

Intended for
John Holland Rail Pty Ltd

Document type
Plan

Date
August 2020

Project Number
Sampling Analysis and Quality Plan (SAQP) – Surface Water Monitoring

SAMPLING ANALYSIS AND QUALITY PLAN (SAQP) – SURFACE WATER MONITORING TARAGO LEAD MANAGEMENT

TARAGO LEAD MANAGEMENT SAMPLING ANALYSIS AND QUALITY PLAN (SAQP) – SURFACE WATER MONITORING

Project name **Tarago Lead Management**
Project no. **318000780-T24-01**
Recipient **John Holland Rail Pty Ltd**
Document type **Plan**
Version **0**
Date **6/08/2020**
Prepared by **Stephen Cadman/Jordyn Kirsch**
Checked by **Stephen Maxwell**
Approved by **Fiona Robinson**
Description **This document comprises the Sampling Analysis and Quality Plan (SAQP) for surface water monitoring associated with management of lead contamination from the Tarago rail corridor.**

Ramboll
Level 2, Suite 18 Eastpoint
50 Glebe Road
PO Box 435
The Junction
NSW 2291
Australia

T +61 2 4962 5444
<https://ramboll.com>

This document is issued in confidence to John Holland Rail Pty Ltd for the purposes of providing a Sampling Analysis and Quality Plan for surface water monitoring at Tarago NSW, and subject to NSW EPA Accredited Site Auditor review. It should not be used for any other purpose.

The report must not be reproduced in whole or in part except with the prior consent of Ramboll Australia Pty Ltd and subject to inclusion of an acknowledgement of the source. No information as to the contents or subject matter of this document or any part thereof may be communicated in any manner to any third party without the prior consent of Ramboll Australia Pty Ltd.

Whilst reasonable attempts have been made to ensure that the contents of this report are accurate and complete at the time of writing, Ramboll Australia Pty Ltd disclaims any responsibility for loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this report.

© Ramboll Australia Pty Ltd

Ramboll Australia Pty Ltd.
ACN 095 437 442
ABN 49 095 437 442

CONTENTS

1.	INTRODUCTION	1
1.1	Preamble	1
1.2	Background	1
1.3	Regulation	1
1.4	Objective	1
2.	SITE IDENTIFICATION	2
3.	REGULATORY REQUIREMENTS	3
4.	SUMMARY OF CONCEPTUAL SITE MODEL	4
5.	SITE ACCEPTANCE CRITERIA	5
6.	DATA QUALITY OBJECTIVES	7
6.1	Step 1: State the problem	7
6.1.1	Contaminants of Concern	7
6.2	Step 2: Identify the decisions / goal of the study	7
6.3	Step 3: Identify the information inputs	8
6.4	Step 4: Definition of the Study Boundary	8
6.5	Step 5: Develop the decision rules or analytical approach	8
6.6	Step 6: Specify the performance or acceptance criteria	9
6.6.1	The tolerable limits on decision errors are as follows:	9
6.6.2	Evaluation of Analytical Data	9
6.7	Step 7: Develop a plan for obtaining data	11
7.	SAMPLING PLAN	12
7.1.1	Surface Water Sampling Locations	12
7.1.2	Water Quality Monitoring Performance Criteria	12
8.	REPORTING	14
8.1	Surface Water Monitoring Report	14
9.	REFERENCES	15

LIST OF TABLES

Table 2-1: Site Identification	2
Table 4-1 Conceptual Site Model Summary	4
Table 5-1: Surface Water Investigation Levels (µg/L)	5
Table 5-2: Sediment Assessment Criteria – Ecological Investigation Criteria (mg/kg)	6
Table 7-1 Surface Water Sampling Locations	12
Table 7-2 Surface Performance Criteria	13

APPENDICES

Appendix 1

Figures

1. INTRODUCTION

1.1 Preamble

Ramboll Australia Pty Ltd (Ramboll) was engaged by John Holland Rail Pty Limited (JHR) on behalf of Transport for NSW (TfN) to complete periodic surface water monitoring upstream and downstream of contamination within the Goulburn – Bombala rail corridor at Tarago, New South Wales, Australia.

1.2 Background

The site is identified as part Lot 22 Deposited Plan (DP) 1202608 and is located in Tarago, NSW. The site occupies an area of approximately three hectares and is located approximately 32 km south of Goulburn.

