Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
QC01A	**08-Dec-2021**	**----**	----	----	**19-Dec-2021**	22-Dec-2021	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
QC01A	**08-Dec-2021**	**----**	----	----	**15-Dec-2021**	05-Jan-2022	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
QC01A	**08-Dec-2021**	**----**	----	----	**20-Dec-2021**	06-Jun-2022	✓
EG051G: Ferrous Iron by Discrete Analyser							
Clear Plastic Bottle - HCl (EG051G)							
QC01A	**08-Dec-2021**	**----**	----	----	**16-Dec-2021**	09-Dec-2021	×
EP033: C1 - C4 Hydrocarbon Gases							
Amber VOC Vial - Sulfuric Acid (EP033)							
QC01A	**08-Dec-2021**	**----**	----	----	**15-Dec-2021**	22-Dec-2021	✓
EP075(SIM)A: Phenolic Compounds							
Amber Glass Bottle - Unpreserved (EP075(SIM))							
QC01A	**08-Dec-2021**	**16-Dec-2021**	15-Dec-2021	×	**18-Dec-2021**	25-Jan-2022	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM))							
QC01A	**08-Dec-2021**	**16-Dec-2021**	15-Dec-2021	×	**18-Dec-2021**	25-Jan-2022	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071)							
QC01A	**08-Dec-2021**	**16-Dec-2021**	15-Dec-2021	×	**18-Dec-2021**	25-Jan-2022	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
QC01A	**08-Dec-2021**	**21-Dec-2021**	22-Dec-2021	✓	**21-Dec-2021**	22-Dec-2021	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071)							
QC01A	**08-Dec-2021**	**16-Dec-2021**	15-Dec-2021	×	**18-Dec-2021**	25-Jan-2022	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
QC01A	**08-Dec-2021**	**21-Dec-2021**	22-Dec-2021	✓	**21-Dec-2021**	22-Dec-2021	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080)							
QC01A	**08-Dec-2021**	**21-Dec-2021**	22-Dec-2021	✓	**21-Dec-2021**	22-Dec-2021	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
C1 - C4 Gases	EP033	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	1	**200.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	14	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	16	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
C1 - C4 Gases	EP033	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
C1 - C4 Gases	EP033	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
C1 - C4 Gases	EP033	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	14	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	16	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Ferrous Iron by Discrete Analyser	EG051G	WATER	In house: Referenced to APHA 3500 Fe-B. A colorimetric determination based on the reaction between phenanthroline and ferrous iron at pH 3.2-3.3 to form an orange-red complex that is measured against a five-point calibration curve. This method is compliant with NEPM Schedule B(3).
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM Schedule B(3)
C1 - C4 Gases	EP033	WATER	Technical Guidance for the Natural Attenuation Indicators: Methane, Ethane, and Ethene, US EPA - Region 1, EPA New England, July 2001. Automated static headspace, dual column GC/FID. A 12 mL sample is pipetted into a 20 mL headspace vial containing 3g of sodium chloride and sealed. Each sample is equilibrated with shaking at 40 degrees C for 10 minutes prior to analysis by GC/FID using a pair of PLOT columns of different polarity.
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015 The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions

Preparation Methods	Method	Matrix	Method Descriptions
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for purging.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2144789**	Page	: 1 of 6
Client	: **GREENCAP-NAA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR DYLAN BYFORD	Contact	: Peter Ravlic
Address	: 11/14 Winnellie Road WINNELLIE NT, AUSTRALIA 0820	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 08 8299 9955	Telephone	: +6138549 9645
Project	: J168829 ORA Diesel Spill	Date Samples Received	: 14-Dec-2021 07:00
Order number	: ----	Date Analysis Commenced	: 15-Dec-2021
C-O-C number	: ----	Issue Date	: 22-Dec-2021 14:18
Sampler	: VARUN BHAGWAT		
Site	: Berrimah Freight Terminal		
Quote number	: EN/333 - secondary work only		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP075 (SIM): Where reported, Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	QC01A	----	----	----	----
				Sampling date / time	08-Dec-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2144789-001	--------	--------	--------	--------
					Result	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		52	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		52	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		2470	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Manganese	7439-96-5	0.001	mg/L		1.39	----	----	----	----
EG051G: Ferrous Iron by Discrete Analyser									
Ferrous Iron	----	0.05	mg/L		21.0	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		0.29	----	----	----	----
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	10	µg/L		<10	----	----	----	----
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		<1.0	----	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	----	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	----	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	----	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	----	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	----	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	----	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L		<1.0	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	----	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L		<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L		<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L		<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L		<1.0	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	QC01A	----	----	----	----
				Sampling date / time	08-Dec-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2144789-001	--------	--------	--------	--------
					Result	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Fluoranthene	206-44-0	1.0	µg/L		<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L		<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L		<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L		<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L		<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L		<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L		<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L		<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L		<1.0	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L		<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L		<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	----	----	----	----
>C10 - C16 Fraction	----	100	µg/L		<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	----	----	----	----
Toluene	108-88-3	2	µg/L		<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	----	----	----	----
^ Total Xylenes	----	2	µg/L		<2	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	QC01A	----	----	----	----
				Sampling date / time	08-Dec-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2144789-001	--------	--------	--------	--------
					Result	----	----	----	----
EP080: BTEXN - Continued									
^ **Sum of BTEX**	----	1	µg/L		<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1.0	%		**28.6**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%		**55.9**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%		**43.2**	----	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1.0	%		**68.8**	----	----	----	----
Anthracene-d10	1719-06-8	1.0	%		**97.2**	----	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%		**89.4**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**110**	----	----	----	----
Toluene-D8	2037-26-5	2	%		**116**	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%		**113**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

ntepa Northern Territory Environment Protection Authority

ENVIRONMENT PROTECTION LICENCE

(Pursuant to section 34 of the *Waste Management and Pollution Control Act*)

Licensee	Aurizon Bulk Central
Licence Number	**EPL222 - 02**
Registered Business Address	Aurizon Bulk Central Lvl 4 / 33 Richmond Road Keswick SA 5035
ACN	079 444 296
ABN	17 079 444 296
Anniversary Date:	27 March
Commencement Date:	27/03/2024
Expiry Date:	26/03/2034
Scheduled Activity	Collecting, transporting, storing, re-cycling, treating or disposing of a **listed waste** (as per Table 1) on a commercial or fee for service basis, other than in or for the purpose of a sewage treatment plant.
Description	Aurizon Bulk Central provides a rail service to the freight forwarding and transportation industry. Aurizon Bulk Central receives customer owned, sealed, lockable containers from consigners and transports them via rail between terminals in South Australia and the Northern Territory.

Table 1 - Listed Wastes Authorised to be Handled

Listed Waste	Collection	Transport	Storage	Treatment	Recycling	Disposal
Acidic solutions or acids in solid form	✗	✓	✗	✗	✗	✗
Animal effluent and residues	✗	✓	✗	✗	✗	✗
Antimony, antimony compounds	✗	✓	✗	✗	✗	✗
Arsenic, arsenic compounds	✗	✓	✗	✗	✗	✗
Asbestos	✗	✓	✗	✗	✗	✗
Barium compounds other than barium sulphate	✗	✓	✗	✗	✗	✗
Basic solutions or bases in solid form	✗	✓	✗	✗	✗	✗
Beryllium, beryllium compounds	✗	✓	✗	✗	✗	✗
Boron compounds	✗	✓	✗	✗	✗	✗
Cadmium, cadmium compounds	✗	✓	✗	✗	✗	✗
Ceramic-based fibres with physio-chemical characteristics similar to those of asbestos	✗	✓	✗	✗	✗	✗
Chlorates	✗	✓	✗	✗	✗	✗
Chromium compounds that are hexavalent or trivalent	✗	✓	✗	✗	✗	✗
Clinical and related wastes	✗	✓	✗	✗	✗	✗
Cobalt compounds	✗	✓	✗	✗	✗	✗
Containers that are contaminated with residues of a listed waste	✗	✓	✗	✗	✗	✗
Copper compounds	✗	✓	✗	✗	✗	✗
Cyanides (inorganic)	✗	✓	✗	✗	✗	✗
Encapsulated, chemically fixed, solidified or polymerised wastes	✗	✓	✗	✗	✗	✗
Ethers	✗	✓	✗	✗	✗	✗
Filter cake	✗	✓	✗	✗	✗	✗

Listed Waste	Collection	Transport	Storage	Treatment	Recycling	Disposal
Fire debris and fire washwaters	✗	✓	✗	✗	✗	✗
Fly ash	✗	✓	✗	✗	✗	✗
Grease trap waste	✗	✓	✗	✗	✗	✗
Halogenated organic solvents	✗	✓	✗	✗	✗	✗
Highly odorous organic chemicals (including mercaptans and acrylates)	✗	✓	✗	✗	✗	✗
Inorganic fluorine compounds excluding calcium fluoride	✗	✓	✗	✗	✗	✗
Inorganic sulfides	✗	✓	✗	✗	✗	✗
Isocyanate compounds	✗	✓	✗	✗	✗	✗
Lead, lead compounds	✗	✓	✗	✗	✗	✗
Mercury, mercury compounds	✗	✓	✗	✗	✗	✗
Metal carbonyls	✗	✓	✗	✗	✗	✗
Nickel compounds	✗	✓	✗	✗	✗	✗
Non-toxic salts	✗	✓	✗	✗	✗	✗
Organic phosphorus compounds	✗	✓	✗	✗	✗	✗
Organic solvents excluding halogenated solvents	✗	✓	✗	✗	✗	✗
Organohalogen compounds that are not otherwise specified in this Schedule	✗	✓	✗	✗	✗	✗
Perchlorates	✗	✓	✗	✗	✗	✗
Phenols, phenol compounds including chlorophenols	✗	✓	✗	✗	✗	✗
Phosphorus compounds other than mineral phosphates	✗	✓	✗	✗	✗	✗
Polychlorinated dibenzo-furan (any congener)	✗	✓	✗	✗	✗	✗
Polychlorinated dibenzo-p-dioxin (any congener)	✗	✓	✗	✗	✗	✗
Residue from industrial waste treatment or disposal operations	✗	✓	✗	✗	✗	✗

Listed Waste	Collection	Transport	Storage	Treatment	Recycling	Disposal
Selenium, selenium compounds	✗	✓	✗	✗	✗	✗
Sewage sludge and residues including nightsoil and septic tank sludge	✗	✓	✗	✗	✗	✗
Soils contaminated with a listed waste	✗	✓	✗	✗	✗	✗
Surface active agents (surfactants) that contain principally organic constituents and that may contain metals and inorganic materials	✗	✓	✗	✗	✗	✗
Tannery wastes (including leather dust, ash sludges and flours)	✗	✓	✗	✗	✗	✗
Tellurium, tellurium compounds	✗	✓	✗	✗	✗	✗
Thalium, thallium compounds	✗	✓	✗	✗	✗	✗
Triethylamine catalysts for setting foundry sands	✗	✓	✗	✗	✗	✗
Tyres	✗	✓	✗	✗	✗	✗
Vanadium compounds	✗	✓	✗	✗	✗	✗
Waste chemical substances arising from R&D or teaching activities where the effects on human health and/or the environment are not known	✗	✓	✗	✗	✗	✗
Wastes containing peroxides other than hydrogen peroxide	✗	✓	✗	✗	✗	✗
Waste containing cyanides from heat treatment and tempering operations	✗	✓	✗	✗	✗	✗
Waste from the manufacture, formulation and use of wood preserving chemicals	✗	✓	✗	✗	✗	✗
Waste from the production, formulation and use of biocides and phytopharmaceuticals	✗	✓	✗	✗	✗	✗
Waste from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish	✗	✓	✗	✗	✗	✗
Waste from the production, formulation and use of organic solvents	✗	✓	✗	✗	✗	✗
Waste from the production, formulation and use of photographic chemicals and processing materials	✗	✓	✗	✗	✗	✗
Waste from the production, formulation and use of resins, latex, plasticisers, glues and adhesives	✗	✓	✗	✗	✗	✗
Waste from the production and preparation of pharmaceutical products	✗	✓	✗	✗	✗	✗

Listed Waste	Collection	Transport	Storage	Treatment	Recycling	Disposal
Waste mineral oils unfit for their original intended use	✗	✓	✗	✗	✗	✗
Waste mixtures, or waste emulsions, of oil and water or hydrocarbon and water	✗	✓	✗	✗	✗	✗
Waste pharmaceuticals, waste drugs and waste medicines	✗	✓	✗	✗	✗	✗
Waste resulting from surface treatment of metals and plastics	✗	✓	✗	✗	✗	✗
Waste tarry residues arising from refining, distillation and any pyrolytic treatment	✗	✓	✗	✗	✗	✗
Waste substances and articles containing or contaminated with PCBs, PCNs, PCTs and/or PBBs	✗	✓	✗	✗	✗	✗
Waste of an explosive nature not subject to the Dangerous Goods Act	✗	✓	✗	✗	✗	✗
Wool scouring waste	✗	✓	✗	✗	✗	✗
Zinc compounds	✗	✓	✗	✗	✗	✗

✓ Activity authorised by this licence

✗ Activity not authorised by this licence

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ATTACHMENTS

There are no attachments

INFORMATION ABOUT THIS LICENCE

- This licence does not in any way relieve the licence holder from its obligations to comply with the WMPC Act, including the general environmental duty in section 12 of the WMPC Act and the duty to notify of incidents causing or threatening to cause pollution under section 14 of the WMPC Act.

Duration of a licence (section 40, 43 and 45 of the WMPC Act)

- A licence will remain in force until its expiry date or until it is surrendered by the licensee or is suspended or cancelled in accordance with the WMPC Act.
- The licensee must notify the Northern Territory Environment Protection Authority (NT EPA) within 14 days after ceasing to conduct the activity.
- The licensee may, with the approval of the NT EPA, surrender the licence to the NT EPA.

Amendment or Revocation of a licence (section 37 of the WMPC Act)

- The licensee may apply to amend or revoke a condition of this licence.
- A fee applies and the application must be made using the designated form via NT EPA Online.
- The NT EPA may also amend or revoke a condition of this licence as set out in section 38 of the WMPC Act.

Transfer of a licence (section 46 of the WMPC Act)

- The licensee can apply to transfer their licence to another person.

Renewal of a licence (section 40 of the WMPC Act and section 3 of the Regulations)

- The licensee may apply for the renewal of their licence not earlier than 90 days, and not later than 30 days, before their licence expires.
- A fee applies and the application must be made via NT EPA Online.

Public Register

- A copy of environment protection licences and any plans for environmental management, reports, submissions or documents required as a condition of an environment protection licence, will be placed on a register in accordance with section 9 of the WMPC Act.
- A copy of the Annual Return will be placed on the register.
- The NT EPA makes this register freely available from the NT EPA website.

Environment Protection Objectives (Part 4 of the WMPC Act), and Water Quality Standards (section 73 of the *Water Act 1992*)

- An Environment Protection Objective (EPO) is a statutory instrument to establish principles on which:
  a. environmental quality is to be maintained, enhanced, managed or protected;
  b. pollution, or environmental harm resulting from pollution, is to be assessed, prevented, reduced, controlled, rectified or cleaned up; and
  c. effective waste management is to be implemented or evaluated.
- In accordance with section 18 of the WMPC Act a beneficial use, quality standard, criteria or objective declared under section 73 of the *Water Act 1992* and in force is an environment protection objective for the purposes of the WMPC Act.

- The following EPOs and Beneficial Use Declarations (BUDs) are relevant to this licence:
    - Declaration of Beneficial Uses and Objectives Darwin Harbour Region
        - Surface water: Aquaculture, environment, cultural, rural stock and domestic.
    - BUD's in which the waste transport vehicles are operating. Refer to Beneficial use declarations on the NTG website.

Environmental Interests

- This section highlights sensitivity of the surrounding land use and environment associated with the location of the approved activity.

- Sites of Conservation Significance
    - Darwin Harbour SOC 6
    - The transport activity will occur across the Northern Territory and multiple SOC's will be relevant. Refer to Sites of conservation significance list on the NTG website.

Cultural Interests

- It is the licensee's responsibility to contact the Aboriginal Areas Protection Authority, appropriate land council or other governing body and ensure that any Authority Certificates required as a result of conducting the licenced activity are obtained and complied with.

RULES FOR INTERPRETING THE CONDITIONS OF THIS LICENCE

- Where there is a discrepancy between the conditions of this licence and any plan, standard, guideline or other document referred to in this licence, the conditions of this licence prevail to the extent of the inconsistency.
- Any reference to any standard (Australian or international) in this licence means the relevant parts of the current version of that standard.
- A reference to any guideline or code of practice (or to the relevant parts of any guideline or code of practice) in this licence means the current version of the guideline or code of practice.
- Under section 39 of the WMPC Act, any contravention of or failure to comply with this licence by the licensee may be an offence.
- In determining whether the licensee has committed an offence, the licensee may be liable for the conduct of its directors, employees or agents.
- The licensee should ensure that each of its directors, employees, contractors or agents are aware of, and comply with, this licence.
- In this licence, unless the contrary intention appears, words that are defined in the WMPC Act are intended to have the meaning given to them in that Act.

LICENCE CONDITIONS

GENERAL

1 The licensee must ensure the contact details recorded in NT EPA Online for this licence are correct at all times.

2 The licensee must at all times have a 24 hour emergency contact.

3 The licensee must pay via NT EPA Online the annual fee calculated in accordance with the method prescribed in the Regulations within 10 business days of the anniversary date of this licence, for each year or part of a year that this licence is in force.

4 The licensee must provide to the NT EPA, within 10 business days of a request, a copy of any document, monitoring data or other information in relation to the activity, in the format requested by the NT EPA.

5 All notices, reports, documents or other correspondence required to be provided as a condition of this licence, unless otherwise specified as a condition of this licence, must be provided in electronic form by uploading the document via NT EPA Online (or by emailing environmentalregulation@nt.gov.au).

6 The licensee must implement, maintain and follow the documents listed in Table 2:

Table 2. Documents Relevant to Licensed Activity

Version	Document Title
17 January 2024	Pollution Incident Response Management Plan – Aurizon Bulk Central
12 February 2024	Aurizon Bulk Central Environmental Management Plan - Tarcoola to Darwin Network
22 August 2023	Environmental Aspects and Impacts Register - Tarcoola to Darwin Railway Corridor

7 Within 10 business days of any amendment being made to a document listed in Table 2 the licensee must provide the amended document to the NT EPA, along with:

7.1 a tabulated summary of the amendment(s) with document references;

7.2 reasons for the amendment(s); and

7.3 an assessment of environmental risk associated with the amendment(s).

8 The NT EPA may require the licensee to revise or amend and resubmit any amended document. Where the NT EPA requires a document to be resubmitted, the licensee must submit it to the NT EPA by the date specified by the NT EPA.

9 The licensee must implement, maintain and follow an Emergency Response Plan that addresses procedures for responding to emergencies associated with the activity that may cause environmental harm.

EARLY SURRENDER OF LICENCE

10 Any reports, records or other information required or able to be provided by the licensee under this licence must be submitted to the NT EPA prior to the licensee surrendering the licence. If the date on which a report, record or other information is required falls after the date the licensee requests to surrender this licence, the licensee must provide the report, record or information as far as possible

using data available to the licensee up to and including the date the request to surrender the licence is made.

OPERATIONAL

11 The licensee must not collect, transport, store, recycle, treat or dispose of listed waste other than the listed waste specified in Table 1.

12 The licensee must ensure any plant and equipment used by the licensee in conducting the activity:

12.1 is reasonably fit for the purpose and use to which it is put;

12.2 is maintained;

12.3 is operated by a person trained to use the plant and equipment; and

12.4 is operated by, or operated by a person accompanied by, a person trained to handle, store or dispose of listed waste in connection with the activity.

13 The licensee must cause to be carried with the vehicle used to transport listed waste:

13.1 a legible copy of this licence;

13.2 a legible manifest of the load being carried;

13.3 for interstate transport, a waste transport certificate.

14 The licensee must cause listed waste to be transported in a manner that ensures listed wastes do not escape, spill or leak from the transport vehicle at any time.

15 The licensee must ensure that wastewater generated from washing plant and equipment associated with the activity does not cause pollution.

16 The licensee must only handle asbestos containing material which is packed and contained in accordance with Section 4.8 of the NT Worksafe and Safe Work Australia How to Safely Remove Asbestos Code of Practice.

17 The licensee must ensure that all listed waste is delivered to a premises licenced under section 30 of the WMPC Act to receive that listed waste.

18 The licensee must comply with the National Environment Protection (Movement of Controlled Wastes between States and Territories) Measure.

DISCHARGES AND EMISSIONS

19 The licensee must not allow a contaminant or waste, which causes or may cause environmental harm, to enter water.

20 The licensee must ensure that stormwater does not come into contact with a contaminant or waste, which causes or may cause environmental harm.

21 The licensee must ensure there is no loss of containment or overflow of a contaminant or waste, which causes or may cause environmental harm, while conducting the activity. (For the avoidance of doubt, this condition is not intended to authorise the discharge of a contaminant or waste to any land or water which discharge has not been specifically authorised by another condition of this licence.)

RECORDING AND REPORTING

22 The licensee must keep and maintain records relating to the activity undertaken and the listed waste handled by the licensee in each successive 12 month period following the commencement of this licence, which include:

22.1 the date of collection;

22.2 the source of the listed waste;

22.3 the name of the transport company, if not the licensee;

22.4 the vehicle registration;

22.5 a description of the listed waste;

22.6 the quantity of the listed waste;

22.7 the final destination of the listed waste; and

22.8 whether the listed waste was stored, recycled, treated or disposed of.

23 The licensee must retain records relating to waste, including listed waste, as required by the conditions of this licence, for a period of 2 years after the end of the 12 month period to which the record relates.

24 The licensee must keep records of all non-compliances with this licence. These records must be adequate to enable the licensee to comply with the non-compliance notification conditions of this licence.

25 The licensee must notify the NT EPA of any non-compliance with this licence by completing the Non-Compliance Notification via NT EPA Online (or by emailing environmentalregulation@nt.gov.au), as soon as practicable after (and in any case within 24 hours after) first becoming aware of the non-compliance.

26 The licensee must include in the notification of non-compliance the following information:

26.1 when the non-compliance was detected and by whom;

26.2 the date and time of the non-compliance;

26.3 the actual and potential causes and contributing factors to the non-compliance;

26.4 the risk of environmental harm arising from the non-compliance;

26.5 the action(s) that have or will be undertaken to mitigate any environmental harm arising from the non-compliance;

26.6 corrective actions that have or will be undertaken to ensure the non-compliance does not reoccur;

26.7 if no action was taken, why no action was taken; and

26.8 a date when an incident investigation report will be submitted to the NT EPA.

27 The licensee must submit a completed Annual Return form to environmentalregulation@nt.gov.au within 10 business days after each anniversary date of this licence, which relates to the preceding 12 month period.

END OF LICENCE CONDITIONS

This licence is not valid unless signed below:

Ben McTavish
A/Director Environmental Operations
Delegate of the Northern Territory
Environment Protection Authority
Dated: 19/04/2024

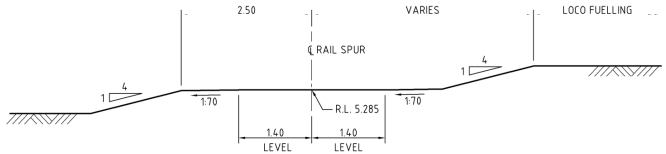
DEFINITIONS

All terms in the Licence which are defined in the *Waste Management and Pollution Control Act* have the meaning given in that Act unless otherwise or further defined in this section.

DEFINITION	In this licence, unless a contrary intention appears:
24 hour emergency contact	the phone number of a person who can be contacted at any time and be capable of responding to and providing information about any incident associated with the activity.
Activity	the Scheduled activity as described on the covering page of this licence.
Air	includes any layer of the atmosphere.
Annual Return	an NT EPA prescribed format for demonstrating and reporting compliance with the conditions of this licence and providing information on waste volumes for the preceding 12 month period.
Contaminant	a solid, liquid or gas or any combination of such substances and includes: (a) noise, odour, heat and electromagnetic radiation; (b) a prescribed substance or prescribed class of substances; and (c) a substance having a prescribed property or prescribed class of properties.
Discharges	allow a liquid, gas or other substance to flow out from where it has been confined.
Environmental harm	(a) any harm to or adverse effect on the environment; or (b) any potential harm (including the risk of harm and future harm) to or potential adverse effect on the environment, of any degree or duration and includes environmental nuisance.
Environmental nuisance	means: (a) an adverse effect on the amenity of an area that: (i) is caused by noise, smoke, dust, fumes or odour; and (ii) unreasonably interferes with or is likely to unreasonably interfere with the enjoyment of the area by persons who occupy a place within the area or are otherwise lawfully in the area; or (b) an unsightly or offensive condition caused by contaminants or waste.
Listed waste	a waste included under Schedule 2 of the Regulations.
Non-compliance notification	an NT EPA prescribed format for notifying the NT EPA of a non-compliance.
NT EPA Online	online system for Environment Protection Licence (EPL), Environment Protection Approval (EPA) and Waste Discharge Licence (WDL) lodgement and maintenance.
Regulations	*Waste Management and Pollution Control (Administration) Regulations*.
Waste transport certificate	the NT EPA waste tracking documentation used to track listed waste being transported interstate as required in accordance with the National Environment Protection (Movement of Controlled Waste Between States and Territories) Measure.
Wastewater	water that contains a contaminant or waste.
Water	includes: (a) surface water, ground water and tidal waters;

(b) coastal waters of the Territory, within the meaning of the *Coastal Waters (Northern Territory Powers) Act 1980* of the Commonwealth; and
(c) water containing an impurity.

WMPC Act	the Northern Territory *Waste Management and Pollution Control Act 1998*.



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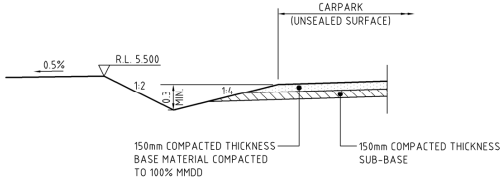

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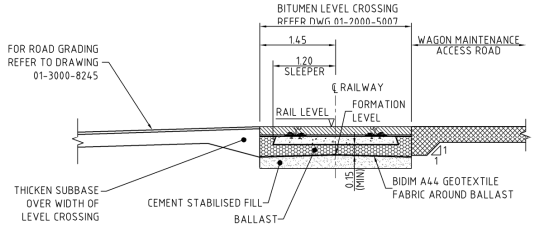

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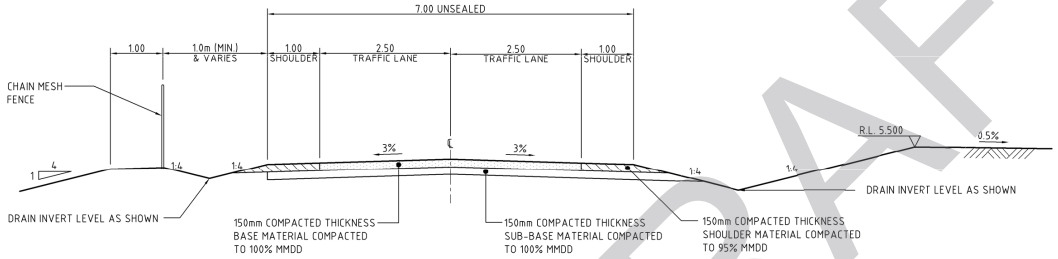

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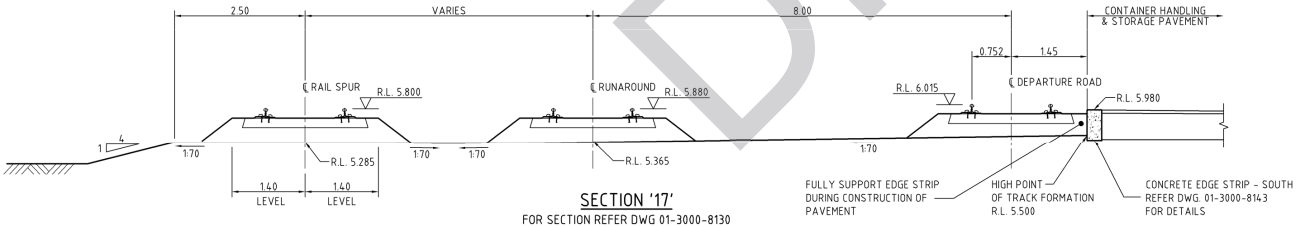

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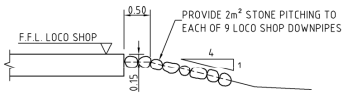

SECTION '24'
FOR LOCATION REFER DWG 01-3000-8129
SCALE 1:50

NOTE: FOR COMPLETE INFORMATION THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH PROJECT QUALITY ASSURANCE AND CONSTRUCTION RECORDS

AB

NOTES
1. TO BE READ IN CONJUNCTION WITH DWG. Nos. 01-3000-8143 & 8145.

FINAL DESIGN DOCUMENTATION

A1	
CAD FILE	01-3000-8156.DWG
REFERENCE FILES	
PLOT SCALE	1:1 AT A1
SCALES USED	AS INDICATED

100 MILLIMETRES ON ORIGINAL DRAWING

CODE	DATE	DESCRIPTION	DA	PA
AB	08.09.03	FINAL DESIGN DOCUMENTATION	CWD	CWD
3	08.02.03	SECTION 17 UPDATED, SECTION 25 DELETED AND SECTION 26 AMENDED	CWD	CWD
2	23.01.03	APPROVED FOR CONSTRUCTION	CWD	CWD
1	13.12.02	SECTION DETAILS AMENDED, SECTION 26 ADDED, ADRAIL APPROVED FOR SUBMISSION TO PRINCIPAL	C.W.D.	C.W.D.
0	12.11.02	ADRAIL APPROVED FOR AUTHORITY APPROVAL	C.W.D.	C.W.D.
A	07.08.02	ISSUED FOR COMMENT		

REVISIONS AND ISSUES

DESIGNER	R.S.W.	DATE 12.11.02
DRAFTER	M.J.V.	JUNE 02
DESIGN CHECKER	C.W.D.	12.11.02
DRAFTING CHECKER	G.S.C.	12.11.02
DESIGN APPROVAL	C.W.D.	DATE 12.11.02
QUALITY CHECK	G.H.	12.11.02
PROJECT APPROVAL	C.W.D.	12.11.02
PRINCIPAL APPROVAL	APTC	15.01.03

ADrail

- Brown & Root Construction Pty Ltd ABN 84 094 542 533
- Barclay Mowlem Construction Limited ABN 36 009 830 460
- Macmahon Contractors Pty Ltd ABN 37 007 611 485
- John Holland Pty Ltd ABN 11 004 282 268

ALICE SPRINGS - DARWIN RAILWAY PROJECT

BERRIMAH FREIGHT TERMINAL
TYPICAL SECTIONS
SHEET 3 OF 3

DRAWING NUMBER: 01-3000-8156

REVISION CODE: AB

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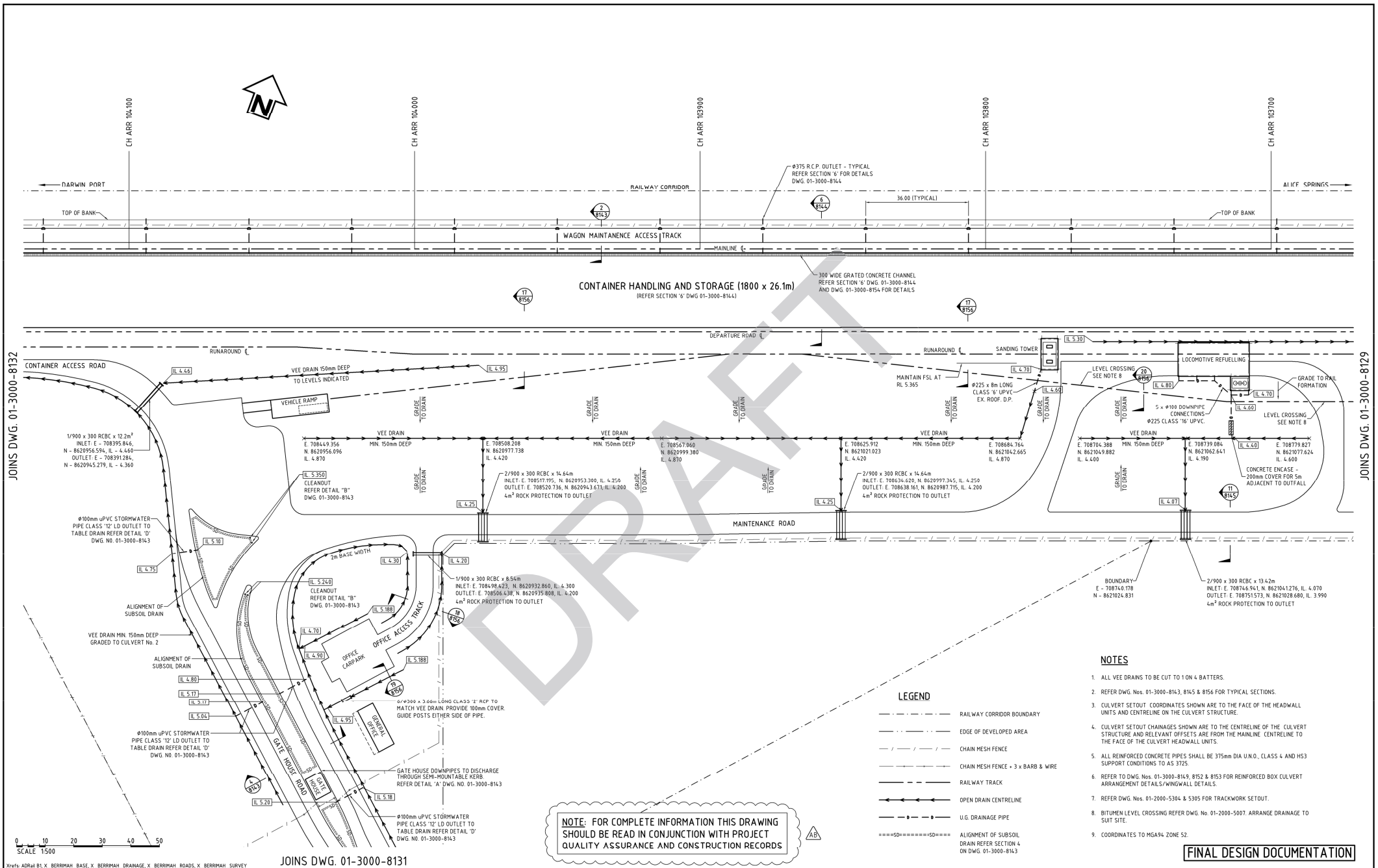

NOTE: FOR COMPLETE INFORMATION THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH PROJECT QUALITY ASSURANCE AND CONSTRUCTION RECORDS

LEGEND

- RAILWAY CORRIDOR BOUNDARY
- EDGE OF DEVELOPED AREA
- CHAIN MESH FENCE
- CHAIN MESH FENCE + 3 x BARB & WIRE
- RAILWAY TRACK
- OPEN DRAIN CENTRELINE
- U.G. DRAINAGE PIPE
- ALIGNMENT OF SUBSOIL DRAIN REFER SECTION 4 ON DWG. 01-3000-8143

NOTES

1. ALL VEE DRAINS TO BE CUT TO 1 ON 4 BATTERS.
2. REFER DWG. Nos. 01-3000-8143, 8145 & 8156 FOR TYPICAL SECTIONS.
3. CULVERT SETOUT COORDINATES SHOWN ARE TO THE FACE OF THE HEADWALL UNITS AND CENTRELINE ON THE CULVERT STRUCTURE.
4. CULVERT SETOUT CHAINAGES SHOWN ARE TO THE CENTRELINE OF THE CULVERT STRUCTURE AND RELEVANT OFFSETS ARE FROM THE MAINLINE CENTRELINE TO THE FACE OF THE CULVERT HEADWALL UNITS.
5. ALL REINFORCED CONCRETE PIPES SHALL BE 375mm DIA U.N.O., CLASS 4 AND HS3 SUPPORT CONDITIONS TO AS 3725.
6. REFER TO DWG. Nos. 01-3000-8149, 8152 & 8153 FOR REINFORCED BOX CULVERT ARRANGEMENT DETAILS/WINGWALL DETAILS.
7. REFER DWG. Nos. 01-2000-5304 & 5305 FOR TRACKWORK SETOUT.
8. BITUMEN LEVEL CROSSING REFER DWG. No. 01-2000-5007. ARRANGE DRAINAGE TO SUIT SITE.
9. COORDINATES TO MGA94 ZONE 52.

FINAL DESIGN DOCUMENTATION

Xrefs: ADrail B1, X_BERRIMAH_BASE, X_BERRIMAH_DRAINAGE, X_BERRIMAH_ROADS, X_BERRIMAH_SURVEY

B1	
CAD FILE	01-3000-8131.dwg
REFERENCE FILES	see above
PLOT SCALE	1:1
SCALES USED	1:500

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DRAWING INDEX

CODE	DATE	DESCRIPTION	DA	PA
AB	08.09.03	FINAL DESIGN DOCUMENTATION	CWD	CWD
6	31.07.03	3m WIDE OPEN DRAIN DELETED, VEE DRAIN ADDED	CWD	CWD
5	23.04.03	CONTAINER PAVEMENT PIPE SIZE CHANGED TO 375mm AND NOTES AMENDED	CWD	CWD

REVISIONS AND ISSUES

CODE	DATE	DESCRIPTION	DA	PA
4	08.02.03	CONTAINER PAVEMENT & NORTHERN FENCE AMENDED, SOUTHERN BDY. COORD'S CORRECTED. NOTES AMENDED	CWD	CWD
3	23.01.03	APPROVED FOR CONSTRUCTION	CWD	CWD
		TOP OF BANK MOVED NORTH 1.8m, PRECAST RCP OUTLETS DELETED. ROCK PROT. INCREASED TO 4m		
2	13.12.02	DRAIN, GRADING NOTES & CONC. EDGE STRIP ADDED	C.W.D.	C.W.D.
1	12.11.02	ISSUED FOR AUTHORITY APPROVAL,	C.W.D.	C.W.D.
		ROADWORKS DETAILS REMOVED, VARIOUS DRAINAGE DETAILS AMENDED		
0	13.06.02	ADRAIL APPROVED FOR SUBMISSION TO PRINCIPAL	C.W.D.	C.W.D.

