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JME20005-5 – 21D and 21F School Drive Tomago

Groundwater Contamination Assessment Report 28 April 2021

For and on behalf of JM Environments

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EXECUTIVE SUMMARY

This report presents a Groundwater Sampling and Analysis Quality Plan (SAQP) commissioned by Jackson Environment and Planning Pty Ltd on behalf of Remondis Australia Pty Ltd, and undertaken by JM Environments (JME) for 21D and 21F School Drive, Tomago NSW (the site). The site is identified as Lots 8 and 11 in Deposited Plan (DP) 270328 (as defined in the website maps.six.nsw.gov.au), and is approximately 3.9 hectares in area.

The objectives of this groundwater assessment are to:

- Assess the current groundwater contamination status of Lots 8 and 11; and
- Assess the groundwater flow direction.
- Improve understanding of the contamination status of groundwater beneath the site.

The objectives of the SAQP are to:

- Identify data gaps in the current Conceptual Site Model (CSM);
- Define the vertical and lateral study boundaries of the this phase of site assessment;
- Identify investigation criteria that groundwater results will be compared against;
- Describe the sampling methodologies to be undertaken in order to assess groundwater contamination across the site;
- Describe quality assurance/quality control (QA/QC) procedures to be undertaken while sampling;
- Describe Data Quality Indicators (DQIs) that will be adopted during the assessment; and
- Identify a contingency plan for unexpected conditions.

The site has had a two main industrial land use including sand mining and metal fabrication (steel and aluminium). A soil contamination assessment by JME indicated the site soil in the eastern portion of site was impacted with arsenic, copper, cadmium, lead and zinc. Lead exceeded the human health criteria whilst the remaining metals exceeded the ecological criteria. The RAP prepared by JME recommended the excavation and removal of the significant lead impacted areas with capping and stormwater management to mitigate potential offsite ecological impacts of arsenic, copper, cadmium and zinc.

Groundwater monitoring indicated that the impact of arsenic, cadmium and copper on the groundwater is negligible. Zinc appears to be significantly elevated at MW7 with a concentration of 89 µg/L compared to trigger value of 15 µg/L. The highest zinc soil impacts are associated with the highest lead soil impacts and, as such, are planned to be removed from the site in the remediation process.

PFOS was detected in the downgradient wells up to almost 30 times greater than the adopted DGVs. Although the concentrations in the wells nearer to the Varley site are slightly higher and gradually diminish across the site, the concentrations of PFOS are similar enough in the PFAS impacted wells to consider its presence is unlikely to be caused by onsite migration from the neighbouring site. Therefore, it is considered possible that PFAS was either previously used on site or a significant (bush)fire threatened the site. Either way, the primary source has been removed from site and the groundwater concentrations of PFAS should naturally attenuate with time. No PFOS was detected in the upgradient wells, MW9 and MW9. It is important to note that the PFOS detections were significantly lower than human health trigger values.

The site is within the TAC buffer zone. The TAC buffer zone is a special environment management zone and is define in the TAC conditions of consent and is derived from the ambient fluoride levels associated with TAC operations. Fluoride and aluminium concentrations were largest in the upgradient wells and appeared to diminish the further away from TAC the groundwater well was located. No further action is required for fluoride and aluminium because these will continue to migrate onto site whilst the TAC smelter is still

operable. The concentration of fluoride does exceed the drinking water guidelines in some wells and therefore the drinking of groundwater should be strictly prohibited on site.

JME considers that the presences of arsenic, cadmium, copper and lead have not had a significant impact on the groundwater beneath site and do not require any further mitigation to protect the groundwater into the future. It is noted that zinc is significantly elevated in one monitoring well, MW7. The zinc impacted soils with the highest concentrations are associated with the lead impacted soils that are planned to be removed in accordance with the RAP prepared by JME. The RAP also recommends the placement of a cap over the remainder of site. The cap, in conjunction with a storm water system was intended to reduce stormwater percolation through the soil thereby reducing the metal leaching potential.

On this basis, it considered that groundwater specific remediation is not required.

CONTENTS

1	INTRODUCTION.....	1
1.1	Background.....	1
1.1.1	General Area Information.....	1
1.1.2	Detailed Soil Assessment.....	1
1.1.3	Groundwater Monitoring.....	2
1.2	Objectives.....	3
2	CONCEPTUAL SITE MODEL.....	3
2.1	Site History Summary.....	3
2.2	Site Condition.....	4
2.3	Source Zone Characteristics.....	4
2.3.1	Primary Groundwater Contaminant Sources.....	4
2.3.2	Identified Contaminants of Concern.....	4
2.4	Contaminant Transport Mechanisms.....	5
2.5	Contaminant Exposure Pathways.....	5
2.6	Identification of Receptors at Risk.....	5
3	DATA GAP ANALYSIS.....	7
3.1	Groundwater.....	7
4	DATA QUALITY OBJECTIVES.....	7
4.1	Step 1 State the Problem.....	7
4.2	Step 2 Identify the Decisions.....	7
4.3	Step 3 Identify the Inputs into the Decision.....	7
4.3.1	Groundwater Assessment Criteria.....	8
4.4	Step 4 Define the Site Boundaries.....	10
4.5	Step 5 Develop an Analytical Approach.....	10
4.6	Step 6 Specify the Performance or Acceptance Criteria.....	10
4.7	Step 7 Optimise the Design for Obtaining Data.....	11
5	SAMPLING PLAN.....	11
5.1	Groundwater Assessment.....	11
5.2	Installation of Wells.....	11
5.3	Sampling Plan.....	12
6	HEALTH, SAFETY and the ENVIRONMENT.....	12
6.1	Hazards and Control Measures.....	12
6.2	Personal Protective Equipment.....	12
7	ANALYSIS PLAN.....	13
8	QUALITY ASSURANCE/QUALITY CONTROL PLAN.....	13

8.1	Data Quality Indicators for the Project.....	13
8.2	Sampling Protocols.....	14
8.3	Field Quality Control Samples.....	14
8.4	Laboratory Quality Control	14
9	POST-ASSESSMENT ACTION PLAN.....	14
9.1	Data Assessment.....	14
9.2	Requirement for Groundwater Remediation.....	15
10	GROUNDWATER ASSESSMENT.....	15
10.1	Field Work	15
10.2	Laboratory Analysis.....	15
10.3	Quality Assurance and Quality Control.....	16
10.4	Results	16
10.4.1	Field Observations	16
10.4.2	Groundwater Flow Direction Groundwater Gradient and Infiltration Rate.....	17
10.4.3	Laboratory Analysis	17
11	DISCUSSION	18
12	CONCLUSION	19
13	REFERENCES.....	20
14	LIMITATIONS.....	21

ATTACHMENTS

Figure 1	Site Location Plan
Figure 2	Groundwater Well Location Plan
Figure 3	Groundwater Contour Plan
Summary Table 1	
Appendix A	Borehole logs
Appendix B	Calibration Certificates
Appendix C	Laboratory Documents

ACRONYMS

ABC	ambient background concentration
ACM	asbestos containing material
AEC	Area of Environmental Concern
ANZECC	Australian and New Zealand Environment and Conservation Council
APHA	American Public Health Association
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BaP	benzo[a]pyrene
BaP TEQ	benzo[a]pyrene toxicity equivalent quotient
BTEX	benzene, toluene, ethylbenzene and xylene
COC	Contaminant of Concern
CoC	Chain of Custody
CSM	Conceptual Site Model
DEC	Department of Environment and Conservation
DO	dissolved oxygen
DP	Deposited Plan
DQI	Data Quality Indicator
DSI	Detailed Site Investigation
EC	electrical conductivity
EIL	ecological investigation level
ENM	Excavated Natural Material
EPA	Environment Protection Authority
ESL	ecological screening level
HIL	health investigation level
HSL	health screening level
HSE	health, safety and the environment
JME	JM Environments
LEP	Local Environmental Plan
LOR	limit of reporting
LTEMP	Long Term Environmental Management Plan
mbgl	metres below ground level
NATA	National Association of Testing Authorities

NEPM	National Environment Protection (Assessment of Site Contamination) Measure
OCP	organochlorine pesticides
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PID	photoionisation detector
PPE	personal protective equipment
PSH	phase separated hydrocarbons
QA/QC	Quality Assurance/Quality Control
RAP	Remedial Action Plan
RL	relative level
RPD	relative percentage difference
SAQP	Sampling and Analysis Quality Plan
SD	standard deviation
SGS	SGS Australia, Sydney
TPH	total petroleum hydrocarbons
SWMS	Safe Work Method Statement
TCLP	toxicity characteristic leaching procedure
TRH	total recoverable hydrocarbons
UCL	upper confidence limit
USEPA	United States Environment Protection Authority
UST	underground storage tank
VCH	volatile chlorinated hydrocarbons
VOC	volatile organic compounds
WA DoH	Western Australian Department of Health

1 INTRODUCTION

This report presents a Groundwater Sampling and Analysis Quality Plan (SAQP) commissioned by Jackson Environment and Planning Pty Ltd on behalf of Remondis Australia Pty Ltd, and undertaken by JM Environments (JME) for 21D and 21F School Drive, Tomago NSW (the site). The site is identified as Lots 8 and 11 in Deposited Plan (DP) 270328 (as defined in the website maps.six.nsw.gov.au), and is approximately 3.9 hectares in area. The site location is shown in Figure 1.