The Woodlawn Mines Ore Concentrate Load-Out Complex operated within the Goulburn – Bombala rail corridor at Tarago from the 1970s – 1990s. Concentrates were produced at the Woodlawn Mine approximately 6.5 km west and included a zinc concentrate consisting mainly of sphalerite (zinc sulphide), a lead concentrate of galena (lead sulphide) and copper concentrates of chalcopyrite (copper iron sulphide).

An extensive body of work has been completed to characterise contaminant impacts associated with historic operation of the site. This work has included assessment of soil, groundwater and surface water across the site and assessment of soil, groundwater, surface water and airborne dust within the surrounding area. Recent assessments identified contaminants within approximately 900 lineal meters of the rail formation at Tarago. This area is herein referred to as the 'site' and is presented on **Figure 1, Appendix 1**.

Offsite contaminant migration in surface water appears limited to three culverts which pass beneath the rail formation onsite. Contaminants of potential concern (CoPC) relevant to receiving surface waters appear limited to metals (aluminium, cadmium, copper, lead, nickel, zinc) which exceed the adopted relevant health and/or ecological assessment criteria.

1.3 Regulation

On 25 March 2020 the NSW Environment Protection Authority (NSW EPA) declared the site as significantly contaminated under Section 11 of the Contaminated Land Management Act 1997 (Declaration Number 20201103). Transport for NSW is currently managing the contamination under a Voluntary Management Proposal (VMP) which includes further assessment of site contamination and remediation to address the potential risks to human health and the environment posed by the contamination.

1.4 Objective

The objective of the surface water monitoring is to collect reliable water quality data, providing a data continuum which forms a basis for assessment of impacts from the site on surrounding surface water receptors.

2. SITE IDENTIFICATION

The site locality is shown in **Figure 1**, Error! Reference source not found..

The site details are presented in **Table 2-1**.

Table 2-1: Site Identification

Information	Description
Street Address:	Accessed from Stewart Street and Goulburn Street Tarago NSW
Identifier:	Part Lot 1 DP 595856
Site Area:	Approximately 7.5 ha
Local Government:	Goulburn Mulwaree Shire
Owner:	Transport for NSW
Current Site Use:	Forms part of the Goulburn to Bombala rail line and the Country Regional rail Network (CRN)

3. REGULATORY REQUIREMENTS

This SAQP has been prepared in general accordance with the following guidance documents:

1. Australia and New Zealand Environment and Conservation Council, *Guidelines for Fresh and Marine Water Quality* (ANZECC, 2018)
2. National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013* (NEPM, 2013)
3. NSW EPA, *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Lands* (NSW EPA 2020)
4. NSW EPA, *Guidelines for the Site Auditor Scheme (3rd Edition)* (NSW EPA, 2017)

4. SUMMARY OF CONCEPTUAL SITE MODEL

A Conceptual Site Model (CSM) was prepared as part of a Detailed Site Investigation prepared by Ramboll (2020). The CSM provides a summary of the source-pathway-receptor linkages for surface water and sediment and is summarised in **Table 4-1**.

Table 4-1 Conceptual Site Model Summary

Exposure Pathway	Onsite Workers	Onsite Ecology	Residents	Community Activities	Offsite Workers	Offsite Ecology	Irrigation and Livestock
Surface Water							
Direct contact	N	P	N	N	N	P	P
Incidental ingestion	N	P	N	N	N	P	P
Root uptake	N/A	P	N/A	N/A	N/A	P	N/A
Migration to groundwater	N	P	N	N	N	P	P
Sediment							
Direct Contact	P	P	P ¹	N	P	P	P
Inhalation	P	P	P ¹	N	P	P	P
Incidental Ingestion	P	P	P ¹	N	P	P	P
Root Uptake	N/A	P	N/A	N/A	N/A	N/A	N/A

¹Potentially complete exposure pathways between the Contaminant in soil and offsite residents are limited to approved (though not current) use of one residential property.

5. SITE ACCEPTANCE CRITERIA

The assessment criteria proposed for surface water was sourced from the following references:

1. National Environment Protection Council (NEPC), National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013 (NEPM, 2013)
2. National Health and Medical Research Council (NHMRC) (2001) National Resource Management Ministerial Council (NRMMC) Australian Drinking Water Guidelines 6, Version 3.5 updated August 2018, (ADWG 2011)
3. National Health and Medical Research Council (NHMRC), National Resource Management Ministerial Council (NRMMC) Guidelines for Managing Risks in Recreational Water (NHMRC, 2008).
4. Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) (available at www.waterquality.gov.au/anz-guidelines).
5. Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) Australian
6. New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000)

Based on the review of potential beneficial uses of surface water, the criteria for protection of aquatic ecosystems and recreational use will be adopted. The adopted criteria are presented in **Table 5-1**. Dissolved metals will be assessed against ecological criteria (95% Freshwater (ANZG 2018)) while total metals will be assessed against all other criteria.