REVISIONS AND ISSUES

		DATE
DESIGNER	T.C.	13.06.02
DRAFTER	M.L.	13.06.02
DESIGN CHECKER	D.B.	13.06.02
DRAFTING CHECKER	G.S.C.	13.06.02
DESIGN APPROVAL	C.W.D.	13.06.02
QUALITY CHECK	G.J.H.	13.06.02
PROJECT APPROVAL	C.W.D.	13.06.02
PRINCIPAL APPROVAL	A.P.T.C.	15.01.03

ADrail

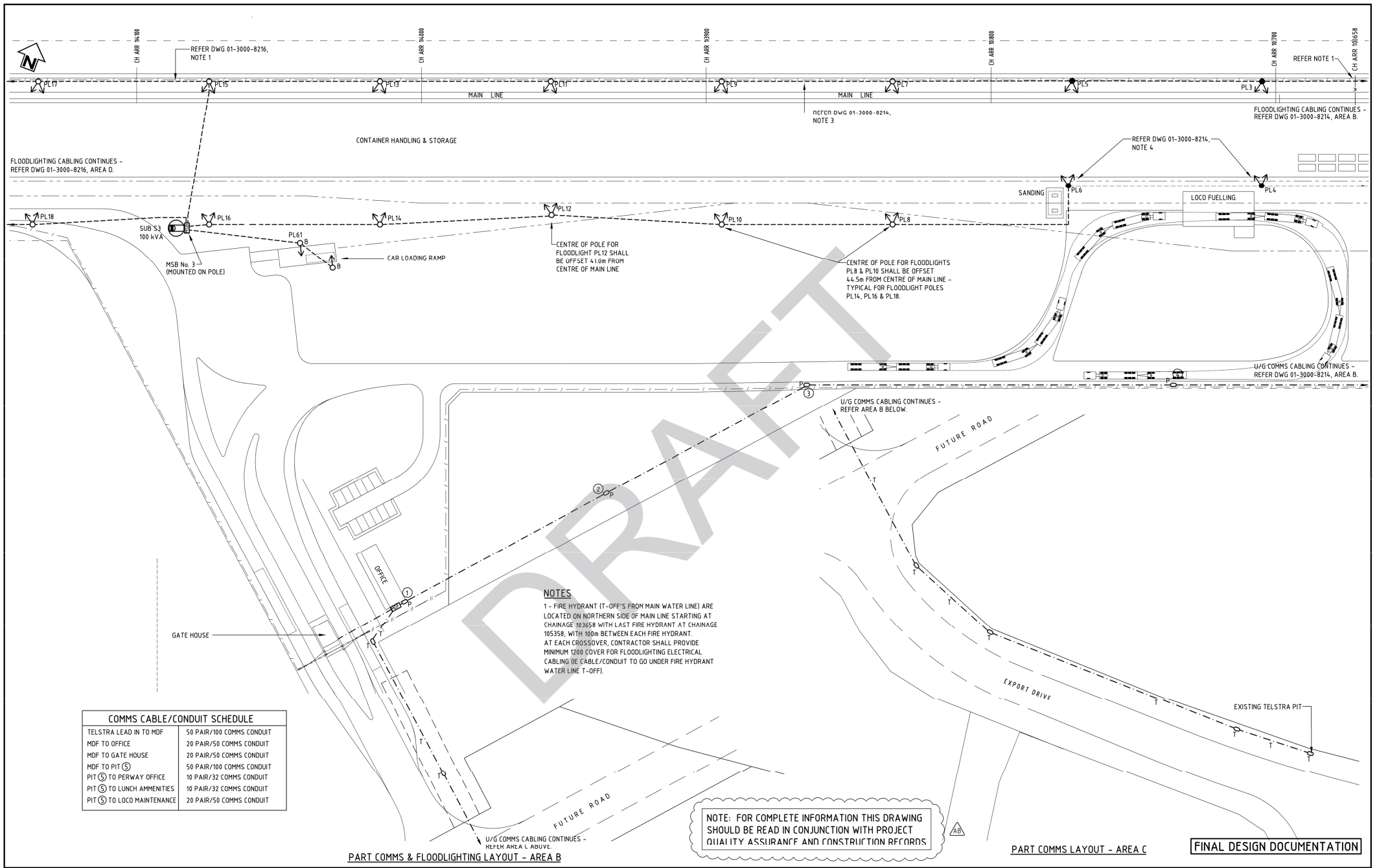
- Brown & Root Construction Pty Ltd ABN 84 094 542 533
- Barclay Mowlem Construction Limited ABN 36 009 830 460
- Macmahon Contractors Pty Ltd ABN 37 007 611 485
- John Holland Pty Ltd ABN 11 004 282 268

ALICE SPRINGS - DARWIN RAILWAY PROJECT

BERRIMAH FREIGHT TERMINAL DRAINAGE
SHEET 2 OF 7

DRAWING NUMBER: 01-3000-8130

REVISION CODE: AB



NOTES

1 - FIRE HYDRANT (T-OFF'S FROM MAIN WATER LINE) ARE LOCATED ON NORTHERN SIDE OF MAIN LINE STARTING AT CHAINAGE 103658 WITH LAST FIRE HYDRANT AT CHAINAGE 105358, WITH 100m BETWEEN EACH FIRE HYDRANT. AT EACH CROSSOVER, CONTRACTOR SHALL PROVIDE MINIMUM 1200 COVER FOR FLOODLIGHTING ELECTRICAL CABLING (IE CABLE/CONDUIT TO GO UNDER FIRE HYDRANT WATER LINE T-OFF).

COMMS CABLE/CONDUIT SCHEDULE

TELSTRA LEAD IN TO MDF	50 PAIR/100 COMMS CONDUIT
MDF TO OFFICE	20 PAIR/50 COMMS CONDUIT
MDF TO GATE HOUSE	20 PAIR/50 COMMS CONDUIT
MDF TO PIT (5)	50 PAIR/100 COMMS CONDUIT
PIT (5) TO PERWAY OFFICE	10 PAIR/32 COMMS CONDUIT
PIT (5) TO LUNCH AMMENITIES	10 PAIR/32 COMMS CONDUIT
PIT (5) TO LOCO MAINTENANCE	20 PAIR/50 COMMS CONDUIT

NOTE: FOR COMPLETE INFORMATION THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH PROJECT QUALITY ASSURANCE AND CONSTRUCTION RECORDS

PART COMMS & FLOODLIGHTING LAYOUT - AREA B

PART COMMS LAYOUT - AREA C

FINAL DESIGN DOCUMENTATION

B1	
CAD FILE	AGA192-2_E4-2
REFERENCE FILES	
PLOT SCALE	1:1
SCALES USED	1:500

100 MILLIMETRES ON ORIGINAL DRAWING
0 10 20 30 40 50
SCALE 1:500

AGA CONSULTING ENGINEERS PTY LTD
ELECTRICAL & MECHANICAL
ACN 070 242 296
GPO BOX 3097
DARWIN NT 0801
TELEPHONE: 08 89416582
FACSIMILE: 08 89421400

CODE	DATE	DESCRIPTION	DA	PA
AB	12.09.03	FINAL DESIGN DOCUMENTATION	CWD	CWD
3	20.06.03	INCOMING LINE AMENDED	CWD	CWD
2	03.04.03	APPROVED FOR CONSTRUCTION	CWD	CWD
1	23.01.03	FLOODLIGHTS ADDED. FLOODLIGHTS RELOCATED.	CWD	CWD
0	7.11.02	ADRAIL APPROVED. ISSUED FOR AUTHORITY APPROVAL.	CWD	CWD

REVISIONS AND ISSUES

DESIGNER	A.GANGUR	JULY 02
DRAFTER	L.GAULT	JULY 02
DESIGN CHECKER	A.GANUGR	JULY 02
DRAFTING CHECKER	A.GANGUR	JULY 02
DESIGN APPROVAL	CWD	7.11.02
QUALITY CHECK	G.JH	7.11.02
PROJECT APPROVAL	CWD	7.11.02
PRINCIPAL APPROVAL	APTC	26.02.03

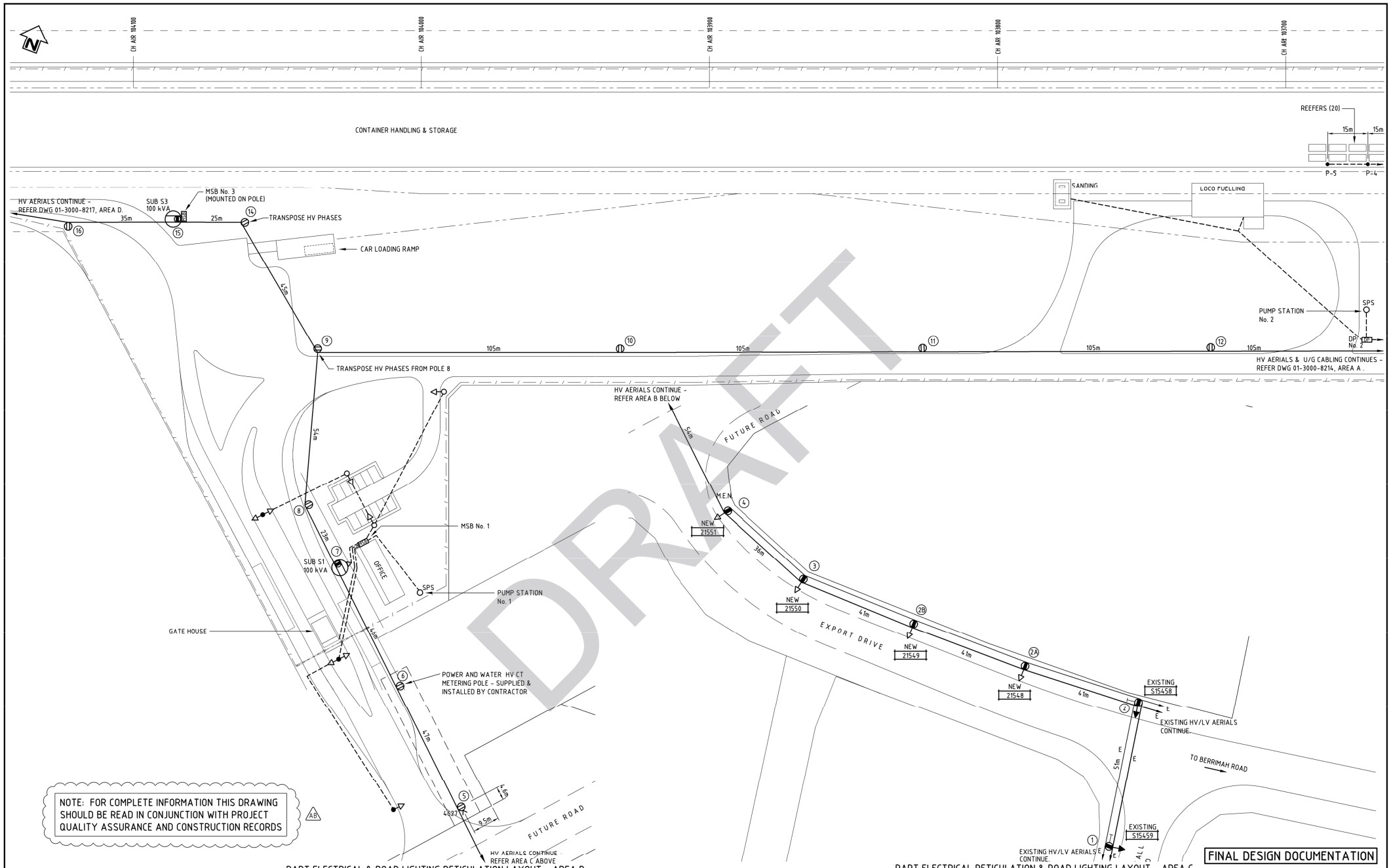
ADrail

- Brown & Root Construction Pty Ltd ABN 84 094 542 533
- Barclay Mowlem Construction Limited ABN 36 009 830 460
- Macmahon Contractors Pty Ltd ABN 37 007 611 485
- John Holland Pty Ltd ABN 11 004 282 268

ALICE SPRINGS - DARWIN RAILWAY PROJECT

BERRIMAH FREIGHT TERMINAL
COMMS RETICULATION & FLOODLIGHTING LAYOUT

DRAWING NUMBER: 01-3000-8216
REVISION CODE: AB



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SCALES USED	1:500

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SCALE 1:500

AGA CONSULTING ENGINEERS PTY LTD
ELECTRICAL & MECHANICAL
ACN 070 242 296
GPO BOX 3097
DARWIN NT 0801
TELEPHONE: 08 89416582
FACSIMILE: 08 89427400

CODE	DATE	DESCRIPTION	DA	PA
AB	12.09.03	FINAL DESIGN DOCUMENTATION	CWD	CWD
4	01.07.03	POLE SPACING AMENDED. POLE 5 OFFSETS ADDED.	CWD	CWD
3	20.06.03	POLES 1 TO 7 AMENDED. STREET LIGHTS ADDED.	CWD	CWD
2	03.04.03	APPROVED FOR CONSTRUCTION	CWD	CWD
1	23.01.03	POLE TERMINATIONS ADDED, POLE NOTE AMENDED.	CWD	CWD
0	7.11.02	ADRAIL APPROVED. ISSUED FOR AUTHORITY APPROVAL	CWD	CWD

REVISIONS AND ISSUES

		DATE
DESIGNER	A.GANGUR	JULY 02
DRAFTER	L.GAULT	JULY 02
DESIGN CHECKER	A.GANGUR	JULY 02
DRAFTING CHECKER	A.GANGUR	JULY 02
DESIGN APPROVAL	CWD	7.11.02
QUALITY CHECK	G.JH	7.11.02
PROJECT APPROVAL	CWD	7.11.02
PRINCIPAL APPROVAL		

ADrail

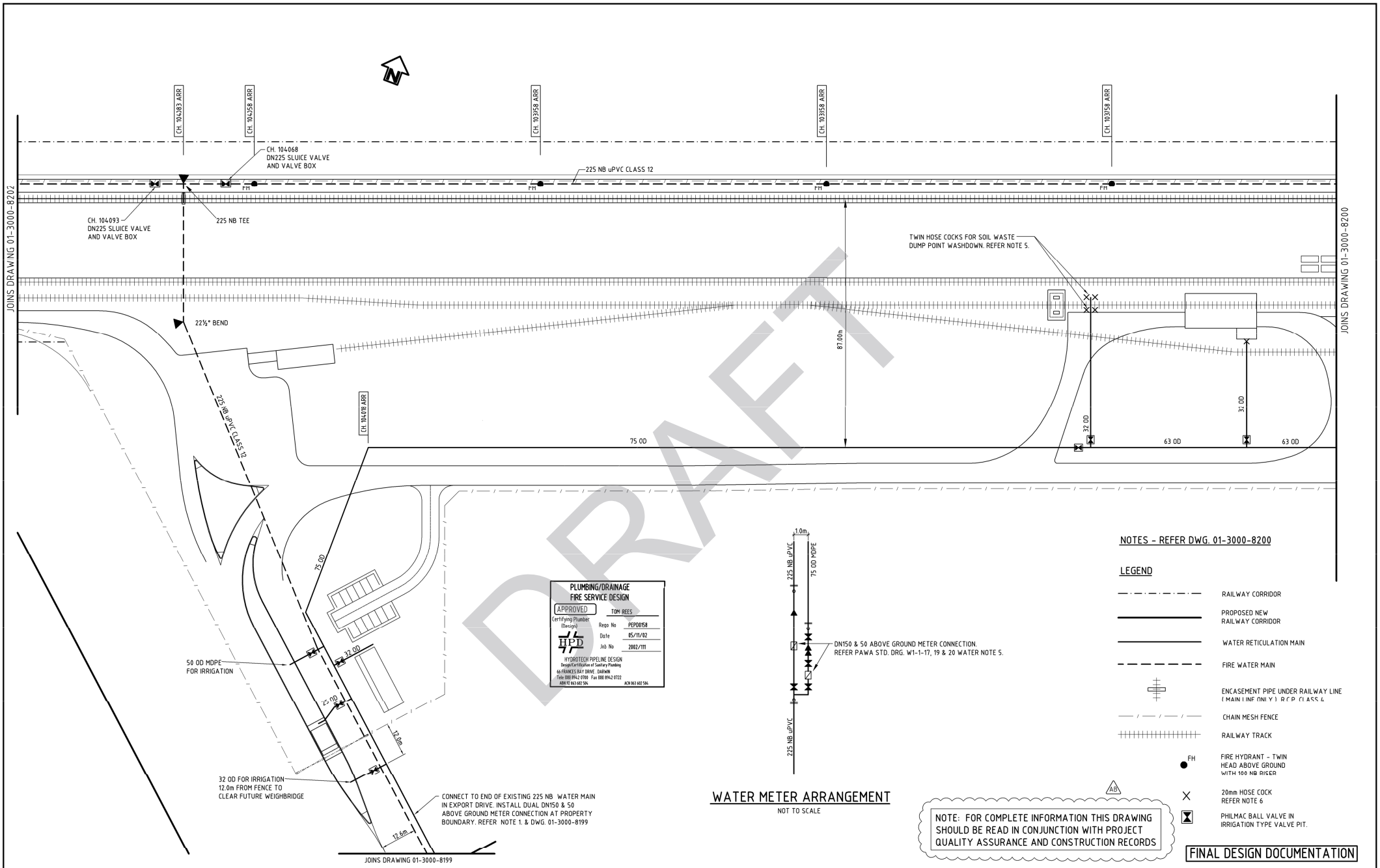
- Brown & Root Construction Pty Ltd ABN 84 094 542 533
- Barclay Mowlem Construction Limited ABN 36 009 830 460
- Macmahon Contractors Pty Ltd ABN 37 007 611 485
- John Holland Pty Ltd ABN 11 004 282 268

ALICE SPRINGS - DARWIN RAILWAY PROJECT

BERRIMAH FREIGHT TERMINAL
ELECTRICAL RETICULATION & ROAD LIGHTING LAYOUT

DRAWING NUMBER 01-3000-8215

REVISION CODE AB



PLUMBING/DRAINAGE
FIRE SERVICE DESIGN

APPROVED — TOM REES

Certifying Plumber (Design)

Rego No PEPD0158
Date 05/11/02
Job No 2002/111

HYDROTECH PIPELINE DESIGN
Design/Certification of Sanitary Plumbing
66 FRANCES BAY DRIVE, DARWIN
Tele (08) 8942 0788 Fax (08) 8942 0722
ABN 97 063 602 584 ACN 063 602 584

DN150 & 50 ABOVE GROUND METER CONNECTION.
REFER PAWA STD. DRG. W1-1-17, 19 & 20 WATER NOTE 5.

WATER METER ARRANGEMENT

NOT TO SCALE

NOTES - REFER DWG. 01-3000-8200

LEGEND

- RAILWAY CORRIDOR
- PROPOSED NEW RAILWAY CORRIDOR
- WATER RETICULATION MAIN
- FIRE WATER MAIN
- ENCASEMENT PIPE UNDER RAILWAY LINE (MAIN LINE ONLY) RCP CLASS 4
- CHAIN MESH FENCE
- RAILWAY TRACK
- FH — FIRE HYDRANT - TWIN HEAD ABOVE GROUND WITH 100 NB RISER
- 20mm HOSE COCK REFER NOTE 6
- PHILMAC BALL VALVE IN IRRIGATION TYPE VALVE PIT.

AB

NOTE: FOR COMPLETE INFORMATION THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH PROJECT QUALITY ASSURANCE AND CONSTRUCTION RECORDS

FINAL DESIGN DOCUMENTATION

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CAD FILE	01-3000-8201.dwg
REFERENCE FILES	
PLOT SCALE	1:1
SCALES USED	AS SHOWN

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AB	12.09.03	FINAL DESIGN DOCUMENTATION	CWD	CWD
4	27.06.03	SLUICE VALVES ADDED	CWD	CWD
3	14.05.03	AMENDMENTS AS SHOWN	SA	
2	11.02.03	APPROVED FOR CONSTRUCTION	CWD	CWD
1	07.02.03	ADRAIL APPROVED FOR SUBMISSION TO PRINCIPAL	CWD	CWD
0	12.11.02	ADRAIL APPROVED FOR AUTHORITY APPROVAL	CWD	CWD

REVISIONS AND ISSUES

		DATE
DESIGNER	R.J.S.	12.11.02
DRAFTER	O.R.	12.11.02
DESIGN CHECKER	S.W.	12.11.02
DRAFTING CHECKER	R.J.S.	12.11.02
DESIGN APPROVAL	CWD	12.11.02
QUALITY CHECK	G.JH	12.11.02
PROJECT APPROVAL	CWD	12.11.02
PRINCIPAL APPROVAL	APTC	07.02.03

ADrail

- Brown & Root Construction Pty Ltd ABN 84 094 542 533
- Barclay Mowlem Construction Limited ABN 36 009 830 460
- Macmahon Contractors Pty Ltd ABN 37 007 611 485
- John Holland Pty Ltd ABN 11 004 282 268

ALICE SPRINGS - DARWIN RAILWAY PROJECT

BERRIMAH FREIGHT TERMINAL
WATER SUPPLY & FIRE SERVICES
LAYOUT PLAN
SHEET 2 OF 4

DRAWING NUMBER 01-3000-8201

REVISION CODE AB

GREENCAP
Proudly part of wsp

Unit 11 / 14 Winnellie Road
Winnellie NT 0820

GROUNDWATER MONITORING AND MANAGEMENT PLAN

July 2023
J168829-07

AURIZON
Berrimah Freight Terminal

greencap.com.au

ABN 76 006 318 010

Adelaide | Auckland | Brisbane | Canberra | Darwin | Melbourne | Newcastle | Perth | Sydney | Wollongong

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This Report should be read in whole and should not be copied in part or altered. The Report as a whole set outs the findings of the investigations. No responsibility is accepted by Greencap for use of parts of the Report in the absence (or out of context) of the balance of the Report.

Document Control

Document Quality Management Details		
Report Name:	Groundwater Monitoring and Management Plan	
Site Details:	Berrimah Freight Terminal	
Project Number:	J168829-07	
Client Name:	Aurizon	
Signatures:	Prepared By:  Varun Bhagwat Environmental Consultant	Prepared/Reviewed By:  Alex Sereda Principal Hydrogeologist
	Reviewed/Approved By:  Dylan Burford Practice Manager - Environmental & Contaminated Land Management	Reviewed/Approved By:  Shya Jackson Technical Executive - Contaminated Land Management

Issue Status

Version No.	Status	Date	Creator	Reviewer
1	Draft	23/12/2022	VB/AS	DB
2	Final	28/02/2023	VB/AS	DB
3	Final_Rev3	Feb 2023	VB	AS
4	Final_Rev4	Apr 2023	VB	AS
5	Final_Rev5	June 2023	VB/AS	AS/SJ
6	Updated_Rev 6	24/07/2023	AS	SJ

Document Circulation

Version	Company
1	Aurizon
2	Aurizon, Senversa
3	Aurizon, Senversa
4	Aurizon, Senversa
5	Aurizon, Senversa

Groundwater Monitoring and Management Plan

Aurizon

Berrimah Freight Terminal

Table of Contents

1 INTRODUCTION

Greencap was engaged by Aurizon (formerly One Rail Australia) to prepare a Groundwater Management and Monitoring Plan (GMMP) for the Berrimah Freight Terminal, Export Drive, Berrimah, Northern Territory (the site).

The site location is shown on **Figure *1*** and site details are presented in **Table *1*** below.

Figure 1: Site Layout and Surrounding Land Use

Table 1: Site Details Summary

Details	Description
Street Address	Export Drive, Berrimah NT
Certificate of Title	Volume 757 Folio 262; and Volume 754 Folio 416
Parcel Reference	NT Portions 5411; and 5641, Hundred of Bagot
Plan	S2000/1912B; and S2003/163
Zoning	Zoned as Railway under the NT Planning Scheme
Local Government Authority	Darwin City
Current Uses	The Site is used as a freight rail terminal and consists of four railway lines (Main Line, 1 Road, Auxiliary Road and Ramp Road) all generally running east-west, an asphalt sealed container pad used for the loading and transfer of freight to and from heavy rail, locomotive/car maintenance sheds at the east end of the Site and an office building and gatehouse to the south on Export Drive

The GMMP has been prepared to monitor and manage potential risks to off-site ecological and human receptors potentially posed by groundwater contamination which remains under the site following remediation of a diesel spill which occurred in May 2020 (refer to **Figure 3** and **Figure 4** for areas of remaining contamination).

This version of the GMMP forms an update to the previous version of the document (Greencap, 2021[1]).

A separate environmental management plan (EMP, Greencap, 2023) has been prepared to manage potential risks which the remaining onsite contamination could pose to health of site workers and visitors. It should be noted that any changes in groundwater quality identified from the sampling detailed in this GMMP will be used to update the EMP (as required).

The primary objectives of the GMMP are:

- mitigating risks to downgradient human and ecological receptors (posed by remaining groundwater contamination) by establishing a monitoring and management protocol (defined in this document).
- identifying criteria which trigger contingent investigation or remediation actions or alternatively allow cessation of monitoring.

[1] Greencap. Groundwater Monitoring and Management Plan, One Rail Australia, Berrimah Freight Terminal. March 2021. Ref: J168829-01.

2 ENVIRONMENTAL LEGISLATION AND REQUIREMENTS

The Northern Territory Environment Protection Authority (NT EPA) guidance documents followed during the development of the current GMMP included:

- Northern Territory Contaminated Land Guideline (June 2017); and
- Guideline for Reporting on Environmental Monitoring (May 2016).

The Territory and Commonwealth legislation relevant to this GMMP included:

- Rail Safety (National Uniform Legislation) Act (2012) which provides for the protection of human life and rail infrastructure and general requirements for accessing and operating on rail land within the NT. As the site is an active rail corridor the Rail Safety Act applies to any works (management or mitigation) conducted onsite.
- Waste Management and Pollution Control Act 1998 (updated 2022) and associated Regulations, which requires the protection of the environment through encouragement of effective waste management and pollution prevention and control practices and for related purposes.
- Environmental Protection Act 2019 and associated Regulations, which defines the environment as being "all aspects of the surroundings of man including the physical, biological, economic, cultural and social aspects" and ensures to the greatest extent practicable that each matter which could reasonably have a significant effect on the environment is fully examined and considered.
- Water Act 1992 (updated 2023), which provides for investigation, management and administration of water resources, including extraction of groundwater, wastewater and water pollution> It also refers to general environmental duty for the protection of surface and groundwater as well as the duty to notify relevant authorities of environmental harm.

3 SITE DETAILS

3.1 Regional and Physical Setting

The Site is located in the upper reaches of East Arm in Darwin Harbour, approximately 7 kilometres (km) east of the City of Darwin, NT and occupies an area of approximately 19 hectares (ha) (refer **Figure *1***).

Land uses surrounding the Site include the following and are shown in Figure 1:

- Directly to the north, intertidal marine aquatic mangrove habitats / ecosystems zoned Development, further north of which is Bleesers Creek (Darwin Harbour) and intertidal mangrove habitat zoned Conservation. There is the potential for human recreational use of the mangroves and Bleesers Creek.
- Directly to the east, unoccupied, cleared land zoned Development, further east of which is Berrimah Road and a small amount of uncleared forest.
- Directly to the west, the Darwin passenger rail terminal; and
- Directly to the south are numerous industrial/commercial premises.

3.2 Geology

Most of the site area is covered with asphalt or ballast underlain by fill material comprising sandy gravelly silt. The encountered thickness of the fill ranged between 0.3 and 3.9 metres. Natural soils were encountered beneath the fill material at the site area and along the northern edge of the site and comprised silty and sandy clays.

The site is in an area identified as having a high probability of occurrence (with very low confidence) of acid sulphate soils (ASRIS online database, 2020) and natural materials encountered on the edge of the mangroves were noted as containing sulfurous odours.

3.3 Hydrology

The stormwater runoff and overland flow at the portion of the site subject to this GMMP moves following local topography into existing unlined Vee-drains along which it travels west-southwest and south respectively, redirecting runoff under and around the site to the intertidal mangrove community and Bleesers Creek to the north (see **Figure *2***).

3.4 Hydrogeology

During the site investigations, the groundwater at the site area is

- found at approximately 3.5 metres below ground level within both fill and natural material with levels appeared to vary seasonally undergoing seasonal fluctuation up to 0.7 metres between wet (October to March) and dry (April to September) seasons.
- flowing to the north towards mangroves and Bleesers Creek (refer **Figure *2***) under maximum hydraulic gradient of 0.0007.
- flowing with the estimated flow velocity of 12 m/year, but is likely to be lower when hydraulic gradients are essentially flat (which is noted to occur during the dry season).
- reducing to oxidising, acidic to neutral and brackish to saline varying seasonally.

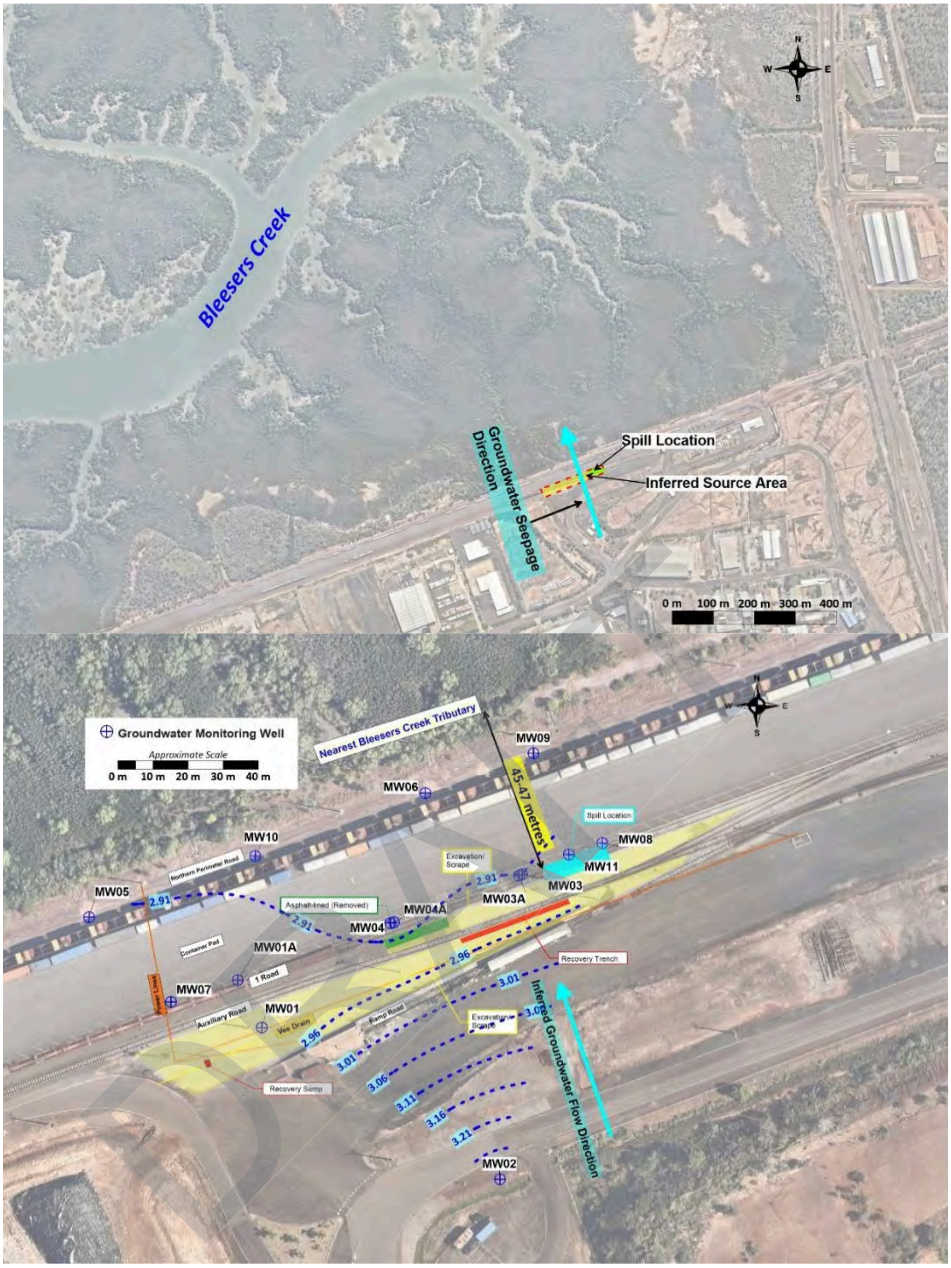

Figure 2: Groundwater Flow Direction

4 NATURE AND EXTENT OF CONTAMINATION

Sections below present discussion on the removed and residual potential sources of groundwater contamination which remains under the site area as well as nature and extent of groundwater contamination.

4.1 Sources

The following events related to groundwater contamination occurred at the site:

- A spill of 20,000 L of diesel fuel was lost to ground on 30 May 2020 during automatic refueling of a diesel locomotive.
- Investigation and remediation works were subsequently completed by Aurizon, which was subject to regulation by EPA (refer to Addendum DSI[2] for detail).
- The remediation removed an estimated 18,000 L of the diesel, with the following contamination remaining in soil and shown on **Figure 3**:
    - under the rail lines adjacent the spill to depths of approximately 0.5m below surface.
    - In the base of backfilled excavations extended to the groundwater interface in and around the location of the temporary sump.
- The remaining diesel contaminated soils form a potential source of ongoing groundwater contamination.

The diesel contaminated soil that was excavated immediately following the spill has been stockpiled southwest of the spill areas and is underlain and covered by geotextile and is not considered to form a source of groundwater and surface runoff contamination. This has been confirmed by surface water sampling completed at the site (refer DSI and surface water monitoring included in monitoring report submitted as a part of the previous version of GMMP).

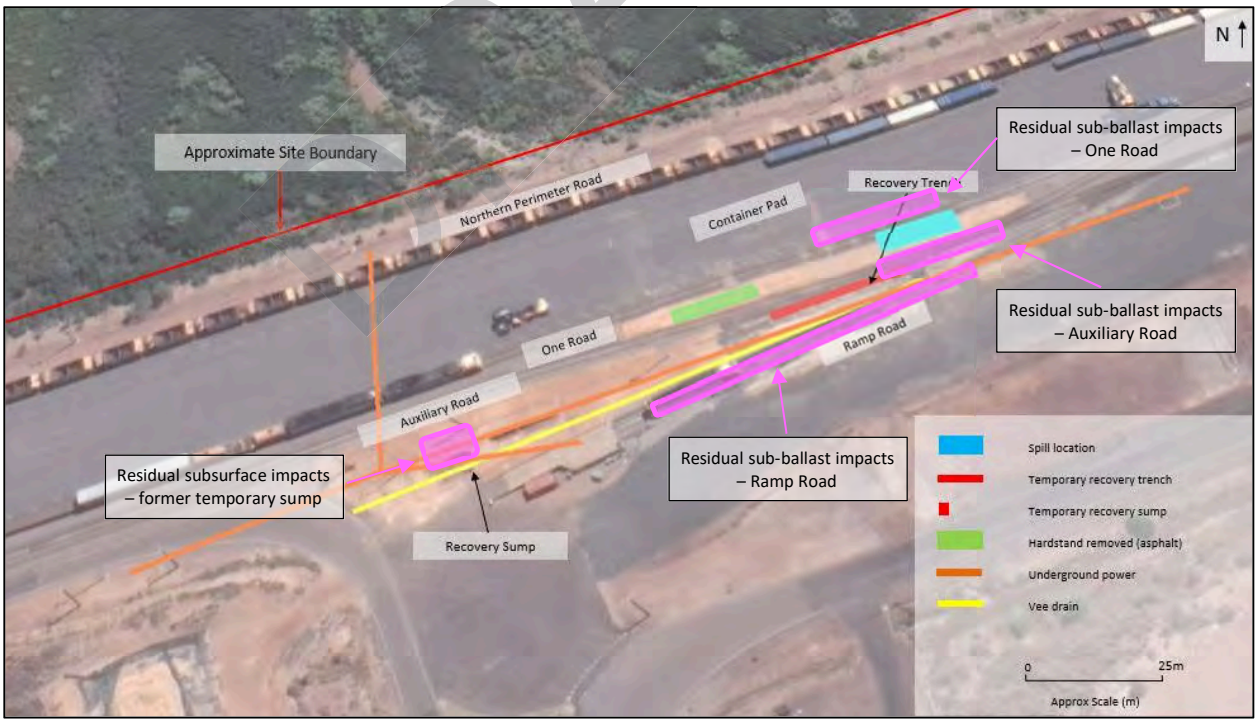

Figure 3: Areas of Remaining Soil Contamination

4.2 Receptors and Pathways to Groundwater Contamination

As reported in the DSI[3] and Addendum the following represent potential receptors and pathways for exposure to site-related contamination:

- On-site receptors – on-site workers and site visitors. Note: mitigation measures for the reduction of the risks to the human health are addressed in the EMP document (Greencap, 2023) submitted under separate cover.
- Down-gradient receptors –
    - The marine aquatic ecosystem of the mangroves and Bleseers Creek which discharges into Frances Bay of the Darwin Harbour; and
    - Recreational users of the mangroves.