1.1 Background

1.1.1 General Area Information

The site is located in Tomago NSW. Beneath the site is the Tomago Sand Aquifer. Hunter Water extract water from this aquifer and following treatment the extracted water forms part of the Hunter regions reticulated drinking water supply. Hunter Waters groundwater extraction areas is the north and west of the site. It is expected the regional ground water flow would be toward the Hunter River and a s such groundwater from the site is not likely to affect the quality of groundwater extracted by Hunter Water.

The Williamtown RAAF base is located approximately 9.5km north west of the site. The per- and poly-fluoroalkyl substances (PFAS) groundwater contamination associated Williamtown RAAF base are unlikely to impact on the site's groundwater. Located to the west of the site the Varley Group manufacturing facility. Amongst the specialised vehicle manufactured include fire fighting trucks. On that basis it was considered that testing of new fire trucks, including spraying PFAS foams, feasible.

The Tomago Aluminium Company (TAC) is located just over 200m to the west of the site. It has been smelting aluminium since 1983. The *"Tomago Aluminium Company Pty Ltd Production Capacity Increase 585,000 to 600,000 tonnes Saleable Production Project Description and Statement of Environment Effects"*, dated August 2016 reports that fluoride concentrations measured in its "eastern boundary bores" ranged from 5.2-6.6mg/L between 2011 and 2015. JME has assumed that the fluoride concentration are an average of six wells located off the TAC site and in proximity to the TAC eastern boundary.

1.1.2 Detailed Soil Assessment

A Detailed Contamination Assessment (DCA) was prepared by JME, dated 2 June 2020, (herein referred to as JME2005-2).. JME2005-2 reported the site was mostly flat, and divided into two parts. The western part of the site (Lot 11) was paved, and contained two large sheds, and some smaller buildings and water tanks. Beneath the pavement was brown gravelly sand, containing some concrete and brick rubble to a depth of between 1mbgl and 1.8mbgl and was interpreted to be fill. This material was assessed during the construction phase as meeting the criteria for excavated natural material, and for commercial/industrial land use. Light brown fine to medium grained sand beneath the fill was interpreted as representing in-situ, 'natural' material.

The eastern part of the site (Lot 8) was unpaved, and sparsely covered with grass and other low vegetation. Fill mounds including concrete, metal and timber were observed, and concrete beams and concrete-filled tyres had been stockpiled in the northern part of Lot 8.

Fill, comprising brown to black sand, and containing some plastic, road base gravel, brick, concrete, metal and rocks, was observed to a depth of approximately 0.5 - 1mbgl across much of Lot 8. Elevated zinc and copper concentrations in this material were considered to be consistent with the use of sandblasting in the metal manufacturing process.

Beneath the fill, brown sand, interpreted as representing in-situ material, appeared to be largely uncontaminated.

Elevated cadmium, arsenic and lead concentrations were observed in dark sandy material on the surface in the northeast corner of the site. These analytes are commonly found at high concentrations in slag from the Pasminco lead smelter.

Based on this assessment, it was considered that the site had been impacted by contamination comprising heavy metals at concentrations exceeding guideline values for commercial/ industrial land use. JME considers that the site could meet the environmental requirements for commercial/industrial land use subject to the development and successful implementation of an appropriate Remedial Action Plan. In Lot 8, the RAP recommended the excavation and removal of the human health impacted material, capping the remainder of site with a low permeable material and installation of a stormwater drainage system.

1.1.3 Groundwater Monitoring

At the request of Remondis, groundwater contamination was not considered in JME20005-2 for budgetary purposes at the early stages of this project. JME had conducted groundwater monitoring during construction and operational phase of the Midal Cables facility, the previous land use on Lot 11. Midal Cables produced electrical transmission cable from molten aluminium produced at TAC. Midal Cables operated from March 2014-April 2017.

Construction groundwater monitoring was required as part of the consent conditions for the Midal Project. Construction groundwater monitoring was aimed primarily at dewatering areas of the site for building sumps and footings and hence potential activation of potential acid sulfate soils. Hence depth to groundwater and pH were monitored. There was a drop of around 1.1-1.4 pH units in one month of the monitoring, May 2013, which was at the height of the construction dewatering. The pH returned to the normal range in the respective wells the following month.

Operational ground water monitoring was required to satisfy the Operational Environmental Management Plan (OEMP) and the Environmental Protection Licence 20254 (EPL) for the Midal Cables International plant.

The OEMP recognised that there were potential impacts on the local groundwater quality from use of the Waste Water Treatment Plant (WWTP) and spills entering the storm water infiltration system. The OEMP required that:

- Static water level, pH and electrical conductivity (EC) on a monthly basis for the first quarter of operation then quarterly thereafter; and
- Major ions (Ca, Mg, Na, K, Cl, CO₃²⁻, HCO₃⁻, SO₄²⁻), dissolved metals (Al, As, Cr, Cd, Cu, Fe, Hg, Mn, Ni, Pb, Zn), nutrients (total nitrogen (including ammonia) and total phosphorous), and total petroleum hydrocarbons (TPH (C₆-C₃₆)) on an annual basis,

be monitored in one up gradient well (OEMP monitoring well MW6, EPL Point 8) and two down gradient wells (monitoring well MW4/EPL Point 6 and monitoring well MW5/EPL Point 7). Well locations are shown in Figure 2.

The EPL required that:

- Static water level, pH and EC on a monthly basis; and
- Nutrients and hydrocarbons on a quarterly basis,

be monitored in MW4/EPL point 6, MW5/EPL Point 7 and MW6/EPL Point 8.

The final draft 2016 annual groundwater report prepared by JME reported that nutrient levels were analysed for increasing/decreasing trends using the Mann-Kendall module of the ProUCL 5.0 software. The confidence coefficient was set at 0.95 and the level of significance was set at 0.05.

Mann-Kendall analysis indicated:

- A decreasing trend in ammonia at MW4 and MW5;
- An increasing trend in nitrate at MW4 and MW5;
- A decreasing trend in TKN at MW5; and
- An increasing trend in total nitrogen at MW4.

The WWTP was decommissioned around April 2015. A sewage pump out tank system was used in its stead.

1.2 Objectives

The objectives of this groundwater assessment are to:

- Assess the current groundwater contamination status of Lots 8 and 11; and
- Assess the groundwater flow direction.
- Improve understanding of the contamination status of groundwater beneath the site.

The objectives of the SAQP are to:

- Identify data gaps in the current Conceptual Site Model (CSM);
- Define the vertical and lateral study boundaries of the this phase of site assessment;
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- Identify a contingency plan for unexpected conditions.

2 CONCEPTUAL SITE MODEL

Based on the summary information above and previous reports a conceptual site model was prepared.

2.1 Site History Summary

The site lies on a former sand mine and hence it is likely that the top 3-4m has been disturbed and the heavy minerals been extracted. “Tailing slimes” often have low permeabilities and are enriched in iron. Post sand mining the site was previously part of larger steel fabrication site. Metal cleaning and polishing via sand blasting was common practice for such a land use. Heavy minerals extracted from sand mining such as rutile and ilmenite and, at times, Pasminco slag sand were used as sandblasting media. From 2012-2013 the western portion of site was redeveloped in the Midal Cables facility. The Midal Cables facility manufactured aluminium transmission cable from molten aluminium sourced from the nearby TAC. During construction the site surface was classified as insitu ENM by JME. Due to the thickness of the concrete slabs and relatively short life of the facility it is considered very unlikely that the Midal operations impacted on the groundwater quality of the site with the exception of a former septic system in the southern portion of Lot 11.