Table 5-1: Surface Water Investigation Levels ($\mu\text{g/L}$)

Contaminant	95% Freshwater (ANZG 2018)	Recreational ⁹	Irrigation Short-term Trigger Value (ANZECC 2000)	Stock Water (ANZECC 2000)
Heavy Metals				
Aluminium	55 ^a	-	20,000	5,000
Arsenic	24 ^b	100	2,000	500-5,000
Barium	-	20	-	-
Beryllium	-	6	500	-
Cadmium	0.2	20	50	10
Chromium	1.0 ^c	500	1,000	1,000
Cobalt	1.4	-	100	1,000
Copper	1.4	20,000	5,000	400-5,000
Iron	-	-	10,000	not sufficiently toxic
Lead	3.4	100	5,000	100
Manganese	1,900	5000	10,000	not sufficiently toxic
Mercury	0.06 ^{d, e}	10	2	2
Nickel	11	200	2,000	1,000
Zinc	8	-	5,000	20,000
Inorganics				
Ammonia (as N)	900	-	-	-
Nitrate	-	500,000	-	-
Nitrite	-	-	-	-
Total nitrogen	-	-	25,000-125,000	-

Total phosphate (as P)	-	-	800-12,000	-
BTEXN				
Benzene	950	10	-	-
Toluene	180	8000	-	-
Ethylbenzene	80	3000	-	-
Total xylenes	75 ^f	6000	-	-
Naphthalene	16	-	-	-

blank cell denoted with – indicates no criterion available.

^a Aluminium guidelines for pH > 6.5, based on the pH of groundwater measured at the site and surrounding area.

^b Guideline value for arsenic (III).

^c Guideline value for chromium (VI).

^d Guideline value for inorganic mercury.

^e 99% species protection level DGV has been adopted to account for the bioaccumulating nature of this contaminant.

^f Guideline value for m-xylene. Guideline values also exist for both o-xylene and p-xylene as per ANZG (2018). The default guideline value for m-xylene guideline has been adopted as it is the most conservative.

^g Recreational investigation values calculated by multiplying drinking water guidelines (ADWG 2018) by 10 as recommended in NHMRC (2008) Guidelines for Managing Risks in Recreational Water

The criteria proposed for the assessment of sediment contamination are sourced from the default guideline values in ANZG (2018). The adopted assessment criteria for sediment are summarised in **Table 5-2**.

Table 5-2: Sediment Assessment Criteria – Ecological Investigation Criteria (mg/kg)

Contaminant	Sediment DGV	GV-High
Aluminium	-	-
Arsenic	20	70
Barium	-	-
Beryllium	-	-
Cadmium	1.5	10
Chromium	80	370
Cobalt	-	-
Copper	65	270
Iron	-	-
Lead	50	220
Manganese	-	-
Mercury	0.15	1.0
Nickel	21	52
Zinc	200	410

The DGV was derived using a ranking of both observed field and laboratory ecotoxicity-effects and represents the 10th percentiles of that data distribution.

GV-high represents the median of that data distribution to provide an upper guideline value. Effects on sediment biota are rarely seen for concentrations below the DGV, while effects are more frequently evident above the GV-high value.

6. DATA QUALITY OBJECTIVES

To achieve the objectives and purpose of the surface water monitoring program, both the field and laboratory programs must result in data that is representative of the conditions at the site. As such, specific Data Quality Objectives (DQOs) have been developed for the tasks to be completed to validate the remediation of the site. The DQO process is a systematic, seven step process that defines the criteria that the validation sampling should satisfy in accordance with the *Guidelines for the NSW Site Auditor Scheme (3rd Edition)* (NSW EPA 2017).

The seven step DQOs process comprises:

1. Step 1: State the problem;
2. Step 2: Identify the decisions/ goal of the study;
3. Step 3: Identify the information inputs;
4. Step 4: Define the boundaries of the study;
5. Step 5: Develop the decision rules or analytical approach;
6. Step 6: Specify the performance or acceptance criteria;
7. Step 7: Develop the plan for obtaining data.