The current extent of the remaining groundwater contamination under the site is described in the Section 4.3 (below) – including the potential for downgradient receptors to be exposed to site-related groundwater contamination.

4.3 Nature and Extent of Groundwater Contamination

Based on the most recent groundwater sampling (sampling report results) diesel related chemical substances associated with the spill were detected at monitoring wells MW01, MW01A, MW03, MW04 MW08 and MW11 located within and in the vicinity of the spill area included the presence of floating diesel in the form of light non-aqueous phase liquid (LNAPL) which was only observed at MW01 shortly after the spill up until the September 2021. The locations of these wells are shown on **Figure *4*** and the results are summarised in **Table *2*** with the full list of results included in Appendix C.

As shown in **Table *2*** the exceedances of the adopted criteria for diesel spill related chemicals (i.e TRH) were reported at a single monitoring well MW01A and there was no evidence of groundwater contamination along the down gradient boundary at the mangroves fringe.

Contamination transport predictive modelling as part of the DSI Addendum indicated that groundwater contamination was unlikely to reach the downgradient mangroves (prior to and following reaching a predicted steady state condition after 12 years under a conservative scenario which included a constant source with no contaminant degradation in the plume)

Groundwater sampling results from the monitoring events conducted since the spill occurred are summarised in the DSI and DSI Addendum reports and detailed in the groundwater monitoring event reports. The data set shows diesel type hydrocarbon impacts (>C_{10} to C_{34}) at monitoring wells located along the spilled diesel migration path, indicating that a portion of the spilled diesel appears to have infiltrated to groundwater.

[2] Greencap. Detailed Site Investigation - Addendum, Aurizon, Berrimah Freight Terminal. March 2023. Ref: J168829

[3] Greencap. Detailed Site Investigation, Aurizon, Berrimah Freight Terminal. March 2023. Ref: J168829

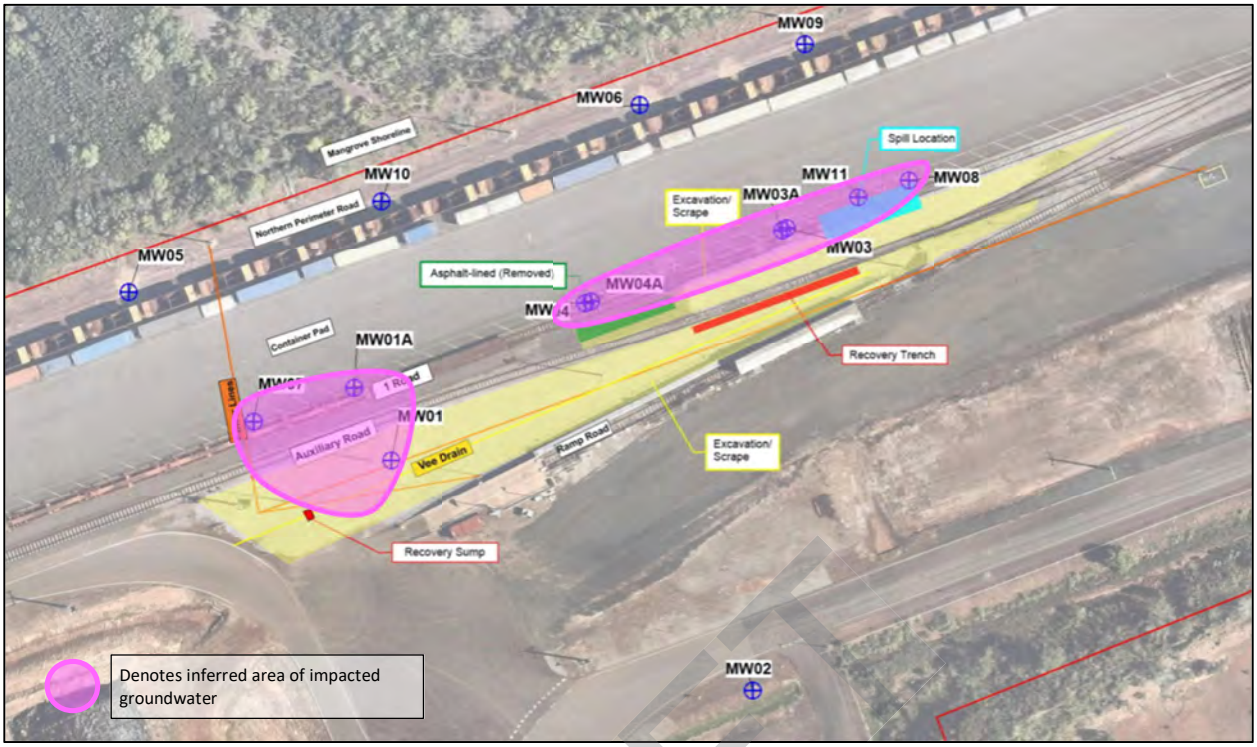

Figure 4: Hydrocarbon Impacts in Groundwater

Table 2: Hydrocarbon Impacts in Groundwater

		Concentrations (mg/L)				
Monitoring Well	**Sampling Dates**	**F1: TRH (C_6-C_{10} less BTEX)**	**F2: TRH (C_{10}-C_{16} less naphthalene)**	**F3: TRH ($>C_{16}$-C_{34})**	**F4: TRH ($>C_{34}$-C_{40})**	**Diesel Range TRH ($>C_{10}$-C_{34})**
NEPM HSLs for Vapour Intrusion, Commercial/ Industrial (2 to <4m)		6,000	NL	-	-	-
Marine Aquatic Ecosystem (ANZECC 2000)		-	-	-	-	-
CWB Environmental Screening Levels for Gasoline and Diesel - Aquatic Ecosystem		440	640	640	640	640
ANZECC Primary Contact Recreational		100	900	900	900	900
MW01	Dec-21	<20	**860**	**900**	<100	**1,760**
MW01A	Dec-21	<20	<50	**100**	<100	<100
MW03	Dec-21	<20	<50	**400**	<100	**400**
MW04	Dec-21	<20	<50	**400**	<100	**400**
MW07	Dec-21	<20	<50	**500**	<100	**500**
MW08	Dec-21	<20	<50	**200**	<100	**200**
MW11	Dec-21	<20	<50	**300**	<100	**300**

5 GROUNDWATER MANAGEMENT AND MONITORING PLAN

The updated GMMP comprises the following components:

- The groundwater monitoring schedule and analytical program;
- Definition of adopted trigger levels;
- Contingency measures established for the situations if the trigger levels are exceeded; and
- Periodic review of the practicability of GMMP to address the required objectives as well as triggers for the monitoring cessation.

5.1 Responsible Parties

The party responsible for the implementation of this GMMP is Aurizon. Aurizon should ensure that:

- The integrity of the groundwater monitoring well network is maintained throughout the implementation of the GMMP.
- Work procedures are developed to address site specific management issues and WHS requirements relating to this GMMP, which may include the engagement of suitably qualified Environmental Consultants.
- Groundwater monitoring and reporting activities are conducted by suitably trained, experienced and qualified Environmental Consultants (relevant tertiary degree and/or practitioner certification) on behalf of the responsible party.
- Engage a suitably qualified and an accredited environmental auditor to review and approve the GMMP and the future monitoring under this GMMP.

5.2 Monitoring Network

5.2.1 Groundwater Monitoring Wells

The groundwater monitoring wells that form part of this GMMP were positioned to target groundwater underlying the spill area, down inferred gradient from the spill area, as well as upgradient of the spill site to assess the quality of incoming groundwater (to distinguish between the spill related and non-spill-related impacts).

Groundwater monitoring well installation targets, survey and construction details are summarised in **Table *3***. The monitoring well locations are presented in **Figure 5**. Monitoring well installation logs are logs and construction details are attached in **Appendix A.**

Table 3: GMMP Groundwater Monitoring Well Network Details

Location ID	Easting	Northing	Elevation – TOC* (mAHD**)	Screen Interval (from-to mbgl)	Rationale / Target
MW01	708423.8	8620973	5.958	1.9 – 4.9	Assess groundwater quality directly beneath the temporary sump created to intercept and capture spilt diesel
MW01A	708416.9	8620987	5.921	1.8 - 4.8	Assess groundwater quality immediately down inferred gradient of a sump constructed to collect spilt diesel
MW02	708491.8	8620930	5.026	1.2 – 5.2	Background well, up-gradient of spill site

Location ID	Easting	Northing	Elevation – TOC* (mAHD**)	Screen Interval (from-to mbgl)	Rationale / Target
MW03	708498.1	8621017	5.891	1.3 – 4.3	Assess groundwater quality immediately adjacent/downgradient of the spill location
MW03A	708497.3	8621016	5.869	6.0 – 8.4	Assess groundwater quality immediately adjacent/downgradient of the spill location
MW04	708461.6	8621003	5.867	0.85 – 3.85	Assess groundwater quality immediately adjacent/downgradient of the spill location
MW04A	708460.6	8621003	5.931	0.4 – 3.4	Assess groundwater quality immediately adjacent/downgradient of the spill location
MW05	708374.7	8621004	5.906	1.0 – 4.0	Assess groundwater quality at mangrove fringe
MW06	708470.5	8621040	5.970	1.0 – 4.0	Assess groundwater quality at mangrove fringe
MW07	708398.1	8620980	5.262	1.0 – 5.0	Assess groundwater quality down gradient from the spill
MW08	708521	8621026	5.249	1.0 – 5.0	Assess groundwater quality down gradient from the spill
MW09	708501.4	8621051	5.177	1.5 – 5.0	Assess groundwater quality at mangrove fringe
MW10	708422.1	8621022	5.179	1.5 – 5.0	Assess groundwater quality at mangrove fringe
MW11	708511.5	8621022	5.894	2.0 – 5.0	Assess groundwater quality immediately adjacent to spill point

Notes:

[1]LNAPL – light non-aqueous phase liquid (floating diesel fuel from the spill)

*TOC – top of casing for groundwater wells;
**AHD = Australian Height Datum
mbgl – metres below ground level

5.2.2 Maintenance of Monitoring Points

The integrity of all monitoring wells must be maintained. If during any monitoring event, monitoring wells are found to be damaged, the following protocol should be followed:

- Any damaged well(s) should be repaired prior to the next scheduled monitoring event.
- If any of the wells are damaged beyond repair, the damaged wells should be decommissioned as per requirements outlined in the "*Minimum Construction Requirements for Water Bores in Australia (edition 4, 2020)*" and replacement wells installed as soon as practicable.
- The replacement wells should be installed by a licenced and experienced drilling contractor as close as practicable targeting same screen intervals and following same construction details as a decommissioned well.
- The replacement wells should be developed and allowed to stabilise for a period of 7 days prior to sampling being conducted.
- All replacement wells should be professionally surveyed prior to a subsequent monitoring event.

Figure 5 – Groundwater Monitoring Well Locations

5.3 Monitoring Program

The groundwater monitoring program is outlined in **Table 4**.

Table 4: Groundwater Monitoring Program

Activity / Item	Details
Monitoring Requirements	Monitoring events are to be conducted by an experienced environmental consultant.
Monitoring Frequency and Duration	Whilst the inferred groundwater velocity is slow (approximately 12m/year), bi-annual monitoring is to be undertaken to coincide with the wet (~December to April) and dry (~May to November) seasons. The duration of the program is two wet/dry seasons, i.e. two years commencing April 2023 (end of wet season) on the basis that since the time of the spill, if the plume was to reach the mangroves, it would have done by November 2024 (i.e would travel some 50 metres and cover the distance to the monitoring wells at the mangroves fringe, **Figure *2***). If no evidence of migration of impacts from spill area are confirmed, it is assumed monitoring will no longer be required (detailed in **Section 7**).

Groundwater Sampling Methodology	• Prior to collecting groundwater samples, depth to the base of the wells and standing water levels are to be measured from the top of the casing and recorded. LNAPL product detected will also be measured and recorded. *Note: if wells found to be silted up a redevelopment is required prior to groundwater sampling).*
	• Groundwater sampling is to be conducted using low-flow sampling techniques (peristaltic) with dedicated tubing. The base of the intake tubing shall be positioned within the screened interval to ensure representative groundwater is collected. The flow rate must be monitored and regulated using an interface probe to maintain a stable water level during purging and sampling of the groundwater. If the water level is observed to draw down excessively (greater than 0.1m), an alternative sampling method should be adopted (i.e. purging well dry and collecting samples once water levels recover). Refer to **Appendix B**.
	• Water quality parameters (pH, temperature, electrical conductivity, oxidation-reduction potential and dissolved oxygen) are to be monitored during purging using a calibrated water quality meter. Sampling can occur when the drawdown and the water quality parameters have shown to stabilise. The drawdown should not exceed 0.1 m and stabilisation limits for water quality parameters are:
	  • Temperature (+/- 0.2)
	  • pH (+/- 0.1 pH unit)
	  • Electrical conductivity (+/- 5%)
	  • Oxidation-reduction potential (+/- 10mV)
	  • Dissolved oxygen (+/- 10%)
	(note: excessive drawdowns i.e greater 0.1m if unavoidable should be justified during the reporting of results)
	• The sampler is to wear a clean pair of disposable nitrile gloves when collecting each sample.
	• All groundwater samples are to be collected in appropriate, decontaminated bottles/vials provided by an analytical laboratory and immediately placed in a chilled esky for transportation to a laboratory.

Activity / Item	Details
Quality Assurance / Quality Control	1 intra- and 1 inter-laboratory duplicate groundwater samples are to be collected per monitoring event. Duplicate samples will be tested for the same parameters as the primary samples (detailed below). Monitoring equipment is to be decontaminated between the sampling of each monitoring point. Rinsate blank samples are to be collected at a rate of one per day from non-dedicated sampling/monitoring equipment (e.g. water quality meter, tubing, etc) and analysed for TRH. Trip blanks are to be collected at a rate of one per sampling day and will be analysed for volatile TRH (F1 fraction). Samples are to be collected, chilled and analysed in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM) (as updated 2013). Samples are to be analysed within required holding times for each specific analyte and the laboratory limits of reporting are required to be lower than the guideline values adopted for the GMMP.
Analytical Program	Groundwater samples are to be analysed for diesel fuel-related contaminants of potential concern (COPC) i.e. total recoverable hydrocarbons (TRH) from C6 to C40. Groundwater samples will also be analysed for a suite of parameters to allow for the assessment of natural attenuation (natural biodegradation of petroleum hydrocarbons in groundwater), this includes: • Alkalinity • Ferrous Iron (Fe^{2+}) • Manganese • Methane (CH_4) • Nitrate (NO_3) • Sulphate (SO_4) Analyses are to be undertaken at National Association of Testing Authorities (NATA)-accredited analytical laboratories. Samples are to be analysed within the appropriate holding times for all COPC and natural attenuation parameters.
Reporting Frequency and Requirements	A factual report is to be issued to Aurizon following each of the wet season monitoring events and include tabulated field data and analytical results compared with adopted trigger values. A detailed annual monitoring report is to be issued to Aurizon and the Auditor for review following the dry season monitoring events, including trend analysis of the monitoring data collected throughout the year and a recommendation regarding any changes to the monitoring program. The second scheduled annual report following the last monitoring event completed in 2024 (end of dry season) should include recommendations for ongoing monitoring and/or expansion/reduction of the monitoring network or cessation of monitoring. Reports are to be prepared in accordance with the NT EPA: • *Guideline for Reporting on Environmental Monitoring* (2016); and • *Northern Territory Contaminated Land Guideline* (2017).

6 TRIGGER VALUES

6.1 Environmental Values and Trigger Levels

The groundwater environmental values relevant to the sensitive receptors include a protection of marine aquatic ecosystems (aquatic ecosystems associated with the mangroves and Bleesers Creek) and human health associated with primary contact with contaminated groundwater during recreational activities in the mangroves.

The groundwater assessment criteria for the identified environmental values of groundwater (refer Sections 1 and 4.3) are presented in **Table 5** and sourced from the following documents:

- NEPM 2013 Table 1C Groundwater Investigation Levels (GILs) – Marine Waters.
- NHMRC 2008 Guidelines for Managing Risks in Recreational Water.
- Australian Drinking Water Guidelines (ADWG) (2019).
- ANZECC (2000) and ANZG (2018).
- California Water Boards (2019) – San Francisco Bay Regional Water ESLs.
- WHO (2008) – Drinking Water Values.

The adopted trigger values listed in the following table (Table 5) have been obtained from the above-listed guidelines for the relevant downgradient receptors of groundwater contamination.

Furthermore, considering that an increase in manganese concentration could be indicative of reducing conditions in groundwater formed as a result of biodegradation of petroleum hydrocarbons (associated with the diesel spill), manganese was included in the table below and assigned with a trigger level representing average background concentrations report in the upgradient well MW02.

Table 5: Groundwater Trigger Levels and Environmental Values (µg/L)

Analyte	Marine Aquatic Ecosystem		Primary contact Recreation (Health)	Primary Contact Recreation (Aesthetic)	Adopted Trigger Levels
	ANZECC 2000	CWB Environmental Screening Levels for Gasoline and Diesel	10 x WHO 2008 and ADWG 2011	ADWG 2011	
C_6-C_{10} (F1)	-	440	100	-	100
>C_{10}-C_{16} (F2)	-	640	900	-	640
>C_{16}-C_{34} (F3)	-	640	900	-	640
>C_{34}-C_{40} (F4)	-	640	900	-	640
Attenuation Parameters					
Manganese	-	-	5,000	100	8,700 ^

^ Based on average background concentrations

Summary tables presenting the results of groundwater sampling conducted to date are included as Appendix C.

It is noted that no trigger levels have been set for the physico-chemical parameters measured during groundwater sampling as these are only considered indicators to assess whether groundwater conditions generally support natural biodegradation of petroleum hydrocarbons The physico-chemicals parameters measured during the most recent groundwater monitoring event are included in Appendix C.

6.2 Application of Trigger Levels

In the event that a reported concentration of an analyte exceeds a trigger level presented in **Table 5** then response measures outlined below shall be applied.

Level 1 – Additional Monitoring, Assessment and Review

If LNAPL is identified during gauging in any monitoring well Level 2 contingency measures are to be applied.

If the sampling result does not exceed the adopted trigger value then no further action is necessary. Re-sampling and/or further investigation should be triggered by one or more of the following:

- Increasing COPC concentrations. This will be assessed using the Mann-Kendall statistical analysis which will demonstrate whether additional sampling results show statistically significant increasing trends.
- COPCs being reported at monitoring wells where it was previously not reported – in particular at wells adjacent to the mangroves.
- COPCs being reported greater than the adopted trigger level for the first occasion.

If the result meets one or more of the above three criterion, then the groundwater well(s) which showed the result should be re-sampled within two weeks to verify the result. If the elevated result is confirmed, adopt the following protocol:

1. Increase frequency of groundwater monitoring events to quarterly for the well(s) in which an exceedance was reported;
2. If results are below trigger levels during two subsequent consecutive monthly rounds, continue with the original scheduled monitoring; and
3. If results exceed trigger levels in two subsequent monthly monitoring events, implement Level 2 actions.

Level 2 – Implement Contingency Measures

1. NT EPA to be notified if appropriate.
2. Consider installation of additional groundwater monitoring wells aiming to further delineate the plume and inform any subsequent sampling and assessment.
3. Assess risks to human health and the environment based on any additional information available. This may include updating the exiting modelling completed in the DSI.
4. Consider implementation of groundwater contamination control measures e.g. skimming, pump and treat and/or soil remediation at the areas where subsurface residual diesel impacts are present.

7 REVIEW AND CESSATION OF MONITORING

This GMMP is to be reviewed by a suitably qualified environmental consultant and environmental auditor at the end of the fourth round of monitoring which will occur in late 2024. The review will include a recommendation regarding the continuation, expansion/reduction or cessation of the program consistent with environmental and legal requirements.

The triggers for the cessation of monitoring are as follows:

- the concentrations of COPCs in groundwater are reported to not exceed the adopted trigger levels for both the 2024 wet and dry seasons (except at MW01, which represents a residual source area where contamination may persist beyond 2024) and groundwater sampling results are consistent with the model predictions for the relevant time scale; and
- there is no evidence that the concentrations of hydrocarbons in groundwater are migrating towards the mangroves, i.e no hydrocarbons reported above LORs and no changes in natural attenuation parameters indicative of biodegradation of hydrocarbons in the vicinity of mangroves fringe wells.

A decision to cease or reduce monitoring must be subject to review/approval by the engaged auditor and the NT EPA.

8 REFERENCES

ASRIS Database: http://www.asris.csiro.au/

Baker et. al (2005) Northern Territory Bioregions – Assessment of Key Biodiversity Values and Threats

Bureau of Meteorology Weather: http://www.bom.gov.au/nt/

Greencap (August 2020) Berrimah Freight Rail Terminal Diesel Spill – Updated Interim Remediation Action Plan, Letter Report

Greencap (August 2020) Berrimah Freight Rail Terminal Diesel Spill – Groundwater Monitoring Event (July 2020), Letter Report

Greencap (December 2020) Berrimah Freight Rail Terminal Diesel Spill – Groundwater Monitoring Event (October 2020), Letter Report

Greencap (March 2021) Berrimah Freight Rail Terminal Diesel Spill – Groundwater Monitoring Event (January 2021), Letter Report

Greencap (October 2021) Berrimah Freight Terminal - Surface Water and Sediment Sampling, Letter Report

Greencap (March 2021) Groundwater Monitoring and Management Plan, One Rail Australia, Berrimah Freight Terminal

Greencap (April 2021) Detailed Site Investigation Report, One Rail Australia, Berrimah Freight Terminal, Export Drive, Berrimah NT

Greencap (July 2021) Groundwater Monitoring Event – Annual Report, One Rail Australia, Berrimah Freight Terminal

Greencap (February 2022) Sampling Analytical and Quality Plan, One Rail Australia, Berrimah Freight Terminal

Greencap (March 2022) Groundwater Monitoring Events – September and December 2021, One Rail Australia, Berrimah Freight Terminal

Greencap (October 2022) Diesel-Impacted Soil Remediation Methodology and Management Plan, One Rail Australia, Berrimah Freight Terminal

Greencap (2023) Groundwater Monitoring and Management Plan, Aurizon, Berrimah Freight Terminal

International Erosion Control Association (2008) Best Practice Erosion and Sediment Control

ISO 19011: Guideline for Auditing of management Systems, 2018

National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013).

NT EPA (2015) Guideline for the Preparation of an Environmental Management Plan, Version 1.0

NT EPA (2017) Contaminated Land Guideline, Version 1.0

NT Fauna Atlas: https://nt.gov.au/environment/environment-data-maps/fauna-atlas

July 2023

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Appendix A: Groundwater Well Logs and Survey Results

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MONITORING WELL LOG

Client: One Rail Australia	**Date Drilled:** 16/07/2020	**Bore No.:** MW01
Project: Diesel Spill	**Drilling Co:** Proactive Drilling Services	**Easting:** 708423.825
Project No: J168829	**Total Depth (m):** 4.90	**Northing:** 8620973.001
Location Berrimah, NT	**Diameter (mm):** 50	**Logged by:** VB
		Checked by: AS

COMMENTS

Depth/Elevation	WATER STRIKE	Graphic Log	SOIL DESCRIPTION	Moisture	Well Diagram	Field ID	PID (ppm)	Comment	Depth (m)
			FILL: Silty Gravelly SAND, fine to medium grained sand, medium dense, fine to medium gravel, brownish grey.	M	Concrete	MW01_0.0-0.1	0.0	Faint hydrocarbon odour.	
0.2			FILL: Silty Sandy GRAVEL, fine to medium gravel, medium dense, fine to medium grained sand, light greyish brown.	M		MW01_0.2-0.3	0.0		
0.45			FILL: Sandy Gravelly SILT, firm, fine to medium grained sand, fine to medium gravel, reddish brown.	S/M	Bentonite	MW01_0.45-0.55	0.0		
1.0						MW01_1.0-1.1	0.0		1
2.0			NATURAL: Gravelly Sandy SILT, medium dense, fine to coarse gravel, fine to medium grained sand, light greyish purple.	M					2
				W	Sand	MW01_3.0-3.1	0.0	QA07/QA08	3
3.15				W		MW01_3.1-3.2	0.0		
				S/M					
3.85			NATURAL: Gravelly Sandy Clayey SILT, firm, fine to medium gravel, fine to medium grained sand, yellowish brown to light grey.	M					4
4.4						MW01_4.35-4.45	0.0	Push Tube refusal.	
4.9			MW01 Terminated at 4.90m bgl.						5

MONITORING WELL LOG

Client: One Rail Australia
Project: Diesel Spill
Project No: J168829
Location Berrimah, NT

Date Drilled: 16/07/2020
Drilling Co: Proactive Drilling Services
Total Depth (m): 4.92
Diameter (mm): 50

Bore No.: MW01A
Easting: 708423.825
Northing: 8620973.001
Logged by: VB
Checked by: AS

COMMENTS

Depth/Elevation	WATER STRIKE	Graphic Log	SOIL DESCRIPTION	Moisture	Well Diagram	Field ID	PID (ppm)	Comment	Depth (m)
			FILL: Sandy Gravelly SILT, firm, fine to medium sand, fine to coarse gravel, light brown.	S/M	Concrete	MW01A_0.0-0.1	0.0		
						MW01A_0.5-0.6	0.0		
					Bentonite	MW01A_1.0-1.1	0.0		1
1.9			NATURAL: Sandy Gravelly SILT, soft, fine to medium sand, fine to coarse gravel, yellowish brown.			MW01A_2.0-2.1	0.0		2
2.9	▽		NATURAL: Sandy Gravelly SILT, hard, fine to medium sand, fine to coarse gravel, yellowish brown.		Sand	MW01A_3.0-3.1	0.0		3
									4
4.92			MW01A Terminated at 4.92m bgl.						5

MONITORING WELL LOG

Client: One Rail Australia
Project: Diesel Spill
Project No: J168829
Location Berrimah, NT

Date Drilled: 13/07/2020
Drilling Co: Proactive Drilling Services
Total Depth (m): 5.21
Diameter (mm): 50

Bore No.: MW02
Easting: 708491.822
Northing: 8620929.677
Logged by: VB
Checked by: AS

COMMENTS

Depth/Elevation	WATER STRIKE	Graphic Log	SOIL DESCRIPTION	Moisture	Well Diagram	Field ID	PID (ppm)	Comment	Depth (m)
0.0			FILL: Gravelly Sandy SILT, fine to course gravels, fine to medium grained sand, dark yellowish brown.	S/M	Concrete	MW02_0.0-0.1	0.0		
0.2			FILL: Gravelly Silty SAND, fine to medium grained sand, fine to coarse gravel, light brown.			MW02_0.2-0.3	0.0	QA01/QA02	
0.6			FILL: Sandy GRAVEL, fine to medium gravel, fine to medium grained sand, light brownish grey.	D	Bentonite	MW02_0.6-0.7	0.0		
0.75			FILL: Gravelly SILT - firm, yellowish brown, grey to red/brown purple sedimentary stone.	M		MW02_0.75-0.85	0.0		1
						MW02_1.5-1.6	0.0		
1.7			NATURAL: SILT - firm, minor inclusions of sedimentary stone, brownish red.	S/M					
2.0	1	1			1	MW02_2-2.1	0.0		2
2.45			NATURAL: Clayey SILT - firm, light grey.	M		MW02_2.45-2.55	0.0		
2.6	2	2	NATURAL: Silty Sedimentary STONE - highly weathered, dark brownish red.	W	2	MW02_2.6-2.7	0.0		
						MW02_2.7-2.8	0.0		
3.0			NATURAL: Clayey SILT - firm, light grey.		Sand	MW02_3.0-3.1	0.0		3
						MW02_3.1-3.2	2.2		
3.25			NATURAL - Clayey SILT - soft, light bluish grey.			MW02_3.25-3.35	0.0		
3.9						MW02_3.9-4.0	0.0	Push Tube refusal.	4
						MW02_4.0-4.1	0.0	QA03/QA04	
						MW02_5.1-5.2	0.0		5
5.21			MW02 Terminated at 5.21 m bgl.						

MONITORING WELL LOG

Client: One Rail Australia
Project: Diesel Spill
Project No: J168829
Location Berrimah, NT

Date Drilled: 15/07/2020
Drilling Co: Proactive Drilling Services
Total Depth (m): 5.0
Diameter (mm): 50

Bore No.: MW03
Easting: 708498.128
Northing: 8621016.708
Logged by: VB
Checked by: AS

COMMENTS

Depth/Elevation	WATER STRIKE	Graphic Log	SOIL DESCRIPTION	Moisture	Well Diagram	Field ID	PID (ppm)	Comment	Depth (m)
			FILL: Gravelly Silty SAND, fine to medium grained sand, fine to medium gravel, medium dense, light brownish grey.	M	Concrete	MW03_0.0-0.1	5.6		
0.58			FILL: Gravelly Sandy SILT, stiff, fine to medium gravel, fine to medium grained sand, yellowish brown to reddish brown.	M		MW03_0.6-0.7	5.1		
0.71			FILL: Gravelly Sandy SILT, firm, fine to medium gravel, fine to medium grained sand, brownish red.	S/M	Bentonite	MW03_0.75-0.85	7.3		1
1.1			FILL: Gravelly Sandy SILT, firm, fine to coarse gravel, yellowish brown to light greyish purple.			MW03_1.1-1.2	4.9		
1.6			NATURAL - Gravelly Sandy SILT, firm, medium dense, fine to coarse gravel, fine to medium grained sand, yellowish brown.			MW03_1.6-1.7	8.1		
						MW03_1.8-1.9	6.0		2
						MW03_2.2-2.3	4.1		
				S/M		MW03_2.4-2.5	7.7		
					Sand				3
				W		MW03_3.4-3.5	4.4		
				M				Push Tube refusal.	
3.9			NATURAL: Sandy Silty CLAY, soft, fine to medium grained sand, trace fine gravel, dark greenish grey.			MW03_4.0-4.5	7.6		4
						MW03_4.5-4.6	6.0		
5.0			MW03 Terminated @ 5.0m bgl.						5

MONITORING WELL LOG

Client: One Rail Australia
Project: Diesel Spill
Project No: J168829
Location Berrimah, NT

Date Drilled: 15/07/2020
Drilling Co: Proactive Drilling Services
Total Depth (m): 8.41
Diameter (mm): 50

Bore No.: MW03A
Easting: 708497.314
Northing: 8621016.232
Logged by: VB
Checked by: AS

COMMENTS

Depth/Elevation	WATER STRIKE	Graphic Log	SOIL DESCRIPTION	Moisture	Well Diagram	Field ID	PID (ppm)	Comment	Depth (m)
			FILL: Gravelly Silty SAND, fine to medium grained sand, fine to medium gravel, medium dense, light brownish grey.	M	Concrete				
0.58									
0.71			FILL: Gravelly Sandy SILT, stiff, fine to medium gravel, fine to medium grained sand, yellowish brown to reddish brown.	M S/M					
			FILL: Gravelly Sandy SILT, firm, fine to medium gravel, fine to medium grained sand, brownish red.						
1.6			FILL: Gravelly Sandy SILT, firm, fine to coarse gravel, yellowish brown to light greyish purple.						
			NATURAL - Gravelly Sandy SILT, firm, medium dense, fine to coarse gravel, fine to medium grained sand, yellowish brown.						
				S/M	Bentonite	MW03A_3.0-3.1	2.0		
	▽			W		MW03A_3.5-3.6	1.8		
				M					
3.95			NATURAL: Sandy Silty CLAY, soft, fine to medium grained sand, trace fine gravel, dark greenish grey.			MW03A_4.0-4.1	4.0		
						MW03A_4.5-4.6	3.9		
					Sand				
8.41			MW03A Terminated @ 8.41m bgl.						

MONITORING WELL LOG

Client: One Rail Australia	**Date Drilled:** 16/07/2020	**Bore No.:** MW04
Project: Diesel Spill	**Drilling Co:** Proactive Drilling Services	**Easting:** 708460.568
Project No: J168829	**Total Depth (m):** 3.80	**Northing:** 8621002.703
Location Berrimah, NT	**Diameter (mm):** 50	**Logged by:** VB
		Checked by: AS

COMMENTS

Depth/Elevation	WATER STRIKE	Graphic Log	SOIL DESCRIPTION	Moisture	Well Diagram	Field ID	PID (ppm)	Comment	Depth (m)
			FILL: Gravelly Sandy SILT, medium dense, fine to medium gravel, fine to medium grained sand, brownish grey.	M	Concrete	MW04_0.0-0.1	0.0	Hydrocarbon odour.	
0.25			FILL: Sandy Silty GRAVEL, fine to medium gravel, fine to medium grained sand, firm, reddish brown and grey.			MW04_0.25-0.35	0.0		
0.4			FILL: Gravelly Sandy SILT, firm, fine to medium grained sand, fine to coarse gravel, brownish red to yellowish brown with depth.			MW04_0.4-0.5	0.0		
0.8				S/M	Bentonite	MW04_0.8-0.9	7.3		1
1.3			FILL: Sandy Silty GRAVEL, coarse gravel, fine to medium grained sand, loose, brownish yellow.	D		MW04_1.3-1.4	0.0		
1.4			NATURAL: Sandy Gravelly SILT, firm, fine to medium grained sand, fine to coarse gravel, reddish to yellowish brown.	M		MW04_1.4-1.5	0.4		
						MW04_2.0-2.1	0.0		2
					Sand				
2.8			NATURAL: Gravelly Sandy SILT, firm, fine to medium gravel, fine to medium grained sand, light brown.	S/M		MW04_2.8-2.9	0.0		
								Push Tube refusal.	3
3.4	▽		NATURAL: Gravelly Sandy SILT, soft, fine to medium gravel, fine to medium grained sand, light brown.	W		MW04_3.4-3.5	0.0		
	▽					MW04_3.5-3.6	0.0		
3.8			MW04 Terminated at 3.8m bgl.						4

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MONITORING WELL LOG

Client: One Rail Australia
Project: Diesel Spill
Project No: J168829
Location Berrimah, NT

Date Drilled: 16/07/2020
Drilling Co: Proactive Drilling Services
Total Depth (m): 3.80
Diameter (mm): 50

Bore No.: MW04A
Easting: 708461.577
Northing: 8621003.05
Logged by: VB
Checked by: AS

COMMENTS

Depth/Elevation	WATER STRIKE	Graphic Log	SOIL DESCRIPTION	Moisture	Well Diagram	Field ID	PID (ppm)	Comment	Depth (m)
			FILL: Gravelly Silty SAND, fine to medium grained sand, fine to medium gravel, medium dense, light brownish grey.	M	Concrete				
0.58			FILL: Gravelly Sandy SILT, stiff, fine to medium gravel, fine to medium grained sand, yellowish brown to reddish brown.	M					
0.71			FILL: Gravelly Sandy SILT, firm, fine to medium gravel, fine to medium grained sand, brownish red.	S/M	Bentonite				1
1.1			FILL: Gravelly Sandy SILT, firm, fine to coarse gravel, yellowish brown to light greyish purple.						
1.6			NATURAL - Gravelly Sandy SILT, firm, medium dense, fine to coarse gravel, fine to medium grained sand, yellowish brown.		Sand				2
				S/M					3
				W					
				M					
3.8			MW04A Terminated @ 3.80m bgl.						4

ENVIRONMENTAL LOGGING SHEET

Project Name	Berrimah Terminal
Client	
Project No.	
Location	
Datum	

Bore / Well ID	MW05
Page	
Total Depth	3.2m
Drilling Contractor	Proactive
Drill Method	Air
Drill Rig Model	
Drilling Fluid	
Logged by	AR
Checked by	

Date Started	13/10/2020
Date Finished	13/10/2020
Elevation	
Northing	
Easting	
Borehole Dia. (mm)	120
Permit No	
Water Depth Cut (m)	2.5
Water Depth Standing (m)	2

Depth Scale	Method	Penetration - 1=S, 2=M, 3=H, 4=R	Lithology: Depth From / To	Classification	Primary Lithology	Secondary Lithology	Primary Colour	Secondary Colour	Grain Size	Shape	Plasticity	Moisture	Consistency - cohesive soils only	Additional Comments (secondary lithology description / structure / minor components / mottling / general observations)	Odour	Staining	Sample / Duplicate ID	PID	Well Constr.
0	RA	M	0 1	N	SI	SA	Br	-	F/C	-	-	D		Silty Sand, gravels to 25mm.	N	N		0	
1		M	1 1	N	SI	SA	Br	-	F/C	-	-	D		Silty Sand, gravels to 25mm.					
2		M	2 3	N	CL	SA	Br	-	F/C	-	-	D/M		Light brown, slight moisture	N	N		0	
3		M	3 4	N	CL	SA	Br	-	F/C	-	-	W		Becoming wet at 3m, drilled to 4m, collapse back to 3.2m.	N	N		0	
4																			
			50mm PVC																
			3 metre screen																
			0.2m casing with gatic.																