The site is adjacent to a specialised vehicle manufacturer and it is considered likely that hydrocarbons, degreasers and PFAS were used.

TAC is situated to the west of the site. TAC is likely to be up hydraulic gradient from the site.

2.2 Site Condition

The site appears to contain fill extended to approximately 0.3 to 1.0mbgl, and was observed to be primarily sand and include traces to some:

- Brick;
- Ceramics;
- Glass;
- Concrete;
- Coal;
- Ash; and
- Slag.

Contamination, above the adopted guidelines for industrial use, within the fill had been found to include heavy metals (arsenic, cadmium, copper, lead and zinc)

Beneath the fill, a layer of light grey to dark grey sand was observed, interpreted as representing reinstated sand mining tailings.

2.3 Source Zone Characteristics

2.3.1 Primary Groundwater Contaminant Sources

The primary source of impact on the site was considered to be heavy metal contamination resulting from sandblasting media and the metallic surface upon which they were used.

The primary source of offsite groundwater impact is the potential use of hydrocarbons, degreasers and fire fighting foams on the western neighbouring site and the smelting of aluminium further to the west.

2.3.2 Identified Contaminants of Concern

The groundwater chemicals of concern in clude site were considered to include:

- Hydrocarbons:
 - TRH F1
 - TRH F2
 - Benzo[a]pyrene (BaP)
 - Total PAH
- Degreasers (Chlorinated hydrocarbons, CHCs)
- Heavy metals
 - Aluminium
 - Arsenic
 - Cadmium
 - Copper
 - Lead and
 - Zinc
- PFAS

2.4 Contaminant Transport Mechanisms

Primary transport mechanism that were considered to have potential to cause the migration of contamination was predominantly the infiltration of stormwater and groundwater flow.

If present, volatile and semi volatile hydrocarbons (VHC and SVHC) in groundwater have the potential to partition into the air in the soil pore spaces and can move into buildings, ambient air, confined spaces or excavations on a site.

2.5 Contaminant Exposure Pathways

For contaminated soil to pose a risk to a receptor, a complete exposure pathway must exist between the source of the impact and the receptor. A complete exposure pathway consists of the following elements:

- A source and mechanism for release;
- A storage and/or transport medium (e.g. contaminants stored in groundwater and transported into the atmosphere via volatisation);
- An exposure point, where the receptor comes in contact with the contamination; and
- An exposure route (e.g. inhalation).

It was considered that construction and associated earthworks during the proposed redevelopment of the site had the potential to create human health exposure pathways, including:

- Exposure to excavation/construction workers on the proposed development via dermal contact and/or incidental ingestion of COCs in groundwater; and
- Soil gas during excavation could move into the atmosphere, creating an exposure pathway to inhalation by site workers and patrons of nearby premises.
- Inhalation by site users and visitors of soil vapour through joins or fissures in the concrete slab.

Other potential exposure pathways include groundwater dependent ecosystems and surface water at the groundwater discharge point.

2.6 Identification of Receptors at Risk

Potential sensitive receptors were considered to include:

- Site workers;
- Maintenance workers;
- Trespassers; and
- Neighbouring groundwater dependent ecosystems.

TABLE 1: DP2018 CONCEPTUAL SITE MODEL

Known and Potential Primary Sources	Contaminants of Concern	Release Mechanism	Potential Impacted Media	Potential Receptors	Exposure Pathways
Site surface soils	Arsenic, cadmium, copper, lead and zinc	Infiltration of storm water	Groundwater	Site workers Maintenance workers Trespassers	Inhalation Dermal contact Incidental ingestion
Up hydraulic gradient groundwater	TRH, PAH, BTEX, CHC, PFAS, aluminium and fluoride	On site migration of groundwater	Groundwater and soil vapour	Neighbouring groundwater dependent ecosystems	Uptake of groundwater via the root system

3 DATA GAP ANALYSIS

The following gaps in the current data set were identified as needing to be addressed in order to gain a more complete understanding of the contamination status of the site.

3.1 Groundwater

The groundwater contamination status for a broad range of contaminants has been monitored on Lot 11 from 2013-2017. Although having a similar previous history, the groundwater contamination status of Lot 8 is unknown.

Additional groundwater assessment was required to increase confidence that groundwater contamination did not represent a significant AEC on the site. Groundwater assessment would assess:

- Depth and flow direction of groundwater beneath the site; and
- Contamination status of groundwater beneath the sites.

Collected data would be used to inform a decision on whether or not groundwater contamination (if present) represented regional contamination, or site-specific impact and whether remediation of groundwater, if required, is practical or not.

4 DATA QUALITY OBJECTIVES

4.1 Step 1 State the Problem

Previous assessments indicated that the site has been used for sand mining, steel manufacturing and aluminium smelting purposes, and that the surface of the site has been covered with uncontrolled fill. The previous site uses have caused the surface soils to be impacted with arsenic, cadmium, copper, lead and zinc. Offsite upgradient groundwater is known to be impacted with fluoride and potentially impacted with VHC, SVHC, CHC, PFAS and aluminium.

Problems to be addressed in this SAQP are:

- The contamination status of the groundwater beneath the site; and
- The extent, if any, of on-site migration of up gradient contamination;
- The impact of groundwater contamination on the proposed site use;
- The groundwater flow direction, hydraulic gradient and groundwater velocity.
- Potential impact of groundwater contamination on sensitive receptors.

4.2 Step 2 Identify the Decisions

The decisions that are required to be made are:

- What is the groundwater contamination status of the site?
- Is groundwater beneath the site being contaminated by on-site contamination;
- Is contamination being transported off site via groundwater migration;
- Is contamination being transported on site via groundwater migration; and
- Is remediation of the groundwater required?

4.3 Step 3 Identify the Inputs into the Decision

The primary inputs to the decision regarding soil contamination described in Step 2 are:

- Analytical results from groundwater samples collected by JME;
- Survey data and depth to groundwater data;
- Groundwater pump test data; and

- Assessment of analytical results against investigation criteria.

The primary inputs to the decision regarding groundwater contamination described in Step 2 are:

- Groundwater gradient obtained from current and proposed groundwater wells on and near the site;
- Groundwater analytical results from neighbouring locations (where available);
- Analytical results from groundwater samples collected by JME; and
- Assessment of analytical results against investigation criteria.

4.3.1 Groundwater Assessment Criteria

Drinking Water

Because the site is located in an area with a reticulated water supply, it is unlikely that groundwater would be used for domestic drinking purposes. No current registered bores exist for this purpose. Likewise, it was considered unlikely groundwater would be used for recreational purposes, such as the filling of swimming pools, in an area with a reticulated water supply.

Due to the shallow (<1m) depth of groundwater beneath the site, it was considered that trench workers may potentially contact and incidentally ingest groundwater seepage in trenches on the site.

Drinking water validation criteria were established from:

- National Health and Medical Research Council (NHMRC) Australian Drinking-Water Guidelines 6, Version 3.4 Updated October 2017. National Water Quality Management Strategy;
- World Health Organization (WHO) 2017 Guidelines for drinking-water quality, 4th edition, incorporating the 1st addendum; and
- USEPA RSLs Residential Tap Water Criteria. Online database of assessment criteria that are current as of November 2017.

It was considered that incidental ingestion would only involve small amounts of groundwater, therefore a factor of 10 has been applied to non-carcinogenic contaminant criteria. It is noted that NHMRC guidelines for toluene, ethyl benzene and xylene were not adjusted by a factor of ten as they are based on the inhalation exposure pathway only. Criteria derived by the USEPA for carcinogenic compounds were multiplied by x10 to adjust the target cancer risk level from 1:1,000,000 to 1:100,000, to be consistent with Australia's recommended target cancer risk level.

Groundwater Vapour

Due to the proposed redevelopment incorporating ground floor offices, vapour intrusion was considered to be a potential exposure pathway on the site.

Groundwater beneath the site is expected to be about 2m below ground surface. CRC CARE Technical Report No. 10 Health screening levels for petroleum hydrocarbons in soil and groundwater states that at depths of <2m, soil vapour measurements should be compared with soil vapour HSLs. Soil vapour HSLs have been sourced from Table 1A(3) Soil HSLs for vapour

intrusion – Low-high density residential, in the NEPM Schedule B1, Guideline on Investigation Levels for Soil and Groundwater (see Section 5.3).