The seven step DQO process has been completed for surface water monitoring to be completed before, during and after site remediation.

6.1 Step 1: State the problem

Due to historic loadout of ore concentrate surface water flow over ore impacted soils has been identified to result in migration of total and dissolved metal concentrations from the site. Elevated concentrations can impact on surface water and sediments off site. Remediation of the site is proposed however the extent of remediation required for impacted sediments is not known. The site has been declared significantly contaminated land by the NSW EPA and a VMP has been prepared to describe how associated risks to human health and the environment will be managed.

Concurrently, Ramboll has worked under engagement to JHR to assess risks associated with site contamination and provide management advice to mitigate associated risks.

6.1.1 Contaminants of Concern

Contaminant of Concern relevant to receiving surface waters appear limited to metals (aluminium, cadmium, copper, lead, nickel, zinc) which exceed the adopted relevant health and/or ecological assessment criteria.

Historical observations are summarised on **Figure 1, Appendix 1** and show lead concentrations in surface water above the freshwater ecosystems criteria and above the stock watering criteria, with the higher lead concentrations reported in SW3, SW4 and SW1 located within the area of known lead impact in the rail corridor. Upstream samples, SW1_UP and SW9, and SW8 located downstream of the Mulwaree River tributary did not report lead concentrations above the laboratory limit of reporting. Lead concentrations in sediment followed a similar distribution to the surface water samples, with the highest lead concentrations reported in SED1, SED2 and SED4 above the GV-high criterion. Other heavy metals were variably reported above the adopted criteria for surface waters and sediments, with the highest concentrations generally reported in sample locations within the area of known lead impact (SW1, SW3 and SW4).

6.2 Step 2: Identify the decisions / goal of the study

The goal of the study is to assess the migration of metal(loid) contamination from the site in surface waters and the impact of migration to surface waters and sediments off site.

Based on the decision-making process for assessing urban redevelopment sites, detailed in the *NSW Site Auditor Guidelines, 3rd Edition 2017*, the following decisions must be made with respect to the targeted validation goals:

1. Is the data collected of sufficient quality to meet the project objectives?
2. Is the data reliable?
3. What is the fate and transport of contaminant offsite?
4. What are the potential risks to human health and the environment?

6.3 Step 3: Identify the information inputs

Inputs to the decisions will be sourced from:

1. Review of historical surface water monitoring and sediment results
2. Physico-chemical properties collected for each of the 10 surface water sampling locations
3. Sampling of surface water and analysis for contaminants of concern
4. Analytical results for metal(loid)s for each of the 10 sampling locations (surface water and co-located sediment)
5. Quality Assurance / Quality Control data review
6. Comparison of the above samples to the site acceptance criteria outlined in **Section 5**.
7. All sample analyses conducted using National Association of Testing Authorities (NATA) registered methods in accordance with ANZECC (1996) and NEPC (1999) guidelines
8. All samples appropriately preserved and handled in accordance with the sampling methodology
9. PQLs less than the adopted assessment criteria

6.4 Step 4: Definition of the Study Boundary

The spatial boundaries are shown on **Figure 1** and include:

1. Three tributaries of the Mulwaree River, one located approximately 100 m west of the rail corridor at CH. 262.600, one adjacent to a culvert on the western side of the rail line at CH 262.600 and one adjacent a culvert on the eastern side of the rail line at CH 262.600.
2. Four locations adjacent to culverts, one western side of the rail line at CH 262.300, one on the eastern side of the rail line at CH 262.300, one on the western side of the rail line at CH 262.000 and one on the eastern side of the rail line at CH 262.000.
3. The dam located downgradient from the site northern rail culvert forming part Lot A DP 440822, and two locations along the Mulwaree River

The vertical boundaries are limited to surface waters and co-located sediment.

The temporal boundary includes historical surface water and sediment results as well as data collected under this SAQP comprising quarterly monitoring events over pre-remediation, remediation and post-remediation periods. Two post remediation surface water monitoring events will be included in the validation report.

Sediment sampling will be completed on one occasion.

6.5 Step 5: Develop the decision rules or analytical approach

The decisions rules for this investigation are as follows:

1. Has contaminant migration via surface water been adequately assessed?

2. Have contaminant impacts to surface water and sediment off site been adequately assessed?
3. Is the data reliable?
4. Does the data define clear presence / absence of unacceptable risk when assessed against Tier 1 criteria?
5. If Tier 1 assessment of risk is not clear, then does Tier 2 / Tier 3 risk assessment define absence of unacceptable risk?
6. Are there any remaining data gaps?