Well Constr.: Gatic; Standpipe; Enviro cap; Pvc cap; Pvc (mm):; Surface seal:; Backfill:; Seal:; Filterpack: (Depth, Anulus, Casing, Anulus)

ENVIRONMENTAL LOGGING SHEET

Project Name	Berrimah Terminal
Client	
Project No.	
Location	
Datum	

Bore / Well ID	MW06
Page	
Total Depth	4m
Drilling Contractor	Proactive
Drill Method	Auger
Drill Rig Model	
Drilling Fluid	
Logged by	AR
Checked by	

Date Started	13/10/2020
Date Finished	13/10/2020
Elevation	
Northing	
Easting	
Borehole Dia. (mm)	120
Permit No	
Water Depth Cut (m)	2.5
Water Depth Standing (m)	2

Depth Scale	Method	Penetration - 1=S, 2=M, 3=H, 4=R	Lithology: Depth From / To	Classification	Primary Lithology	Secondary Lithology	Primary Colour	Secondary Colour	Grain Size	Shape	Plasticity	Moisture	Consistency - cohesive soils only	Additional Comments (secondary lithology description / structure / minor components / mottling / general observations)	Odour	Staining	Sample: Sample / Duplicate ID	Sample: PID	Well Constr.
0	A	M	0 1	N	SI	SA	Br	-	F/C	-	-	D		Silty Sand, gravels to 25mm.	N	N		0	
1		M	1 1	N	SI	SA	Br	-	F/C	-	-	D		Silty Sand, gravels to 25mm.					
2		M	2 3	N	CL	SA	Br	-	F/C	-	-	D/M		Light brown, slight moisture	N	N		0	
3		M	3 4	N	CL	SA	Br	-	F/C	-	-	W		Becoming wet at 3m, drilled to 4m, collapse back to 3.2m.	N	N		0	
4																			
			50mm PVC																
			3 metre screen																
			0.2m casing with gatic.																

Well Constr.

Gatic	
Standpipe	
Enviro cap	
Pvc cap	
Pvc (mm):	
Surface seal:	
Backfill:	
Seal:	
Filterpack:	

Depth	Anulus	Casing	Anulus

ENVIRONMENTAL LOGGING SHEET

Project Name	Berrimah Terminal
Client	
Project No.	
Location	
Datum	

Bore / Well ID	MW07
Page	
Total Depth	5
Drilling Contractor	Proactive
Drill Method	Auger
Drill Rig Model	
Drilling Fluid	
Logged by	AR
Checked by	

Date Started	14/10/2020
Date Finished	14/10/2020
Elevation	
Northing	
Easting	
Borehole Dia. (mm)	120
Permit No	
Water Depth Cut (m)	4
Water Depth Standing (m)	3

Depth Scale	Method	Penetration - 1=S, 2=M, 3=H, 4=R	Lithology: Depth From	Lithology: Depth To	Classification	Primary Lithology	Secondary Lithology	Primary Colour	Secondary Colour	Grain Size	Shape	Plasticity	Moisture	Consistency - cohesive soils only	Additional Comments (secondary lithology description / structure / minor components / mottling / general observations)	Odour	Staining	Sample / Duplicate ID	PID	Well Constr.
0	A	M	0	0	F	SA	Gr	Br		C-30mm			D		Bitumen at surface 200mm Road base to 400mm	N	N		0	
1	A	M	1	2	N	SI	SA	Br	-	F/C	-	-	D		Silty Sand, gravels to 25mm.	N	N		0	
2		M	2	3	N	SI	SA	Br	-	F/C	-	-	D		Silt					
3		M	3	4	N	CL	SA	Br	-	F/C	-	-	D/M		Light brown, slight moisture	N	N		0	
4		M	4	5	N	CL	SA	Br	-	F/C	-	-	W		Becoming wet at 4m	N	N		0	
5																				

50mm PVC
4 metre screen
1m casing with gatic.

Well Constr.: Gatic; Standpipe; Enviro cap; Pvc cap; Pvc (mm):; Surface seal:; Backfill:; Seal:; Filterpack:; Depth; Anulus; Casing; Anulus

ENVIRONMENTAL LOGGING SHEET

Project Name	Berrimah Terminal
Client	
Project No.	
Location	
Datum	

Bore / Well ID	MW08
Page	
Total Depth	5
Drilling Contractor	Proactive
Drill Method	Auger
Drill Rig Model	
Drilling Fluid	
Logged by	AR
Checked by	

Date Started	14/10/2020
Date Finished	14/10/2020
Elevation	
Northing	
Easting	
Borehole Dia. (mm)	120
Permit No	
Water Depth Cut (m)	4
Water Depth Standing (m)	3

Depth Scale	Method	Penetration - 1=S, 2=M, 3=H, 4=R	Lithology: Depth From	Lithology: Depth To	Classification	Primary Lithology	Secondary Lithology	Primary Colour	Secondary Colour	Grain Size	Shape	Plasticity	Moisture	Consistency - cohesive soils only	Additional Comments (secondary lithology description / structure / minor components / mottling / general observations)	Odour	Staining	Sample / Duplicate ID	PID	Well Constr.
0	A	M	0	0	F	SA	Gr	Br		C-30mm			D		Bitumen at surface 200mm Road base to 400mm	N	N		0	
1	A	M	1	2	N	SI	SA	Br	-	F/C	-	-	D		Silty Sand, gravels to 25mm.	N	N		0	
2		M	2	3	N	SI	SA	Br	-	F/C	-	-	D		Silt					
3		M	3	4	N	CL	SA	Br	-	F/C	-	-	D/M		Light brown, slight moisture	N	N		0	
4		M	4	5	N	CL	SA	Br	-	F/C	-	-	W		Becoming wet at 4m	N	N		0	
5																				

50mm PVC
4 metre screen
1m casing with gatic.

Well Constr.: Gatic; Standpipe; Enviro cap; Pvc cap; Pvc (mm):; Surface seal:; Backfill:; Seal:; Filterpack:; Depth; Anulus; Casing; Anulus

MONITORING WELL LOG

Client: One Rail Australia	**Date Drilled:** 6/12/2021	**Bore No.:** MW09
Project: Diesel Spill	**Drilling Co:** Proactive Drilling Services	**Easting:**
Project No: J168829	**Total Depth (m):** 4.738	**Northing:**
Location Berrimah, NT	**Diameter (mm):** 150	**Logged by:** VB
		Checked by: AS

COMMENTS Well collapsed twice when attempting to put PVC in.

WATER STRIKE	Graphic Log	SOIL DESCRIPTION	Moisture	Well Diagram	Comment	Depth (m)
		FILL: Silty SAND, fine to medium grained sand, fine to coarse sized gravels throughout, light brown.	M	Concrete Cement Grout Bentonite W Sand		1 2 3 4
		MW09 Terminated at 4.738m bgl.				5

MONITORING WELL LOG

Client: One Rail Australia	**Date Drilled:** 6/12/2021	**Bore No.:** MW10
Project: Diesel Spill	**Drilling Co:** Proactive Drilling Services	**Easting:**
Project No: J168829	**Total Depth (m):** 4.841	**Northing:**
Location Berrimah, NT	**Diameter (mm):** 150	**Logged by:** VB
		Checked by: AS

COMMENTS

WATER STRIKE	Graphic Log	SOIL DESCRIPTION	Moisture	Well Diagram	Comment	Depth (m)
		REWORKED NATURAL: Silty SAND, fine to medium grained sand, fine to coarse sized gravel throughout, light brown.	M	Concrete Cement Grout Bentonite Sand		1 2 3 4
		MW10 Terminated at 4.841m bgl.				5

W

MONITORING WELL LOG

Client: One Rail Australia	**Date Drilled:** 6/12/2021	**Bore No.:** MW11
Project: Diesel Spill	**Drilling Co:** Proactive Drilling Services	**Easting:**
Project No: J168829	**Total Depth (m):** 5.061	**Northing:**
Location Berrimah, NT	**Diameter (mm):** 150	**Logged by:** VB
		Checked by: AS

COMMENTS

WATER STRIKE	Graphic Log	SOIL DESCRIPTION	Moisture	Well Diagram	Comment	Depth (m)
		BITUMEN LAYER (0-0.05m bgl) FILL - Silty Clayey SAND, fine to medium grained sand, low to medium plasticity, fine to coarse sized gravel throughout, red / brown.	M	Concrete Cement Grout Bentonite		1
▽		NATURAL - Silty SAND, fine to medium grained sand, fine to coarse naturally occurring gravels throughout.	W	Sand		2 3 4
		MW11 Terminated at 5.061m bgl.				5

Darwin Corporate Park
Tenancy 412
Building 4, Level 1
631 Stuart Highway
Berrimah NT 0828

PO Box 1726
Berrimah NT 0828
T 61 8 8944 7888

Fyfe Pty Ltd
ABN 57 008 116 130
fyfe.com.au

Our Ref 73488

13 August 2020

Adam Reed
Environment Manager
One Rail Australia
Level 3
33 Richmond Road
Keswick South Australia 5035

Dear Adam,

BERRIMAH RAIL TERMINAL – MONITORING WELL LOCATIONS

Please see table below showing monitoring well locations and elevations at both the top of PVC casing and adjacent surface. The poly pipes have been marked with a black line at the exact spot where the elevation refers to.

Well ID	Easting	Northing	Well Elev	Surface Elev
MW01	708423.825	8620973.001	5.958	5.227
MW01A	708416.945	8620986.556	5.921	6.005
MW02	708491.822	8620929.677	5.026	5.093
MW03	708498.128	8621016.708	5.891	5.989
MW03A	708497.314	8621016.232	5.869	5.999
MW04	708460.568	8621002.703	5.867	5.99
MW04A	708461.577	8621003.05	5.931	5.995

Origin for both Horizontal (MGA94) and Vertical Datum (AHD) was CRM S97185066, on the corner of O-Sullivan CCT and Export Dr.

Kind Regards

Thomas St John
Surveyor

Darwin Corporate Park
Tenancy 412
Building 4, Level 1
631 Stuart Highway
Berrimah NT 0828

PO Box 1726
Berrimah NT 0828
T 61 8 8944 7888

Fyfe Pty Ltd
ABN 57 008 116 130
fyfe.com.au

Our Ref 73488-1

22 October 2020

Adam Reed
Environment Manager
One Rail Australia
Level 3
33 Richmond Road
Keswick South Australia 5035

Dear Adam,

BERRIMAH RAIL TERMINAL – MONITORING WELL LOCATIONS

Please see table below showing additional monitoring well locations and elevations at both the top of PVC casing and adjacent surface. The poly pipes have been marked with a black line at the exact spot where the elevation refers to.

Well ID		Easting	Northing	Well Elev	Surface Elev
MW10	MW07	708398.119	8620980.232	5.906	5.983
MW11	MW08	708521.037	8621025.589	5.970	5.994
MW12	MW06	708470.486	8621039.916	5.262	5.320
MW13	MW05	708374.723	8621004.469	5.249	5.309

Origin for both Horizontal (MGA94) and Vertical Datum (AHD) was CRM S97185066, on the corner of O-Sullivan CCT and Export Dr.

Kind Regards

Thomas St John
Surveyor

Darwin Corporate Park
Tenancy 412
Building 4, Level 1
631 Stuart Highway
Berrimah NT 0828

PO Box 1726
Berrimah NT 0828
T 61 8 8944 7888

Fyfe Pty Ltd
ABN 57 008 116 130
fyfe.com.au

Our Ref 73488-1

11th February 2022

Adam Reed
Environment Manager
One Rail Australia
Level 3
33 Richmond Road
Keswick South Australia 5035

Dear Adam,

BERRIMAH RAIL TERMINAL – MONITORING WELL LOCATIONS

Please see table below showing additional monitoring well locations and elevations at both the top of PVC casing and adjacent surface. The poly pipes have been marked with a blue line at the exact spot where the elevation refers to.

Well ID	Easting	Northing	Well Elev	Surface Elev
MW09	708501.421	8621051.257	5.177	5.28
MW10	708422.087	8621021.848	5.179	5.291
MW11	708511.515	8621022.397	5.894	5.994

Origin for both Horizontal (MGA94) and Vertical Datum (AHD) was CRM S97185066, on the corner of O-Sullivan CCT and Export Dr.

Kind Regards

Thomas St John
Surveyor

July 2023

GREENCAP
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Groundwater Monitoring and Management Plan

Aurizon

Appendix B: Groundwater Sampling Methodology

1.0 GROUNDWATER SAMPLING METHODOLOGY

Sampling Procedure

Groundwater samples shall be collected as follows:

- Prior to collecting groundwater samples, standing water levels must be measured from the top of the casing. Measurements must also be taken to check for any separate phase (free) product present in each of the wells.
- Groundwater sampling to be conducted using low-flow sampling techniques. The flow rate must be monitored and regulated using an interface probe to maintain a stable water level during the purging and sampling of the groundwater. If the water level is shown to draw down at a low flow rate (i.e. cannot be maintained), alternative sampling methods should be adopted (i.e. bailer or Wattera).
- Water quality parameters (pH, temperature, electrical conductivity, oxidation reduction potential and dissolved oxygen) should be monitored during purging using a water quality meter. Sampling can occur when the drawdown and these parameters have shown to stabilise in accordance with that described in the NT Department of Mines and Energy M*ethodology for the Sampling of Ground Waters* (2009).
- The sampler must wear a clean pair of latex disposable gloves between collecting each sample.
- All groundwater samples collected to be placed in containers provided by the analytical laboratory.

Quality Control and Quality Assurance (QA/QC)

QA/QC sampling and analysis must comprise the following:

- Intra-laboratory and Inter-laboratory duplicate groundwater samples to be collected at a frequency of 1 sample per 10 primary samples. Duplicated samples should be tested for the same suite of analytes as primary samples.
- Rinsate samples should be collected at a rate of 1 per day for non-dedicated sampling equipment such as micro-purge pumps etc. to assess the quality of the equipment decontamination. These should be analysed for chemicals of concern (specifically volatile organic compounds and TPH).
- Trip blank samples should be collected at a rate of 1 per sampling day. These should be analysed for chemicals of concern (specifically volatile organic compounds and TPH).

2.0 GENERAL QUALITY ASSURANCE / QUALITY CONTROL

The Quality Assurance / Quality Control (QA / QC) measures (as discussed in the previous sections) to be adopted include:

- accuracy (as measured by laboratory spike and surrogate recovery samples) within 75 - 125 % recovery;
- precision (as measured by field and laboratory duplicate sample analyses) within +/- 30% relative percent difference (RPD);
- trip, rinsate and field blanks should be reported below the laboratory detection limits; and
- minimum 95% completeness (as measured by the total number of analyses within acceptance limits).

July 2023

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Appendix C: Groundwater Sampling Results

greencap.com.au

Adelaide | Auckland | Brisbane | Canberra | Darwin | Melbourne | Newcastle | Perth | Sydney | Wollongong

Greencap
Groundwater Level Gauging Form

GREENCAP
Going Further in Managing Risk

Client: ORA		Job No: J168829
Project: Diesel Spill		Gauged by: VB
Location: ORA Berrimah		Date: 8/12/21 & 10/12/21

Water Level Dipper Type (interphase, length etc): IP

Time	Well Name	Depth to Product (m)	Depth to water (m)	Product Thickness (mm)	Depth of Well (m)	Comments
0834	MW07	–	2.441	–	4.655	
0917	MW01A	–	2.459	–	4.888	
1004	MW04	–	2.472	–	3.809	
1040	MW03	–	2.434	–	4.346	
1130	MW11	–	2.441	–	5.061	
1210	MW08	–	2.514	–	5.018	
0213	MW05	–	1.806	–	3.296	
0859	MW10	–	1.756	–	4.248	
0946	MW06	–	1.816	–	4.000	
1045	MW09	–	1.742	–	4.371	
1139	MW02	–	1.583	–	5.227	
1221	MW01	–	2.517	–	4.482	SLIGHT HC ODOUR ON PROBE

Observations / Comments:
Weather Conditions (e.g. cloudy, sunny, windy etc), Pumping, etc

SUNNY, HOT

Greencap
Groundwater Level Gauging Form

GREENCAP
Going Further in Managing Risk

Client: ORA		Job No: J168829
Project: Diesel Spill		Gauged by: VB
Location: ORA Berrimah		Date: 8/12/21 & 10/12/21

Water Level Dipper Type (interphase, length etc): IP

Time	Well Name	Depth to Product (m)	Depth to water (m)	Product Thickness (mm)	Depth of Well (m)	Comments
0834	MW07	–	2.441	–	4.655	
0917	MW01A	–	2.459	–	4.888	
1004	MW04	–	2.472	–	3.809	
1040	MW03	–	2.434	–	4.346	
1130	MW11	–	2.441	–	5.061	
1210	MW08	–	2.514	–	5.018	
0213	MW05	–	1.806	–	3.296	
0859	MW10	–	1.756	–	4.248	
0946	MW06	–	1.816	–	4.000	
1045	MW09	–	1.742	–	4.371	
1139	MW02	–	1.583	–	5.227	
1221	MW01	–	2.517	–	4.482	SLIGHT HC ODOUR ON PROBE

Observations / Comments:
Weather Conditions (e.g. cloudy, sunny, windy etc), Pumping, etc

SUNNY, HOT

Groundwater Sampling Record

GREENCAP
Going Further In Managing Risk

Client:	ORA	Job No:	J168829
Project:	Diesel Spill	Sampled by:	VB
Location:	ORA Berrimah	Date:	8/12/21

Well ID: MW01A

WELL DETAILS			SAMPLING EQUIPMENT				
Well depth:	4.886	(m)	Device:	micropurge	(peristaltic)	footvalve	bailer
Casing diameter:	50	(mm)	Method:	(low-flow)	4-well-volume	(purged dry)	
Casing type:	(PVC) / steel / other		WQM Make:	YSI			
Depth to product	–	(m bTOC)	WL Meter:	interface	non-interface		
Depth to water:	2.459	(m bTOC)	Screen (from - to), m	1.886 – 4.886			
Product thickness	–	(m)	Pump Depth (m bTOC)				

*Other Sampling Equipment / Method

Field observations: eg. well condition, nearby activities, weather, vegetation, etc

SUNNY, WARM

Purging instructions:

Low Flow: Start purging and stabilise the water level at ~ 0.1m drawdown. Once water level stabilises start taking water quality readings. Readings are to be taken every 3 minutes or every flow-through-cell volume (whichever is greater). Purging finishes when the three consecutive readings are within the ranges below.

4-well volume: The purging will continue until at least 4 well volumes and three consecutive readings are within the ranges below. Water quality readings are to be taken at half-well-volume apart.
Well volume: 50mm (2") diameter - 2 L/metre; 100mm (4") diameter - 8 L/metre; 150mm (6") diameter - 18 L/metre

Stabilisation Criteria (3 readings within ranges)		Drawdown stable <0.1m	± 0.2 °C	± 0.1 pH unit	± 5%	± 10mv	± 10%	Comment
Time	Cumulative Volume purged (L)	Water Level (m bTOC)	Temp °C	pH Units	Sp. Cond (µS/cm) mS/cm	ORP mV	DO mg/L / ppm / (%)	Turbidity, Colour, Odour, Sheen, etc
0919	INT	2.532	35.5	5.78	65921	7.3	9.2	L-M TURB, clear, no sheen/odour
0923	2.5	2.906	35.8	5.97	57583	-13.8	17.8	
0926	4.5	3.191	35.7	6.16	48947	-22.4	26.0	
0929	6.5	3.389	35.7	6.10	47216	-21.1	44.1	
0932	8.5	3.633	35.6	6.18	42103	-23.6	47.5	
0935	10.5	3.914	35.7	6.20	36645	-19.3	46.7	
* 0944	14.5	DRY	35.4	5.99	50260	-10.3	70.3	
* * 1253	~~Hose~~	3.472	35.9	5.21	56517	45.8	110.6	
			SAMPLED					

Observations during Sampling:- eg. odours, sheens, turbidity, water colour, etc

L-M TURB, CLEAR, NO SHEEN/ODOUR

Container Volume (L)	No of containers	Preservative
Glass amber (100-250ml)	3	none
Glass vial (40mL)	6	HCl
Plastic (60mL) - **metals***	3	HNO3
Plastic (60mL) - cyanide, CrVI*		NaOH
Plastic (60mL) - nutrients	3	H2SO4
Plastic (500mL) - inorganics	3	none
Plastic (Fe)	3	
Plastic ( )		
	21	

*samples for dissolved metals to be filtered in the field prior to filling sampling container

Duplicates

Duplicate ID: QC01

Triplicate ID: QC01A

Blanks

Rinsate ID:

Other Comments

* WENT DRY AFTER 14.5 L PURGED

* * SAMPLED AFTER 3 HOURS ~~DRY~~ SINCE PURGED DRY

DRAFT

Groundwater Sampling Record

GREENCAP
Going Further In Managing Risk

Client:	ORA	Job No:	J168829
Project:	Diesel Spill	Sampled by:	VB
Location:	ORA Berrimah	Date:	10/12/21

Well ID: MW01

WELL DETAILS		SAMPLING EQUIPMENT				
Well depth:	4.482 (m)	Device:	micropurge	(peristaltic)	footvalve	bailer
Casing diameter:	50 (mm)	Method:	(low-flow)	4-well-volume	purged dry	
Casing type:	(PVC) / steel / other	WQM Make:	YSI			
Depth to product	— (m bTOC)	WL Meter:	(interface)	non-interface		
Depth to water:	2.517 (m bTOC)	Screen (from - to), m	1.482 - 4.482			
Product thickness	— (m)	Pump Depth (m bTOC)				

*Other Sampling Equipment / Method:

Field observations: eg. well condition, nearby activities, weather, vegetation, etc

SUNNY, SLIGHT WIND

Purging instructions:

Low Flow: Start purging and stabilise the water level at ~ 0.1m drawdown. Once water level stabilises start taking water quality readings. Readings are to be taken every 3 minutes or every flow-through-cell volume (whichever is greater). Purging finishes when the three consecutive readings are within the ranges below.

4-well volume: The purging will continue until at least 4 well volumes and three consecutive readings are within the ranges below. Water quality readings are to be taken at half-well-volume apart.
Well volume: 50mm (2") diameter - 2 L/metre; 100mm (4") diameter - 8 L/metre; 150mm (6") diameter - 18 L/metre

Stabilisation Criteria (3 readings within ranges)		Drawdown stable <0.1m	± 0.2 °C	± 0.1 pH unit	± 5%	± 10mv	± 10%	Comment
Time	Cumulative Volume purged (L)	Water Level (m bTOC)	Temp °C	pH Units	Sp. Cond (µS/cm) / mS/cm	ORP mV	DO mg/L / ppm / (%)	Turbidity, Colour, Odour, Sheen, etc
1223	INT	2.521	37.7	5.68	72.2	45.9	93.5	L-M turb, clear, no sheen, slight HC odour
1226	2	2.521	37.4	5.61	67.7	43.8	89.8	
1229	4	2.521	37.2	5.60	65.3	44.8	89.3	
1232	6	2.521	~~37.2~~ 37.2	5.60	64.8	44.9	89.2	
1235	8	2.521	37.1	5.59	60.5	48.2	104.5	
1238	10	2.521	36.9	5.57	59.8	49.8	103.8	
1242	12	2.521	36.8	5.53	57.9	53.2	104.9	
			SAMPLED					

Observations during Sampling:- eg. odours, sheens, turbidity, water colour, etc

SAMPLED AFTER 12L PURGED, QUICK RECHARGE
L-M TURB, CLEAR, NO SHEEN/ODOUR

Container Volume (L)	No of containers	Preservative
Glass amber (100-250ml)	1	none
Glass vial (40mL)	2	HCl
Plastic (60mL) - metals*	1	HNO3
Plastic (60mL) - cyanide, CrVI*		NaOH
Plastic (60mL) - nutrients	1	H2SO4
Plastic (500mL) - inorganics	1	none
Plastic (Fe)	1	
Plastic ( )	(2)	

*samples for dissolved metals to be filtered in the field prior to filling sampling container

Duplicates

Duplicate ID

Triplicate ID

Blanks

Rinsate ID

Other Comments

Groundwater Sampling Record

GREENCAP
Going Further in Managing Risk

Client:	ORA	Job No:	J168829
Project:	Diesel Spill	Sampled by:	VB
Location:	ORA Berrimah	Date:	10/12/21

Well ID: MW02

WELL DETAILS			SAMPLING EQUIPMENT				
Well depth:	5.227	(m)	Device:	micropurge	(peristaltic)	footvalve	bailer
Casing diameter:	50	(mm)	Method:	(low-flow)	4-well-volume	purged dry	
Casing type:	(pvc) / steel / other		WQM Make:	YSI			
Depth to product	—	(m bTOC)	WL Meter:	(interface)	non-interface		
Depth to water:	1.583	(m bTOC)	Screen (from - to), m	2.227 - 5.227			
Product thickness	—	(m)	Pump Depth (m bTOC)				

***Other Sampling Equipment / Method**

Field observations: eg. well condition, nearby activities, weather, vegetation, etc

SUNNY, SLIGHT WIND

Purging instructions:

Low Flow: Start purging and stabilise the water level at ~ 0.1m drawdown. Once water level stabilises start taking water quality readings. Readings are to be taken every 3 minutes or every flow-through-cell volume (whichever is greater). Purging finishes when the three consecutive readings are within the ranges below.

4-well volume The purging will continue until at least 4 well volumes and three consecutive readings are within the ranges below. Water quality readings are to be taken at half-well-volume apart.
Well volume: 50mm (2") diameter - 2 L/metre; 100mm (4") diameter - 8 L/metre; 150mm (6") diameter - 18 L/metre

Stabilisation Criteria (3 readings within ranges)		Drawdown stable <0.1m	± 0.2 °C	± 0.1 pH unit	± 5%	± 10mv	± 10%	Comment
Time	Cumulative Volume purged (L)	Water Level (m bTOC)	Temp °C	pH Units	Sp. Cond (µS/cm) / mS/cm	ORP mV	DO mg/L / ppm / (%)	*Turbidity, Colour, Odour, Sheen, etc*
1145	INT	1.585	34.5	5.71	17105	50.4	90.3	L-M turb, clear, no sheen/odour
1148	2	1.585	34.6	5.43	14496	41.9	92.8	
1151	4	1.585	34.7	5.39	12689	39.8	92.0	
1154	6	1.585	34.7	5.35	11846	38.2	90.4	
1157	8	1.585	34.7	5.32	11748	37.4	89.0	
1200	10	1.585	34.7	5.30	11753	36.4	87.9	
			SAMPLED					

Observations during Sampling:- eg. odours, sheens, turbidity, water colour, etc

SAMPLED AFTER 10L PURGED, QUICK RECHARGE
L-M TURB, CLEAR, NO SHEEN/ODOUR

Container Volume (L)	No of containers	Preservative
Glass amber (100-250ml)	1	none
Glass vial (40mL)	2	HCl
Plastic (60mL) - **metals***	1	HNO3
Plastic (60mL) - cyanide, CrVI*		NaOH
Plastic (60mL) - nutrients	1	H2SO4
Plastic (500mL) - inorganics	1	none
Plastic ( ) Fe	1	
Plastic ( )		

Duplicates

Duplicate ID

Triplicate ID

Blanks

Rinsate ID

Other Comments

*samples for dissolved metals to be filtered in the field prior to filling sampling container

Groundwater Sampling Record

GREENCAP
Going Further in Managing Risk

Client:	ORA	Job No:	J168829
Project:	Diesel Spill	Sampled by:	VB
Location:	ORA Berrimah	Date:	8/12/24

Well ID: MW03

WELL DETAILS			SAMPLING EQUIPMENT				
Well depth:	4.346	(m)	Device:	micropurge	peristaltic	footvalve	bailer
Casing diameter:	50	(mm)	Method:	low-flow	4-well-volume	purged dry	
Casing type:	(PVC) / steel / other		WQM Make:	YSI			
Depth to product	–	(m bTOC)	WL Meter:	interface	non-interface		
Depth to water:	2.434	(m bTOC)	Screen (from - to), m	1.346 – 4.346			
Product thickness	–	(m)	Pump Depth (m bTOC)				

*Other Sampling Equipment / Method

Field observations: eg. well condition, nearby activities, weather, vegetation, etc

SUNNY, PARTLY OVERCAST, SLIGHT WIND TRAIN PARKED ADJACENT TO WELL

Purging instructions:

Low Flow: Start purging and stabilise the water level at ~ 0.1m drawdown. Once water level stabilises start taking water quality readings. Readings are to be taken every 3 minutes or every flow-through-cell volume (whichever is greater). Purging finishes when the three consecutive readings are within the ranges below.

4-well volume The purging will continue until at least 4 well volumes and three consecutive readings are within the ranges below. Water quality readings are to be taken at half-well-volume apart.
Well volume 50mm (2") diameter - 2 L/metre; 100mm (4") diameter - 8 L/metre; 150mm (6") diameter - 18 L/metre

Stabilisation Criteria (3 readings within ranges)		Drawdown stable <0.1m	± 0.2 °C	± 0.1 pH unit	± 5%	± 10mv	± 10%	Comment
Time	Cumulative Volume purged (L)	Water Level (m bTOC)	Temp °C	pH Units	Sp. Cond µS/cm / mS/cm	ORP mV	DO mg/L / ppm / %	Turbidity, Colour, Odour, Sheen, etc
1042	INT	2.5006	36.6	5.19	3938	72.6	57.0	L-M turb, clear, no sheen/odour
1045	2	2.676	36.9	4.63	1972	91.0	58.1	
1048	4	2.772	36.7	4.66	2160	85.4	50.4	
1051	6	2.809	36.6	4.78	2252	76.2	44.7	
1056	7.5	2.809	36.6	5.23	1896	51.0	41.0	
1103	9.0	2.809	36.5	5.28	1848	47.3	41.0	
1110	10.5	2.809	36.4	5.35	1802	45.0	45.0	
				SAMPLED				

Observations during Sampling:- eg. odours, sheens, turbidity, water colour, etc

MED RECHARGE, SAMPLED AFTER 10.5L PURGED
L-M TURB, CLEAR, NO SHEEN/ODOUR

Container Volume (L)	No of containers	Preservative
Glass amber (100-250ml)	1	none
Glass vial (40mL)	2	HCl
Plastic (60mL) - **metals***	1	HNO3
Plastic (60mL) - cyanide, **CrVI***		NaOH
Plastic (60mL) - nutrients	1	H2SO4
Plastic (500mL) - inorganics	1	none
Plastic ( ) Fe	1	
Plastic ( )		
	(7)	

Duplicates
Duplicate ID
Triplicate ID
Blanks
Rinsate ID

Other Comments

*samples for dissolved metals to be filtered in the field prior to filling sampling container

Groundwater Sampling Record

GREENCAP
Going Further in Managing Risk

Client:	ORA	Job No:	J168829
Project:	Diesel Spill	Sampled by:	VB
Location:	ORA Berrimah	Date:	8/12/21

Well ID: MW04

WELL DETAILS		SAMPLING EQUIPMENT				
Well depth:	3.809 (m)	Device:	micropurge	peristaltic	footvalve	bailer
Casing diameter:	50 (mm)	Method:	low-flow	4-well-volume	purged dry	
Casing type:	PVC / steel / other	WQM Make:	YSI			
Depth to product	(m bTOC)	WL Meter:	interface	non-interface		
Depth to water:	2.472 (m bTOC)	Screen (from - to), m	0.809 - 3.809			
Product thickness	— (m)	Pump Depth (m bTOC)				

*Other Sampling Equipment / Method:

Field observations: eg. well condition, nearby activities, weather, vegetation, etc
SUNNY, PARTLY CLOUDY, TRAIN STOPPED ADJACENT TO WELL

Purging instructions:

Low Flow: Start purging and stabilise the water level at ~ 0.1m drawdown. Once water level stabilises start taking water quality readings. Readings are to be taken every 3 minutes or every flow-through-cell volume (whichever is greater). Purging finishes when the three consecutive readings are within the ranges below.

4-well volume: The purging will continue until at least 4 well volumes and three consecutive readings are within the ranges below. Water quality readings are to be taken at half-well-volume apart.
Well volume: 50mm (2") diameter - 2 L/metre, 100mm (4") diameter - 8 L/metre, 150mm (6") diameter - 18 L/metre

Stabilisation Criteria (3 readings within ranges)		Drawdown stable <0.1m	± 0.2 °C	± 0.1 pH unit	± 5%	± 10mv	± 10%	Comment
Time	Cumulative Volume purged (L)	Water Level (m bTOC)	Temp °C	pH Units	Sp. Cond µS/cm / mS/cm	ORP mV	DO mg/L / ppm / %	Turbidity, Colour, Odour, Sheen, etc
1007	INT	2.479	36.0	6.05	15022	40.6	48.3	L-M turb, L. brown, no sheen odour
1010	2	2.477	36.1	5.59	15123	43.4	48.4	
1013	4	2.477	36.0	5.43	15176	42.1	48.9	
1016	6	2.477	36.0	5.36	15187	40.6	49.5	
1019	8	2.477	36.2	5.32	15214	39.2	50.3	
1021	10	2.477	36.2	5.30	15234	38.1	50.9	
			SAMPLED					

Observations during Sampling:- eg. odours, sheens, turbidity, water colour, etc
SAMPLED AFTER 10L PURGED, QUICK RECHARGE
L-M TURB, L. BROWN, NO SHEEN/ODOUR

Container Volume (L)	No of containers	Preservative
Glass amber (100-250ml)	1	none
Glass vial (40mL)	2	HCl
Plastic (60mL) - **metals***	1	HNO3
Plastic (60mL) - cyanide, **CrVI***		NaOH
Plastic (60mL) - nutrients	1	H2SO4
Plastic (500mL) - inorganics	1	none
Plastic ( ) Fe	1	
Plastic ( )		

Duplicates
Duplicate ID
Triplicate ID
Blanks
Rinsate ID

Other Comments

*samples for dissolved metals to be filtered in the field prior to filling sampling container

Groundwater Sampling Record

GREENCAP
Going Further in Managing Risk

Client:	ORA	Job No:	J168829
Project:	Diesel Spill	Sampled by:	VB
Location:	ORA Berrimah	Date:	10/12/21

Well ID: MW05

WELL DETAILS		SAMPLING EQUIPMENT				
Well depth:	3.296 (m)	Device:	micropurge	(peristaltic)	footvalve	bailer
Casing diameter:	50 (mm)	Method:	(low-flow)	4-well-volume	purged dry	
Casing type:	(PVC) / steel / other	WQM Make:	YSI			
Depth to product	— (m bTOC)	WL Meter:	(interface)	non-interface		
Depth to water:	1.806 (m bTOC)	Screen (from - to), m	0.296 – 3.296			
Product thickness	— (m)	Pump Depth (m bTOC)				

*Other Sampling Equipment / Method

Field observations: eg. well condition, nearby activities, weather, vegetation, etc

SUNNY, LIGHT WIND

Purging instructions:

Low Flow: Start purging and stabilise the water level at ~ 0.1m drawdown. Once water level stabilises start taking water quality readings. Readings are to be taken every 3 minutes or every flow-through-cell volume (whichever is greater). Purging finishes when the three consecutive readings are within the ranges below.

4-well volume The purging will continue until at least 4 well volumes and three consecutive readings are within the ranges below. Water quality readings are to be taken at half-well-volume apart.
Well volume 50mm (2") diameter - 2 L/metre, 100mm (4") diameter - 8 L/metre, 150mm (6") diameter - 18 L/metre

Stabilisation Criteria (3 readings within ranges)		Drawdown stable <0.1m	± 0.2 °C	± 0.1 pH unit	± 5%	± 10mv	± 10%	Comment
Time	Cumulative Volume purged (L)	Water Level (m bTOC)	Temp °C	pH Units	Sp. Cond (µS/cm) / mS/cm	ORP mV	DO mg/L / ppm / (%)	Turbidity, Colour, Odour, Sheen, etc
0820	INT	1.813	33.8	8.24	36785	-46.8	78.1	1cm turb, clear, no sheen/ odour
0823	2	1.813	34.0	7.19	36797	-25.4	80.2	
0826	4	1.813	340	6.82	36873	-28.7	80.2	
0829	6	1.813	34.1	6.55	36725	-25.7	80.9	
0832	8	1.813	340	6.33	36756	-17.9	82.3	
0835	10	1.813	340	6.20	37044	-10.6	83.5	
0838	12	1.813	34.0	6.10	37369	-6.3	85.5	
0841	14	1.813	34.0	6.06	37476	-3.1	86.0	
0844	16	1.813	34.0	6.02	37248	-0.8	85.8	

Observations during Sampling:- eg. odours, sheens, turbidity, water colour, etc

SAMPLED AFTER 16L PURGED, QUICK RECHARGE

Container Volume (L)	No of containers	Preservative
Glass amber (100-250ml)	1	none
Glass vial (40mL)	2	HCl
Plastic (60mL) - metals*	1	HNO3
Plastic (60mL) - cyanide, CrVI*		NaOH
Plastic (60mL) - nutrients	1	H2SO4
Plastic (500mL) - inorganics	1	none
Plastic ( ) Fe	1	
Plastic ( )		
	(7)	

*samples for dissolved metals to be filtered in the field prior to filling sampling container

Duplicates

Duplicate ID

Triplicate ID

Blanks

Rinsate ID

RB02

TB02

Other Comments

Groundwater Sampling Record

GREENCAP
Going Further In Managing Risk

Client:	ORA	Job No:	J168829
Project:	Diesel Spill	Sampled by:	VB
Location:	ORA Berrimah	Date:	16/12/21

Well ID: MW06

WELL DETAILS			SAMPLING EQUIPMENT				
Well depth:	4.000	(m)	Device:	micropurge	peristaltic	footvalve	bailer
Casing diameter:	50	(mm)	Method:	low-flow	4-well-volume	purged dry	
Casing type:	PVC / steel / other		WQM Make:	YSI			
Depth to product	–	(m bTOC)	WL Meter:	interface	non-interface		
Depth to water:	1.816	(m bTOC)	Screen (from - to), m	1.000 - 4.000			
Product thickness	–	(m)	Pump Depth (m bTOC)				

*Other Sampling Equipment / Method

Field observations: eg. well condition, nearby activities, weather, vegetation, etc

SUNNY, SLIGHT WIND

Purging instructions:

Low Flow: Start purging and stabilise the water level at ~ 0.1m drawdown. Once water level stabilises start taking water quality readings. Readings are to be taken every 3 minutes or every flow-through-cell volume (whichever is greater). Purging finishes when the three consecutive readings are within the ranges below.

