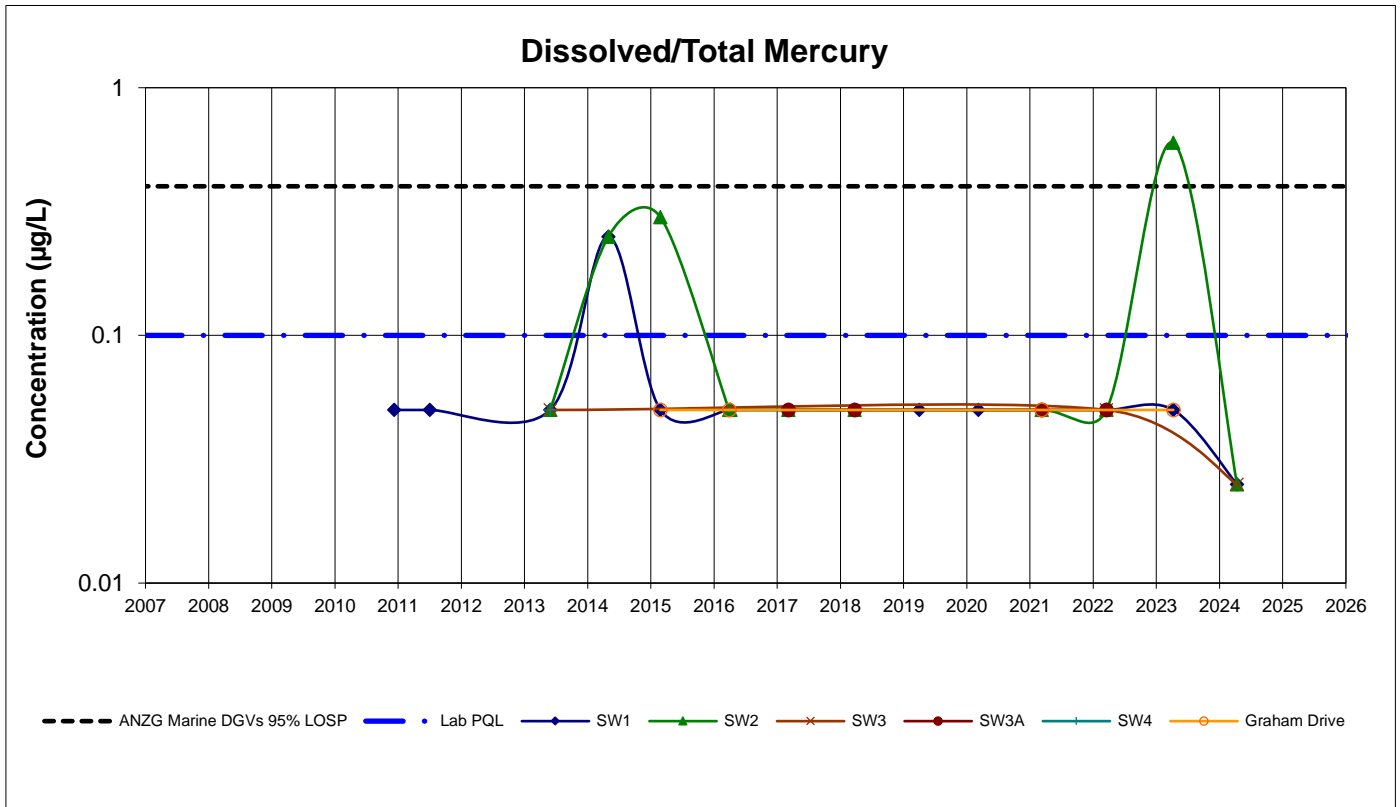


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no published criteria
3. ANZG - Marine water guideline values