CRC CARE Technical Report No. 10 provides HSLs for contaminants in soil vapour in Table B1 Soil Vapour Health Screening Levels. Soil Vapour criteria were established for Intrusive Maintenance Worker (Shallow Trench) – 0m to <2m, as well as for HSL-D (Commercial/Industrial) use.

Adopted criteria are shown in Table 2 (below).

Protection of Aquatic Ecosystems

The investigation levels presented on the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG) website are considered applicable for the protection of the ecosystems of receiving waters. As these guidelines apply to receiving waters, it is generally conservative to apply these to groundwater on site.

ANZG advocates a site-specific approach to developing guideline trigger values, based on such factors as local biological effects data, the current level of disturbance of the ecosystem, etc. The guidelines provide detailed approaches and advice on identifying appropriate guideline values for selected indicators. These guideline values help to ensure that agreed community values and their management goals are protected.

The nearest surface water receptor is in the tidal zone of the Hunter River, approximately 890m south of site. The default guideline values from ANZG were based on slightly to moderately disturbed marine water.

Adopted criteria are shown in Table 2 (below).

TABLE 2: ADOPTED GROUNDWATER CONTAMINANT TRIGGER VALUES

Analyte Name	Units	Adopted Trigger Value	Reliability/Comment
Benzene	µg/L	500	moderate
Toluene	µg/L	180	unknown
Ethylbenzene	µg/L	80	unknown
m/p-xylene	µg/L	75	unknown
o-xylene	µg/L	350	unknown
Chloroform	µg/L	370	unknown
1,1,2,2-Tetrachloroethylene	µg/L	70	unknown
1,1,2-Trichloroethylene	µg/L	330	unknown
1,1-Dichloroethylene	µg/L	700	unknown
Chloroethylene	µg/L	100	unknown
1,1,1-Trichloroethane	µg/L	270	unknown
1,1,2,2-Tetrachloroethane	µg/L	400	unknown
1,1,2-Trichloroethane	µg/L	1,900	unknown
1,2-Dichloroethane	µg/L	1,900	unknown
1,1-Dichloropropane	µg/L	500	unknown
1,2-Dichloropropane	µg/L	900	unknown
1,3-Dichloropropane	µg/L	1,100	unknown
TRH C6-C10 (F1)	µg/L	50	unknown
TRH >C10-C16 (F2)	µg/L	60	LOR
TRH >C16-C34 (F3)	µg/L	500	LOR
TRH >C34-C40 (F4)	µg/L	500	LOR

Analyte Name	Units	Adopted Trigger Value	Reliability/Comment
Naphthalene	µg/L	50	moderate
Phenanthrene	µg/L	0.6	unknown
Anthracene	µg/L	0.01	unknown
Fluoranthene	µg/L	1.0	unknown
Benzo(a)pyrene	µg/L	0.1	unknown
Arsenic	µg/L	13*	unknown
Cadmium, Cd	µg/L	0.7	very high
Chromium, Cr (VI)	µg/L	4.4	very high
Copper, Cu	µg/L	1.3	very high
Lead, Pb	µg/L	4.4	low
Nickel, Ni	µg/L	7	very high
Zinc, Zn	µg/L	15	moderate
Aluminium (pH>6.5)	µg/L	55*	unknown
Mercury	µg/L	0.1	very high
PFOS	µg/L	0.00023	unknown
PFOA	µg/L	19	unknown
Fluoride	mg/L	15	Australian Drinking Water guideline x 10

4.4 Step 4 Define the Site Boundaries

The lateral extent of the site was defined as Lots 8 and 11 in Deposited Plan (DP) 270328 (as defined in the website maps.six.nsw.gov.au).

The vertical extent of assessment was defined as groundwater up to 2m below the apparent groundwater table.

This assessment was expected to take place within April 2021.

4.5 Step 5 Develop an Analytical Approach

The analytical approach will be as follows:

- DQIs will be applied as per Section 8.1. If the results of the analytical data validation are acceptable with respect to the DQIs, then the data will be deemed suitable for the purposes of this assessment; and
- Results from previously and newly installed groundwater monitoring wells will be assessed. If contaminant concentrations are less than the trigger values established in Section 4.3.1, or are considered to be comparable to regional values, then it will be considered that no groundwater-specific remediation is required. Otherwise, appropriate contingency measures will be assessed.

4.6 Step 6 Specify the Performance or Acceptance Criteria

The null hypothesis was that groundwater beneath the site has not been significantly contaminated by current and previous on and offsite activities.

Potential decision errors are considered to include:

- Sampling errors, which occur when collected samples are not representative of conditions within the investigation area; and
- Measurement errors, which occur during sample collection, handling, preparation, analysis and data production.

These errors may lead the decision maker to make the following errors:

- Deciding that the investigation area is suitable for industrial/commercial land use when it is actually not; and
- Deciding that the investigation area is not suitable for industrial/commercial land use when it actually is.

An assessment will be made as to the likelihood of a decision error being made based on the results of the QA/QC assessment, and the closeness of analytical results to the investigation criteria outlined in Section 4.3. It is considered that a margin for error is accounted for by the level of conservatism built into guideline trigger values.

4.7 Step 7 Optimise the Design for Obtaining Data

In order to optimise the quality of data collected, JME will use:

- Licensed drillers and experienced JME field staff to install wells and collect samples;
- Registered surveyors to survey the wells;
- Calibrated equipment to collect field data; and
- NATA-accredited laboratories. Laboratory analysis will be in accordance with the requirements of the NEPM (Schedule B3) and will be referenced to USEPA or APHA methods.

Details of sampling methods and analytical requirements are discussed in Section 5.

5 SAMPLING PLAN

5.1 Groundwater Assessment

In order to assess the contamination status of groundwater beneath the site, JME proposes to install three groundwater monitoring wells across the site – one up-gradient wells near the western boundary, and two down-gradient wells near the eastern boundary. JME will also utilise three existing wells used for the operational groundwater monitoring of the Midal Cables Facility. It is intended that the positioning of these wells will allow for:

- Assessment of groundwater gradient and flow direction;
- Comparison of the contamination status of groundwater entering and leaving site;
- Assessment of the impact of on-site contamination of groundwater;
- Comparison of current groundwater conditions with historic groundwater conditions; and
- Assessment of potential for off-site migration of groundwater to cause on-site contamination to impact a receiving body of water.

5.2 Installation of Wells

Boreholes will be drilled using a drilling rig fitted with hollow flight augers, and logged to record changes in lithology and sampling intervals. Particular note will be made of the base of fill, and depth at which groundwater is encountered, based on the driller's observations and visual observation of samples.

In each well, 3m of machine-slotted 50mm PVC screen will be installed over an interval from 2m below to 1m above the perceived top of groundwater. 50mm solid PVC casing will be installed from the top of the slotted screen to approximately 0.5m above the ground surface. The annulus around the casing will be filled with clean coarse sand and gravel to approximately 0.3m above the top of the slotted casing. Bentonite will be placed in the annulus above the sand, and protruding casing will be left in place as a standpipe.

Following installation, groundwater wells will be developed using a Typhoon™ submersible pump to surge the hole, and then to rapidly pump out accumulated groundwater. This procedure is designed to remove from the hole sediment and water stirred up during drilling operations.

5.3 Sampling Plan

Groundwater gauging and sampling collection will be conducted approximately one week after the installation of groundwater wells, to allow them to settle and equilibrate. Sampling will be conducted in accordance with the following protocols:

- Prior to purging, the presence or absence of phase separated hydrocarbons (PSH) and depth to groundwater will be measured using an oil-water interface probe;
- Prior to sampling, each well will be purged using a low flow peristaltic pump until uniform turbidity is (visually) obtained, and field water quality parameters (electrical conductivity (EC), pH and temperature) have stabilised to within 10% difference for three successive readings at least three minutes apart. If water quality parameters do not stabilise, groundwater will not be sampled until at least three times the volume of the sampling equipment has been purged; and
- Field measurements - pH, EC, temperature, dissolved oxygen (DO) and redox potential (Eh) – will be recorded during purging.

Sampling QA/QC protocols are described in Section 8.

6 HEALTH, SAFETY AND THE ENVIRONMENT

6.1 Hazards and Control Measures

During drilling and sampling operations, there is potential for hazards to be encountered that present risks to health, safety and the environment (HSE). These risks will be addressed via the use of Safe Work Method Statements (SWMS), including considerations as detailed in Table 3.