4-well volume: The purging will continue until at least 4 well volumes and three consecutive readings are within the ranges below. Water quality readings are to be taken at half-well-volume apart.
Well volume: 50mm (2") diameter - 2 L/metre; 100mm (4") diameter - 8 L/metre, 150mm (6") diameter - 18 L/metre

Stabilisation Criteria (3 readings within ranges)		Drawdown stable <0.1m	± 0.2 °C	± 0.1 pH unit	± 5%	± 10mv	± 10%	Comment
Time	Cumulative Volume purged (L)	Water Level (m bTOC)	Temp °C	pH Units	Sp. Cond µS/cm / mS/cm	ORP mV	DO mg/L / ppm / %	Turbidity, Colour, Odour, Sheen, etc
0958	INT	1.824	32.7	7.24	22737	-47.4	109.9	L-m turb, clear, no sheen/odour
1001	2	1.822	32.0	6.45	22639	-11.7	122.0	
1004	4	1.822	32.0	6.08	21818	-7.7	122.0	
1007	6	1.822	32.0	5.77	22407	-5.6	120.8	
1010	8	1.822	32.0	5.63	21792	-3.4	119.8	
1015	10	1.822	32.0	5.56	22922	-1.8	118.0	
1018	12	1.822	32.0	5.41	23005	5.7	118.4	
1021	14	1.822	32.1	5.39	22998	7.1	113.9	
1024	16	1.822	32.0	5.36	22999	8.5	114.1	

Observations during Sampling:- eg. odours, sheens, turbidity, water colour, etc

SAMPLED AFTER 16L PURGED, QUICK RECHARGE

Container Volume (L)	No of containers	Preservative
Glass amber (100-250ml)	1	none
Glass vial (40mL)	2	HCl
Plastic (60mL) - metals*	1	HNO3
Plastic (60mL) - cyanide, CrVI*		NaOH
Plastic (60mL) - nutnents	1	H2SO4
Plastic (500mL) - inorganics	1	none
Plastic ( ) Fe	1	
Plastic ( )		
	(7)	

*samples for dissolved metals to be filtered in the field prior to filling sampling container

Duplicates

Duplicate ID

Triplicate ID

Blanks

Rinsate ID

Other Comments

Groundwater Sampling Record

GREENCAP
Going Further in Managing Risk

Client:	ORA	Job No:	J168829
Project:	Diesel Spill	Sampled by:	VB
Location:	ORA Berrimah	Date:	8/12/21

Well ID: MW07

WELL DETAILS		SAMPLING EQUIPMENT				
Well depth:	4.653 (m)	Device:	micropurge	(peristaltic)	footvalve	bailer
Casing diameter:	50 (mm)	Method:	(low-flow)	4-well-volume	purged dry	
Casing type:	(PVC) / steel / other	WQM Make:	YSI			
Depth to product	— (m bTOC)	WL Meter:	(interface)	non-interface		
Depth to water:	2.441 (m bTOC)	Screen (from - to), m	1.653 - 4.653			
Product thickness	— (m)	Pump Depth (m bTOC)				

Other Sampling Equipment / Method

Field observations: eg. well condition, nearby activities, weather, vegetation, etc

SUNNY, WARM

Purging instructions:

Low Flow: Start purging and stabilise the water level at ~ 0.1m drawdown. Once water level stabilises start taking water quality readings. Readings are to be taken every 3 minutes or every flow-through-cell volume (whichever is greater). Purging finishes when the three consecutive readings are within the ranges below.

4-well volume The purging will continue until at least 4 well volumes and three consecutive readings are within the ranges below. Water quality readings are to be taken at half-well-volume apart.
Well volume: 50mm (2") diameter - 2 L/metre; 100mm (4") diameter - 8 L/metre; 150mm (6") diameter - 18 L/metre

Stabilisation Criteria (3 readings within ranges)		Drawdown stable <0.1m	± 0.2 °C	± 0.1 pH unit	± 5%	± 10mv	± 10%	Comment
Time	Cumulative Volume purged (L)	Water Level (m bTOC)	Temp °C	pH Units	Sp. Cond (µS/cm) mS/cm	ORP mV	DO mg/L / ppm / (%)	Turbidity, Colour, Odour, Sheen, etc
0841	INT	2.443	36.0	7.80	30846	531.9	30.0	L-M TURB, clear, no sheen/odour
0844	2	2.443	36.4	7.73	14774	-28.9	17.7	
0848	4	2.443	36.5	7.59	13811	-30.7	14.8	
0851	6	2.443	36.6	7.19	12712	-27.3	10.5	
0854	8	2.443	36.6	6.86	12382	-21.6	6.3	
0858	10	2.443	36.6	6.63	12387	-17.1	5.6	
0901	12	2.443	36.6	6.59	12049	-13.7	5.8	
0904	14	2.443	36.7	6.57	12285	-9.3	5.9	
				SAMPLED				

Observations during Sampling:- eg. odours, sheens, turbidity, water colour, etc

SAMPLED AFTER 14L PURGED, QUICK RECHARGE
L-M TURBIDITY, CLEAR, NO SHEEN/ODOUR

Container Volume (L)	No of containers	Preservative
Glass amber (100-250ml)	1	none
Glass vial (40mL)	2	HCl
Plastic (60mL) - metals*	1	HNO3
Plastic (60mL) - cyanide, CrVI*		NaOH
Plastic (60mL) - nutrients	1	H2SO4
Plastic (500mL) - inorganics	1	none
Plastic ( ) FE	1	
Plastic ( )	(7)	

*samples for dissolved metals to be filtered in the field prior to filling sampling container

Duplicates

Duplicate ID

Triplicate ID

Blanks

Rinsate ID
RB01
TB01

Other Comments

Groundwater Sampling Record

GREENCAP
Going Further In Managing Risk

Client:	ORA	Job No:	J168829
Project:	Diesel Spill	Sampled by:	VB
Location:	ORA Berrimah	Date:	8/12/21

Well ID: MW08

WELL DETAILS			SAMPLING EQUIPMENT				
Well depth:	5.018	(m)	Device:	micropurge	peristaltic	footvalve	bailer
Casing diameter:	50	(mm)	Method:	low-flow	4-well-volume	purged dry	
Casing type:	PVC / steel / other		WQM Make:	YSI			
Depth to product	–	(m bTOC)	WL Meter:	interface	non-interface		
Depth to water:	2.514	(m bTOC)	Screen (from - to), m	2.018 - 5.018			
Product thickness	–	(m)	Pump Depth (m bTOC)				

*Other Sampling Equipment / Method

Field observations: eg. well condition, nearby activities, weather, vegetation, etc

SUNNY, PARTLY CLOUDY, SLIGHT WIND

Purging instructions:

Low Flow: Start purging and stabilise the water level at ~ 0.1m drawdown. Once water level stabilises start taking water quality readings. Readings are to be taken every 3 minutes or every flow-through-cell volume (whichever is greater). Purging finishes when the three consecutive readings are within the ranges below.

4-well volume The purging will continue until at least 4 well volumes and three consecutive readings are within the ranges below. Water quality readings are to be taken at half-well-volume apart.
Well volume: 50mm (2") diameter - 2 L/metre, 100mm (4") diameter - 8 L/metre, 150mm (6") diameter - 18 L/metre

Stabilisation Criteria (3 readings within ranges)		Drawdown stable <0.1m	± 0.2 °C	± 0.1 pH unit	± 5%	± 10mv	± 10%	Comment
Time	Cumulative Volume purged (L)	Water Level (m bTOC)	Temp °C	pH Units	Sp. Cond µS/cm / mS/cm	ORP mV	DO mg/L / ppm / %	Turbidity, Colour, Odour, Sheen, etc
1216	INT	2.562	34.4	6.00	17055	25.9	80.5	L-M TURB, L BROWN, no sheen/odour
1219	2	2.565	34.5	5.68	16019	28.2	84.6	
1222	4	2.568	34.7	5.48	14267	25.6	88.9	
1226	6	2.564	34.8	5.40	12721	27.9	93.3	
1229	8	2.564	35.0	5.33	12496	28.6	96.9	
1233	10	2.564	35.0	5.28	11861	27.3	99.4	
1236	12	2.565	34.8	5.28	11555	27.2	99.6	
			SAMPLED					

Observations during Sampling:- eg. odours, sheens, turbidity, water colour, etc

SAMPLED AFTER 12L PURGED, QUICK RECHARGE
L-M TURB, L. BROWN, NO SHEEN/ODOUR

Container Volume (L)	No of containers	Preservative
Glass amber (100-250ml)	1	none
Glass vial (40mL)	2	HCl
Plastic (60mL) - metals*	1	HNO3
Plastic (60mL) - cyanide, CrVI*		NaOH
Plastic (60mL) - nutrients	1	H2SO4
Plastic (500mL) - inorganics	1	none
Plastic ( ) FD	1	
Plastic ( )		
	(7)	

Duplicates
Duplicate ID
Triplicate ID
Blanks
Rinsate ID

Other Comments

*samples for dissolved metals to be filtered in the field prior to filling sampling container

Groundwater Sampling Record

GREENCAP
Going Further in Managing Risk

Client:	ORA	Job No:	J168829
Project:	Diesel Spill	Sampled by:	VB
Location:	ORA Berrimah	Date:	16/12/21

Well ID: MW09

WELL DETAILS			SAMPLING EQUIPMENT					
Well depth:	4.371	(m)	Device:	micropurge	(peristaltic)	footvalve	bailer	*Other Sampling Equipment / Method
Casing diameter:	50	(mm)	Method:	(low-flow)	4-well-volume	purged dry		
Casing type:	(PVC) / steel / other		WQM Make:	YSI				
Depth to product	—	(m bTOC)	WL Meter:	(interface)	non-interface			
Depth to water:	1.742	(m bTOC)	Screen (from - to), m	1.371 - 4.371				
Product thickness	—	(m)	Pump Depth (m bTOC)					

Field observations: eg. well condition, nearby activities, weather, vegetation, etc

SUNNY, SLIGHT WIND

Purging instructions:

Low Flow: Start purging and stabilise the water level at ~ 0.1m drawdown. Once water level stabilises start taking water quality readings. Readings are to be taken every 3 minutes or every flow-through-cell volume (whichever is greater). Purging finishes when the three consecutive readings are within the ranges below.

4-well volume The purging will continue until at least 4 well volumes and three consecutive readings are within the ranges below. Water quality readings are to be taken at half-well-volume apart.
Well volume: 50mm (2") diameter - 2 L/metre, 100mm (4") diameter - 8 L/metre, 150mm (6") diameter - 18 L/metre

Stabilisation Criteria (3 readings within ranges)		Drawdown stable <0.1m	± 0.2 °C	± 0.1 pH unit	± 5%	± 10mv	± 10%	Comment
Time	Cumulative Volume purged (L)	Water Level (m bTOC)	Temp °C	pH Units	Sp. Cond (µS/cm / mS/cm)	ORP mV	DO mg/L / ppm / (%)	Turbidity, Colour, Odour, Sheen, etc
1048	INT	1.743	31.8	8.85	23632	-100.4	118.6	M-H turb, brown tea sheen, odour
1101	2	1.743	31.9	7.78	24261	-69.7	119.2	
1104	4	1.743	31.9	7.33	24377	-76.4	116.5	
1108	6	1.743	31.9	6.88	24424	-64.8	114.3	
1111	8	1.743	31.9	6.61	24219	-59.1	110.1	
1114	10	1.743	33.9	6.48	24138	-55.3	104.7	
1117	12	1.743	34.2	6.51	23935	-52.6	98.4	
1120	14	1.743	34.1	6.23	24140	-46.1	102.1	
1124	16	1.743	34.2	6.21	24025	-44.0	101.9	

Observations during Sampling:- eg. odours, sheens, turbidity, water colour, etc

SAMPLED AFTER 16L PURGED, QUICK RECHARGE

Container Volume (L)	No of containers	Preservative
Glass amber (100-250ml)	1	none
Glass vial (40mL)	2	HCl
Plastic (60mL) - metals*	1	HNO3
Plastic (60mL) - cyanide, CrVI*		NaOH
Plastic (60mL) - nutrients	1	H2SO4
Plastic (500mL) - inorganics	1	none
Plastic ( ) FE	1	
Plastic ( )		

Duplicates
Duplicate ID
Triplicate ID

Blanks
Rinsate ID

Other Comments

*samples for dissolved metals to be filtered in the field prior to filling sampling container

Groundwater Sampling Record

GREENCAP
Going Further in Managing Risk

Client:	ORA	Job No:	J168829
Project:	Diesel Spill	Sampled by:	VB
Location:	ORA Berrimah	Date:	10/12/21

Well ID: MW10

WELL DETAILS			SAMPLING EQUIPMENT				
Well depth:	4.248	(m)	Device:	micropurge	peristaltic	footvalve	bailer
Casing diameter:	50	(mm)	Method:	low-flow	4-well-volume	purged dry	
Casing type:	PVC / steel / other		WQM Make:	YSI			
Depth to product	—	(m bTOC)	WL Meter:	interface	non-interface		
Depth to water:	1.756	(m bTOC)	Screen (from - to), m	1.248 – 4.248			
Product thickness	—	(m)	Pump Depth (m bTOC)				

*Other Sampling Equipment / Method

Field observations: eg. well condition, nearby activities, weather, vegetation, etc
SUNNY, SLIGHT WIND

Purging instructions:

Low Flow: Start purging and stabilise the water level at ~ 0.1m drawdown. Once water level stabilises start taking water quality readings. Readings are to be taken every 3 minutes or every flow-through-cell volume (whichever is greater). Purging finishes when the three consecutive readings are within the ranges below.

4-well volume The purging will continue until at least 4 well volumes and three consecutive readings are within the ranges below. Water quality readings are to be taken at half-well-volume apart.
Well volume 50mm (2") diameter - 2 L/metre, 100mm (4") diameter - 8 L/metre, 150mm (6") diameter - 18 L/metre

Stabilisation Criteria (3 readings within ranges)		Drawdown stable <0.1m	± 0.2 °C	± 0.1 pH unit	± 5%	± 10mv	± 10%	Comment
Time	Cumulative Volume purged (L)	Water Level (m bTOC)	Temp °C	pH Units	Sp. Cond µS/cm / mS/cm	ORP mV	DO mg/L / ppm / %	Turbidity, Colour, Odour, Sheen, etc
0913	INT	1.761	34.7	7.46	16906	-68.7	80.5	V-h. Turb, L-Brown, No sheen/odour
0916	2	1.757	34.9	6.95	15224	-43.6	82.2	↓
0919	4	1.757	35.0	6.58	15095	-46.6	82.3	L-m turb, clear, no sheen/odour
0922	6	1.757	35.0	6.38	15006	-52.4	82.6	
0925	8	1.757	35.1	6.20	14910	-61.6	83.0	
0928	10	1.757	35.0	6.10	14903	-68.2	84.3	
0931	12	1.757	35.0	6.01	14839	-73.1	85.1	
0934	14	1.757	35.0	5.96	14754	-77.5	86.4	
0937	16	1.757	35.0	5.94	14735	-77.2	87.3	

Observations during Sampling:- eg. odours, sheens, turbidity, water colour, etc
SAMPLED AFTER 16 L PURGED, QUICK RECHARGE
L-M TURB, CLEAR, NO SHEEN/ODOUR

Container Volume (L)	No of containers	Preservative
Glass amber (100-250ml)	1	none
Glass vial (40mL)	2	HCl
Plastic (60mL) - metals*	1	HNO3
Plastic (60mL) - cyanide, CrVI*		NaOH
Plastic (60mL) - nutnents	1	H2SO4
Plastic (500mL) - inorganics	1	none
Plastic ( ) Fe	1	
Plastic ( )		
	7	

*samples for dissolved metals to be filtered in the field prior to filling sampling container

Duplicates
Duplicate ID
Triplicate ID
Blanks
Rinsate ID

Other Comments

Groundwater Sampling Record

GREENCAP
Going Further in Managing Risk

Client:	ORA	Job No:	J168829
Project:	Diesel Spill	Sampled by:	VB
Location:	ORA Berrimah	Date:	8/12/21

Well ID: MW19

WELL DETAILS			SAMPLING EQUIPMENT				
Well depth:	5.061	(m)	Device:	micropurge	peristaltic	footvalve	bailer
Casing diameter:	50	(mm)	Method:	low-flow	4-well-volume	purged dry	
Casing type:	PVC / steel / other		WQM Make:	YSI			
Depth to product	-	(m bTOC)	WL Meter:	interface	non-interface		
Depth to water:	2.441	(m bTOC)	Screen (from - to), m	2.061	- 5.061		
Product thickness	-	(m)	Pump Depth (m bTOC)				

***Other Sampling Equipment / Method**

Field observations: eg. well condition, nearby activities, weather, vegetation, etc

SUNNY, PARTLY CLOUDY, SLIGHT WIND

Purging instructions:

Low Flow: Start purging and stabilise the water level at ~ 0 1m drawdown. Once water level stabilises start taking water quality readings. Readings are to be taken every 3 minutes or every flow-through-cell volume (whichever is greater) Purging finishes when the three consecutive readings are within the ranges below.

4-well volume The purging will continue until at least 4 well volumes and three consecutive readings are within the ranges below. Water quality readings are to be taken at half-well-volume apart.
Well volume: 50mm (2") diameter - 2 L/metre; 100mm (4") diameter - 8 L/metre; 150mm (6") diameter - 18 L/metre

Stabilisation Criteria (3 readings within ranges)		Drawdown stable <0.1m	± 0.2 °C	± 0.1 pH unit	± 5%	± 10mv	± 10%	Comment
Time	Cumulative Volume purged (L)	Water Level (m bTOC)	Temp °C	pH Units	Sp. Cond µS/cm / mS/cm	ORP mV	DO mg/L / ppm / %	*Turbidity, Colour, Odour, Sheen, etc*
1140	~~2.4442~~ INT	2.442	36.5	5.11	21380	39.1	30.8	L-M TURB, CLEAR, NO sheen/odour
1145	2.5	2.441	36.7	5.51	20411	135	30.2	
1150	5.0	2.441	36.8	5.59	19869	-0.5	39.6	
1154	6.5	2.441	36.7	5.60	19695	-7.9	45.5	
1157	8.5	2.441	36.7	5.61	20065	-11.6	49.4	
1200	10.5	2.441	36.7	5.61	20156	-13.9	55.2	
				SAMPLED				

Observations during Sampling:- eg. odours, sheens, turbidity, water colour, etc

SAMPLED AFTER 10.5 L PURGED, QUICK RECHARGE
L-M TURB, CLEAR, NO SHEEN/ODOUR

Container Volume (L)	No of containers	Preservative
Glass amber (100-250ml)	1	none
Glass vial (40mL)	2	HCl
Plastic (60mL) - **metals***	1	HNO3
Plastic (60mL) - cyanide, CrVI*		NaOH
Plastic (60mL) - nutrients	1	H2SO4
Plastic (500mL) - inorganics	1	none
Plastic ( ) FE	1	
Plastic ( )		
	(7)	

*samples for dissolved metals to be filtered in the field prior to filling sampling container

Duplicates
Duplicate ID
Triplicate ID
Blanks
Rinsate ID

Other Comments

GREENCAP
Going Further in Managing Risk

Groundwater Monitoring Analytical Results
July 2020 to December 2021

J168829

Monitoring Well	Date	TRH - 1999 NEPM Fractions (µg/L)					TRH - 2013 NEPM Fractions (µg/L)								Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylene (µg/L)			Naphthalene (µg/L)	Natural Attenuation Parameters (mg/L)					
		C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	C_{10}-C_{36} (Total)	C_6-C_{10}	F1	$>C_{10}$-C_{16}	F2	F3	F4	$>C_{16}$-C_{34} Total	$>C_{10}$-C_{40} Total				m-	p-	o-		Fe^{2+}	NO_3	SO_4	CaCO3	Manganese	Methane
CRC Care HSL Intrusive Workers, Sand (2 <4m)		-	-	-	-	-	NL	-	NL	-	-	-	-	-	NL	NL	NL	-	-	NL	NL	-	-	-	-	-	-
CRC Care HSL Intrusive Workers, Sand (4 <8m)		-	-	-	-	-	NL	-	NL	-	-	-	-	-	NL	NL	NL	-	-	NL	NL	-	-	-	-	-	-
NEPM HSL[1]		-	-	-	-	-	-	6,000	-	NL	-	-	-	-	5,000	NL	NL	NL	NL	NL	NL	-	-	-	-	-	-
ANZECC[2]		-	-	-	-	-	-	-	-	-	-	-	-	-	500	110	50	50	140	200	50	-	-	-	-	1.2	-
NEPM GIL Marine Waters		-	-	-	-	-	-	-	-	-	-	-	-	-	500	-	-	-	200	350	50	-	-	-	-	1.9	-
ESL CWB (2019)[3]		-	-	-	-	-	-	440	640	640	640	640	640	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Primary Contact Recreational		-	-	-	-	-	-	100	900	900	900	900	900	900	10	8000	3000	6000	6000	6000	-	-	500	5000	-	5	-
Primary Contact Aesthetic		-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	20	-	-	-	-	-	250	-	0.1	-
Marine Ecosystem[4]		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	0.7	-	-	-	-
MW01	30/07/2020	<20	150	<100	<100	150	20	<20	140	140	<100	**<100**	140	**140**	<1	**<1**	**2**	<2		3	<10	-	-	-	-	-	-
MW01	9/09/2021	<20	150	400	<100	550	<20	<20	270	270	200	**<100**	200	**470**	<1	**<1**	**<1**	<2		<1	<10	29	0.02	640	<20	2	<0.05
MW01	10/12/2021	<20	520	1200	<100	1720	<20	<20	860	860	900	**<100**	1760	1760	**<1**	**<1**	**<1**	<2		<1	<10	33	<0.02	320	230	2	<0.05
MW01A	14/10/2020	<20	<50	500	200	700	20	<20	<50	<50	**600**	**<100**	600	600	**<1**	**<1**	**2**	<2		3	<10	-	-	-	-	-	-
MW01A	21/01/2021	<20	<50	<100	<100	<100	<20	<20	<50	<50	**<100**	**<100**	**<100**	<100	**<1**	**<1**	**<1**	<2		<1	<10	20	0.63	2900	90	1.2	<0.05
MW01A	5/05/2021	<20	<50	<100	<100	<100	<20	<20	<50	<50	**<100**	**<100**	**<100**	<100	**<1**	**<1**	<1	<2		<1	<10	7.6	0.11	2800	87	2.2	<0.05
MW01A	9/09/2021	<20	<50	<100	<100	<100	<20	<20	<50	<50	**<100**	**<100**	**<100**	**<100**	**<1**	**<1**	<1	<2		<1	<10	12	<0.02	3100	85	2.1	<0.05
MW01A	8/12/2021	<20	<50	100	<100	<100	<20	<20	<50	<50	100	**<100**	**<100**	**100**	<1	**<1**	<1	<2		<1	<10	10	0.38	2900	52	1.5	<0.05
MW02	30/07/2020	<20	<50	<100	<100	<100	<20	<20	<50	<50	**<100**	**<100**	**<100**	**<100**	<1	<1	<1	<2		<1	<10	-	-	-	-	-	-
MW02	14/10/2020	<20	<50	<100	<100	<100	<20	<20	**<50**	<50	**<100**	<100	<100	**<100**	<1	<1	<1	<2		<1	<10	-	-	-	-	-	-
MW02	21/01/2021	<20	<50	<100	<100	<100	<20	<20	**<50**	**<50**	**<100**	**<100**	<100	**<100**	**<1**	<1	<1	<2		<1	<10	<0.05	0.46	480	<20	3.8	<0.05
MW02	20/05/2021	<20	<50	<100	<100	<100	<20	<20	**<50**	**<50**	**<100**	**<100**	<100	<100	**<1**	<1	<1	<2		<1	<10	0.08	0.11	920	<20	9.8	<0.05
MW02	9/09/2021	<20	<50	<100	<100	<100	<20	**<20**	**<50**	**<50**	**<100**	**<100**	<100	<100	**<1**	<1	<1	<2		<1	<10	0.07	<0.02	860	<20	16	<0.05
MW02	12/12/2021	<20	<50	<100	<100	<100	<20	**<20**	**<50**	**<50**	**<100**	<100	**<100**	**<100**	<1	<1	<1	<2		<1	<10	0.12	0.23	490	<20	5.2	<0.05
MW03	30/07/2020	<20	<50	<100	<100	<100	<20	<20	**<50**	**<50**	<100	**<100**	**<100**	**<100**	<1	<1	<1	<2		<1	<10	-	-	-	-	-	-
MW03	14/10/2020	<20	<50	<100	<100	<100	<20	<20	**<50**	**<50**	<100	**<100**	**<100**	<100	<1	<1	<1	<2		<1	<10	-	-	-	-	-	-
MW03	21/01/2021	<20	<50	300	<100	300	<20	**<20**	<50	**<50**	300	**<100**	**300**	300	<1	<1	<1	<2		<1	<10	<0.05	1	180	<20	1.1	<0.05
MW03	5/05/2021	<20	<50	<100	<100	<100	<20	**<20**	<50	**<50**	**<100**	**<100**	<100	<100	<1	<1	<1	<2		<1	<10	0.4	1.7	190	<20	1.1	<0.05
MW03	9/09/2021	<20	<50	<100	<100	<100	**<20**	**<20**	<50	**<50**	**<100**	**<100**	<100	<100	<1	<1	<1	<2		<1	<10	2.5	0.06	700	<20	2.6	<0.05
MW03	8/12/2021	<20	<50	400	<100	400	**<20**	**<20**	<50	**<50**	**400**	**<100**	400	400	<1	<1	<1	<2		<1	<10	0.1	0.68	110	<20	1.8	<0.05
MW04	30/07/2020	<20	100	600	<100	700	**<20**	**<20**	240	**240**	**400**	<100	640	640	<1	<1	<1	<2		<1	<10	-	-	-	-	-	-
MW04	14/10/2020	<20	210	1600	<100	1810	**<20**	**<20**	520	520	1300	<100	1820	1820	<1	<1	<1	<2		1	<10	-	-	-	-	-	-
MW04	21/01/2021	<20	210	1600	**<100**	<100	**<20**	<20	<50	<50	300	<100	<100	<100	<1	<1	<1	<2		1	<10	0.18	1.2	290	21	1.2	<0.05
MW04	5/05/2021	<20	160	<100	**<100**	160	**<20**	<20	**240**	**240**	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	0.36	0.78	410	24	2.4	<0.05
MW04	9/09/2021	<20	<50	**<100**	**<100**	**<100**	<20	**<20**	**<50**	**<50**	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	4.8	<0.02	800	<20	2	<0.05
MW04	8/12/2021	<20	<50	**400**	<100	**400**	<20	**<20**	**<50**	**<50**	400	<100	400	400	<1	<1	<1	<2		<1	<10	2.5	<0.02	660	<20	1.8	<0.05
MW05	31/10/2020	<20	<50	<100	<100	**<100**	**<20**	**<20**	**<50**	**<50**	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	-	-	-	-	-	-
MW05	21/01/2021	<20	<50	<100	<100	<100	**<20**	<20	**<50**	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	5.8	<0.02	2100	35	0.88	<0.05
MW05	30/04/2021	<20	<50	**<100**	**<100**	<100	**<20**	<20	**<50**	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	2.6	0.13	1600	28	0.96	<0.05
MW05	9/09/2021	<20	<50	**<100**	**<100**	<100	**<20**	<20	**<50**	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	7.4	<0.02	1700	55	0.88	<0.05
MW05	10/12/2021	<20	<50	**<100**	**<100**	**<100**	**<20**	**<20**	**<50**	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	6	<0.02	2100	55	1.1	<0.05
MW06	31/10/2020	<20	**<50**	**<100**	**<100**	**<100**	<20	**<20**	**<50**	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	-	-	-	-	-	-
MW06	21/01/2021	<20	**<50**	**<100**	**<100**	**<100**	<20	**<20**	**<50**	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	<0.05	1.1	320	<20	1	<0.05
MW06	30/04/2021	<20	**<50**	**<100**	**<100**	**<100**	<20	**<20**	**<50**	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	0.08	0.66	490	<20	1.5	<0.05
MW06	9/09/2021	<20	**<50**	**<100**	**<100**	**<100**	<20	**<20**	**<50**	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	1.1	0.09	1100	26	1.3	<0.05
MW06	10/12/2021	<20	<50	**<100**	**<100**	**<100**	<20	<20	<50	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	0.25	0.26	610	<20	1.3	<0.05
MW07	31/10/2020	<20	<50	<100	**<100**	**<100**	<20	<20	<50	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	-	-	-	-	-	-
MW07	21/01/2021	<20	<50	<100	**<100**	**<100**	<20	<20	<50	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	3.8	0.69	850	37	1	<0.05
MW07	5/05/2021	<20	<50	<100	**<100**	**<100**	<20	<20	<50	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	6.2	0.7	530	21	1.4	<0.05
MW07	9/09/2021	<20	<50	<100	**<100**	**<100**	<20	<20	<50	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	18	0.13	1600	40	1.1	<0.05
MW07	8/12/2021	<20	<50	400	<100	400	<20	<20	<50	<50	500	<100	500	500	<1	<1	<1	<2		<1	<10	0.75	0.35	580	97	1.2	<0.05
MW08	31/10/2020	<20	<50	<100	<100	<100	<20	<20	<50	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	-	-	-	-	-	-
MW08	21/01/2021	<20	<50	100	<100	100	<20	<20	<50	<50	100	<100	<100	<100	<1	<1	<1	<2		<1	<10	1	1.2	290	<20	1.3	<0.05
MW08	5/05/2021	<20	<50	<100	<100	<100	<20	<20	<50	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	2.3	1.3	430	24	1.6	<0.05
MW08	9/09/2021	<20	<50	<100	<100	<100	<20	<20	<50	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	5.3	<0.02	1600	390	1.6	<0.05
MW08	8/12/2021	<20	<50	200	<100	200	<20	<20	<50	<50	200	<100	200	200	<1	<1	<1	<2		<1	<10	1.4	1.1	500	<20	1.5	<0.05
MW09	10/12/2021	<20	<50	<100	<100	<100	<20	<20	<50	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	3.1	0.21	1100	36	1.3	<0.05
MW10	10/12/2021	<20	<50	<100	<100	<100	<20	<20	<50	<50	<100	<100	<100	<100	<1	<1	<1	<2		<1	<10	7.6	<0.02	590	31	2.4	<0.05
MW11	8/12/2021	<20	<50	300	<100	300	<20	<20	<50	<50	300	<100	300	300	<1	<1	<1	<2		<1	<10	1.9	<0.02	870	34	2.3	<0.05

F1 = C_6-C_{10} less BTEX; F2 = $>C_{10}$-C_{16} less naphthalene; F3 = $>C_{16}$-C_{34}; F4 = $>C_{34}$-C_{40}

$Fe2+$ = Ferrous Iron; N = Nitrate; SO^4 = Sulphate; $CaCO_3$ = Total Alkalinity

1 = Groundwater Health Screening Level for vapour intrusion – Commercial/industrial land use with sand 2 m to <4 m. *Assessment of Site Contamination National Environment Protection Measure* (1999). National Environment Protection Council (as amended 2013)

2 = Marine ecosystems (99% protection) – ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

3 = California Water Board Guidelines for Environmental Screening Levels (2019 rev. 2) - Aquatic Habitat Goal Levels (Saltwater Ecotox)

4 = ANZECC (2000)

GREENCAP
Going Further in Managing Risk

Groundwater Monitoring Analytical Results
July 2020 to December 2021

J168829

Monitoring Well	Date	PAH (mg/L)																	Phenols (mg/L)																							
		Acenaphthene	Acenaphthylene	Anthracene	Benz[a]anthracene	Benzo[a]pyrene	Benzo[b&j]fluoranthene	Benzo[g, h, i]perylene	Benzo[k]fluoranthene	Chrysene	Dibenz[a,h]anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	Total PAH*	2,4,5-Trichlorophenol	2,4,6-Trichlorophenol	2,4-Dichlorophenol	2,6-Dichlorophenol	2-Chlorophenol	4-Chloro-3-methylphenol	Pentachlorophenol	Tetrachlorophenols - Total	Total Halogenated Phenol*	2,4-Dimethylphenol	2,4-Dinitrophenol	2-Cyclohexyl-4,6-dinitrophenol	2-Methyl-4,6-dinitrophenol	2-Methylphenol (o-Cresol)	2-Nitrophenol	3&4-Methylphenol (m&p-Cresol)	4-Nitrophenol	Dinoseb	Phenol	Total cresols*	Total Non-Halogenated Phenols*
CRC Care HSL Intrusive Workers, Sand (2-<4m)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CRC Care HSL Intrusive Workers, Sand (4-<8m)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPM HSL[1]		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ANZECC[2]		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPM GIL Marine Waters		-	-	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	-	-	-	0.12	-	0.34	-	0.011	-	-	-	0.045	-	-	-	-	-	-	0.4	-	-	-	-
ESL CRWB (2019)[3]		0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.008	0.015	0.015	0.015	0.0046	0.015	-	0.011	-	-	-	-	-	0.0079	-	-	0.011	0.049	-	-	-	-	-	-	0.0058	-	-
Primary Contact Recreational		-	-	-	-	0.0001	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	2	-	3	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Primary Contact Aesthetic		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.002	0.0003	-	0.0001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marine Ecosystem[4]		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW01	30/07/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW01	9/09/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW01	10/12/2021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	< 0.01	< 0.01	< 0.03	< 0.01	< 0.003	< 0.03	< 0.1	< 0.03	< 0.003	< 0.01	< 0.006	< 0.03	< 0.1	< 0.003	< 0.01	< 0.1
MW01A	14/10/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW01A	21/01/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW01A	5/05/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW01A	9/09/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW01A	8/12/2021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	< 0.01	< 0.01	< 0.03	< 0.01	< 0.003	< 0.03	< 0.1	< 0.03	< 0.003	< 0.01	< 0.006	< 0.03	< 0.1	< 0.003	< 0.01	< 0.1
MW02	30/07/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW02	14/10/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW02	21/01/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW02	20/05/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW02	9/09/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW02	12/12/2021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	< 0.01	< 0.01	< 0.03	< 0.01	< 0.003	< 0.03	< 0.1	< 0.03	< 0.003	< 0.01	< 0.006	< 0.03	< 0.1	< 0.003	< 0.01	< 0.1
MW03	30/07/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW03	14/10/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW03	21/01/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW03	5/05/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW03	9/09/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW03	8/12/2021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	< 0.01	< 0.01	< 0.03	< 0.01	< 0.003	< 0.03	< 0.1	< 0.03	< 0.003	< 0.01	< 0.006	< 0.03	< 0.1	< 0.003	< 0.01	< 0.1
MW04	30/07/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW04	14/10/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW04	21/01/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW04	5/05/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW04	9/09/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW04	8/12/2021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	< 0.01	< 0.01	< 0.03	< 0.01	< 0.003	< 0.03	< 0.1	< 0.03	< 0.003	< 0.01	< 0.006	< 0.03	< 0.1	< 0.003	< 0.01	< 0.1
MW05	31/10/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW05	21/01/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW05	30/04/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW05	9/09/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW05	10/12/2021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	< 0.01	< 0.01	< 0.03	< 0.01	< 0.003	< 0.03	< 0.1	< 0.03	< 0.003	< 0.01	< 0.006	< 0.03	< 0.1	< 0.003	< 0.01	< 0.1
MW06	31/10/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW06	21/01/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW06	30/04/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW06	9/09/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW06	10/12/2021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	< 0.01	< 0.01	< 0.03	< 0.01	< 0.003	< 0.03	< 0.1	< 0.03	< 0.003	< 0.01	< 0.006	< 0.03	< 0.1	< 0.003	< 0.01	< 0.1
MW07	31/10/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW07	21/01/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW07	5/05/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW07	9/09/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW07	8/12/2021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	< 0.01	< 0.01	< 0.03	< 0.01	< 0.003	< 0.03	< 0.1	< 0.03	< 0.003	< 0.01	< 0.006	< 0.03	< 0.1	< 0.003	< 0.01	< 0.1
MW08	31/10/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW08	21/01/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW08	5/05/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW08	9/09/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW08	8/12/2021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	< 0.01	< 0.01	< 0.03	< 0.01	< 0.003	< 0.03	< 0.1	< 0.03	< 0.003	< 0.01	< 0.006	< 0.03	< 0.1	< 0.003	< 0.01	< 0.1
MW09	10/12/2021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	< 0.01	< 0.01	< 0.03	< 0.01	< 0.003	< 0.03	< 0.1	< 0.03	< 0.003	< 0.01	< 0.006	< 0.03	< 0.1	< 0.003	< 0.01	< 0.1
MW10	10/12/2021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	< 0.01	< 0.01	< 0.03	< 0.01	< 0.003	< 0.03	< 0.1	< 0.03	< 0.003	< 0.01	< 0.006	< 0.03	< 0.1	< 0.003	< 0.01	< 0.1
MW11	8/12/2021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	< 0.01	< 0.01	< 0.03	< 0.01	< 0.003	< 0.03	< 0.1	< 0.03	< 0.003	< 0.01	< 0.006	< 0.03	< 0.1	< 0.003	< 0.01	< 0.1

F1 = C6-C10 less BTEX; F2 = >C10-C16 less naphthalene; F3 = >C16-C34; F4 = >C34-C40

Fe2+ = Ferrous Iron; N = Nitrate; SO4 = Sulphate; CaCO3 = Total Alkalinity

1 = Groundwater Health Screening Level for vapour intrusion – Commercial/industrial land use with sand 2 m to <4 m. Assessment of Site Contamination National Environment Protection Measure (1999). National Environment Protection Council (as amended 2013)

2 = Marine ecosystems (99% protection) – ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

3 = California Water Board Guidelines for Environmental Screening Levels (2019 rev. 2) - Aquatic Habitat Goal Levels (Saltwater Ecotox)

4 = ANZECC (2000)

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ENVIRONMENTAL MANAGEMENT PLAN

February 2024
J168829-07

Aurizon
Portion of Berrimah Freight Terminal

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Document Control

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1	Electronic	Haydn Franklin	Principal Adviser Environment (Aurizon)
1	Electronic	Graeme Miller	Site Contamination Auditor (Senversa)

Environmental Management Plan

AURIZON

PORTION OF BERRIMAH FREIGHT TERMINAL

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1. INTRODUCTION

1.1 Background

This Environmental Management Plan (EMP) refers to a portion of the Berrimah Rail Terminal (terminal) - located off Export Drive, Berrimah, Northern Territory (NT). The extent of the specific portion of the terminal to which the EMP relates (further referred to as the subject area) is presented on Figure 1.