SURFACE WATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

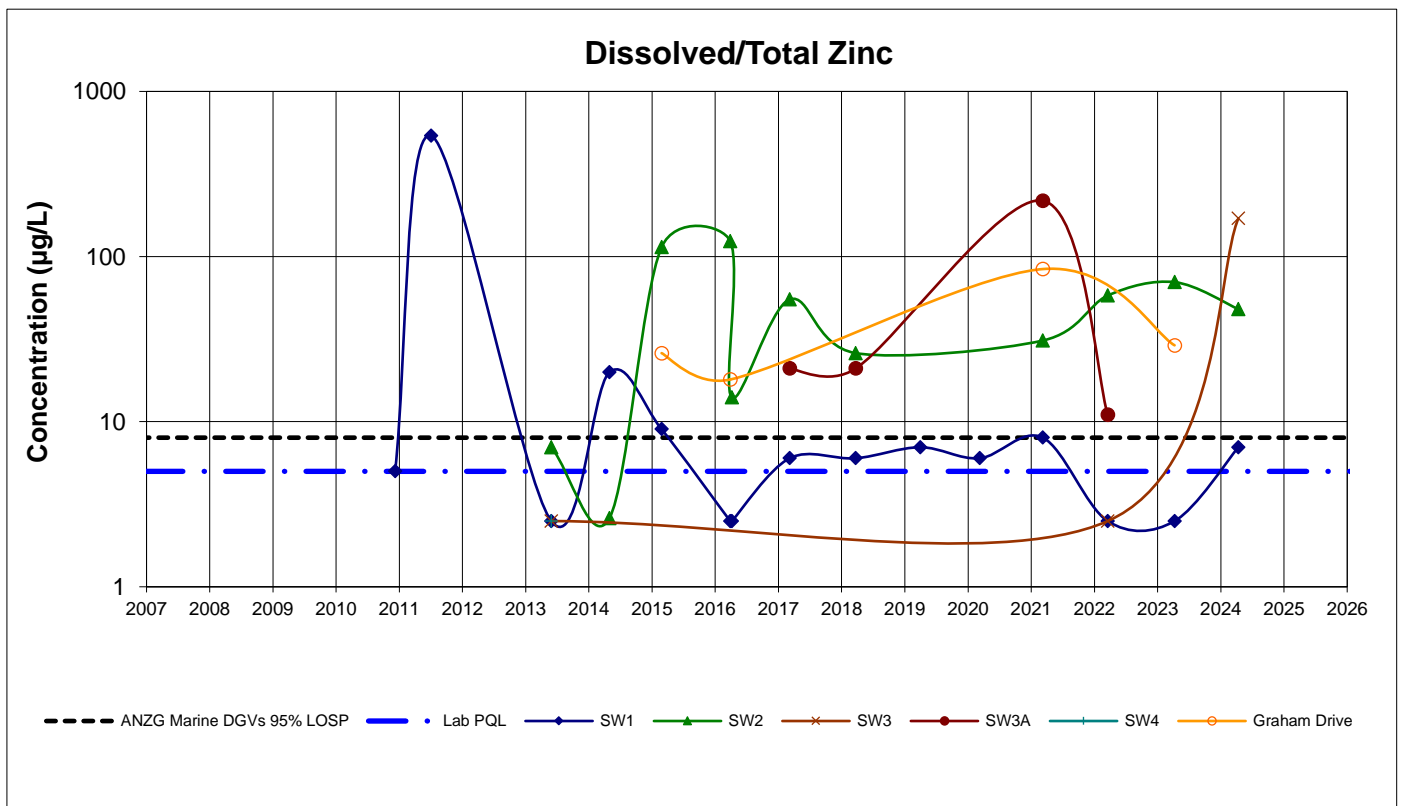
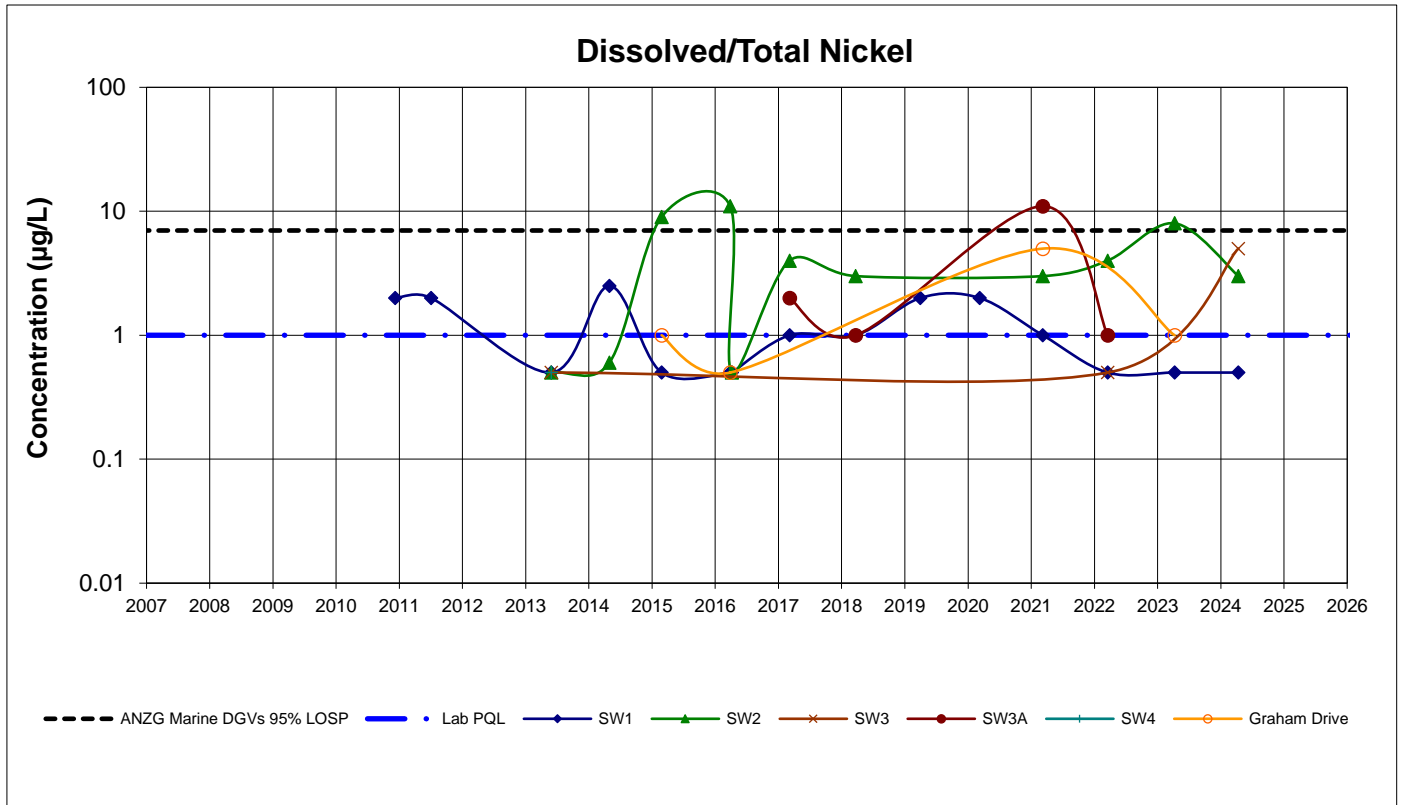