TABLE 3: HSE HAZARDS and CONTROL MEASURES

Activity	Hazard	Control
Set up on site	Interaction with other site users	Sign onto site register
		Demarcate work area, exclusion zone
Drilling	Noise	Hearing protection
	Interaction with rig/excavator	Exclusion zone
		Communicate with operators
Excavation	Dust	Air fibre monitoring
		Dust masks
	Open excavations	Fence site
		Backfill as soon as practicable
	Interaction with rig/excavator	Exclusion zone
		Communicate with operators
Sampling	Sharp/abrasive fill	Neoprene gloves
	Contaminated fill/groundwater	Nitrile gloves
Asbestos assessment	Airborne asbestos fibres	Suit and mask

6.2 Personal Protective Equipment

Personal Protective Equipment (PPE) for the site will include:

- Hard hat;
- Safety glasses;

- Hi-visibility workwear;
- Long sleeves and trousers;
- Steel-capped boots;
- Chemical resistant rubber gloves (for persons coming in contact with soil); and
- Dust resistant disposable overalls and P1 (minimum) dust masks (when handling potentially asbestos contaminated soil).

7 ANALYSIS PLAN

Groundwater samples will be analysed for the analytes listed in Table 2 above.

Primary and intra laboratory duplicate samples will be analysed by SGS Australia (SGS), Sydney. Laboratory analysis will be in accordance with the requirements of the NEPM (Schedule B3) and will be referenced to USEPA or APHA methods. Laboratory analytical methods are summarised in Table 4. Inter laboratory duplicate samples will be analysed by ALS Environmental (ALS) Sydney Laboratory. SGS and ALS are NATA accredited for the analysis to be undertaken.

TABLE 4: SUMMARY OF ANALYTICAL METHOD REFERENCES

Analysis	Medium	SGS Reference
TRH	Water	USEPA 5030B, 8020A, 8260, 3510B and 8015B
PAH	Water	USEPA 3500C and 8270D
Metals	Water	USEPA 6020A
Mercury	Water	APHA 3112 and 3500
VOC	Water	USEPA 5021A/8260 P&T/HS/GC/MS
PFAS	Water	In house LC-MS/MS
Fluoride	Water	APHA 4110 B

8 QUALITY ASSURANCE/QUALITY CONTROL PLAN

The QA/QC plan is designed to achieve predetermined DQIs that will demonstrate accuracy, precision, comparability, representativeness and completeness of the data generated.

8.1 Data Quality Indicators for the Project

DQIs for the project will be based on field and laboratory considerations in the table in Appendix V of the NSW Department of Environment and Conservation (DEC) Guidelines for the NSW Site Auditor Scheme (2nd Edition) Contaminated Sites. Specific DQIs for field and laboratory QA/QC samples are shown in Table 5.

TABLE 5: DATA QUALITY INDICATORS

Type of Quality Control Sample	Control Limit
Duplicate Samples	RPDs within 50% for analyte concentrations greater than 5 x LOR.
Rinsate Samples (deionised water)	Analytes not detected at concentrations greater than the blank deionised water.
Laboratory Spikes	Laboratory spike acceptance limits are a “live” range and updated regularly. The laboratory acceptance limits at the time of analysis will be used.
Laboratory Blanks	Analytes not detected.

A review of the DQIs will be undertaken to assess the usability and representative nature of data generated from the project. The outcome of the DQI assessment will either:

- Recommend the data is suitable to be used for the project; or
- Limit the suitability of the data to be used, or

- Recommend further contamination/validation sampling.

8.2 Sampling Protocols

The following sampling protocols will be observed during the project:

- Dedicated sampling equipment (including the silicon tubing in the peristaltic pump) will be used for groundwater sample collection and will be changed between each sampling location.
- HDPE tubing will be used for groundwater sampling as it considered to present a lower risk of PFAS contamination of the samples.
- Groundwater samples will be collected in appropriate laboratory-supplied vessels;
- Samples will be placed on ice awaiting dispatch to the laboratory;
- Samples will be dispatched to the laboratory under chain of custody (CoC) conditions. CoC documentation will include:
 - sample identification of each sample;
 - date sampled; and
 - date dispatched to the laboratory; and
- Samples will be dispatched within two days of collection, to avoid holding time exceedances.

8.3 Field Quality Control Samples

The following quality control samples will be collected in the field:

- Intra and inter-laboratory duplicates will be collected at the rate of 1 per 20 primary samples collected; and
- A rinsate sample will be collected on every day that non-dedicated or non-disposable sampling equipment is utilised. Rinsate water will be deionised water purchased from a hardware store.

8.4 Laboratory Quality Control

Laboratory quality control protocols will include the following:

- Laboratory analysis of samples will be undertaken by a NATA-accredited environmental testing laboratory;
- The laboratory will implement a quality control plan conforming to the NEPM Schedule B3 Guidelines for Analysis of Potentially Contaminated Soils;
- The laboratory will analyse reagent blanks, spike samples, duplicate spikes, matrix spikes, and surrogate spikes and duplicates to assess the laboratory's quality control; and
- The laboratory will extract and/or analyse the samples within the required holding times.

9 POST-ASSESSMENT ACTION PLAN

9.1 Data Assessment

Field observations, particularly those related to depths of groundwater and fill, will be used to revise the CSM as described in Section 2.

Analytical results will be compared with assessment and validation criteria as outlined in Section 4.3.1.

9.2 Requirement for Groundwater Remediation

The consideration that the leaching of contamination from fill on the site to groundwater or on site migration of contaminated groundwater, and subsequent off-site movement of contamination via groundwater migration, does not represent a significant risk of environmental impact will be considered to be supported if:

- Analytes are not detected at concentrations above the laboratory limit of reporting, or above the trigger values listed in Section 4.3.2; OR
- Groundwater contamination is found to be consistent with samples collected from nearby locations in the same historic land use setting; OR
- The primary source of groundwater contamination has been removed or will be managed/remediated.

In this case, it will be considered that site contamination is not being transported off-site via groundwater migration, and that no groundwater-specific remediation is required.

If field observations and analytical results indicate that contamination is being transported off-site via groundwater migration, the CSM and RAP will be revised.

10 GROUNDWATER ASSESSMENT

10.1 Field Work

Three groundwater monitoring wells (MW7 – MW9) were installed on 6 April 2021 by the FICO group, under the guidance of a JME environmental scientist. The wells were installed as per the requirements of the SAQP.

Construction details of monitoring wells are represented graphically in Appendix A.

Groundwater monitoring wells were left for a week to allow them to settle and equilibrate. Groundwater gauging and sample collection from MW7 – MW9, plus pre-existing monitoring wells MW4-MW6, was conducted by a JME environmental scientist on 13 April 2021. Monitoring wells were sampled in accordance with the SAQP.

Groundwater depths and field parameters are recorded in Table 5 (below).

Following sampling monitoring wells MW7 and MW 8, a typhoon pump was placed down each well to maintain a constant groundwater head. The extracted water was collected in pre-weighed buckets over an 8-10 period. The time was kept with an iPhone stopwatch. The water in the bucket s was weighed on a top load balance. The groundwater head was measured using an interface probe.

10.2 Laboratory Analysis

Primary and inter duplicate and intra laboratory groundwater samples were analysed by SGS Australia (SGS), Sydney. The chain of custody did not direct SGS to forward the inter laboratory duplicate to ALS. This error was not noticed until after the analysis had been completed.

Samples were analysed for:

- PFAS;
- Fluoride
- Metals (Al, As, Cd, Cr, Cu, Ni, Pb, Zn, Hg);
- Volatile organic compounds (VOC);

- PAH; and
- TRH.

10.3 Quality Assurance and Quality Control

Groundwater monitoring wells were installed by drillers licensed to install such wells, and experienced JME field staff.

The interface probe and water quality meter were calibrated prior to use. Calibration certificates are attached in Appendix B.

Dedicated sampling equipment (excluding the flow cell) was used for groundwater sample collection and changed between each sampling location. The flow cell was purged between each sampling location, and not used during sample collection.

Groundwater samples were collected in appropriate laboratory-supplied vessels, kept on ice during transport, and received by the laboratory at a temperature of 3.1°C. Samples were transported under CoC conditions, and received by the laboratory with sufficient time to undertake analyses within specified holding times.

During the assessment, field duplicate (QC1) and triplicate (QC1A) groundwater samples were collected and analysed to assess whether field sampling procedures provided reproducible results. The relative percentage difference (RPD) of analyte concentrations between duplicates and their primary sample were calculated to be within the acceptance criterion of 50% for concentrations greater than 5x the laboratory limit of reporting.