The subject area is associated with a diesel spill, where approximately 20,000 litres (L) of diesel were accidentally realised during automatic refuelling activities of a diesel locomotive on 30 May 2020. The majority of soil contamination was remediated (excavated and replaced by uncontaminated soil) in 2020, but residual contamination remains:

- in soil under the rail lines and at/below the interface with groundwater (where soil remediation could not practicably be completed); and
- in groundwater under isolated areas of the site.

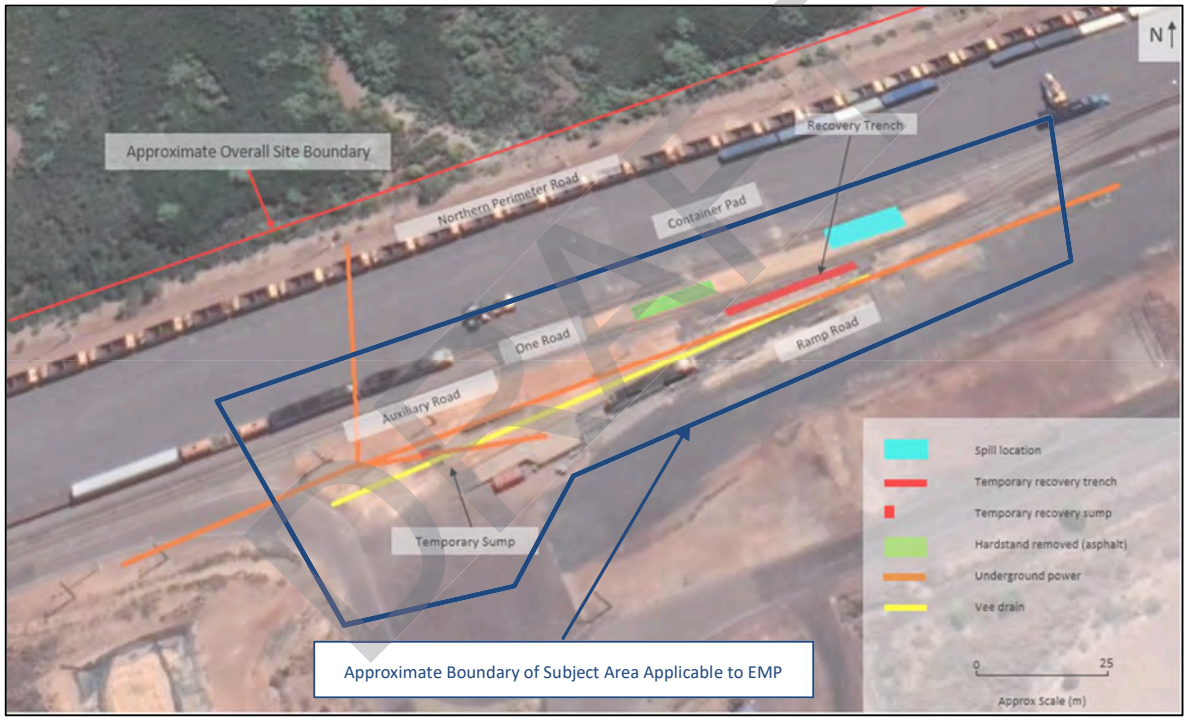

Figure 1: Boundary of Subject Area

The EMP has been provided to the independent environmental Auditor (Graeme Miller of Senversa) for review and endorsement.

1.2 Objective

The overall objective of the EMP described herein is to mitigate risks to site occupants, intrusive workers and surrounding human and ecological receptors which may arise during disturbance (e.g., excavation, dewatering activities and/or development of occupied structures) of residual soil and/or groundwater contamination known to be present beneath the subject area .

A groundwater management and monitoring plan (*Groundwater Monitoring and Plan Management Plan, Aurizon, Berrimah Freight Terminal*, Greencap, July 2023 (Greencap 2023a) has been prepared to manage and mitigate potential risks associated with potential migration of residual groundwater contamination to down gradient ecological and primary contact recreational receptors located immediately north of the terminal boundary. The plan should be read in conjunction with this EMP if excavations deeper than 2.5 metres (m) below ground level (bgl) are planned within the subject area.

2. ENVIRONMENTAL LEGISLATION AND REQUIREMENTS

The EMP was prepared in general accordance with the following Northern Territory Environment Protection Authority (NT EPA) guidance:

- *Northern Territory Contaminated Land Guideline*, June 2017;
- *Guideline for Reporting on Environmental Monitoring* , May 2016; and
- *Guideline for the Preparation of an Environmental Management Plan,* May 2015.

The Territory and Commonwealth legislation relevant to this EMP include the following:

- Rail Safety (National Uniform Legislation) Act (2012) which provides for the protection of human life and rail infrastructure and general requirements for accessing and operating on rail land within the NT. As the site is an active rail corridor the Rail Safety Act applies to any works (management or mitigation) conducted onsite;
- Waste Management and Pollution Control Act 1998 (updated 2022) and associated Regulations, which requires the protection of the environment through encouragement of effective waste management and pollution prevention and control practices and for related purposes;
- Environmental Protection Act 2019 and associated Regulations, which defines the environment as being "all aspects of the surroundings of man including the physical, biological, economic, cultural and social aspects" and ensures to the greatest extent practicable that each matter which could reasonably have a significant effect on the environment is fully examined and considered; and
- Water Act 1992 (updated 2023), which provides for investigation, management and administration of water resources, including extraction of groundwater, wastewater and water pollution. It also refers to general environmental duty for the protection of surface and groundwater as well as the duty to notify relevant authorities of environmental harm.

3. ENVIRONMENTAL SETTING

3.1 Site Details

A summary of the site (terminal) details is provided in Table 1.

Table 1: Berrimah Rail Terminal Details Summary

Detail	Description
Street Address	Export Drive, Berrimah, NT
Certificate of Title	Volume 757 Folio 262; and Volume 754 Folio 416
Parcel Reference	NT Portions 5411; and 5641, Hundred of Bagot
Plan	S2000/1912B; and S2003/163
Zoning	Zoned as Railway under the NT Planning Scheme
Local Government Authority	Darwin City

3.2 Current Site Land Use

The subject area is within a portion of land (approximate location and layout is shown on Figure 1) currently used as a freight rail terminal which comprises:

- four railway lines [Main Line, 1 Road, Auxiliary Road (or Runaround Road), and Ramp Road] all generally running east-west;
- an asphalt sealed container pad used for the loading and transfer of freight to and from heavy rail to the north of the subject area;
- a locomotive / car maintenance sheds to the east of the subject area; and
- an office building and gatehouse to the south on Export Drive and the subject area.

The site is generally occupied by commercial workers (rail and office workers). Intrusive maintenance workers may periodically carry out works at the site. The site is not considered to have ecological value given its use and cover with asphalt and ballast.

3.3 Surrounding Land Uses

Land uses in the surrounding area of the broader terminal include the following:

- Directly to the north (approximately 50 m from northern boundary of the subject area), intertidal mangrove habitat zoned Development, further north of which is Bleeser Creek (Darwin Harbour) and intertidal mangrove habitat zoned Conservation (The mangrove areas have marine aquatic ecosystems values. Human recreation activities are likely to occur);
- Directly to the east, unoccupied, cleared land zoned Development, further east of which is Berrimah Road and a small amount of uncleared forest;
- Directly to the west, the Darwin passenger rail terminal; and
- Directly to the south are numerous industrial/commercial premises.

3.4 Climate

Darwin has a tropical savanna climate that is defined by distinct wet and dry seasons. Very little rainfall occurs between May and October, with the dry season also having more moderate temperatures. The wet season is characterised by high humidity, monsoonal rains and storms. The average annual rainfall is 1,727 mm and January is the wettest month.

3.5 Hydrology

The stormwater runoff and overland flow at the subject area moves following local topography into existing unlined Vee-drains along which it travels west-southwest and south respectively, redirecting runoff under and around the broader terminal to the intertidal mangrove community and Bleesers Creek to the north.

3.6 Geology

Most of the area is covered with asphalt or ballast underlain by fill material comprising sandy gravelly silt. The encountered thickness of the fill ranged between 0.3 and 3.9 m. Natural soils were encountered beneath the fill material and comprised silty and sandy clays (Detailed Site Investigation Report – Addendum Aurizon, Berrimah Freight Terminal, Export Drive, Berrimah, NT, Greencap, March 2023 (Greencap 2023b)).

The subject area and broader terminal are in an area identified as having a high probability of occurrence (with very low confidence) of acid sulphate soils (ASRIS online database, 2020) and natural materials encountered on the edge of the mangroves were noted as containing sulfurous odours.

3.7 Hydrogeology

Groundwater beneath the subject area was identified to be (Greencap 2023b):

- at a depth of approximately 3.5 m bgl within both fill and natural material. Groundwater levels appeared to vary seasonally undergoing seasonal fluctuation up to 0.7 m between wet (October to March) and dry (April to September) seasons;
- flowing in northerly direction towards mangroves and Bleesers Creek under a maximum hydraulic gradient of 0.0007;
- flowing with the estimated flow velocity of 12 m/year but is likely to be lower when hydraulic gradients are essentially flat (which is noted to occur during the dry season); and
- reducing to oxidising, acidic to neutral and brackish to saline varying seasonally.

4. NATURE AND EXTENT OF CONTAMINATION

4.1 Soil

Soil contamination (in the context of the current land use of the site) is associated with total recoverable hydrocarbons (TRH) which exists at and beneath the subject area (in Areas 2 and 2a to c) as shown in Figure 2 and described as follows (Greencap 2023b) :

- Under the rail lines adjacent the spill area to depths of approximately 0.5 m below surface. This includes in the walls of excavations underlying rail lines in Area 2 and Area 3, where excavation could not extend further without damaging the integrity of the rail lines; and
- In the base of backfilled excavations extended to the groundwater interface in and around the location of the temporary sump.

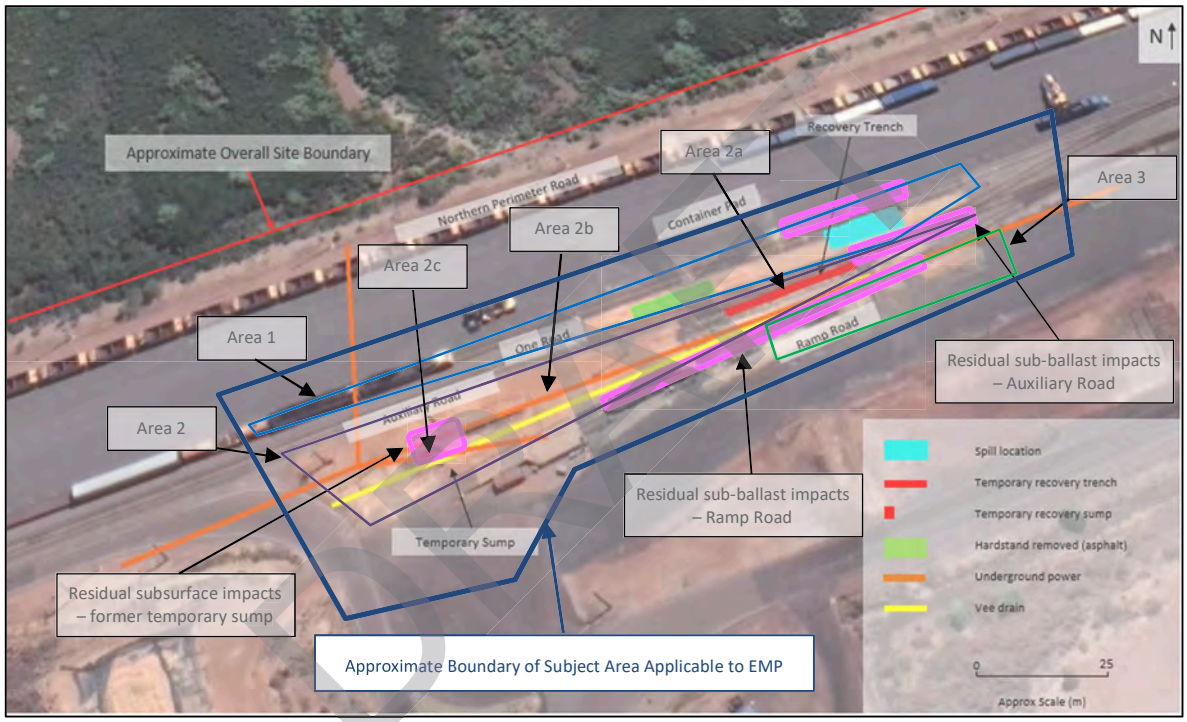

Figure 2: Areas of Residual Soil Contamination

TRH concentrations ranges of residual hydrocarbon impacts and relevant assessment criteria that have been exceeded for each of the areas are summarised in Table 2 (Greencap 2023b).

Table 2: Residual Hydrocarbon Impacts in Soil

Area	TRH (C_6-C_{10})	TRH F1	TRH (>C_{10}-C_{16})	TRH F2	TRH F3	TRHF4
Area 2 (excluding Areas 2a, 2b and 2c)	91	86	3,400	3,400	3,400	<100
Area 2a	<20 - 700	<20 - **590**	590 – *31,000*	590 – 30,998	2,000 – 20,000	<100 – 1,100
Area 2b/c	<20 - 280	<20 – **270**	200 – 14,000	200 – 14,000	230 – 11,000	<100 - 510
Area 3	<20 – 240	<20 – 220	240 – 17,000	240 – 16,999	640 – 17,000	<100 – 4,900
Near the rail lines (One Road Rail Line, Ramp Road Rail Line, Auxiliary Road Rail Line)	<20-480	<20 – **440**	550 – *27,000*	550 – 27,000	570 – 23,000	<100 - <10,000

Legend:

	NEPM1 Ecological Screening Levels (ESLs) for commercial/industrial land use (coarse soil) .
	NEPM Management Limits (MLs) for commercial/ industrial land use (coarse soil).
260	NEPM Health Screening Level (HSL) soil vapour intrusion for commercial/ industrial land use (sand, depth < 1 m).
20,000	CRC Care HSL direct contact, commercial/ industrial.

Since some areas of the site were inaccessible (under rail lines), higher concentrations than that presented in Table 2 may exist.

4.2 Groundwater

Based on the most recent groundwater sampling (Greencap 2023b) TRHs associated with the spill were detected at monitoring wells MW01, MW01A, MW03, MW04 MW08 and MW11 located within the subject area. The presence of floating diesel in the form of light non-aqueous phase liquid (LNAPL) was only observed at monitoring well MW01 (located in the western portion of the subject area near the Vee drain) shortly after the spill up until the September 2021. The locations of the wells are shown on Figure 3 below.

Hydrocarbon contamination in groundwater was not reported adjacent to the mangrove community located to the north of the subject area, suggesting no significant migration or expansion of a groundwater plume (if any) has occurred. Groundwater modelling indicates the plume is unlikely to reach the mangrove community downgradient of the subject area. The potential for groundwater contamination to pose a risk to the down gradient ecological and recreational receptors is considered to be low (Greencap 2023b).

The inferred extent of groundwater contamination is shown on Figure 3 below.

[1] National Environment Protection (Assessment of Site Contamination) Measure 1999 (Updated 2013) (NEPM)

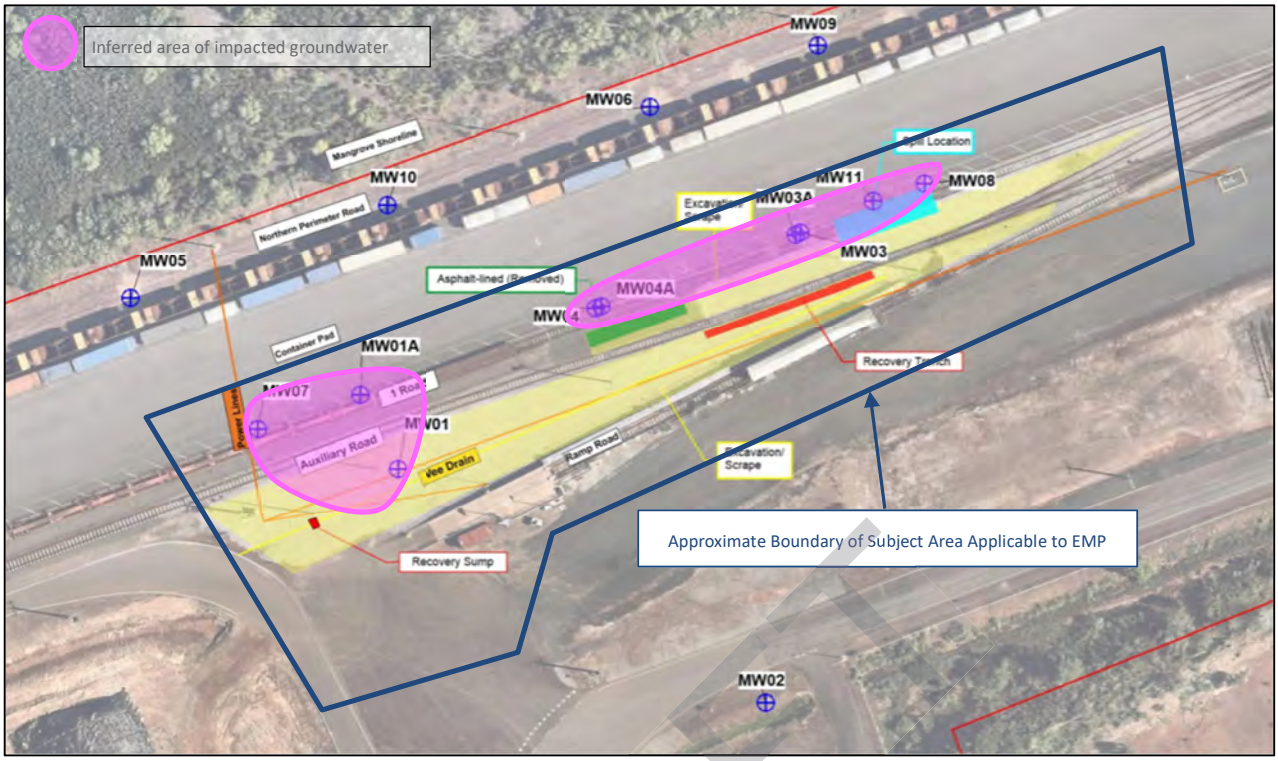

Figure 3: Hydrocarbon Impacts in Groundwater

Groundwater analytical results from the December 2021 groundwater assessment and relevant assessment criteria that have been exceeded are summarised in Table 3 below (Greencap 2023b).

Table 3: Hydrocarbon Impacts in Groundwater

		Concentrations (mg/L)				
Monitoring Well	**Sampling Dates**	**TRH F1**	**TRH F2**	**TRH F3**	**TRH F4**	**Diesel Range TRH (>C10-C34)**
MW01	Dec-21	<20	**860**	**900**	<100	**1,760**
MW01A	Dec-21	<20	<50	**100**	<100	<100
MW03	Dec-21	<20	<50	**400**	<100	**400**
MW04	Dec-21	<20	<50	**400**	<100	**400**
MW07	Dec-21	<20	<50	**500**	<100	**500**
MW08	Dec-21	<20	<50	**200**	<100	**200**
MW11	Dec-21	<20	<50	**300**	<100	**300**

Legend:

California Water Board (CWB) Environmental Screening Levels for Gasoline and Diesel - Aquatic Ecosystem

Australian and New Zealand Environment and Conservation Council (ANZECC) Primary Contact Recreational

5. POTENTIAL RECEPTOR AND EXPOSURE PATHWAYS

Potential human and ecological receptors and exposure pathways with consideration of the ongoing current use of the subject area are summarised in Table 4.

Table 4: Potential Exposure Pathways and Risk to Receptors

Receptors	Potential Exposure Pathways Considered	Potential Risks identified from Exposure Pathways
Intrusive Maintenance (Trench) Workers	**Inhalation** **Dermal** **Ingestion**	Although risks to intrusive maintenance workers posed by known residual soil contamination is considered to be low, higher TRH concentrations may exist (i.e., between sample locations), and as such the potential for exposure via inhalation of vapours or dust, dermal contact or ingestion of TRH contaminated soils may exist and is to be considered. Inhalation, dermal contact and ingestion of shallow contaminated groundwater may also exist and is to be considered.
Permanent Site Workers and Visitors	**Dermal** **Ingestion**	There are TRH concentrations greater than the direct contact HSL for commercial and industrial workers in parts of the site. Similar or higher concentrations may exist in areas near the spill locations which were not accessible / able to be remediated (e.g. under the rail lines). Potential risks associated direct contact exposure pathway remain and will require management.
	Vapour intrusion (future occupied structures)	The vapour intrusion pathway will need to be considered should occupied buildings/ structures be constructed within the subject areas in the future. Concentration of volatile TRHs greater than adopted assessment criteria have been previously reported in isolated areas – but may be present at higher concentration across the subject area. If an occupied structure is proposed to be built on top of the areas of contamination, the vapour intrusion risk should be assessed to determine remediation and/or management options.
Groundwater Users	**Ingestion, dermal, inhalation**	A source-pathway-receptor linkage has not been identified for the potential users of groundwater due to the absence of registered groundwater bores in the area. Furthermore, the groundwater beneath the spill area is highly saline and therefore unlikely to be used for drinking and/or irrigation purposes.

Receptors	Potential Exposure Pathways Considered	Potential Risks identified from Exposure Pathways
Ecological and Primary Contact Recreation	**Direct contact with potentially contaminated water discharged in the intertidal mangrove community and/or Darwin Harbour (surface water) and primary contact recreation human receptors**	A potential source-pathway-receptor linkage has not been identified as no groundwater impacts were reported for the monitoring wells located along the edge of the mangrove fringe and groundwater modelling indicates that impacts will not reach the ecological receptor. The potential linkage; however, may appear in the future if groundwater plume migrates towards this area. The certainty of this linkage; however, can only be ascertained through future groundwater monitoring through the implementation of the groundwater monitoring and management plan (Greencap 2023a) . The potential for surface water contamination is deemed to be unlikely as surface soil contamination has been removed during remediation works. Additionally, prior surface water monitoring results have shown negligible impact resultant from the subject area, with majority of surface water concentrations reported below laboratory detection limits[2]. Surface water in the subject area can only feasibly be considered a possible pathway for the movement and migration of contamination towards the identified receptors (mangrove community, and/or Darwin Harbour and human primary contact) if excavated contaminated soil is not appropriately managed. There is also a potential for groundwater generated from dewatering activities to escape / discharge to the mangrove community impacting on ecological and primary contact recreational receptors.

In summary, contamination within the subject area is unlikely to pose an unacceptable risk to the identified human and environmental receptors. However, the risk to the receptors may change (and may require further management) if the following occurs:

- disturbance of contaminated soil and / or groundwater; and / or
- construction of occupied structures within the subject area.

[2] Greencap. Surface Water and Sediment Sampling, One Rail Australia, Berrimah Freight Terminal. October 2021. Ref: J168829

6. ROLES AND RESPONSIBILITIES

The responsibility and authority pertaining to environmental performance of the subject area is specified below.

6.1 All Personnel

All personnel (including sub-contractors) have a general environmental duty of care (as defined under Clause 12 of the Waste Management and Pollution Control Act 1998) and are responsible for their own environmental performance whilst on the project.

As a minimum, personnel are required to:

- Comply with the requirements of applicable environmental legislation and environmental authorities including the specific requirements of the project approvals and supporting documentation;
- Undertake all activities in an environmentally responsible manner;
- Undertake all activities in accordance with this EMP, procedures and any subsequent work method statements;
- Identify and report any non-conformances with environmental management, legislative or approvals requirements;
- Ensure that they are aware of the contact person regarding environmental matters and report any activity that has resulted in or has the potential to result in an environmental harm; and
- Ensure that they attend any environmental training provided relevant to their role and responsibilities.

6.2 Key Personnel

6.2.1 Site Manager/ Environmental Manager (EM) - Aurizon

The Site Manager/ EM has to ensure that environmental impacts are minimised, and obligations are met. They will have a direct role in the compliance with identified environmental procedures and controls. They will also be responsible for checking the subject area on a regular basis and ensuring that regular maintenance is undertaken to minimise environmental impacts and that personnel are provided with appropriate environmental "toolbox" training, prepared by the Environment Representative (ER)/Consultant (refer to Section 6.2.2 below for definition). The Site Manager/ EM will work in conjunction with the ER, as required to ensure that the team delivers the prescribed environmental outcomes. Key tasks include:

- Notification of any identified site contamination issues to the EPA in accordance with Section 14 of the Waste Management and Pollution Control Act 1998;
- Ensure compliance with all applicable legal, approval and project environmental obligations including but not limited to this EMP;
- Ensure all project staff have a clear understanding of the environmental requirements relevant to their area / scope of work, including the presence and extent of contamination, potential risks to human health and the environment;
- Ensure all project staff are competent to undertake their duties including fulfilment of the general environmental duty, with regard to appropriate education, training and experience;
- Ensure the necessary resources and processes are in place for implementation of required environmental controls;

- Ensure all supervisors are familiar with environmental obligations, project approvals, EMP and Site level plans, relevant environmental management plans and associated documents, and their responsibilities within them;
- Participate and provide guidance in the regular review of the EMP and any associated documents;
- Take action in the event of an emergency and allocating the required resources to minimise environmental impact;
- Identify and report non-conformances;
- Ensure non-conformances are identified, recorded and reported and that required corrective and remedial actions are implemented;
- Review and assess adequacy of safe work methods and plans prepared by all at risk contractors;
- Report any activity that has resulted in an environmental incident to the ER within two hours of the incident occurring; and
- Review statutory compliance and ensure/ check all approvals are complied with.

6.2.2 Environmental Representative/ Consultant (ER)

The ER is an individually appointed and independent third party, with experience and qualifications in environmental management and remediation. The ER has primary responsibility for environmental management and compliance during any construction or intrusive works. The key responsibilities of the ER are to:

- Develop and implement this EMP;
- Update EMP (as required) for any changes in site conditions, environmental controls following the results of audits, non-conformances or incidents (which indicate an update may be necessary);
- Conduct or assist the Site Manager/ EM in environmental briefings and toolboxes to construction staff;
- Conduct or assist the Site Manager/ EM in environmental site inspections during any remediation works and other earthworks onsite;
- Assist the EM in monitoring the implementation and effectiveness of the EMP to determine the need for any changes to the EMP;
- Conduct sampling of soil, groundwater, surface water, and waste stockpiles to determine any changes to EMP or appropriate management approaches and (as required) as part of incident investigations;
- Complete environmental reporting requirements as requested by the EM; and
- Provide advice and direction to the EM on environmental matters, incident response and corrective actions.

6.2.3 Earth Works/ Construction Personnel

In addition to the key positions outlined above, with respect to environmental management, all staff that will disturb soil and / or groundwater under the site (which could include drilling contractors, excavation and dewatering contractors and others) have the responsibility for environmental performance on the subject area. The responsibilities of these personnel include:

- Attend all environmental training required and adhere to and remain familiar with the principles covered in the training session(s) and this EMP;
- Undertake all activities in accordance with procedures and safe work methods approved by both the ER and EM;
- Ensure that they are aware of the contact person for environmental matters;
- Ensure that any clearances are obtained from the EM where required; and
- Report any activity that has resulted in an environmental incident.

It is Aurizon's responsibility to ensure that all persons on the project including sub-contractors and their employees are notified on their need to comply with the relevant environmental requirements. As a minimum, sub-contractors and their employees will be required to comply in full with the EMP.

The following roles have been established for those involved in the implementation EMP.

Contact Details

Title	Name	Phone	Email
Aurizon Representative			
Environmental Manager (EM)	Haydn Franklin	0460 652 800	haydn.franklin@aurizon.com.au
Site Manager	Gregg Newton	0404 048 546	gregg.newton@aurizon.com.au
Environmental Representative (ER)/ Consultant (WSP)			
Technical Lead	Shya Jackson	0408 644 022	Shya.Jackson@wsp.com
NT EPA (Regulator)			
Environmental Officer	Christina Rodriguez	08 8924 4161	Christina.Rodriguez@nt.gov.au

7. ENVIRONMENTAL RISK MANAGEMENT STRATEGY

Aurizon utilises a robust risk management process for all its activities to achieve and to ensure the following key outcomes:

- Risks are understood, eliminated or reduced and controlled to an acceptable level;
- Controls are owned, assured and continuously reviewed for effectiveness;
- All activities are compliant with regulatory standards and are guided by best practice; and
- All stakeholders are confident in the way activities are conducted to manage risks.

A GMMP (Greencap 2023) has been prepared, as endorsed by the Auditor which shall be implemented for the ongoing monitoring and management of groundwater quality to ensure protection of ecological and human receptors associated with the intertidal mangrove community and Bleesers Creek.

This section includes a risk management summary table that will provide an overview of the activities, potential impacts, management controls, performance measures and monitoring and records. Risk management allows the mitigation of potential risks posed to site workers, visitors, and contractors to remaining contamination in soil and groundwater under the site. In addition, the residual risk rating and a statement of the effectiveness of the proposed controls to manage the environmental risk is also provided. The rationale for how each residual risk and risk control effectiveness are deduced are included following in Table 5 and Table 6.

Table 5: Risk Treatment and Acceptance Criteria

Details	Description
Low	• No risk treatment required; and • No ongoing review or monitoring required.
Medium	• Risk treatment may be considered; and • Review risk two yearly.
High	• Risk treatment must be considered; and • Review risk annually at a minimum.
Very High	• Risk treatment must be in place immediately; and • Review risk quarterly.

Table 6: Risk Control Effectiveness Definition

Details	Description
Effective	• Controls are well designed and address the root cause(s) of the risk; • Controls are recognized industry best practice; • All controls operate to the required level; • All controls are within the power of Aurizon; and • Ongoing monitoring required.
Can Be Improved	• Majority of controls are well designed and address the root cause(s) of the risk; • Majority of controls operate to the required level; • Some controls are outside the power of Aurizon, with multiple external factors beyond control; • Ongoing monitoring required; and • Certain controls can be improved or have elements below industry best practice.
Must Be Improved	• Most controls are not well designed and do not address the root cause(s) of the risk; • Most controls are not operating to the required level;

Details	Description
	• A large number of controls are outside the power of Aurizon, with multiple external factors; and • The majority of controls require improvement and are well below industry best practice.

Table 7: Risk Management Summary

Environmental Aspect	Activity	Potential Impacts	Management Controls	Performance Measures	Monitoring Records
Exposure to contaminated soil, sediment, and groundwater	Civil and intrusive works by maintenance workers and site staff (track maintenance and upgrade, road works, utility works). Storage and transportation of contaminated waste soil. Potential dewatering of contaminated groundwater in development of earthworks.	Disturbance and potential spreading and mobilisation of contaminated soils at surface resulting in direct contact exposure for commercial and intrusive workers, resulting in potential dermal contact, vapour/ dust inhalation and ingestion. Contaminated soil and sediment erosion and sedimentation, potentially impacting offsite receptors, particularly down gradient mangrove areas of Bleesers Creek. Maintenance intrusive worker exposure to contaminated soil, sediment, and groundwater. Discharge of contaminated soil, sediment, and groundwater to adjacent surface water environments (mangroves).	Following any earthworks, the surface area is to be reinstated or covered as soon as possible. Excavation and stockpiles are to be fenced or cordoned off the work area to prevent unauthorised access or interaction. Stockpiles should be covered and bunded and removed offsite or placed in-situ onsite a maximum of 48 hours following construction or sampling. The benefits of covers include reduction in wind generated dust, reduction in odours, reduced surface water run-off and in the case of tarpaulins and plastic covers cleaner surface water run-off. Ensure contaminated soils excavated during intrusive works are returned to depth and covered by uncontaminated soils or disposed offsite appropriately. If excavated contaminated soils are disposed offsite, clean soils must be used as replacement.	Any unauthorised access will be reported to the Site Manager. Any issues with the integrity of fencing around construction areas are to be repaired immediately. Bunding present around contaminated stockpiles and excavation areas and in good condition (no breaches), as well as soil stockpiles all covered during storage. Contractor safe work methods address human health and environmental risks associated with intrusive works undertaking. Tanks holding extracted groundwater and bunding in good condition with no loss of integrity / containment. Ensure all staff, intrusive workers, contractors, and visitors complete an induction and have access to and appropriate training in the implementation of the afore mentioned measures. Maintain records of inductions and training as well as any non-conformances to the above.	Visual monitoring for soil erosion and related issues are best undertaken at critical stages, such as: • After a specific phase of activity such as civil excavation work, all areas disturbed should be inspected for signs of compaction, erosion, and soil degradation; and • After significant rainfall events. Auditing of contractor compliance with EMP including provision of bunding, fencing, storage tanks and record of contractor inspections / maintenance Maintain and log workspace monitoring results – including any waste disposal certificates if taken to land fill. Inspection logs and records performance /

Environmental Aspect	Activity	Potential Impacts	Management Controls	Performance Measures	Monitoring Records
			Implement appropriate OHS measures for intrusive workers, contractors and visitors which may include but not be limited to the following (in addition to those already required by Aurizon); wearing long sleeved pants and shirts, disposal nitrile gloves, and appropriate dust masks (to be determined based on works undertaken), establishment of hand washing facilities, enforcement of no smoking zones, monitoring of atmospheric vapour concentrations within and adjacent the work zone etc. Any surplus soils requiring offsite disposal are to be tested and classified by an environmental consultant prior to offsite transport and disposal by a licensed contractor to a facility licensed to accept that waste. Monitoring of VOCs and ground gases is to be undertaken. The requirements for workspace monitoring and relevant action/ trigger levels are to be included in the health, safety and environmental plan required for any works within the subject area.		compliance with management controls will be kept and any non-compliance with management controls and performance measures will trigger investigation and implementation of corrective actions. If this includes loss of containment and discharge of contaminated soil, sediment or water across the site and/or into the mangroves, then investigation (sampling and analysis of relevant media) may be necessary to determine the impacts of management control failure. Notification to EPA associated with a loss of containment may also be necessary in some instances.