6.6 Step 6: Specify the performance or acceptance criteria

6.6.1 The tolerable limits on decision errors are as follows:

1. Probability that 95% of data will satisfy the DQIs, therefore a limit on decision error will be 5% that a conclusive statement may be incorrect:
 - 1.1. A 5% probability of a false negative (i.e. assessing that the average concentration of contaminants of concern are less than the assessment criteria when they are not); and
 - 1.2. A 5% probability of a false positive (i.e. assessing that the average concentration of contaminants of concern are more than the assessment criteria when they are not).

The potential for significant errors will be minimised by:

1. Completion of QA/QC measures of the investigation data to assess if the data satisfies the DQIs.
2. Assessment of whether appropriate sampling and analytical densities were completed for the purposes of the investigation.
3. Ensuring that the criteria set for the investigation were appropriate for the land use.

DQIs have been established to set acceptance limits on field and laboratory data collected as part of the investigation and are discussed further below.

6.6.2 Evaluation of Analytical Data

Acceptable limits and the manner of addressing possible decision errors for laboratory analysis associated with water quality monitoring and verification of imported materials are outlined below.

Accuracy: Accuracy is defined as the nearness of a result to the true value, where all random errors have been statistically removed. Internal accuracy is measured using percent recovery '%R' and external accuracy is measured using the Relative Percent Difference '%RPD'.

Internal accuracy will be tested utilising:

Surrogates	Surrogates are QC monitoring spikes, which are added to all field and QA/QC samples at the beginning of the sample extraction process in the laboratory, where applicable. Surrogates are closely related to the organic target analytes being measured, are to be spiked at similar concentrations, and are not normally found in the natural environment;
Laboratory control samples	An externally prepared and supplied reference material containing representative analytes under investigation. These will be undertaken at a frequency of one per analytical batch.
Matrix spikes	Field samples which are injected with a known concentration of contaminant and then tested to determine the potential for adsorption onto the matrix. These will be undertaken at a frequency of 5%.

Recovery data shall be categorised into one of the following control limits:

- 70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances.

External accuracy will be determined by the submission of inter-laboratory duplicates at a frequency of 5%. Data will be analysed in accordance with the following control limits:

- 70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances.

Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation.

Precision: The degree to which data generated from replicate or repetitive measurements differ from one another due to random errors. Precision is measured using the standard deviation 'SD' or Relative Percent Difference '%RPD'.

Internal precision will be determined by the undertaking of laboratory duplicates, where two sub samples from a submitted sample are analysed. These will be undertaken at a frequency of 10%. A RPD analysis is calculated and results compared to:

- 70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances.

Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation.

External precision will be determined by the submission of intra-laboratory duplicates at a frequency of 5%. The external duplicate samples are to be obtained by mixing and then splitting the primary sample to create two identical sub samples. Field duplicate samples are to be labelled with a unique identification that does not reveal the association between the primary and duplicate samples e.g., QA1.

It must be noted that significant variation in duplicate results is often observed (particularly for solid matrix samples) due to sample heterogeneity or concentrations reported near the Practical Quantification Limit (PQL).

A RPD analysis is calculated and results compared to:

- 70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances.

Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation.

Blank samples will be submitted with the analytical samples and analysed for the contaminants of concern. One field blank will be collected and analysed per matrix type for each batch samples/each day.

The laboratory will additionally undertake a method blank with each analytical batch of samples. Laboratory method blank analyses are to be below the PQLs. Results shall be examined, and any positive results shall be examined. Positive blank results may not be subtracted from sample results.

Positive results may be acceptable if sample analyte concentrations are significantly greater than the amount reported in the blank (ten times for laboratory reagents such as methylene chloride, chloroform, and acetone etc., and five times for all other analytes). Alternatively, the laboratory PQL may be raised to accommodate blank anomalies provided that regulatory guidelines are not compromised by any adjustment made to the PQL.

Completeness: The completeness of the data set shall be judged as:

1. The percentage of data retrieved from the field compared to the proposed scope of works. The acceptance criterion is 95%.
2. The percentage of data regarded as acceptable based on the above data quality objectives. 95% of the retrieved data must be reliable.
3. The reliability of data based on cumulative sub-standard performance of data quality objectives.
4. All PQLs are below adopted assessment criteria.