RPD results are included in Summary Table 1 (attached).

An equipment blank sample (QCA) was not collected, However, identical sampling trains from the same supplier have previously assessed by JME and shown not to introduce PFOA or PFOS. In addition, PFOA or PFAS was not detected in two of the samples analysed. Hence it is considered unlikely that PFOA or PFOS were introduced by the sampling train.

Groundwater quality assurance/quality control (QA/QC) results are presented in Summary Table 1 (attached).

SGS is National Association of Testing Authorities (NATA)-accredited for the analyses requested. SGS conducted internal quality control using spikes, laboratory duplicates and method blanks. A review of SGS's Data Quality Objective (DQOs) for the analysis of soil samples indicated that DQOs were met, with the following exceptions:

- Surrogate analysis for PFAS in Aqueous Samples - Low Level for two items; and
- Surrogate analysis for PAH in Water for two items.

It should be noted that the surrogate recovery for the PFAS compounds of interest were within Laboratory QA/QC documentation is included in Appendix C.

Based on a review of QA/QC results it is considered that analytical results are indicative of the contamination status of the site at the time of sampling.

10.4 Results

10.4.1 Field Observations

Groundwater depths are listed in Table 5, and borehole logs are included in Appendix A.

TABLE 5: MONITORING WELL GROUNDWATER PROPERTIES 27 February 2020

Well	Top of Case Elevation (mAHD)	Groundwater Depth (mbTOC)	Calculated Groundwater Elevation (mAHD)	Dissolved Oxygen (ppm)	Electrical Conductivity ($\mu\text{S}/\text{cm}$)	pH	Redox Potential (mV)	Temperature ($^{\circ}\text{C}$)
MW4	5.07	1.534	3.536	0.25	630	6.45	-149	23.5
MW5	5.19	1.636	3.554	0.98	617	6.78	-180	22.3
MW6	7.05	2.667	4.383	8.73	94.4	5.15	-118	20.9
MW7	6.04	2.199	3.841	2.02	244	5.96	-148	22.6
MW8	6.13	2.241	3.889	2.16	224	5.67	-150	22.5
MW9	7.22	2.904	4.316	2.45	200	5.73	-148	22.8

10.4.2 Groundwater Flow Direction Groundwater Gradient and Infiltration Rate

The tops of the casing of groundwater wells MW4 -MW9 were surveyed by registered surveyors DeWitt Consulting Pty Ltd. The survey results were combined with the depth to groundwater results obtained by JME to assess the altitude of the groundwater at each groundwater well location. Groundwater contours were generated using Surfer 13™. The groundwater contours indicate that the groundwater flows in a south south east direction. The groundwater contours are shown in Figure 3.

The groundwater gradient was estimated using the collected data for monitoring wells MW4 and MW9. Monitoring wells MW4 and MW9 are approximately 312m apart and the difference in the groundwater elevation is approximately 0.76m. Therefore, the hydraulic gradient is approximately 0.0024.

During the constant head test in monitoring well MW7, 64 kg (L) of water was collected in a ten-minute (600 second) period whilst maintaining a well head 0.112m below the standing groundwater level. Hence the inflow rate was 0.107 L/s

The slotted well casing in MW7 was set approximately 2.3m below the standing ground water level. The borehole annulus had a radius of 0.1m. Hence the area of the borehole annulus was 1.45m². Hence the flow rate of the aquifer at MW7 was approximately 0.074 L/s/m².

During the constant head test in monitoring well MW8, 65 kg (L) of water was collected in a\n eight-minute (480 second) period whilst maintaining a well head 0.121m below the standing groundwater level. Hence the inflow rate was 0.135 L/s

The slotted well casing in MW8 was set approximately 2.26m below the standing ground water level. The borehole annulus had a radius of 0.1m. Hence the area of the borehole annulus was 1.42m². Hence the flow rate of the aquifer at MW8 was approximately 0.095 L/s/m².

10.4.3 Laboratory Analysis

Laboratory results from groundwater monitoring wells were compared with adopted DGVs (as developed in the SAQP). The comparison is summarised in Summary Table 1 (attached). Note that PFAS results were only tabulated if the analyte was detected above the laboratory LOR.

BTEX, TRH and PAH were not detected at concentrations above the laboratory LOR.

CHCs were not detected at concentrations above the laboratory LOR, with the exception of chloroform, which was detected in sample MW5 at a concentration significantly below the adopted DGV.

Several PFAS compounds were detected in the six samples collected. The PFAS fingerprint in the samples collected from MW4, MW5, MW7 and MW8 appeared similar in the makeup of compounds and their concentrations. PFOS was detected at concentrations above the adopted DGV in monitoring wells MW4, MW5, MW7 and MW8. PFOA was detected at concentrations below the adopted DGV in monitoring wells MW4, MW5, MW7 and MW8. PFOS and PFOA were not detected above the laboratory limit of report in monitoring wells MW6 and MW9.

Fluoride was detected below the adopted DGV in monitoring wells MW4, MW5, MW6, and MW9.

Arsenic, cadmium, nickel, lead and mercury were either not detected at concentrations above the laboratory LOR or detected in some wells above the laboratory detection limit but below the adopted DGVs.

The following metals were detected in some samples at concentrations which exceeded adopted guideline values:

- Aluminium was detected at concentrations significantly greater than the adopted DGV in each of the monitoring wells sampled;
- Copper was detected in monitoring wells MW4, MW5 and MW7;
- Chromium was detected in MW6; and
- Zinc was detected in monitoring wells MW4, MW5, MW7 and MW8.

Laboratory analytical reports are presented in Appendix C.

11 DISCUSSION

The site is situated in Tomago with the topography sloping downward from north northwest to a south southeast. The groundwater flows in a similar direction.

The site has had a two main industrial land use including sand mining and metal fabrication (steel and aluminium). A soil contamination assessment by JME indicated the site soil in the eastern portion of site was impacted with arsenic, copper, cadmium, lead and zinc. Lead exceeded the human health criteria whilst the remaining metals exceeded the ecological criteria. The RAP prepared by JME recommended the excavation and removal of the significant lead impacted areas with capping and stormwater management to mitigate potential offsite ecological impacts of arsenic, copper, cadmium and zinc.

Groundwater monitoring indicated that the impact of arsenic, cadmium and copper on the groundwater is negligible. Zinc appears to be significantly elevated at MW7 with a concentration of 89 µg/L compared to trigger value of 15 µg/L. The highest zinc soil impacts are associated with the highest lead soil impacts and, as such, are planned to be removed from the site in the remediation process.

PFOS was detected in the downgradient wells up to almost 30 times greater than the adopted DGVs. Although the concentrations in the wells nearer to the Varley site are slightly higher and gradually diminish across the site, the concentrations of PFOS are similar enough in the PFAS impacted wells to consider its presence is unlikely to be caused by onsite migration from the neighbouring site. Therefore, it is considered possible that PFAS was either previously used on site or a significant (bush) fire threatened the site. Either way, the primary source has been removed from site and the groundwater concentrations of PFAS should naturally attenuate with time. No PFOS was detected in the upgradient wells, MW9 and MW9. It is important to note that the PFOS detections were significantly lower than human health trigger values.

The site is within the TAC buffer zone. The TAC buffer zone is a special environment management zone and is defined in the TAC conditions of consent and is derived from the ambient fluoride levels associated with TAC operations. Fluoride and aluminium concentrations were largest in the upgradient wells and appeared to diminish the further away from TAC the groundwater well was located. No further action is required for fluoride and aluminium because these will continue to migrate onto site whilst the TAC smelter is still operable. The concentration of fluoride does exceed the drinking water guidelines in some wells and therefore the drinking of groundwater should be strictly prohibited on site.

12 CONCLUSION

JME considers that the presences of arsenic, cadmium, copper and lead have not had a significant impact on the groundwater beneath site and do not require any further mitigation to protect the groundwater into the future. It is noted that zinc is significantly elevated in one monitoring well, MW7. The zinc impacted soils with the highest concentrations are associated with the lead impacted soils that are planned to be removed in accordance with the RAP prepared by JME. The RAP also recommends the placement of a cap over the remainder of site. The cap, in conjunction with a storm water system was intended to reduce stormwater percolation through the soil thereby reducing the metal leaching potential.

On this basis, it is considered that groundwater specific remediation is not required.