Environmental Aspect	Activity	Potential Impacts	Management Controls	Performance Measures	Monitoring Records
			Erosion control measure(s) (in addition to those outlined for the management of stockpiles) to be implemented and maintained during any works that involve soil disturbance across the subject area (e.g., surface diversions around excavation areas) The retention of vegetation buffers surrounding the Site, particularly north of the Site adjacent waterways. Regular inspection will be conducted by Aurizon to inspect implemented OHS measures, stockpile and water management measures, surface capping and soils and to repair any breaches through erosion where encountered (suitable inspection intervals are to be determined based on activities and rainfall (e.g., daily during heavy rain fall). All regulated wastes are to be removed offsite immediately. Ensure surface is retained level and excavations are compacted. Ensure all groundwater generated during dewatering for ground disturbance purposes is either stored in bunded tanks or disposed of appropriately offsite (to a Licenced waste facility).		
Residual Risk?		**High**	**Risk Control Effectiveness?**		**Effective**

Environmental Aspect	Activity	Potential Impacts	Management Controls	Performance Measures	Monitoring Records
Exposure to contaminated surface water	Civil and intrusive works by maintenance workers and site staff (track maintenance and upgrade, road works, utility works). Heavy rainfall events causing leaching and dissolution of contaminated soil and resulting contamination of surface water Improper stockpiling / storage of contaminated soils Loss of contaminated extracted groundwater to the ground surface	Potential risks to human and ecological receptors in down gradient intertidal mangrove community and Bleesers Creek from discharge of contaminated surface water. Potential exposure to hydrocarbon contaminated surface water onsite if potentially contaminated soils are left exposed at surface, resulting in direct contact exposure for commercial and intrusive workers, resulting in potential dermal contact, vapour inhalation and ingestion. Pooling of contaminated surface water.	Implement appropriate OHS measures for intrusive workers, contractors and Site visitors which may include but not be limited to the following (in addition to those already required by Aurizon); wearing long sleeved pants and shirts, disposal nitrile gloves, and appropriate dust masks (to be determined based on works undertaken), establishment of hand washing facilities, enforcement of no smoking zones, monitoring of atmospheric vapour concentrations within and adjacent the work zone etc. Following any earthworks, the surface area is to be reinstated or covered as soon as possible. To reduce surface water run-off, stockpiles should be covered and bunded and removed offsite or placed in-situ onsite a maximum 48 hours following construction or sampling. Erosion control measure(s) to be implemented and maintained during any works that involve soil disturbance across the Site. The retention of vegetation buffers surrounding the Site, particularly north of the Site adjacent waterways.	No release of Site stormwater or wastewater exceeding surface water quality parameters provided within the GMMP. No release of surface water or extracted groundwater to occur unless approved by Aurizon's site management team. Ensure all staff, intrusive workers, contractors and Site visitors complete a Site induction and have access to and appropriate training in the implementation of the afore mentioned OHS measures. Maintain records of inductions and training as well as any non-conformances to the above. Ensure tanks holding extracted groundwater and all bunding are in good condition with no loss of integrity / containment.	Visual monitoring for surface water impacts (i.e., sheens on surface water in the onsite drainage network) is to be undertaken opportunistically following rainfall events. No formal surface water sampling is scheduled. Surface water sampling will need to be undertaken opportunistically in the event potential contamination indicators are observed or if off-disposal to a liquid treatment plant is required. Maintain and log surface water sampling results and fate of tested water (including disposal documentation if disposed offsite). Inspection logs and records performance / compliance with management controls will be kept and any non-compliance with management controls and performance measures will trigger

Environmental Aspect	Activity	Potential Impacts	Management Controls	Performance Measures	Monitoring Records
			Regular inspection will be conducted by Aurizon to inspect implemented OHS measures, stockpile and water management measures, surface capping and soils and to repair any breaches through erosion where encountered (suitable inspection intervals are to be determined based on activities and rainfall (e.g., daily during heavy rain fall). All regulated wastes are to be removed offsite immediately. Ensure surface is retained level and excavations are compacted. Earthworks should be scheduled for drier seasons to avoid potential impact on stormwater. If unavoidable, extensive silt / sediment capture systems must be installed within all drainage areas. Ensure surface cover is reinstated with compact and uncontaminated soils only. Ensure all groundwater generated during dewatering for ground disturbance purposes is either stored in bunded tanks or disposed of appropriately offsite (to a licenced waste facility). Any collected potentially contaminated stormwater is to be tested by an experienced environmental consultant and disposed offsite by a suitably licensed contractor if contaminated.		investigation and implementation of corrective actions. If this includes loss of containment and discharge of contaminated soil, sediment or water across the site and/or into the mangroves, then investigation (sampling and analysis of relevant media) may be necessary to determine the impacts of management control failure. Notification to EPA associated with a loss of containment may also be necessary in some instances. Auditing of contractor compliance with EMP / OHS plans including provision of bunding, fencing and record of contractor inspections / maintenance.

Environmental Aspect	Activity	Potential Impacts	Management Controls	Performance Measures	Monitoring Records
Residual Risk?		**High**	**Risk Control Effectiveness?**		**Effective**
Waste Management	Civil and intrusive works by maintenance workers and site staff (track maintenance and upgrade, road works, utility works). Storage and transportation of waste soil. Management of surplus surface water and extracted groundwater that is potentially contaminated or confirmed to be contaminated.	Disturbance and potential illegal dumping of contaminated soils. Risks to intrusive workers, contractors and Site visitors through dermal contact, ingestion and inhalation of vapours and potentially contaminated soils. Risk to site workers and environment by poorly managed waste material stored onsite (refer to exposure to contaminated soil, sediment, groundwater and surface water in previous rows).	Implement appropriate OHS measures for intrusive workers, contractors and Site visitors which may include but not be limited to the following (in addition to those already required by Aurizon); wearing long sleeved pants and shirts, disposal nitrile gloves, and dust mask (to be determined based on works undertaken), establishment of hand washing facilities, enforcement of no smoking zones, monitoring of atmospheric vapour concentrations within and adjacent the work zone etc. Monitoring of VOCs and ground gases is to be undertaken. The requirements for workspace monitoring and relevant action/ trigger levels are to be included in the health, safety and environmental plan required for any works within the subject area. Designated waste storage and handling area to be established onsite away from site boundaries, site and adjacent buildings. Waste soils stockpiled onsite should be disposed of as soon as practical and kept covered to avoid erosion.	The outcomes of waste management practices can be assessed against the performance criteria for: • Waste soils generated through works onsite are removed promptly; • Waste disposal registers are maintained onsite; • Ensure all staff, intrusive workers, contractors and Site visitors complete a Site induction and have access to and appropriate training in the implementation of the afore mentioned OHS measures. Maintain records of inductions and training as well as any non-conformances to the above; and • Waste soil, sediment, groundwater and surface water is managed onsite such that it does not have an impact on human health and the environment (refer to soil, sediment, groundwater and surface water rows, above).	Visual assessment of adequacy of control measures to mitigate risk posed by onsite storage of contaminated waste soil, sediment, groundwater and surface water. Inspections to be conducted weekly or daily during heavy rain events. Internal auditing of contractor compliance with EMP / OHS plans – including provision of bunding, fencing and record of contractor inspections / maintenance. All waste to be disposed of offsite to have been classified appropriate for offsite disposal (licenced facility). Waste disposal records are kept by Aurizon onsite for potential audit purposes. Inspection logs and records performance / compliance with management controls will be kept and any

Environmental Aspect	Activity	Potential Impacts	Management Controls	Performance Measures	Monitoring Records
			Waste soils are to be disposed offsite in accordance with the requirements of NT waste disposal legislation. Prior to offsite disposal, waste soils are to be classified according to guidelines used by the suitably licensed Shoal Bay Waste Management Facility. No soils are to be disposed offsite without the express permission of an experienced environmental consultant. Ensure the availability of spill cleanup equipment for operations and ensure that all Aurizon staff are experienced in the usage. All regulated wastes are to be removed offsite immediately. Waste contractors to be used are to be listed on the NT EPA waste handling contractors register. Refer to controls for soil, sediment and surface water to mitigate potential impacts to human health and the environment from poor stockpiling, storage and management of contaminated soil and surface water generated at the site.		non-compliance with management controls and performance measures will trigger investigation and implementation of corrective actions. If this includes loss of containment and discharge of contaminated soil, sediment or water across the site and/or into the mangroves, then investigation (sampling and analysis of relevant media) may be necessary to determine the impacts of management control failure. Notification to EPA associated with a loss of containment may also be necessary in some instances.
Residual Risk?		**High**	**Risk Control Effectiveness?**		**Effective**

Environmental Aspect	Activity	Potential Impacts	Management Controls	Performance Measures	Monitoring Records
Air Quality – Dust Emissions	Civil and intrusive works by maintenance workers and site staff (track maintenance and upgrade, road works, utility works). Storage and transportation of waste soil.	Risks to intrusive workers, contractors and Site visitors through inhalation of potentially contaminated dust (including from poorly managed contaminated stockpiles), dermal contact and also ingestion. Exposed areas/surfaces contributing to increased dust emissions on Site. Excessive dust emissions during earthworks resulting in a community complaint. Aesthetic impacts.	Implement appropriate OHS measures for intrusive workers, contractors and Site visitors which may include but not be limited to the following (in addition to those already required by Aurizon); wearing long sleeved pants and shirts, disposal nitrile gloves, and dust masks (to be determined based on works undertaken), establishment of hand washing facilities, enforcement of no smoking zones, monitoring of atmospheric vapour concentrations within and adjacent the work zone etc. Designated waste storage and handling area to be established onsite away from site boundaries, site and adjacent buildings. Stockpiles should be covered and bunded and removed offsite or placed in-situ onsite for a maximum 48 hours following construction or sampling. Waste soils are to be removed and disposed from Site as soon as practical, following approval from the environmental consultant. Earthworks and soil transportation should be avoided during periods of high winds.	Minimal complaints regarding dust/ air quality. No visible dust emissions during disturbance of contaminated soils onsite. Ensure all staff, intrusive workers, contractors and Site visitors complete a Site induction and have access to and appropriate training in the implementation of the afore mentioned OHS measures. Maintain records of inductions and training as well as any non-conformances to the above.	Any complaints and any dust monitoring reports are to be retained onsite by Aurizon. Internal auditing of contractor compliance with EMP / OHS plans – including the presence of soil covers. Maintain and log daily (during dust generating activities - e.g., excavation, stockpiling and backfilling) surface visual inspections for excessive dust emissions Inspection logs and records performance / compliance with management controls will be kept and any non-compliance with management controls and performance measures will trigger investigation and implementation of corrective actions.
Residual Risk?		**High**	**Risk Control Effectiveness?**		**Effective**

8. TRAINING AWARENESS AND COMPETENCE – SITE CIVIL WORKS

The following training shall be provided onsite for any staff or contractors who will be undertaking works in the subject area.

8.1 Site Induction (Environment & OHS)

Prior to working onsite, all personnel and sub-contractors will undertake an induction incorporating Environmental and OHS requirements. The induction will address a range of environmental awareness issues including, but not limited to:

- The EMP (purpose, objectives, nature of site contamination and key issues);
- Legal requirements including due diligence, duty of care and potential consequences of infringements;
- Environmental responsibilities under relevant Territory and Federal legislation (refer to **Section 2**);
- Conditions of licenses, permits and approvals;
- Presence of site contamination, its nature, likelihood of encountering it, and associated risks;
- Identification of boundaries for location of refuse bins, washing, refuelling and maintenance of vehicles, plant and equipment;
- Management and monitoring requirements to mitigate risks to human health and environment during works which may disturb soil and groundwater in the contaminated areas (including excavation works, groundwater extraction to allow excavation etc.);
- Incident management and emergency plans; and

  Reporting process for environmental harm/ incidents.

8.2 Toolbox Training

"Toolbox" training will help to ensure that relevant information is communicated to the workforce and that feedback can be provided on issues of interest or concern. "Toolbox" training will generally be prepared and delivered by the EM. These toolboxes can be integrated into Construction Method Statements (CMSs) delivered to personnel prior to commencing specific activities may encounter site contamination or can be used as a stand-alone training tool.

"Toolbox" training topics may include:

- Management of contaminated soil, sediment, surface water and groundwater to minimise pathways for human and ecological exposure to contamination;
- Soil stockpiling area, contaminated groundwater and surface water storage area – as well as management requirements;
- Stormwater management procedures;
- Dust control;
- Waste and wastewater management, minimisation and recycling;
- Installation and maintenance of erosion and sediment control devices; and
- Other general Site issues.

8.3 Contingencies

When a non-conformance or incident occurs onsite, or if monitoring indicates an environmental objective or performance criteria is not being achieved, corrective actions should be designed to prevent any further impact and to ensure that environmental objectives are met. In the context of the site, contingency measures may therefore be required in instances where despite implementing the environmental controls as

previously mentioned, the remaining contamination is found to have an impact on ecological and human receptors.

If implemented environmental controls appear to not be satisfactory in preventing potential impact to ecological and human receptors (e.g., during escape of contamination off-site, improper management of soil on-site or off-site, worker exposure to contamination), appropriate risk treatment needs to be developed. The recommended hierarchy for risk treatment from highest to lowest is as follows:

1. Eliminate the hazard, e.g. Stop the works.
2. Reduce the hazard, e.g. Modify the works, change equipment.
3. Block the pathway, e.g. Install bunding.
4. Administrative controls, e.g. update procedures.

Management controls as described in Table 7, Section 7 are required to be implemented early to ensure non conformances or unforeseen impacts are averted. Although the potential exists for a number of minor incidents to occur onsite, the following generalised examples of a potential minor incidents details the contingency procedures that should be implemented.

Table 8: Example of Environmental Incident Management Procedures for Loss of Control / Containment of Contaminated Soil, Sediment, Groundwater and Surface Water

	Action	Responsibilities	Comments
1	Identify the source	Person who observed loss of control / containment	Identify the source of the breach whether it be a breached containment pond, eroded section of land etc.
2	Inform Site Manager and EM	Person who observed loss of control / containment	Cease all works and stop human and vehicular traffic and isolate area.
3	Determine the magnitude and destination of the loss of control / containment	Site Manager/ EM	If contaminated soil, sediment, groundwater, extracted groundwater and surface water has escaped offsite (i.e. into the site stormwater system (which drains to the adjacent intertidal mangrove community and Bleesers Creek) and across other uncontaminated areas of the Site, contact the Environmental Manger immediately.
4	Place barriers around drains and outlets	Site Manager	Seal drain entry points by blocking with sandbags or other available material.
5	Contain the materials	Site Manager	Once drainage areas are protected, contain the flow or material within the one area of the site with either the construction of bunds or sumps preventing potential impact to other areas of the site and offsite drains.
6	Clean up of contaminated materials and remediation of area	Site Manager/ EM	Following containment either test and dispose of contaminated waters and or soil as appropriate in accordance with guidelines and validate any impacted areas through sampling.
7	Complete incident log	Site Manager/ EM	Record incident and investigate and notify EPA if required by relevant legislation. Follow through with a sampling program of the receiving environment to assess for potential impacts from the contamination release.

Table 9: Example of Environmental Incident Management Procedures for Flooding During Excavation Works

	Action	Responsibilities	Comments
1	Bolster sediment fences and stormwater controls	Site Manager	If safe to do so, ensure all stormwater controls are cleared and functional, consider the installation of additional measures within drains including sediment barriers.
2	Inform Project Manager and ER	Site Manager	Stop human and vehicular traffic and isolate area.
3	Determine the magnitude and destination of the run-off	Site Manager	For flood waters carrying potentially contaminated sediment offsite contact the Environmental Manger immediately.
4	Form a barrier around the worksite to contain	Site Manager	Unimpacted soil or hay bales can be utilised.
5	Monitor drains and barrier points	Site Manager/ EM	Monitor all installed sediment traps and barriers.
6	Complete incident log	Site Manager/EM	Record incident and investigate. Follow through with a sampling program of the receiving environment to assess for potential impacts from the contamination release.

8.4 Incident Investigation and Reporting

All incidents will be documented, investigations conducted, and action plans established in order that the event does not occur again.

In complying with EPA's expectations regarding incident reporting, an environmental investigation report is expected to include the following basic elements:

- Incident or activity that has caused contamination or environmental harm;
- Nature of contamination and chemicals of concern;
- Area affected (on or offsite);
- Aspects of the environment affected and whether remediation of these affected areas is required; and
- Any other relevant information.

Further to this, an environmental investigation will also include:

- Identifying and implementing the necessary remedial and corrective action;
- Identifying the personnel responsible for carrying out the corrective action;
- Implementing or modifying controls necessary to avoid a repeat occurrence of the incident; and
- Recording any changes in written procedures required.

8.5 Compliance

The tasks in the following subsections are required wherever potential disturbance to the remaining contamination may be necessary.

8.5.1 Environmental Monitoring, Inspections and Auditing

The Site Manager will be required to track all activities on the subject area. Information recorded will include, but not be limited to:

- The general conditions of the area including weather conditions and status of environmental controls;
- Activities carried out; and
- The type and amount of contaminated material generated.

The effectiveness of environmental protection measures will be assessed by the EM (as described in Table 7) or their nominated delegate, unless otherwise specified. The purpose of the monitoring is to:

- Provide a surveillance tool to ensure that safeguards are being implemented;
- Identify where issues might be occurring; and
- Facilitate the early resolution and action of issues.

Any actions that are identified during these inspections are to be addressed. The actions will remain "open" until:

- The issue has been resolved / closed out;
- A new or revised procedure has been established and implemented; and
- Training has been provided to relevant personnel/ sub-contractors.

8.5.2 Monitoring Non-Conformances

Where a non-conformance is detected or monitoring results are outside of the expected range:

- The results will be analysed by the EM in more detail with the view of determining possible causes for the non-conformance;
- A site inspection will be undertaken by the EM;
- An agreed action plan will be identified, or an action will be implemented to rectify the problem.

An environmental incident report (EIR) or an environmental improvement notice (EIN) may be issued by the EM to the non-conforming party in response to the problem if it is found to be construction related.

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Sampling, Analytical and Quality Plan

Berrimah Freight Terminal
Export Drive, Berrimah, NT

Prepared for:	Aurizon
Date:	6 November 2024
Reference:	JC1580
Version:	JC1580_SAQP-05

Agon Environmental Pty Ltd

Address
1/41 Jessop Crescent,
Berrimah, NT 0828

Phone
+61 8 7918 7807

Email
enquiries@agonenviro.com.au

A.B.N.
29 167 746 063

TABLE OF CONTENTS

TABLES

FIGURES

AGON DOCUMENT CONTROL

Report Title	Project Reference
SAMPLING, ANALYTICAL AND QUALITY PLAN Berrimah Freight Terminal Export Drive, Berrimah, NT	JC1580
Written	**Approved**
 **Varun Bhagwat** Senior Environmental Consultant	 **Chris Gamble** Principal Environmental Scientist

Rev No	Status	Date	Author	Reviewer
01	For Review	30/05/2024	VB	CG
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03	For Review	11/07/2024	VB	CG
04	For Review	25/10/2024	VB	CG
05	Final	06/11/2024	VB	CG

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01	1 electronic	Aurizon & Senversa
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05	1 electronic	Aurizon & Senversa

1.0 INTRODUCTION

1.1 Background

Agon Environmental Pty Ltd (Agon) was commissioned by Aurizon, to prepare this Sampling, Analytical and Quality Plan (SAQP) to undertake a soil investigation at a portion of the Berrimah Freight Terminal, Export Drive, Berrimah, Northern Territory (NT) (the site).

A diesel spill estimated at approximately 20,000 litres occurred on the site during automatic refuelling of a diesel locomotive in May 2020. It is understood that most of the diesel impacted soil at the site has been excavated and subsequently backfilled. However, the composition of the backfill material is unknown. This identified data gap is to be addressed in the form of a soil investigation as per the request of an independent environmental Auditor (Graeme Miller of Senversa).

1.2 Objectives

The objective of this SAQP is to describe the scope of and rationale for the soil investigation works proposed for the site to:

- Assess the chemical and physical quality of the backfill material to determine its contamination status with regards to current land use of the site.
- Determine the suitability of the backfill material use and if unsuitable, determine appropriate management measures.
- Obtain accurate data to adequately assess potential risks associated with the backfilled material at the site.
- Assess data in terms of appropriate investigation (assessment) levels.

2.0 SITE DETAILS

Details for the site are provided in Table 1 and the site location is shown in Figure 1. Areas where diesel impacted soils have been excavated and subsequently backfilled (areas of remediation) are shown in Figure 2 (with selected validation sample locations and depth from previous investigations).

Table 1: Site Details

Aspect	
Site Address	Export Drive Berrimah
Suburb	Berrimah
Certificates of Title	Volume 757 Folio 262 Volume 754 Folio 416
Parcel Reference	NT Portion 5411, Hundred of Bagot
Land Zoning	Zoned as Railway under the NT Planning Scheme
Local Government Authority	Darwin City
Site Area	~0.24 hectares
Current Land Use	Freight rail terminal
Surrounding Land Use	**North**: Intertidal mangrove zone and Bleesers Creek. **East**: Unoccupied and cleared land. **West**: Darwin passenger rail terminal. **South**: Numerous industrial/ commercial premises.

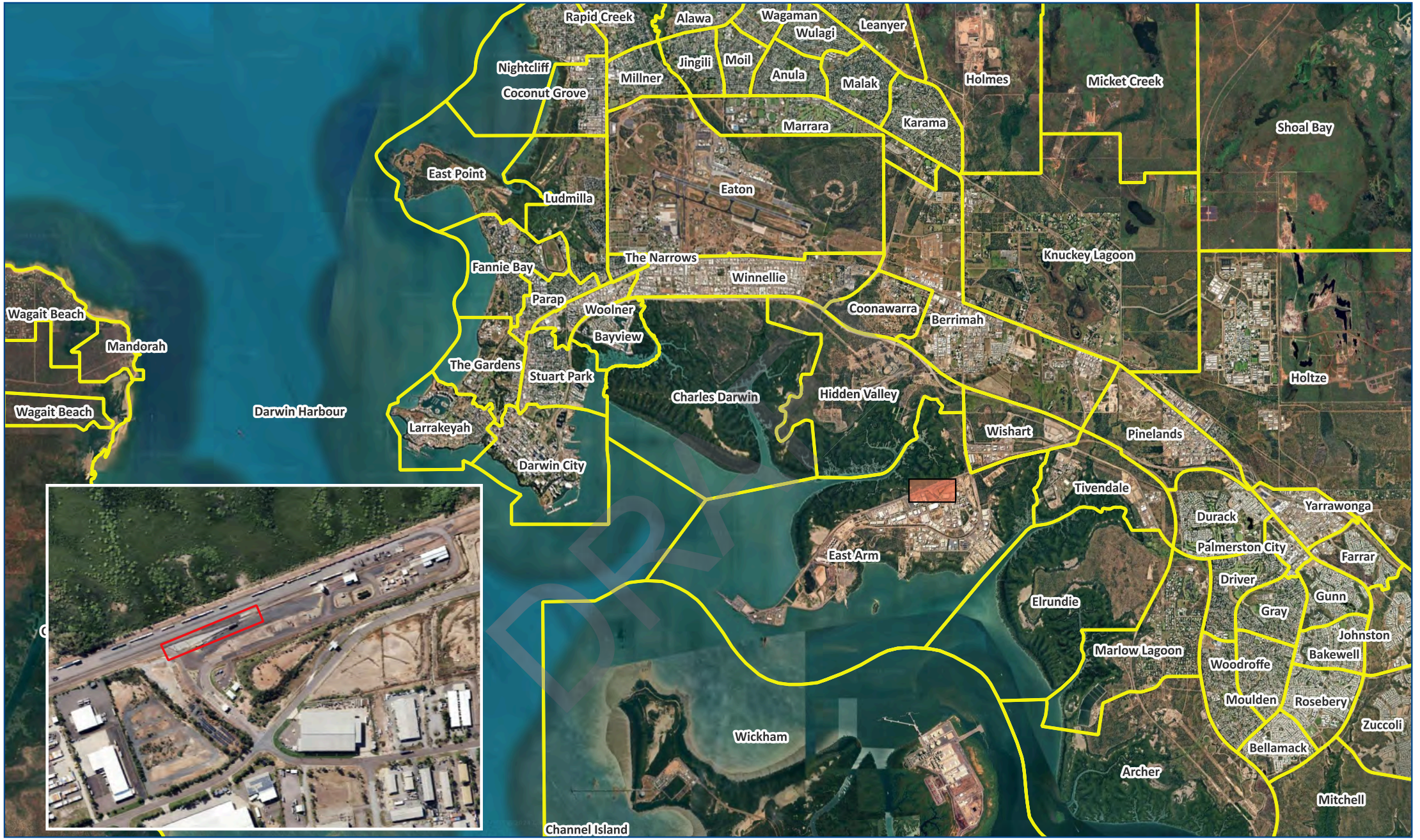

Figure 1. Site Location

Berrimah Freight Terminal
Export Drive, Berrimah, NT
Prepared for: Aurizon

Legend

- Localities
- Area of Study

agon ENVIRONMENTAL

Agon Environmental Pty Ltd
1/41 Jessop Crescent,
Berrimah
North Territary, 0828
agonenviro.com.au

0 1 2 km

N

Projection: Transverse Mercator
Horizontal Datum: GDA 94
Grid: GDA 94 / MGA Zone 52
Aerial Image: Nearmap, 2024

REVISION: 1
Date: 06/08/2024
Reference: JC1580
Prepared by Agon

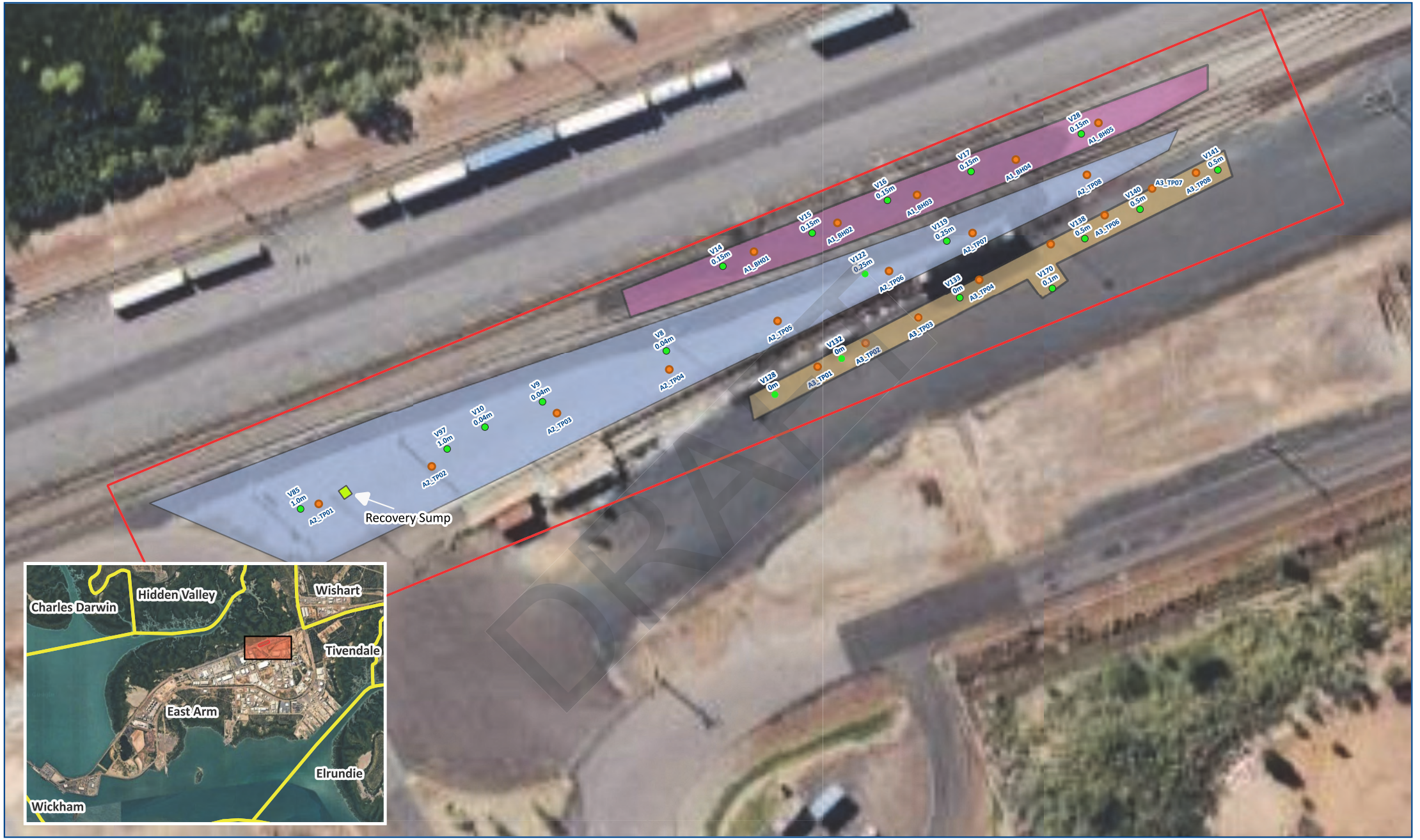

Figure 2. Remediation Areas

Berrimah Freight Terminal
Export Drive, Berrimah, NT
Prepared for: Aurizon

Legend

- Soil invetigation Locations
- Validation Sample Locations

Areas of Remediation

- Area 1
- Area 2
- Area 3
- Localities

agon ENVIRONMENTAL
Agon Environmental Pty Ltd
1/41 Jessop Crescent,
Berrimah
North Territary, 0828
agonenviro.com.au

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Projection: Transverse Mercator
Horizontal Datum: GDA 94
Grid: GDA 94 / MGA Zone 52
Aerial Image: Nearmap, 2024

REVISION: 3
Date: 04/11/2024
Reference: JC1580
Prepared by Agon

3.0 PREVIOUS INVESTIGATIONS

3.1 Detailed Site Investigation

A Detailed Site Investigation (DSI) was conducted by Greencap in April 2021[1] which addressed the impacts of the diesel spill that occurred in May 2020. The objectives of the DSI were to:

- Characterise the type of contamination sustained as a result of the spill.
- Estimate the quantities of diesel spilled and recovered.
- Delineate the vertical and lateral extent of the soil and groundwater impacts associated with the diesel spill.
- Assess the mobility of hydrocarbons still present in the spill site (if any).
- Assess risks to human health and environment associated with the residual soil and groundwater impacts.

The findings of the DSI are summarised below:

- Diesel impacted soils were excavated to the extents practicable.
- Approximately 2,000 litres of diesel is estimated to remain in situ within the spill site.
- The presence of hydrocarbon impacts in groundwater was reported in two of eleven groundwater monitoring wells installed.
- Human and ecological receptors that could potentially be exposed to contamination at the diesel spill site include – onsite workers, site visitors and contractors, the intertidal mangrove zone and the Darwin Harbour.
- It is indicated that the site in its current condition (at the time of the DSI) does not pose an unacceptable risk to the identified human health and ecological receptors. However the risk to the receptors may change if:
  - Site development occurs involving excavation of contaminated soils; or
  - Groundwater is extracted for any human consumption; or
  - Contaminated groundwater reaches the intertidal area.

3.2 Detailed Site Investigation Report – Addendum

Additional work was undertaken by Greencap in March 2023[2] in order to address data gaps identified by the Auditor as part of the review of the DSI.

[1]Greencap, Detailed Site Investigation Report, One Rail Australia, Berrimah Freight Terminal, Export Drive, Berrimah NT (April 2021).
[2]Greencap, Detailed Site Investigation – Addendum Report, One Rail Australia, Berrimah Freight Terminal, Export Drive, Berrimah NT (March 2023).

The additional works concluded that the nature and extent of the contamination relating to the spill of the diesel and subsequent remedial activities have been adequately assessed. As per recommendations from the Addendum DSI, a Groundwater Monitoring and Management Plan[3] was updated and re-implemented, and an Environmental Management Plan[4] was prepared to address management of in-situ impacts with respect to maintenance and any other future works.

[3]Greencap, Groundwater Monitoring and Management Plan, Aurizon, Berrimah Freight Terminal, Export Drive, Berrimah NT (July 2023)
[4]Greencap, Environmental Management Plan, Aurizon, Berrimah Freight Terminal, Export Drive, Berrimah NT (June 2023)

4.0 PRELIMINARY CONCEPTUAL SITE MODEL

A preliminary conceptual site model (CSM) was developed with potential contaminating activities (PCAs), contaminants of potential concern (COPC), identified receptors, and possible exposure pathways summarised in Table 2.

Table 2: Summary of Preliminary CSM of Backfill Material

Potentially Contaminating Activity/ Source of Contamination	COPC	Pathways	Receptors
Importation / Use of Uncontrolled Fill Materials	Metals TPH/ TRH PAH BTEXN Phenols PCB OCP/ OPP Herbicides PFAS ACM	Leaching of contaminants into groundwater. Horizontal groundwater flow in the underlying aquifer. Discharge of contaminated groundwater in the intertidal mangrove zone and/ or Darwin Harbour (surface water). Overland drainage of contaminants and leachate entering the intertidal mangrove zone and/ or Darwin Harbour (surface water).	Groundwater and surface water
			Ecological and primary contact recreation
		Direct contact, ingestion, inhalation of contaminated soils.	Intrusive maintenance (trench) workers, permanent site workers and visitors and groundwater users.
		Contaminant laden dust liberated from the sites	Intrusive maintenance (trench) workers, permanent site workers and visitors and groundwater users. Surrounding commercial/ industrial land occupants.
		Direct contact with potentially contaminated water discharged in the intertidal mangrove zone and/ or Darwin Harbour (surface water) and primary contact recreation human receptors.	Ecological and primary contact recreation

Metals: As, Be, Bo, Cd, Co, CrVI, Cu, Pb, Mn, Hg, Ni, Se, Zn
TPH / TRH: Total petroleum hydrocarbons / total recoverable hydrocarbons
PAH: Polycyclic aromatic hydrocarbons
BTEXN: Benzene, toluene, ethylbenzene, xylenes, and naphthalene
PCB: Polychlorinated biphenyls
OCP/ OPP: Organochlorine pesticides and organophosphorus pesticides
PFAS: Per-and polyfluoroalkyl substances
ACM: Asbestos containing material

5.0 DATA QUALITY OBJECTIVES AND DATA QUALITY INDICATORS

All elements of a SAQP, from data quality objectives through laboratory analysis and reporting, affect the quality of data and necessitate decisions as to what level of uncertainty is appropriate or acceptable. Depending on the identified COPC and their concentrations, coupled with their perceived impacts on the environment and/ or human health, data needs to be justifiable and defensible and capable of indicating their presence or absence. Data Quality Objectives (DQO) establish the quality assurance and quality control (QAQC) parameters for the field and laboratory programs to ensure data of appropriate reliability have been used to assess the presence of site contamination and make informed decisions on remediation or management (if required).

In determining the type, quantity and quality of data needed to support decisions relating to the environmental condition of the site and remediation design, the seven-step DQO process has been undertaken as presented in the following sections.

5.1 Step 1: State the Problem

It is understood that the quality of the material used to backfill the site post remediation works is unknown and is an identified data gap. This data gap needs to be addressed to classify the backfilled material to further inform human health and ecological risks. In summary, the soil investigation is required to:

- Assess the chemical and physical quality of the backfill material to determine its contamination status with regards to current land use of the site.
- Determine the suitability of the backfill material use and if unsuitable, determine appropriate management measures.
- Obtain accurate data to adequately assess potential risks associated with the backfilled material at the site.

5.2 Step 2: Identify the Decisions

The decision required to meet the objectives of the investigation is:

- Are there any potential unacceptable risks to human health and/ or ecological receptors from chemicals in the backfilled material?

5.3 Step 3: Identify Inputs to the Decision

The investigation program will use a risk-based approach to characterising soil conditions across the sites.

The inputs required to inform the Decisions as listed in Section 5.2 include:

- Site information obtained from previous investigations undertaken by Greencap.
- Systematic (grid-based) soil investigation, with:
    - Field observations to be made.
    - Field measurements to be collected for volatile organics in soil samples.
    - Laboratory analytical data to be obtained of collected soil samples.

- Screening level assessment of soil analytical results to values approved by the Auditor and applied in the DSI Addendum.

5.4 Step 4: Define the Study Boundaries

The site is described in Table 1 and shown in Figure 1. Figure 2 shows the extent and depth of excavation of diesel impacted soils and subsequent backfilling that occurred in each remediation area, the extent of which forms the study boundary.

5.5 Step 5: Develop a Decision Rule

A component of the DQO process for the sampling program is to compare soil analytical results with the following Auditor approved adopted guidelines/ legislation in the DSI Addendum (where applicable):

- National Environment Protection Council (NEPC). 2013b. Schedule B (1) Guideline on Investigation Levels for Soil and Groundwater. National Environmental Protection (Assessment of Site Contamination) Measure (NEPM).
- CRC Care Health Screening Levels. 2011. Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater.

The soil analytical results will be compared to the following Auditor approved adopted criteria provided in the DSI Addendum:

- NEPM 2013 Table 1A(1) Health Investigation Levels (HILs) (D) for Soil Contaminants – Commercial/ Industrial land use.
- NEPM 2013 Table 1A(3) Health Screening Levels (HSLs) (D) for Vapour Intrusion – Commercial/ Industrial land use.
- NEPM 2013 Table 1B(6) Ecological Screening Levels (ESLs)/Ecological Investigation Levels (EILs) – Commercial/ Industrial land use.
- NEPM 2013 Table 1B(7) Management Limits (MLs) – Commercial/Industrial land use.
- CRC Care (2011) Health Screening Levels for direct contact (commercial/industrial and intrusive maintenance worker scenarios).
- CRC Care (2011) Health Screening Levels for vapour intrusion (commercial/industrial land use and intrusive maintenance worker scenarios).

Screening levels are applied based on the soil type encountered and the depth of sample collection, where relevant. The investigation exposure settings for coarse soils (sands) were adopted based on the field observations during previous excavation works.

The analytical and field data generated through the assessment process will be compared to the adopted site assessment criteria, and in the context of the overarching objectives, the decision rules become:

1. If evidence of soil contamination suggests a risk to human health and the environment, further detailed investigation, risk assessment, or site remediation/ management may be required, comprising one or more of the following:
    a. Further assessment of soils to determine nature and extent of impacts.
    b. Further consideration of potential for groundwater impacts.
    c. Further consideration of the potential for the contamination to be generating soil vapour/ landfill gas.

d. Development of remediation plans; and/ or management plans.

2. If contaminant concentrations in soil and groundwater are less than the relevant screening criteria, then further assessment, investigation, remediation and/ or management is unlikely to be required.

5.6 Step 6: Specify Limits on Decision Errors

Pre-determined data quality indicators (DQIs) of completeness, comparability, representativeness, precision, and accuracy as presented in the ASC NEPM are to be used to evaluate data acceptability, as follows:

- Precision: The precision of the analytical data and sampling techniques is assessed by calculating the Relative Percentage Difference (RPD) of field and laboratory duplicate samples.
- Accuracy: The accuracy of the laboratory data is a measure of the closeness of the analytical results obtained by a method to the 'true' value and will be assessed by reference to the analytical results of laboratory control samples, laboratory spikes and analysis against reference standards, method blanks and staff appropriately trained in the collection of environmental media.
- Representativeness: Will be achieved by collecting samples on a representative basis across the sites, and by adopting an adequate sampling design and density, and using an adequate number of sample locations and samples to characterise the sites to the required accuracy.
- Comparability: Will be achieved through maintaining a level of consistency in sampling techniques, analytical techniques, and statistical analysis.
- Completeness: The objective is to have sufficient valid data generated during the study, defined as the percentage of measurements made which are judged to be valid.