Where two or more data quality objectives indicate less reliability than what the acceptance criteria dictates, the data will be considered with uncertainty.

Representativeness: Sufficient samples must have been collected.

Samples must be collected and preserved in accordance with the sampling methodology proposed in Step 7 to ensure that the sample is representative of the assessed stratum.

Comparability: The data must show little to no inconsistencies with results and field observations and include likely associates e.g. TPH C6-C9 and BTEX.

Decision Error Protocol

If the data received is not in accordance with the defined acceptable limits outlined in Step 6, it may be considered to be an estimate or be rejected. Determination of whether this data may be used or if re-sampling is required will be based on the following considerations:

1. Closeness of the result to the guideline concentrations.
2. Specific contaminant of concern (e.g. response to carcinogens may be more conservative).
3. The area of site and the potential lateral and vertical extent of questionable information.
5. Whether the uncertainty can be effectively incorporated into site management controls.

6.7 Step 7: Develop a plan for obtaining data

The overall design of the sampling plan considers migration of surface water and sediment from the site. Further detail is provided in **Section 7**.

7. SAMPLING PLAN

The sampling plan for surface water quality will be based on quarterly monitoring events over pre-remediation, remediation and post-remediation periods. Two post remediation surface water monitoring events will be included in the validation report.

Sediment sampling at co-located surface water locations will be completed on one occasion.

Surface water sampling will target conditions upstream and downstream of three culverts which direct surface water beneath the rail formation onsite. Surface water at the site only occurs after rainfall and is received to the surrounding environment as follows:

1. Water passing through the northern culvert discharges to an adjacent agricultural property and during high rainfall events to a dam on the agricultural property.
2. Water passing through the middle culvert discharges across a causeway on Boyd Street to an adjacent vacant block.
3. Water passing through the southern culvert discharges beneath Goulburn Street to agricultural land in a tributary to the Mulwaree River (approximately 550m east of site)

Co-located surface water and sediment samples will be collected upstream and downstream of each culvert and in receiving water bodies as shown on **Figure 1**.

Surface water samples will be analysed for total and dissolved metals (Al, As, Ba, Be, Cd, Cr 3, Co, Cu, Fe, Pb, Mn, Hg, Ni, Zn). Sediment samples will be co-located with surface water monitoring locations and be analysed for total metals only (Al, As, Ba, Be, Cd, Cr 3, Co, Cu, Fe, Pb, Mn, Hg, Ni, Zn).

7.1.1 Surface Water Sampling Locations

The co-located surface water and sediment sampling locations are shown on **Figure 1, Appendix 1** and are summarised in **Table 7-1**.

Table 7-1 Surface Water Sampling Locations

Sample Designation Surface Water / Sediment	Location
SW1 – UP / SED1	Intended as an up-gradient sample, located on a western tributary of the Mulwaree River, approximately 100 m west of the rail corridor at CH. 262.600.
SW1 / SED1	Adjacent to a culvert on the western side of the rail line at CH 262.600 on tributary of Mulwaree River.
SW2 / SED2	Adjacent to a culvert on the eastern side of the rail line at CH 262.600 on tributary of Mulwaree River.
SW3 / SED3	Adjacent to a culvert on the western side of the rail line at CH 262.300.
SW4 / SED4	Adjacent to a culvert on the eastern side of the rail line at CH 262.300.
SW5 / SED5	Adjacent to a culvert on the western side of the rail line at CH 262.000.
SW6 / SED6	Adjacent to a culvert on the eastern side of the rail line at CH 262.000.
SW7 / SED7	A dam located downgradient from the site northern rail culvert forming part Lot A DP 440822
SW8 / SED8	Mulwaree River adjacent Lumley Road
SW9 / SED9	Mulwaree River off Braidwood Road

7.1.2 Water Quality Monitoring Performance Criteria

Surface water sampling will be completed in accordance with performance criteria defined in **Table 7-2**.