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no published criteria
3. ANZG - Marine water guideline values

SURFACE WATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

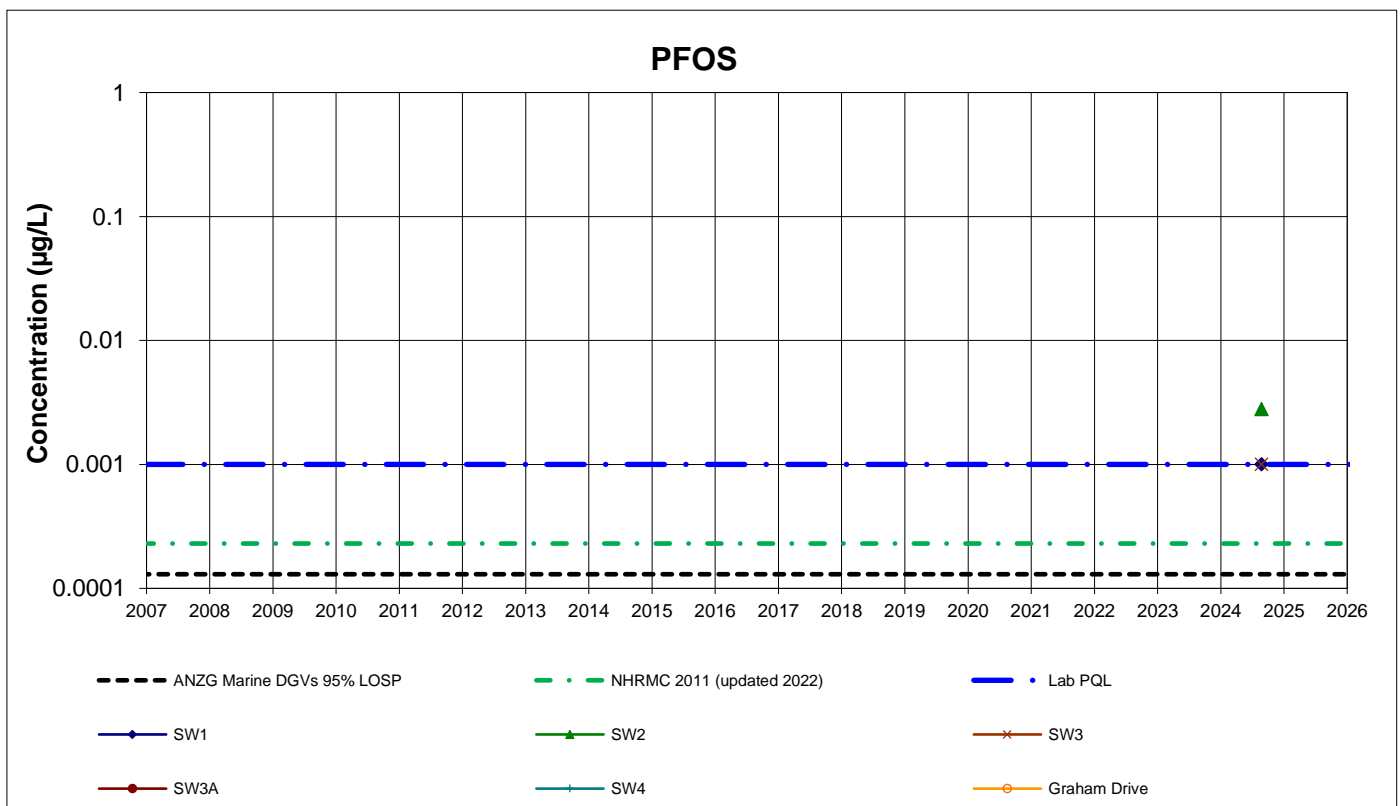
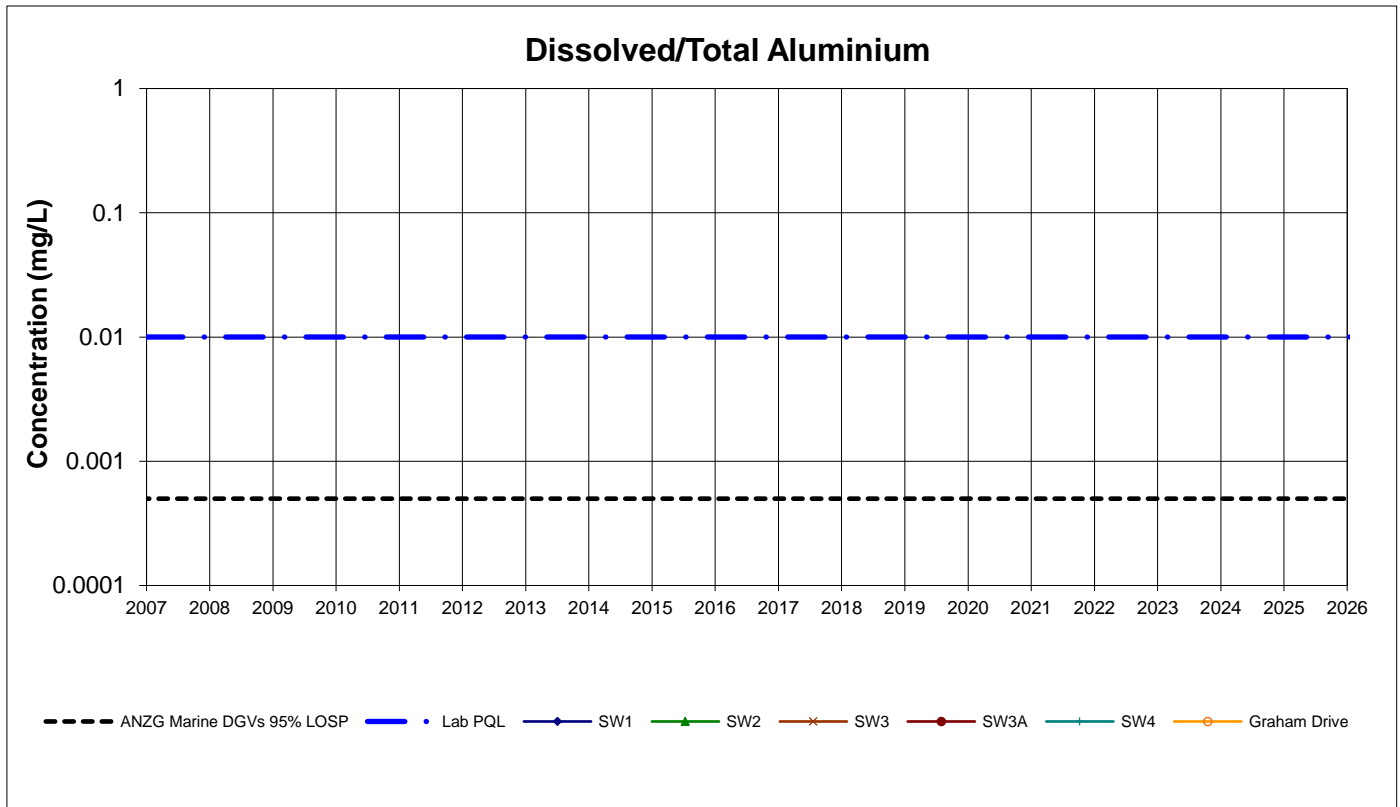


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no published criteria
3. ANZG - Marine water guideline values