13 REFERENCES

Australian and New Zealand Water Quality Guideline website

JME20005-2 Detailed Contamination Assessment 21D and 21F School Drive Tomago, JM
Environments, June 2020

JME20005-3 Remedial Action Plan 21D and 21F School Drive Tomago revision 1, June 2020.

National Environment Protection (Assessment of Site Contamination) Measure (1999, updated
2013) Schedule B1, Guideline on Investigation Levels for Soil and Groundwater

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2013) Schedule B2, Guideline on Site Characterisation

National Environment Protection (Assessment of Site Contamination) Measure (1999, updated
2013) 1999 Errata Updated 30 April 2014

NSW EPA (2017) Guidelines for the NSW Site Auditor Scheme (3rd Edition) Contaminated Sites

NSW Department of Environment and Conservation NSW (2007) Guidelines for the Assessment
and Management of Groundwater Contamination

NSW EPA (2020) Guidelines for Consultants Reporting on Contaminated Sites

Google Earth

PFAS National Environmental Management Plan January 2018, Heads of EPAs Australia and
New Zealand

maps.six.gov.nsw.au

14 LIMITATIONS

It is the nature of contaminated site investigations that the degree of variability in site conditions cannot be known completely, and no sampling and analysis program can eliminate all uncertainty concerning the condition of the site. Professional judgement must be exercised in the collection and interpretation of data.

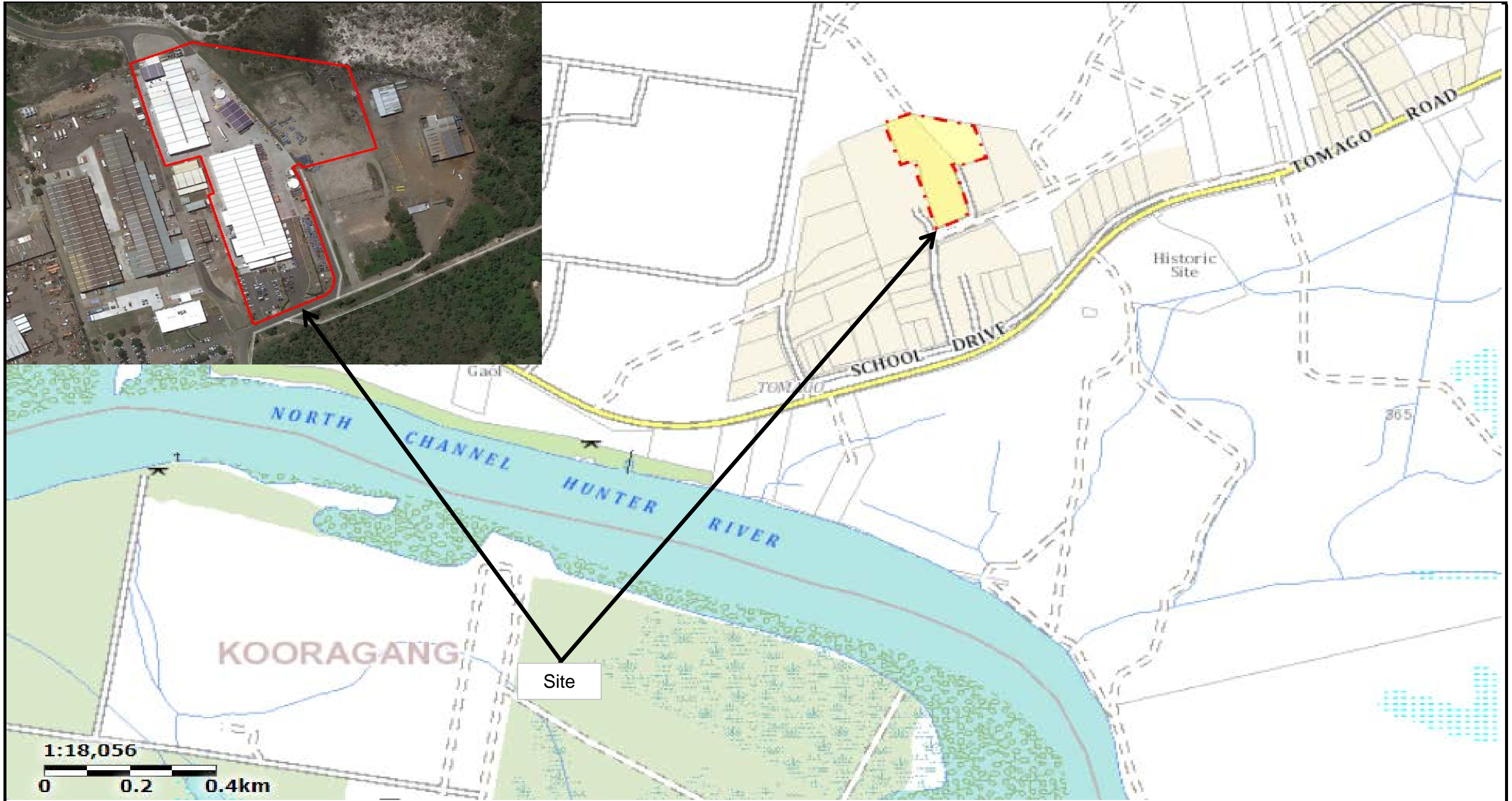
In preparing this report, current guidelines for assessment and management of contaminated land were followed. This work has been conducted in good faith, in accordance with JME's understanding of the client's brief, and general accepted practice for environmental consulting.



This report was prepared for Remondis Australia Pty Ltd, with the objective of refining the understanding of contamination on the site that could potentially impact on the development of the property for use as apartments. No warranty, expressed or implied, is made as to the information and professional advice included in this report. This report is not intended for other parties or other uses, except for the purpose of assessing a Development Application for the site. Anyone using this document does so at their own risk, and should satisfy themselves concerning its applicability and, where necessary, should seek expert advice in relation to the particular situation at the time.

This report is only applicable for the site's proposed redevelopment. If the proposed redevelopment is altered, the report may have to be altered accordingly.

This report does not comprise a geotechnical assessment and should not be used for geotechnical purposes.

Figures



		CLIENT: Remondis	PROJECT: JME20005	DESIGNED: JMc	FIGURE TITLE: Site Location Plan FIGURE NUMBER: 1
		PROJECT TITLE: School Drive, Tomago	DWG #: 1	DRAWN: JH	
			REVISION: 1	STATUS: NFC	
			SCALE: As shown		
			DATE: 2/06/2020		