Table 7-2 Performance Criteria

Category	Validation Criteria
<p>Accuracy: Accuracy in the collection of field data will be controlled by:</p>	<ol style="list-style-type: none"> 1. Calibrated measurement equipment used. The water quality meter will be calibrated by the technical rental company prior to use. 2. Appropriate sampling methodologies utilised and complied with. Works to be completed with regard for AS NZS 5667.6-1998 Water quality - Sampling - Guidance on sampling of rivers and streams. 3. Collection of one intra-laboratory duplicate for surface water and one intra-laboratory duplicate for sediment. 4. Rinsate samples are not proposed to be collected due to surface water samples being collected directly into dedicated sampling containers (or field filtered using single use syringes and filters) using disposable nitrile gloves. Sediment samples will be collected using plastic tubing (bailers) cut down to act as disposable sediment core samplers.
<p>Precision: The degree to which data generated from replicate or repetitive measurements differ from one another due to random errors. Precision of field data will be maintained by:</p>	<ol style="list-style-type: none"> 1. A new pair of disposable nitrile gloves to handle each sample. 2. Samples will be placed immediately into laboratory supplied and appropriately preserved sampling vessels. 3. Samples will be stored in chilled, insulated containers with ice for transportation to the laboratory. 4. Sample numbers, preservation and analytical requirements will be recorded on chain of custody documents. 5. Samples will be transported to the laboratory under chain of custody conditions.
<p>Completeness: The completeness of the data set shall be judged by:</p>	<ol style="list-style-type: none"> 1. All locations sampled as outlined in Sections 7.1.1 and Figure 1, Appendix 1. 2. Sampling completed by experienced personnel. 3. Field documentation completed correctly.
<p>Representativeness: The representativeness of the field data will be judged by:</p>	<ol style="list-style-type: none"> 1. Non-disposable sampling equipment, such as the grab sampler and water quality meter, will be thoroughly decontaminated between locations using Decon 90 solution and deionised rinsate water. 2. At each location, a pair of disposable nitrile gloves will be worn while sampling and handling the sample; gloves will be replaced between each successive sample. 3. Surface water analytical samples will be collected directly into the sampling vessels using an extendable pole sampler where appropriate.
<p>Comparability: Comparability to existing field data will be maintained by:</p>	<ol style="list-style-type: none"> 1. Use of the same appropriate sampling methodologies. 2. Same sampling depths for surface water (where practical). 3. Field water quality parameters will be obtained using a calibrated water quality meter and recorded on a field sheet, comprising pH, temperature, total dissolved solids (TDS), dissolved oxygen (DO), redox potential and electrical conductivity (EC). 4. Samples for dissolved metal analysis will be collected in dedicated disposable 50 mL plastic syringes and field filtered through 0.45 µm filters directly into a sample bottle containing acid preservative. 5. Visual and olfactory observations will also be recorded on the field sheet. 6. Photographs will be taken of sampling location conditions at the time of sampling.

8. REPORTING

8.1 Surface Water Monitoring Report

Following the cessation of surface water sampling, a report will be prepared documenting the completed sampling, trend analysis, quality assurance / quality control and laboratory reports.

The report shall include the following:

1. Executive summary
2. Introduction
3. Objectives and scope of work
4. Summary of completed field sampling and laboratory analysis
5. QA/QC review
6. Mann-Kendall trend analysis
7. Conclusions

8.2 Sediment Reporting

Following sediment sampling a detailed site investigation report will be prepared in general accordance with the National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPC 2013) and Consultants reporting on contaminated sites - Contaminated Land Guidelines (NSW EPA 2020). The report will include:

1. Summary review of previous investigations, preliminary CSM and SAQP as presented here-in
2. Assessment of data against site specific human health and Tier 1 ecological criteria
3. Development of a revised CSM
4. Summary assessment of the degree and extent of remediation (if required)
5. Conclusions.

9. REFERENCES

Australian Government National Health and Medical Research Council (2008) Guidelines for Managing Risks in Recreational Water

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) (available at www.waterquality.gov.au/anz-guidelines)

Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) 2000 Australian New Zealand Guidelines for Fresh and Marine Water Quality

Department of Environment and Conservation (DEC) Guidelines for the Assessment and Management of Groundwater Contamination (DEC, 2007).

NEPM 2013. *National Environment Protection Council (NEPC), National Environment Protection (Assessment of Site Contamination) Measure 1999*, as amended 2013.