SURFACE WATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

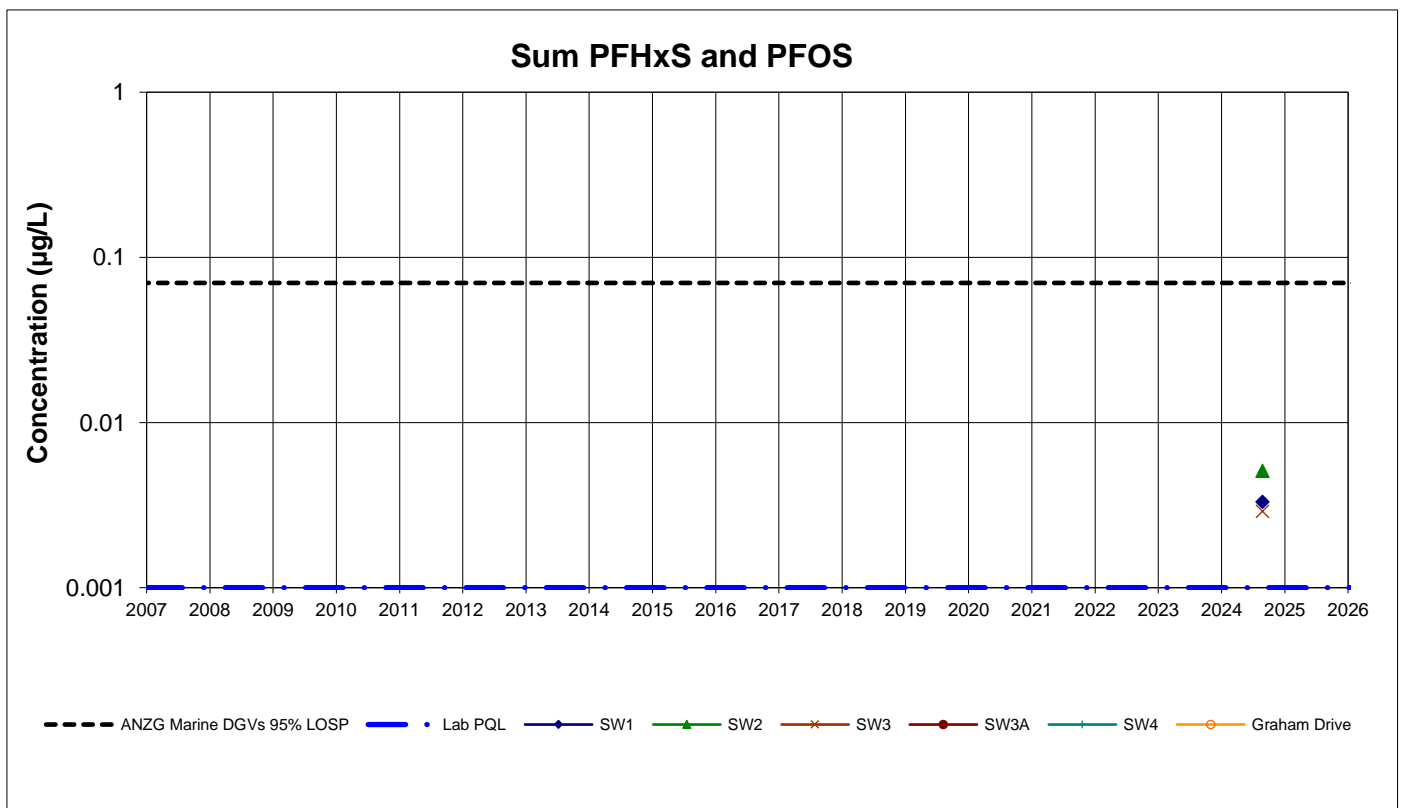
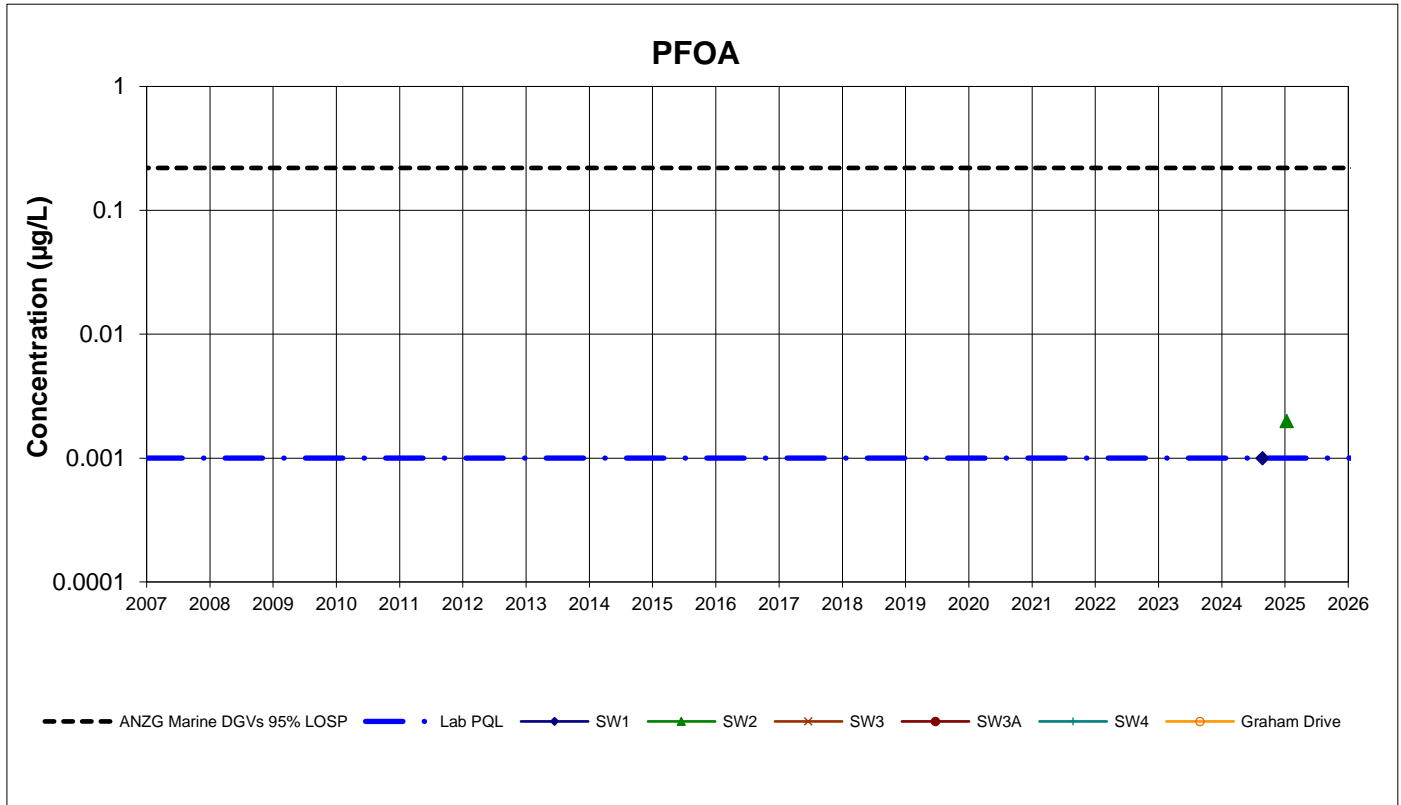