CLIENT: Remondis

PROJECT TITLE: School Drive, Tomago

PROJECT: JME20005

DWG #: 1

REVISION: 1

SCALE: NTS

DATE: 28/04/2021

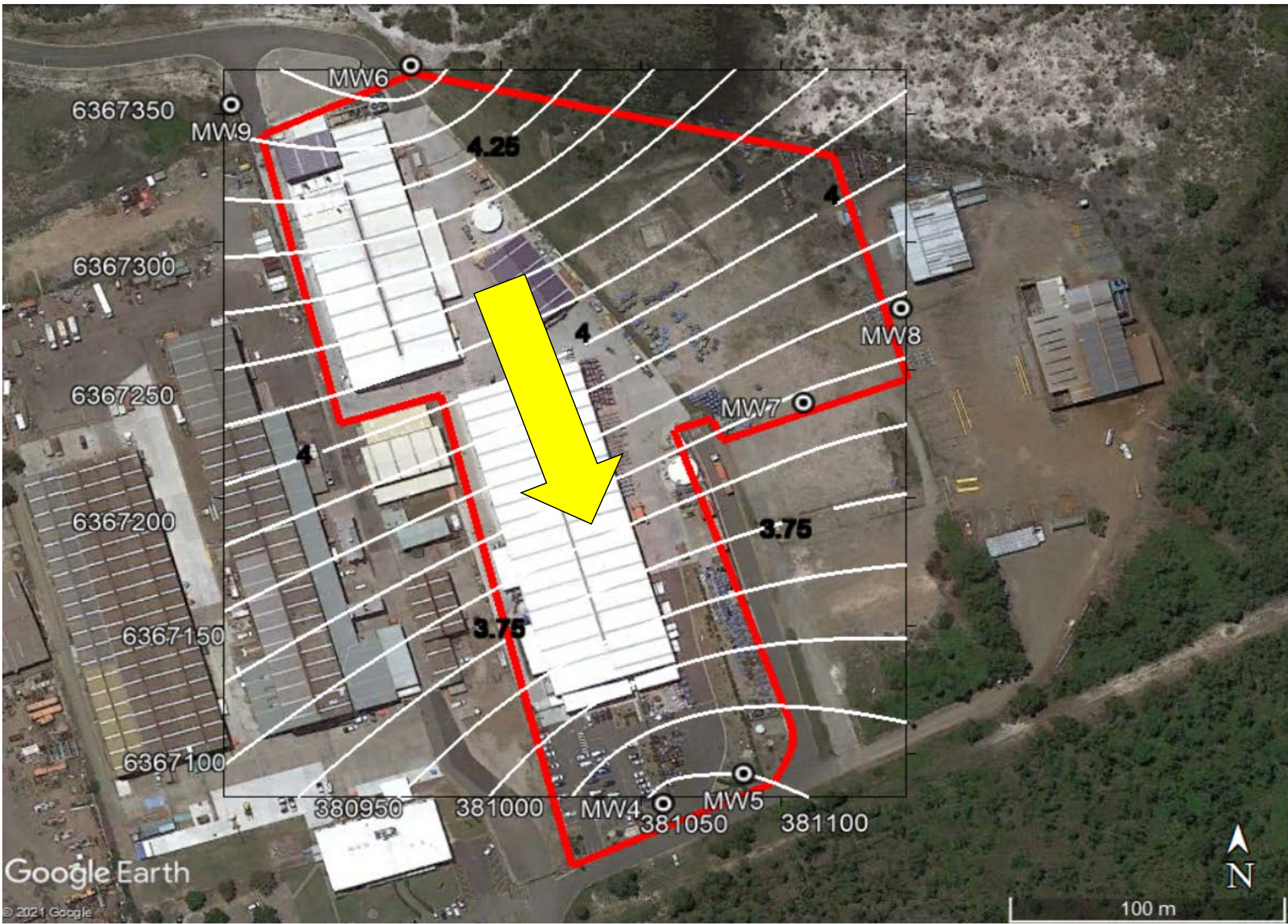
DESIGNED: JMc

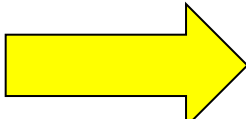
DRAWN: JMc

STATUS: NFC

FIGURE TITLE:
Monitoring Well Locations

FIGURE NUMBER: 2




 Inferred groundwater flow direction



CLIENT: **Remondis**

PROJECT TITLE: **School Drive, Tomago**

PROJECT:	JME20005
DWG #:	1
REVISION:	1
SCALE:	NTS
DATE:	28/04/2021

DESIGNED:	JMc
DRAWN:	JMc
STATUS:	NFC

FIGURE TITLE:
Groundwater Contours
 FIGURE NUMBER: **3**

Summary Table

Summary Table 1

Analyte Name	Units	Adopted	Description	MW4	MW5	MW6	MW7	QC1	Relative	QC1A	Relative	MW8	MW9
		Trigger	Sample Date	13/4/2021	13/4/2021	13/4/2021	13/4/2021	13/4/2021	percentage	13/4/2021	percentage	13/4/2021	13/4/2021
		Value	Matrix	Water	Water	Water	Water	Water	difference	Water	difference	Water	Water
		Reporting Limit	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
Vinyl chloride (Chloroethene)	µg/L	100	0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0%	<0.3	0%	<0.3	<0.3
1,1-dichloroethene	µg/L	700	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
Chloroform (THM)	µg/L	370	0.5	<0.5	0.9	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
1,2-dichloroethane	µg/L	1900	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
1,1,1-trichloroethane	µg/L	270	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
Benzene	µg/L	500	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
1,2-dichloropropane	µg/L	900	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
Trichloroethene (Trichloroethylene, TCE)	µg/L	330	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
1,1,2-trichloroethane	µg/L	1900	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
Toluene	µg/L	180	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
1,3-dichloropropane	µg/L	1100	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
Tetrachloroethene (Perchloroethylene, PCE)	µg/L	70	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
m/p-xylene	µg/L	75	1	<1	<1	<1	<1	<1	0%	<1	0%	<1	<1
1,1,2,2-tetrachloroethane	µg/L	400	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
o-xylene	µg/L	350	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0%	<0.5	0%	<0.5	<0.5
Total VOC	µg/L	-	10	<10	<10	<10	<10	<10	0%	<10	0%	<10	<10
TRH C6-C10 (F1)	µg/L	50	50	<50	<50	<50	<50	<50	0%	<50	0%	<50	<50
TRH >C10-C16 (F2)	µg/L	60	60	<60	<60	<60	<60	<60	0%	<60	0%	<60	<60
TRH >C16-C34 (F3)	µg/L	500	500	<500	<500	<500	<500	<500	0%	<500	0%	<500	<500
TRH >C34-C40 (F4)	µg/L	500	500	<500	<500	<500	<500	<500	0%	<500	0%	<500	<500
Naphthalene	µg/L	50	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1
Phenanthrene	µg/L	0.6	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1
Anthracene	µg/L	0.01	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1
Fluoranthene	µg/L	1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1
Benzo(a)pyrene	µg/L	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1
Fluoride	mg/L	15	0.1	4.6	1.5	8.7	<0.1	<0.1	0%	0.15	40%	<0.1	12
Aluminium	µg/L	55	5	770	270	7100	250	260	4%	240	4%	190	8800
Arsenic, As	µg/L	13	1	2	<1	<1	<1	<1	0%	<1	0%	<1	<1
Cadmium, Cd	µg/L	0.7	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0%	<0.1	0%	<0.1	<0.1
Copper, Cu	µg/L	1.3	1	3	3	1	3	2	40%	<1	100%	<1	<1
Chromium, Cr	µg/L	4.4	1	3	3	6	4	4	0%	4	0%	3	3
Nickel, Ni	µg/L	7	1	2	2	<1	<1	<1	0%	<1	0%	<1	<1
Lead, Pb	µg/L	4.4	1	<1	<1	<1	<1	<1	0%	<1	0%	<1	<1
Zinc, Zn	µg/L	15	5	34	33	6	89	83	7%	77	14%	18	<5
Mercury	mg/L	0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0%	<0.0001	0%	<0.0001	<0.0001
Perfluorobutanoic acid (PFBA)	µg/L	-	0.0005	0.020	0.022	<0.0005	0.0030	0.0024	22%	0.0021	35%	<0.0005	<0.0005
Perfluoropentanoic acid (PFPeA)	µg/L	-	0.0005	0.0079	0.0055	<0.0005	0.0034	0.0023	39%	0.0021	47%	<0.0005	<0.0005
Perfluorohexanoic acid (PFHxA)	µg/L	-	0.0005	0.0095	0.0072	<0.0005	0.0048	0.0039	21%	0.0036	29%	<0.0005	<0.0005
Perfluoroheptanoic acid (PFHpA)	µg/L	-	0.0005	0.0053	0.0022	<0.0005	0.0014	0.0020	35%	0.0015	7%	<0.0005	<0.0005
Perfluorooctanoic Acid (PFOA)	µg/L	19	0.0005	0.0067	0.0023	<0.0005	0.0052	0.0040	26%	0.0045	14%	0.0031	<0.0005
Perfluorobutane sulfonate (PFBS)	µg/L	-	0.001	0.003	0.002	<0.001	0.001	0.001	0%	0.001	0%	0.002	<0.001
Perfluoropentane sulfonate (PFPeS)	µg/L	-	0.001	0.003	0.002	<0.001	<0.001	<0.001	0%	<0.001	0%	0.002	<0.001
Perfluorohexane sulfonate (PFHxS)	µg/L	-	0.0002	0.028	0.015	0.0006	0.0043	0.0033	26%	0.0042	2%	0.023	0.0003
Perfluoroheptane sulfonate (PFHpS)	µg/L	-	0.0002	0.0006	<0.0002	<0.0002	0.0002	<0.0002	0%	<0.0002	0%	0.0004	<0.0002
Perfluorooctane sulfonate (PFOS)	µg/L	0.00023	0.0002	0.0063	0.0057	<0.0002	0.0043	0.0030	36%	0.0038	12%	0.0040	<0.0002
1H,1H,2H,2H-Perfluorooctane sulfonate	µg/L		0.0005	<0.0005	0.0050	<0.0005	<0.0005	<0.0005	0%	<0.0005	0%	<0.0005	<0.0005

Appendix A

Borehole Logs

Appendix B

Calibration Certificate

Appendix B

Laboratory Documents