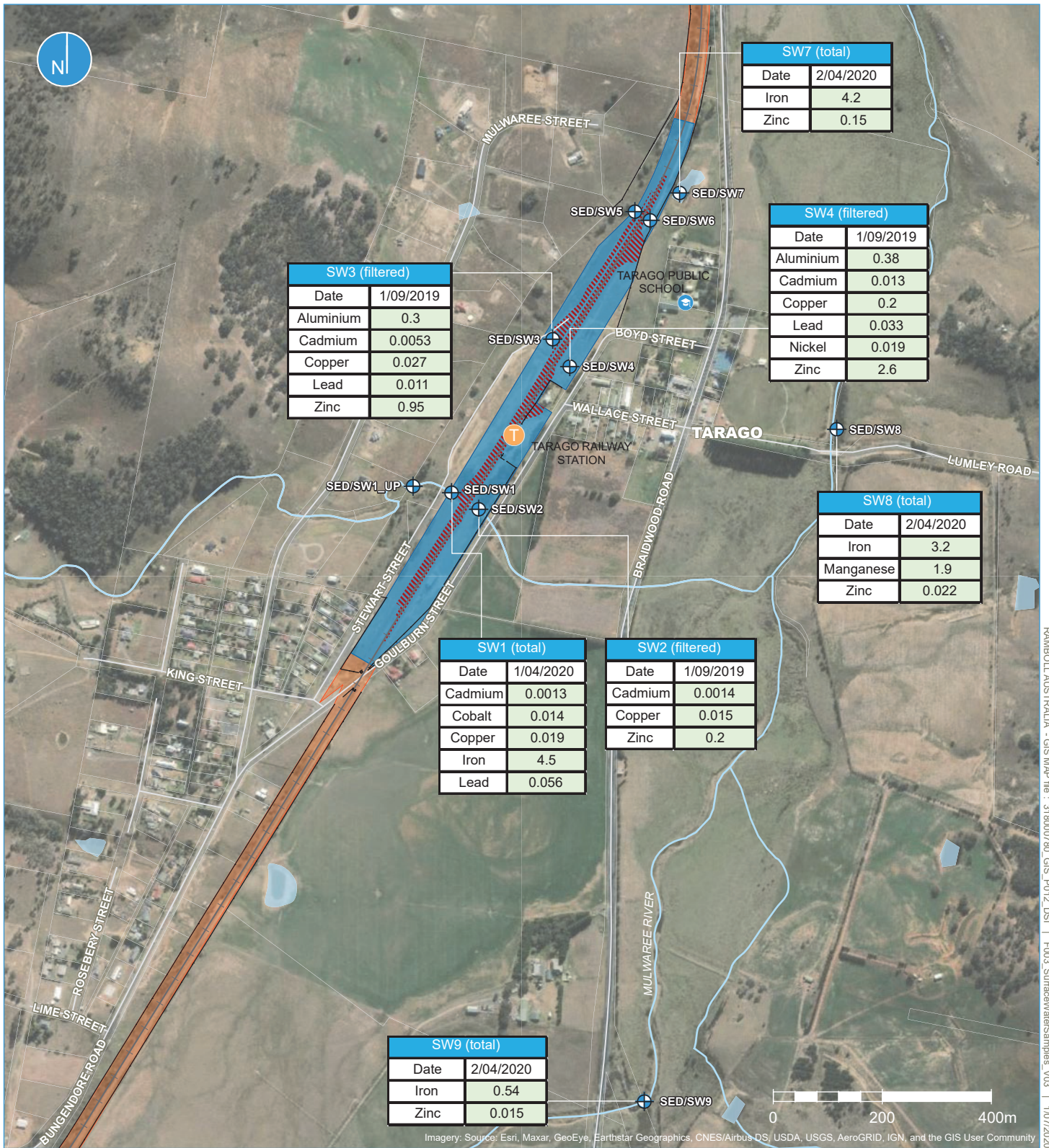
NSW EPA 1995. *Sampling Design Guidelines*.

NSW EPA 2017. *Guidelines for the NSW Site Auditor Scheme (3rd Edition)*.

NSW OEH 2011. *Guidelines for Consultants Reporting on Contaminated Sites*.

APPENDIX 1

FIGURES



Legend

- Surface water and sediment sampling locations (co-located)
- Rail corridor
- Rail corridor fence
- Area of lead exceedance (within rail corridor)

Exceedances (surface water)

Contaminant (mg/L)	> ANZG 2018 Freshwater Ecosystems
Aluminium	0.055
Cadmium	0.0002
Cobalt	0.09
Copper	0.0014
Iron	0.3
Lead	0.0034
Manganese	1.9
Nickel	0.011
Zinc	0.008



Figure 1 | Surface water and sediment sampling locations