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no published criteria
3. ANZG - Marine water guideline values

SURFACE WATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09

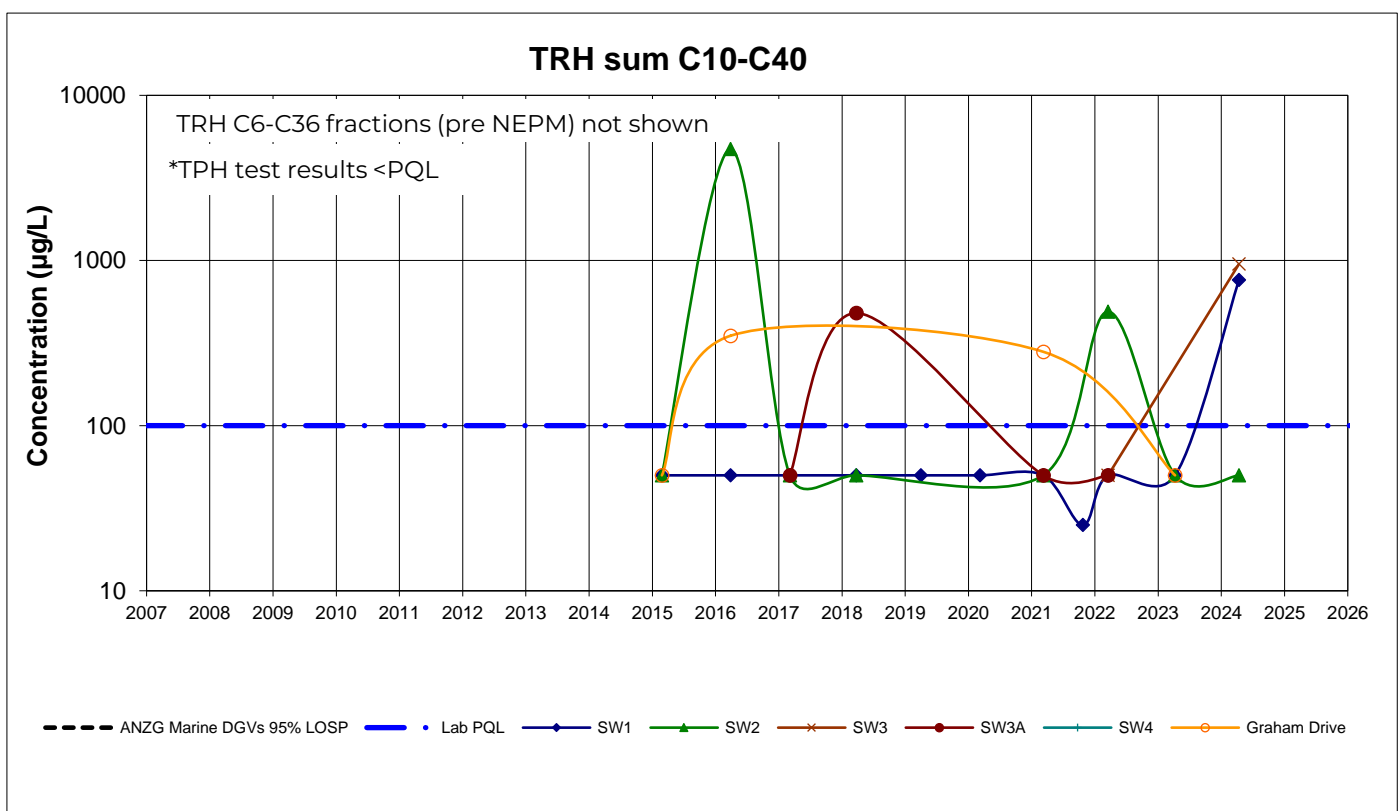
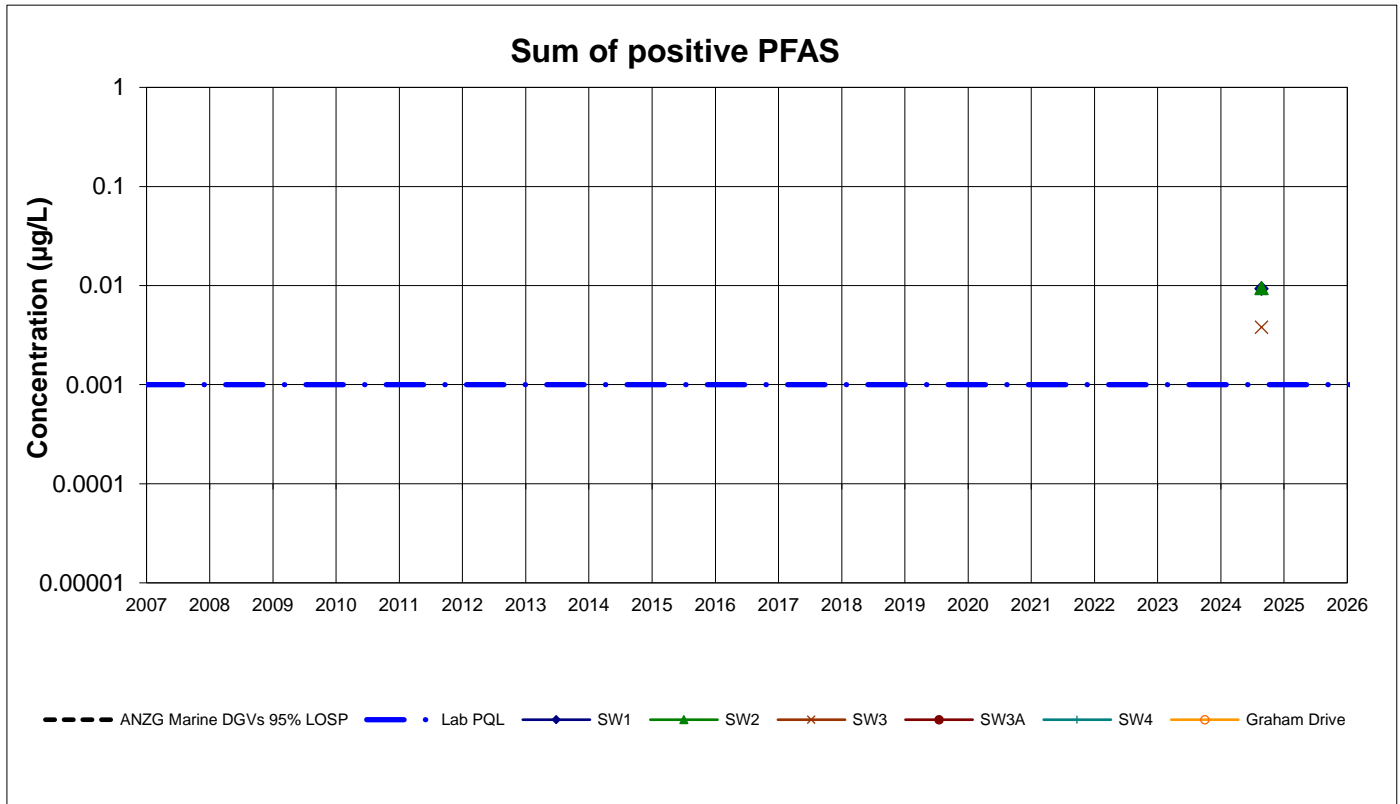


1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no published criteria
3. ANZG - Marine water guideline values

SURFACE WATER QUALITY MONITORING
Tomago Northbank Enterprise Hub
Data Period: 2007 to January 2025

Data set: All data

Project: 39920.09



1. Values reported below PQL are plotted as half PQL
2. If a Criterion line is not plotted, there is no published criteria
3. ANZG - Marine water guideline values

Appendix G

Site Photo Inspection Record – 19 November 2024



Photo 1: Self bunded coolant (1000 L)



Photo 2: Equipment storage near building C



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 1

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 3: Hydraulics sampling - building A

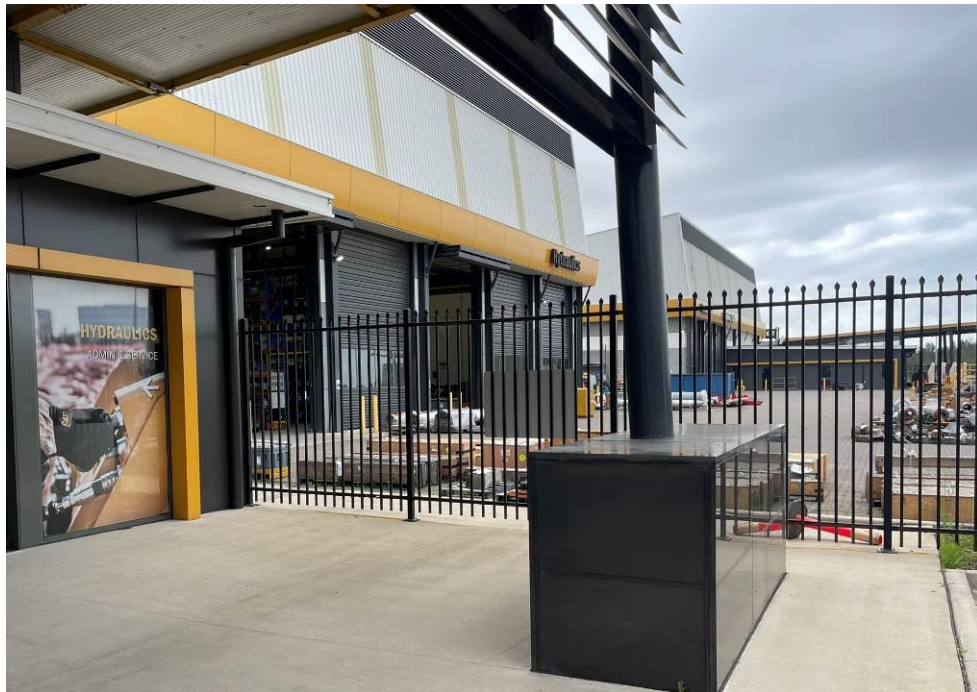


Photo 4: Hydraulics – admin and service



**Site Photo Inspection Record –
 19 November 2024
 Northbank Enterprise Hub
 Lot 212 and Part Lot 211
 DP 1174939, Westrac Drive,
 Tomago**

PROJECT: 39920.09

PLATE No: 2

REV: 1

CLIENT: Northbank Enterprise
 Hub Pty Ltd

DATE: 3-Mar-25



Photo 5: General equipment storage – South of hydraulics, east of machine shop



Photo 6: Empty intermediate bulk storage containers



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 3

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 7: Gas storage, waste bins, equipment storage



Photo 8: Drains within paved areas



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 4

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 9: General work shop area



**Photo 10: Paved areas in south-western corner near security office.
Demonstration bay in background**



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 5

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 11: Water storage containers for fire suppressant. Southern swale in background



Photo 12: Service inspection pits



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 6

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 13: Southern swale and reed vegetation.



Photo 14: Equipment storage



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

CLIENT: Northbank Enterprise
Hub Pty Ltd

PROJECT: 39920.09

PLATE No: 7

REV: 1

DATE: 3-Mar-25



Photo 15: Bulk oil storage within bunded waste depot



Photo 16: Waste bins storage area north of waste depot



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 8

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 17 Sewer pump station and Basin 1 in background



Photo 18: Basin 1 in background



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 9

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 19: General equipment storage on hardstand areas



Photo 20: Hardstand areas in eastern parts of Stage 1



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 10

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 21: Eastern swale flowing north to south



Photo 22: Equipment storage on paved and hardstand areas in the north-eastern portion of Stage 1



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 11

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 23: New machine storage gravel areas in the north-eastern portion of Stage 1



Photo 24: Water and rock feature on north-western corner near Tomago Road



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 12

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 25: Internal concrete roads in the northern portion of the site



Photo 26: Residence north-west of Stage 1 across Tomago Road



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 13

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 27: Vacant sites to the north across Tomago Road



Photo 28: HWC site to the north-east across Tomago Road



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 14

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 29: HWC entry across Tomago Road (HWC)



Photo 30: Rural allotment east of Stage 1. Sheds and equipment in background. Grass and overgrown vegetation.



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 15

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 31: Residential lot to the north-west on Tomago Road



Photo 32: Industrial / commercial site north-west on Tomago Road



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 16

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25



Photo 33: Industrial / commercial site north-west on Tomago Road



**Site Photo Inspection Record –
19 November 2024
Northbank Enterprise Hub
Lot 212 and Part Lot 211
DP 1174939, Westrac Drive,
Tomago**

PROJECT: 39920.09

PLATE No: 17

REV: 1

CLIENT: Northbank Enterprise
Hub Pty Ltd

DATE: 3-Mar-25