The DQIs for the DSI are provided in Table 3. If any of the DQIs are not met, further assessment may be required to assess whether the non-conformance significantly affects the usability of the data. Corrective actions may include request for further information from samplers and/ or analytical laboratories, downgrading the data quality, or in worst case, re-collection of the data.

Table 3: Data Quality Indicators

Data Quality Objectives	Frequency	Data Quality Indicator
Precision		
Blind duplicates (inter- and intra-laboratory) and laboratory duplicates	1 in 20 samples	< 30 % RPD where result is >10 times LOR
Accuracy		
Surrogate spikes	All organic samples	70 – 130 %
Laboratory control samples	1 per sample batch	70 – 130 %
Matrix spikes	1 per sample batch	70 – 130 %
Representativeness		
Appropriate sampling for media and analytes	NA	Laboratory method blanks
Sample extracted and analysed within laboratory holding times	NA	Organics at 14 days Inorganics at 6 months
Rinsate Blanks	1 per day when non-dedicated equipment is used.	< LOR
Trip Blanks	1 per sample batch	< LOR
Comparability		
Agon standard operating procedures for sample collection and handling (refer to Section 7.1)	All samples	All samples
NATA accredited analytical methods	All samples	All samples
Consistent field conditions, experienced investigation staff and laboratory analysis	All samples	All samples
Completeness		
Sample logging and Chain of Custodies completed and appropriate	All samples	All samples
Appropriate documentation completed	All samples	All samples
Satisfactory frequency and result for QC samples	All QA/ QC samples	-
Data from critical samples to be considered valid	NA	All critical samples valid

5.7 Step 7: Optimise the Design for Obtaining Data

The purpose of the sampling program is to assess the chemical and physical quality of the backfill material to determine its contamination status with regards to current land use of the site.

To the above affect, the sampling program will rely on a systematic square grid sampling design to characterise the in-situ backfill material at the site. The sampling pattern and density will aim to satisfy the minimum recommended number of sampling points for a square-grid and based on the surface area of each remediation zone, per the NSW EPA (2022) *Contaminated Land Guidelines, Sampling design part 1 – application*. The number of samples collected will aim to satisfy the minimum number of samples recommended for characterisation of estimated volume of backfilled soils per the NSW EPA (2022) *Contaminated Land Guidelines, Sampling design part 1 – application*. The number of sampling locations and

samples to be collected per remediation area are listed below and assumes that the areas subject to backfill are equivalent to the lateral extent of diesel impacted soil removal:

- Area 1 – encompasses a remediation excavation area of approximately 420 m^2 (0.042 hectares) with approximately 75 m^3 of diesel impacted soils removed to a maximum depth of 0.5 m. A minimum of four (4) sampling points with a minimum of one (1) sample collected from each point will apply to Area 1.
- Area 2 – encompasses an excavation area of approximately 1,700 m^2 (0.17 hectares) with approximately 650 m^3 of diesel impacted soils removed to a maximum depth of 1.75 m. A minimum of eight (8) sampling points with a minimum of one (1) sample collected from each point will apply to Area 2.
- Area 3 – encompasses an excavation area of approximately 250 m^2 (0.025 hectares) with approximately 40 m^3 of diesel impacted soils removed to a maximum depth of 0.2 m. A minimum of three (3) sampling points with a minimum of one (1) sample collected from each point will apply to Area 3. Subsequent judgemental graduated targeted sampling will be applied (if required) to improve the precision of lateral delineation of the backfill material.

6.0 SOIL SAMPLING PROGRAM

The works will be conducted with reference to industry standards and guidelines including, but not limited to:

- EPA Victoria. 2009. Industrial Waste Resource Guidelines. Soil Sampling. Publication IWRG702 (the Vic EPA IWRGs).
- Heads of EPAs Australia and New Zealand (HEPA). 2020. PFAS National Environmental Management Plan (the PFAS NEMP).
- National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) (the ASC NEPM).
- NT EPA, 2017, Northern Territory Contaminated Land Guideline.
- NSW EPA. 2022. Contaminated Land Guidelines. Sampling design part 1 – application (the NSW Contaminated Land Guidelines).

6.1 Environmental, Health and Safety

Site safety is of paramount concern, and the work described will be conducted in accordance with this SAQP and project and site-specific safe work method statement/s (SWMS).

6.2 Investigation Design

The rationale, scope, and methodology of soil investigation work is detailed in Table 4, with a proposed sample location plan shown in Figure 3. Standard field methods, including for sample collection, are provided in Section 7.

Table 4: Soil Sampling Plan

Area	Description	Approach	No. of Test Locations	Maximum Depth of Excavation (m)	Minimum No. of Samples Collected per Test Location	Rationale	Analytical Schedule
1	In-situ Soils (backfill material)	Sampling aimed at determining the nature and extent of the backfill material, to assess for the presence of COPCs. The sampling strategy will adopt a systematic square-grid approach across each backfilled area. Sampling will involve the use of an excavator to dig test pits to the maximum depth of backfill in each area. Sampling for asbestos forms will also be undertaken based on observations/ indicators of asbestos contamination or other commonly co-located waste (e.g., building waste).	4	0.5	1	Sampling pattern and density to satisfy the minimum recommended number of sampling points for a square grid per the NSW Contaminated Land Guidelines. A more linear approach will be applied for sample locations in Area 1 and Area 3 due to the narrow shape of the aforementioned Areas. The linear sampling pattern will satisfy the minimum recommended number of sampling points. Subsequent judgemental graduated targeted sampling to be applied (if required) to improve the precision of lateral delineation of backfill material. Number of samples collected per test location to satisfy the characterisation of volume of backfill material per area per the NSW Contaminated Land Guidelines.	Metals, TPH/ TRH, PAH, BTEXN, phenols, OCP and OPP, PFAS. ACM, asbestos fines (AF), friable asbestos (FA) based on observations/ indicators. Select samples will subject to the NEPM 2013 Basic Suite (R20) plus VOC based on field observations and photo-ionisation detector screening results.
2	In-situ Soils (backfill material)		8	1.8	1		
3	In-situ Soils (backfill material)		3	0.5	1		

Figure 3: Soil Investigation Locations

Berrimah Freight Terminal
Export Drive, Berrimah, NT
Prepared for: Aurizon

Legend

- Soil Investigation Locations

Areas of Remediation

- Area 1
- Area 2
- Area 3
- Area of Study
- Localities

agon ENVIRONMENTAL
Agon Environmental Pty Ltd
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Projection: Transverse Mercator
Horizontal Datum: GDA 94
Grid: GDA 94 / MGA Zone 52
Aerial Image: Nearmap, 2024

REVISION: 1
Date: 06/08/2024
Reference: JC1580
Prepared by Agon

7.0 SOIL SAMPLING METHODOLOGY

7.1 Field Investigation Methods

Soil sampling will be undertaken in accordance with Agon's standard procedures and completed by experienced field personnel with relevant knowledge, skills, and experience. In summary, the following sample collection methodology will be applied for all sample locations:

- Sampling will involve the use of an excavator to dig test pits to beyond the extent of the backfilled material and into the underlying material, with the underlying material being the former validated surface prior to backfilling. The depth of backfill and of underlying material has been informed by depths and observations made in the DSI and Addendum DSI (as presented in Table 4).
- The soils will be fully examined for homogeneity/ heterogeneity and for the presence or absence of anthropogenic material, and for visual and olfactory evidence of contamination.
- Soils will be classified in the field in accordance with the Unified Soil Classification System (USCS) and include inspection of soils for sample appearance (colour, odour, and sheen).
- Soil samples will be collected at regular intervals (not exceeding 500 mm) throughout the backfilled material/ emplaced fill profile, including from the surface, at any identified major strata changes and at the maximum depth of backfill at each remediation area.
- Samples from the top 0.5m will be collected directly from the test pit wall, while deeper samples will be collected from the middle of the excavator/ backhoe bucket.
- Field screening of samples will be conducted for volatile compounds using a photo-ionisation detector (PID) with a 10.6 eV ultraviolet lamp.
- Samples will be collected using nitrile gloves, which will be changed and disposed after the collection of each sample to prevent cross-contamination.
- Samples will be collected in lab-prepared sample containers, which are then to be placed into a pre-chilled cooler chest.
- At completion of excavations, test pits will be backfilled with soil of origin and track rolled for compaction.
- A GPS position will be collected from each test pit.

PFAS at low concentrations can exceed ecological based screening criteria. In addition to the industry standard decontamination procedures to employed during sample collection activities, the following additional measures to minimise cross contamination of PFAS are proposed to be implemented:

- Mitigating the use of the following Products that may contain PFAS, including *new clothing, footwear, PPE and treated fabrics, stain and water-resistant products, sunscreen, moisturisers, cosmetics, fast food wrappers, polytetrafluoroethylene (PTFE) materials (such as TeflonPP©PP), sampling containers with PTFE-lined lids, foil, glazed ceramics, stickers and labels, inks, sticky notes, waterproof papers, drilling fluids, decontamination solutions and reusable freezer blocks* (PFAS NEMP V2.0). The are not be worn or used during any stage of sampling (at site, during transport etc.) where sample contamination could affect analytical results.
- Use of PFAS free equipment: use of field consumables, such as decontamination solutions, that have been confirmed to be PFAS-free. PFAS samples are to be collected into new laboratory supplied containers specific for PFAS analysis.

- Order of sampling: The order of sampling in the field will be ordered from areas of likely low concentrations of PFAS contamination towards likely higher concentrations.
- Prior to sampling, the sampling personnel are to wash their hands with plain soap and rinse thoroughly in tap water before donning a clean, new pair of disposable nitrile gloves.
- Teflon®-coated materials and aluminium foil may not come into contact with the sample.
- During sample processing and storage, minimise the exposure of the sample to light.
- Chemical or gel-based coolant products (e.g. BlueIce®) to maintain samples at 4 °C following sample collection is not recommended.

Differentiation of backfill material and remaining diesel contaminated material will be based on a combination of:

- Known remedial excavation depths.
- Possible physical differences of between the two types of material.
- Other possible indicators such as visual (surface staining) and olfactory.

7.2 Sample Nomenclature

All soil samples will have a unique identification number (e.g., Site number, test pit number and depth). All sampling jars, containers, bottles will be labelled with a project name and number, field identification, date, and sampler.

7.3 Field Records

Lithological logs of the test pits will be completed in the field. Soil logs will be completed in accordance with AS1726:2017 and other appropriate Australian and international standards. Each Log will include as a minimum:

- Date and time.
- Unique sample location ID, coordinates, and elevation (where relevant).
- Type of sampling point, methods, and equipment used.
- Soil profiles and corresponding sample and field screening information, including sample depths and intervals, and PID measurements.
- Sample/ lithological appearance, including colour, odour, sheen, and anthropogenic inclusions.

Daily records will be maintained on an Agon Field Record Form, and will include as a minimum:

- Date.
- Project name and number.
- Field personnel.
- Site start and finish times.
- Weather conditions.
- Subcontractors employed.
- A log of tasks completed.
- Calibration records/ details.

- Any additional pertinent information, including unexpected conditions and work health and safety (WHS) and environmental hazards, near misses and incidents.

7.4 Analysis

Analysis of the samples collected during the investigation works will be conducted by Eurofins and/ or Australian Laboratory Services (ALS). Both are National Association of Testing Authority (NATA) accredited and registered for the analyses proposed.

The laboratory methods will meet the ASC NEPM requirements, and limits of reporting (LORs) requested will be less than applicable assessment criteria for each analyte.

The analytical suite will include the following, selected on the basis of the site PCAs and COPCs identified through previous investigation findings or suspected given the unknown source of the backfill material:

- Metals (13 metals, including As, Be, B, Cd, Co, Cu, Hg, Pb, Ni, Mn, Se, Zn, Cr^{6+}).
- Total recoverable hydrocarbons (TRH).
- Benzene, toluene, ethylbenzene, xylenes, and naphthalene (BTEXN compounds).
- Polycyclic aromatic hydrocarbons (PAH).
- Phenols.
- Organochlorine pesticides (OCP) and organophosphorus pesticides (OPP).
- PFAS: Per-and polyfluoroalkyl substances (PFAS).
- Bonded asbestos containing material (ACM), fibrous asbestos (FA), and asbestos fines (AF).

At least one sample per investigation area will be analysed for a broad analyte suite per the NEPM 2013 Basic Suite (R20) plus volatile organic compounds (VOCs). Samples will be selected based on either field observations or selected randomly (if no obvious contamination indicators are observed in any of the samples).

Allowance to analyse leachable concentrations (per the Australian Standard Leaching Procedure [ASLP]) has been afforded, with samples/ analytes selected for ASLP to be based on review of laboratory results of total concentrations.

7.5 Soil Sample Analysis Selection

The selection process for sample analysis for COPC will be as follows:

- Laboratory analysis on samples collected will be selective, based on field observations and to provide sufficient spatial coverage and representativeness of all soil domains encountered.
- All samples will be held in storage by the laboratory under appropriate conditions.
- Should visual or olfactory evidence of contamination be identified, a specific sample of this material will be analysed.
- A PID will be available in the field to screen samples and where visual or olfactory evidence of hydrocarbon contamination is observed. Should a significant positive PID reading (50 ppm above background) be obtained, confirmatory laboratory analysis for TRH and BTEXN will be considered. A request to screen for volatile organic compounds (VOCs) will also be undertaken by the laboratory in instances where PID readings are deemed significant.

The minimum number of samples collected and analysed will be based on the estimated volume of backfill material per Area and with reference to recommended sampling densities for soil volume characterisation from the NSW Contaminated Land Guidelines. The minimum number of samples to be collected and analysed are as follows:

- Area 1 – contains an estimated volume of 75 m^3 of backfill material and therefore a minimum of four (4) sampling points with a minimum of one (1) sample collected and analysed from each point will apply to Area 1.
- Area 2 – contains an estimated volume of 650 m^3 of backfill material and therefore a minimum of eight (8) sampling points with a minimum of one (1) sample collected from each point will apply to Area 2. A minimum of ten (10) samples will be analysed.
- Area 3 – contains an estimated volume of 40 m^3 of backfill material and therefore a minimum of three (3) sampling points with a minimum of one (1) sample collected and analysed from each point will apply to Area 3.

Subsequent judgemental graduated targeted sampling to be applied (if required) to improve the precision of lateral delineation of backfill material.

7.6 Assessment Criteria

The current and potential future land use of the site is as a freight terminal and accordingly, soil analysis results for COPC will be compared against the following criteria, including Auditor approved criteria as per the DSI Addendum:

1. ASC NEPM:
    a. Health Investigation/ Screening Levels for commercial/ industrial land use (HILs/ HSLs).
    b. Ecological Investigation/ Screening Levels for commercial/ industrial land use (EILs/ ESLs).
    c. Management Limits for petroleum-based compounds for commercial/ industrial land use.
2. CRC Care HSL screening levels (CRC Care, 2011):
    a. Health Screening Levels for Direct Contact for commercial/ industrial land use and intrusive maintenance worker scenarios.

b. Health Screening Levels for Vapour Intrusion – or commercial/ industrial land use and intrusive maintenance worker scenarios.

3. PFAS NEMP:
    a. Health Investigation/ Screening Levels for commercial/ industrial sites (HIL-D).
    b. Ecological direct and indirect exposure guidelines for soil.

It is noted that generic EILs will be applied for this investigation for arsenic, lead, DDT and naphthalene. Generic EILs are EILs that are derived without considering any physiochemical properties of soil. When a generic EIL is developed for a contaminant there is a single numerical maximum concentration that is applicable to all Australian soils within each specified land-use (NEPM, 2013). For EIL screening criteria that require site specific soil properties to calculate values, the most conservative values will be adopted from the ASC NEPM.

In addition to direct comparison of reported concentrations to the adopted assessment criteria, a range of summary statistics will be calculated, including the analyte range, median, arithmetic/ geometric mean, standard deviation, and 95% upper confidence limit (UCL). The 95% UCL and arithmetic mean (or geometric mean in cases where the data is log normally distributed) will be compared to adopted assessment criteria.

8.0 QUALITY ASSURANCE, QUALITY CONTROL AND DATA VALIDATION

The objective of the QAQC program is to provide an assessment of the reliability of the data presented for interpretation for the project in terms of DQO's required for the project.

8.1 Field Data Quality Objectives

The following field methods and quality control measures are defined for the investigation to achieve results of sufficient quality to be used in an assessment of the environmental condition of soil on site.

8.1.1 Sample Collection, Handling and Preservation

Soil samples will be collected in the sample jars and bottles supplied by the selected analytical laboratories, with appropriate preservatives (where applicable). The filled jars and bottles will be aimed to be stored on ice in a chilled, insulated container below 4˚C until received by the analysing laboratory.

Sample numbers, dates, preservation, and analytical requirements will be recorded on Chain of Custody (COC) documentation, which will also be delivered to the analytical laboratories. Written confirmation of receipt of samples by the laboratories will be obtained and will be assessed by Agon to ensure that samples were received chilled, intact and analysed within prescribed holding times.

8.1.2 Field Duplicate Samples

Intra- and inter-duplicate soil samples will be collected in the field at a rate of one in every 20 primary samples and will be analysed at a minimum rate of one per 20 primary samples (for all requested analytes, including AF/ FA). Duplicate soil sample pairs for PFAS will be collected and analysed at a minimum rate of 1 per 10 primary samples in accordance with the PFAS NEMP Duplicated samples will be labelled so as to conceal their relationship from the laboratory.

Duplicates are used to measure the precision of the sampling and analysis process (sampling, sample preparation, and analysis).

The overall precision of field duplicate samples and laboratory duplicates is generally assessed by their Relative Percent Difference (RPD), given by:

$$RPD\ \% = \frac{(C1-C2) \times 100}{(C1+C2)/2}$$

Where:
C1 is the primary sample concentration
C2 is the duplicate sample concentration

RPDs of field and laboratory duplicates will be compared to criteria detailed below in laboratory DQOs.

8.1.3 Rinsate Blanks

Rinsate blank samples will be collected daily during sampling by running deionised water over non-dedicated, reuseable sampling equipment and decanting directly into the laboratory prepared and supplied sample

bottles. The rinsate samples will be taken from the final rinse of the equipment after decontamination and analysed for select metals.

8.1.4 Trip Blanks

A pre-prepared trip blank will be placed within each container of samples transported to the laboratory. Trip blanks will be analysed for BTEX and the TRH fraction F1 (C_6-C_{10}).

8.1.5 Calibration

Screening of samples for VOCs in the field will be undertaken using a portable PID. The PID will be calibrated at least once daily (at the start of each sampling day) with 100 ppm isobutylene which will be available on site for bump testing/ recalibration if required (i.e., in the event unexpected and/ or erroneous readings are reported). Calibration details will be recorded on field sheets.

8.2 Laboratory Data Quality Objectives

Listed below is the predetermined laboratory DQOs defined for the assessment of the laboratory analytical data:

- Maximum acceptable sample holding times are:
  - Seven days for volatile organics.
  - 14 days for semi-volatile organics (including explosive organics).
  - Six months for inorganics, including metals.
  - Indefinite for asbestos.
- Samples to be appropriately preserved and handled.
- Laboratory LOR to be less than the adopted assessment criteria.
- Laboratory method blank analyses to be less than the laboratory LOR.
- Laboratory duplicate samples to be analysed at a rate of one in twenty samples, when the batch size exceeds five samples. The RPD of the laboratory duplicate sample results are to be less than 50%.
- Matrix spike recoveries to be conducted by the laboratory at a rate of one in 20 samples.
- Laboratory control sample (LCS) analysis to be conducted at a rate of one in 20 samples.
- Matrix, LCS and surrogate recoveries to be within the range of 70-130%.

8.3 Analytical Data Validation

Analytical data validation is the process of assessing if data are in compliance with method requirements and project specifications. The primary objectives of this process are to ensure that data of known quality are reported, and to identify if the data can be used to fulfil the overall project objectives.

Specific elements of data validation that will be checked and assessed for this project are:

- Preservation and storage of samples upon collection and during transport to the laboratory.
- Sample holding times.
- Required LOR.
- Frequency of conducting quality control measurements.

- Laboratory blanks.
- Rinsate blanks.
- Trip blanks.
- Field duplicate pairs.
- Laboratory duplicates.
- Laboratory control samples.
- Matrix spike/ matrix spike duplicates.
- Surrogates.
- The occurrence of apparently unusual or anomalous results, e.g., laboratory results that appear to be inconsistent with field observations or measurements.

8.4 Corrective Actions

Analytical data that fail to meet the predetermined data quality objectives and acceptable limits of accuracy and precision will be managed using the following corrective actions on a case-by-case basis:

- Re-analyse suspect samples, provided sample or extract is within holding time.
- Evaluate and amend sampling and/ or analytical procedures.
- Re-sampling and reanalysis.
- Accept the data as an estimate with an acknowledged level of bias and imprecision.
- Discard the data.

In the event that data of questionable reliability are used, restrictions and limitations associated with the use of such data will be clearly identified. Failure to meet the DQOs will be reported and the significance to the outcome of the program will be addressed.

9.0 REPORTING

Agon will prepare a soil investigation report for the site which will outline the sampling undertaken and the results of the sampling program. The report will be prepared with reference to the guidance provided in the ASC NEPM and NT Contaminated Land Guidelines, and will include:

- Documentation of soil investigation work conducted at the site.
- A summary of soil conditions, and all soil contaminant concentrations in comparison to relevant ecological and human health screening criteria for commercial/ industrial land use.
- A sample location plan.
- A summary of the investigation results against applicable guidelines.
- Quality control measures followed, and the samples collected during the sampling program.
- The laboratory analytical methods and procedures applied, the results of the quality control sampling and an assessment of the quality of the data.
- A detailed account of issues encountered and significance of results in the context of potential human health and environmental risks.
- Conclusions and Recommendations: Presents the key findings of the investigation and recommends any remediation and management responses, and/ or the requirement (or otherwise) for further investigation.

10.0 REFERENCES

Environment Protection Authority Victoria. 2009. Industrial Waste Resource Guidelines, Soil Sampling. Publication IWRG702.

CRC Care Health Screening Levels. 2011. Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater.

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Greencap, Detailed Site Investigation – Addendum Report, One Rail Australia, Berrimah Freight Terminal, Export Drive, Berrimah NT (March 2023).

National Environment Protection Council (NEPC). 2013a. Schedule B - General Guidelines for the Assessment of Site Contamination. National Environmental Protection Council, Adelaide. National Environment Protection (Assessment of Site Contamination) Measure.

National Environment Protection Council (NEPC). 2013b. Schedule B (1) Guideline on Investigation Levels for Soil and Groundwater. National Environmental Protection (Assessment of Site Contamination) Measure.

National Environment Protection Council (NEPC). 2013c. Schedule B (2) Guideline on Data Collection, Sample Design and Reporting. National Environmental Protection Council, Adelaide. National Environment Protection (Assessment of Site Contamination) Measure.

National Environment Protection Council (NEPC). 2013d. Schedule B (3) Guideline on Laboratory Analysis of Potentially Contaminated Soils. National Environmental Protection Council, Adelaide. National Environment Protection (Assessment of Site Contamination) Measure.

NSW Environment Protection Authority. 2022. Contaminated Land Guidelines. Sampling design part 1 – application.

NT Environment Protection Authority. 2017. Northern Territory Contaminated Land Guidelines.

11.0 LIMITATIONS OF THIS REPORT

All and any Services proposed by Agon to the Client were subject to the Terms and Conditions listed in Agon's **QFB-008 Consultancy Agreement** (accessible at https://agonenviro.com.au/documents/). Unless otherwise expressly agreed to in writing and signed by Agon, Agon does not agree to any alternative terms or variation of these terms if subsequently proposed by the Client. The Services were carried out in accordance with the current and relevant industry standards of testing, interpretation and analysis. The Services were carried out in accordance with Commonwealth, State, Territory or Government legislation, regulations and/or guidelines. The Client was deemed to have accepted these Terms when the Client signed the Proposal (where indicated) or when the Company commenced the Services at the request (written or otherwise) of the Client.

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Soil Investigation

Berrimah Freight Terminal
Export Drive, Berrimah, NT

Prepared for:	Aurizon
Date:	6 November 2024
Reference:	JC1580
Version:	JC1580_03

Agon Environmental Pty Ltd

Address
1/41 Jessop Crescent,
Berrimah, NT 0828

Phone
+61 8 7918 7807

Email
enquiries@agonenviro.com.au

A.B.N.
29 167 746 063

TABLE OF CONTENTS

TABLES

FIGURES

AGON DOCUMENT CONTROL

Report Title	Project Reference
Soil Investigation Berrimah Freight Terminal Export Drive, Berrimah, NT	JC1580
Written	**Approved**
 **Varun Bhagwat** Senior Environmental Consultant	 **Chris Gamble** Principal Environmental Scientist

Rev No	Status	Date	Author	Reviewer
01	For Review	06/08/2024	VB	CG
02	For Review	25/10/2024	VB	CG
03	Final	06/11/2024	VB	CG

Rev No	Copies	Recipients
01	1 electronic	Aurizon & Senversa
02	1 electronic	Aurizon & Senversa
03	1 electronic	Aurizon & Senversa

1.0 INTRODUCTION

1.1 Background

Agon Environmental Pty Ltd (Agon) was engaged by Aurizon (the client) to undertake a soil investigation at a portion of the Berrimah Freight Terminal, Export Drive, Berrimah, Northern Territory (NT) (the site).

A diesel spill estimated at approximately 20,000 litres occurred on the site during automatic refuelling of a diesel locomotive in May 2020. It is understood remediation actions were undertaken comprising the excavation of diesel impacted soils and subsequent backfill of the remediated areas. However, the source and composition of the backfill material is unknown and has been identified as a data gap to be addressed in the form of a soil investigation at the request of the appointed independent Site Contamination Auditor (Mr Graeme Miller of Senversa [the Auditor]).

This soil investigation has been undertaken in general accordance with the guidance provided within following documents:

- Agon Environmental (2024), Sampling, Analytical and Quality Plan, Berrimah Freight Terminal Export Drive, Berrimah NT.
- National Environment Protection Council (1999; as amended 2013), National Environmental Protection (Assessment of Site Contamination) Measure (ASC NEPM).
- The NSW EPA (2022), Contaminated Land Guidelines, Sampling Design Part 1 – Application (NSW Contaminated Land Guidelines).
- *The Northern Territory Contaminated Land Guideline*, (NT EPA, 2017).
- Heads of EPA (2020), PFAS National Environmental Management Plan, Version 2.0 (PFAS NEMP).
- CRC for Contamination Assessment and Remediation of the Environment. National Remediation Framework (CRC Care, 2018) (CRC Care National Remediation Framework).

The site location is presented in Figure 1.

1.2 Objectives

The objectives of this investigation are as follows:

- Assess the chemical and physical quality of the backfill material to determine its contamination status with regards to the current land use of the site.
- Determine the suitability of the backfill material for use and if unsuitable, determine appropriate management measures.

1.3 Scope of Work

The scope of work undertaken as part of this investigation included the following tasks:

- An intrusive soil investigation at the site, targeting remediated and backfilled areas.
- Comparison of analytical results to relevant adopted assessment criteria (Tier 1 Risk Assessment) for the commercial/ industrial use of the land, with the criteria approved for use by the Auditor.

- Summary of analytical results and a provision of recommendations.

2.0 SITE DETAILS

Details for the site are provided in Table 1 and the site location is shown in Figure 1. Investigation areas are shown in Figure 2, corresponding to the areas of remediation where diesel impacted soils have been excavated and backfilled. Reported depths of excavation and backfill are shown on the figure.

Table 1: Site Details

Aspect	
Site Address	Export Drive Berrimah
Suburb	Berrimah
Certificates of Title	Volume 757 Folio 262 Volume 754 Folio 416
Parcel Reference	NT Portion 5411, Hundred of Bagot
Land Zoning	Zoned as Railway under the NT Planning Scheme (2020)
Local Government Authority	Darwin City
Site Area	~0.24 hectares
Current Land Use	Freight rail terminal
Surrounding Land Use	North: Intertidal mangrove zone and Bleesers Creek. East: Unoccupied and cleared land. West: Darwin passenger rail terminal. South: Numerous industrial/ commercial premises.

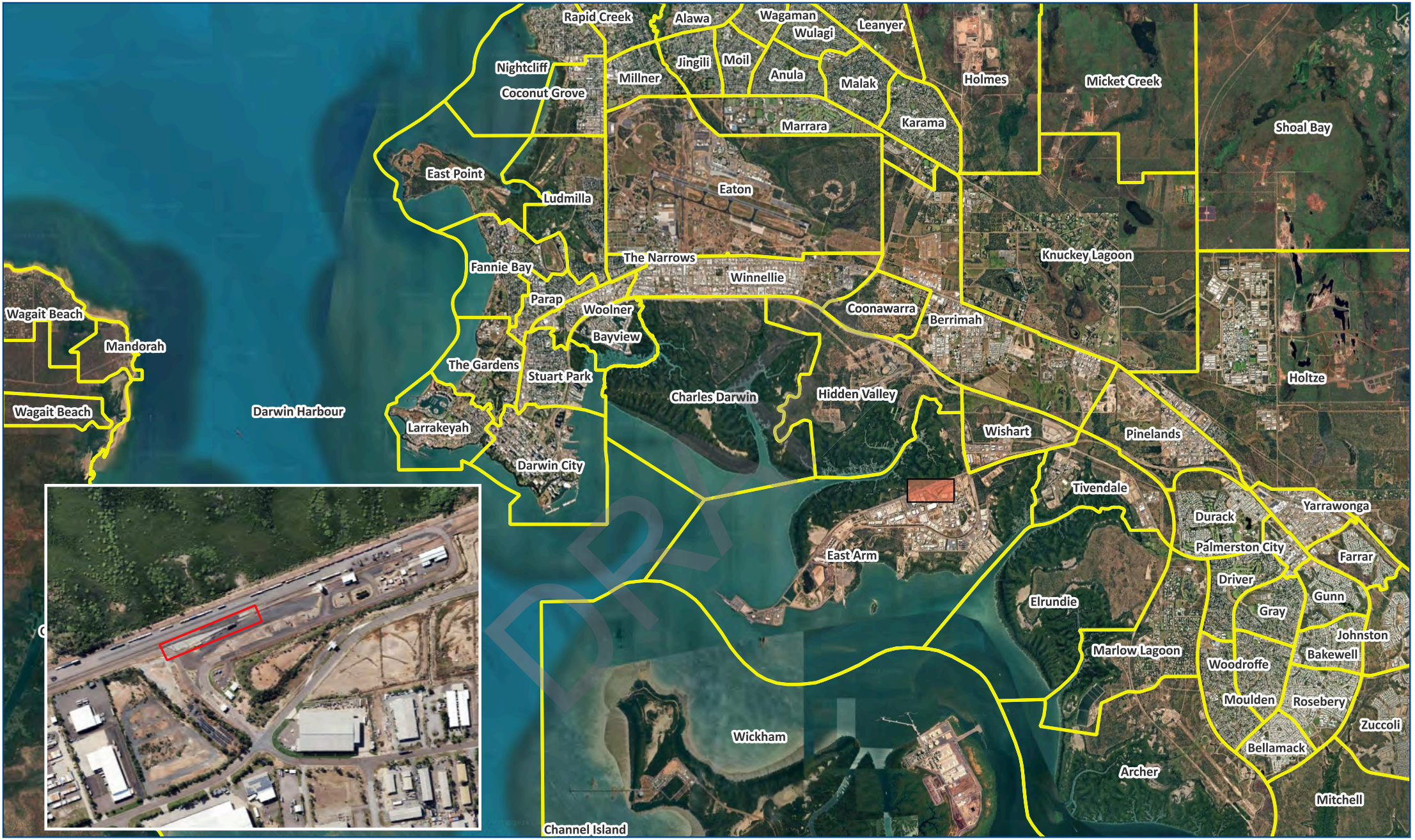

Figure 1. Site Location

Berrimah Freight Terminal
Export Drive, Berrimah, NT
Prepared for: Aurizon

Legend

- Localities
- Area of Study

agon ENVIRONMENTAL

Agon Environmental Pty Ltd
1/41 Jessop Crescent,
Berrimah
North Territary, 0828
agonenviro.com.au

0 1 2 km

N

Projection: Transverse Mercator
Horizontal Datum: GDA 94
Grid: GDA 94 / MGA Zone 52
Aerial Image: Nearmap, 2024

REVISION: 1
Date: 06/08/2024
Reference: JC1580
Prepared by Agon

Figure 2. Remediation Areas

Berrimah Freight Terminal
Export Drive, Berrimah, NT
Prepared for: Aurizon

Legend

- Localities
- Area of Study

Areas of Remediation

- Area 1
- Area 2
- Area 3

agon ENVIRONMENTAL
Agon Environmental Pty Ltd
1/41 Jessop Crescent,
Berrimah
North Territary, 0828
agonenviro.com.au

0 10 20 m

N

Projection: Transverse Mercator
Horizontal Datum: GDA 94
Grid: GDA 94 / MGA Zone 52
Aerial Image: Nearmap, 2024

REVISION: 1
Date: 06/08/2024
Reference: JC1580
Prepared by Agon

3.0 PREVIOUS INVESTIGATIONS

3.1 Detailed Site Investigation

A Detailed Site Investigation (DSI) was conducted by Greencap in April 2021[1] which addressed the impacts of the diesel spill that occurred in May 2020. The objectives of the DSI were to:

- Characterise the type of contamination sustained as a result of the spill.
- Estimate the quantities of diesel spilled and recovered.
- Delineate the vertical and lateral extent of the soil and groundwater impacts associated with the diesel spill.
- Assess the mobility of hydrocarbons still present in the spill site (if any).
- Assess risks to human health and environment associated with the residual soil and groundwater impacts.

The findings of the DSI are summarised below:

- Diesel impacted soils were excavated to the extents practicable.
- Approximately 2,000 litres of diesel is estimated to remain in situ within the spill site.
- The presence of hydrocarbon impacts in groundwater was reported in two of eleven groundwater monitoring wells installed.
- Human and ecological receptors that could potentially be exposed to contamination at the diesel spill site include – onsite workers, site visitors and contractors, the intertidal mangrove zone and the Darwin Harbour.
- It is indicated that the site in its current condition (at the time of the DSI) does not pose an unacceptable risk to the identified human health and ecological receptors. However the risk to the receptors may change if:
    - Site development occurs involving excavation of contaminated soils; or
    - Groundwater is extracted for any human consumption; or
    - Contaminated groundwater reaches the intertidal area.

3.2 Detailed Site Investigation Report – Addendum

Additional work was undertaken by Greencap in March 2023[2] in order to address data gaps identified by the Auditor as part of the review of the DSI.

[1]Greencap, Detailed Site Investigation Report, One Rail Australia, Berrimah Freight Terminal, Export Drive, Berrimah NT (April 2021).
[2]Greencap, Detailed Site Investigation – Addendum Report, One Rail Australia, Berrimah Freight Terminal, Export Drive, Berrimah NT (March 2023).

The additional works concluded that the nature and extent of the contamination relating to the spill of the diesel and subsequent remedial activities have been adequately assessed. As per recommendations from the Addendum DSI, a Groundwater Monitoring and Management Plan[3] was updated and re-implemented, and an Environmental Management Plan[4] was prepared to address management of in-situ impacts with respect to maintenance and any other future works.

3.3 Sampling, Analytical, and Quality Plan – Agon 2024

Agon prepared a Sampling, Analytical, and Quality Plan (SAQP) in support of this soil investigation. The objective of the SAQP was to describe the scope of and rationale for the soil investigation works proposed for the site to:

- Assess the chemical and physical quality of the backfill material to determine its contamination status with regards to current land use of the site.
- Determine the suitability of the backfill material use and if unsuitable, determine appropriate management measures.
- Obtain accurate data to adequately assess potential risks associated with the backfilled material at the site.
- Assess data in terms of appropriate investigation (assessment) levels.

The investigation was completed in general accordance with the SAQP, apart from the minor deviations described in Section 4.6.

[3]Greencap, Groundwater Monitoring and Management Plan, Aurizon, Berrimah Freight Terminal, Export Drive, Berrimah NT (July 2023)
[4]Greencap, Environmental Management Plan, Aurizon, Berrimah Freight Terminal, Export Drive, Berrimah NT (June 2023)

4.0 SOIL INVESTIGATION

An intrusive soil investigation was conducted on 26 and 27 June 2024, and 10 July 2024 by an experienced Agon field scientist. Details are provided in the following sections.

4.1 Soil Investigation Design

The volume of diesel impacted soil appeared to have been replaced with an approximately equivalent amount of backfill material. The soil investigation design was aimed at determining the nature and extent of the backfill material in each area and to assess for the presence of chemicals of potential concern (COPCs). The investigation design for each area is summarised below:

- Area 1 – encompasses a remediated area of approximately 420 m^2 (0.042 hectares) with an estimated 75 m^3 of diesel impacted soils removed to a maximum depth of 0.5 m. The investigation comprised five sampling points with a total of twelve samples collected. Nine samples were selected for analysis for COPCs.
- Area 2 – encompasses a remediated area of approximately 1,700 m^2 (0.17 hectares) with an estimated 650 m^3 of diesel impacted soils removed to a maximum depth of 1.75 m. The investigation has comprised eight sampling points with a total of 17 samples collected. Thirteen samples were selected for analysis for COPCs.
- Area 3 – encompasses a remediated area of approximately 250 m^2 (0.025 hectares) with an estimated 40 m^3 of diesel impacted soils removed to a maximum depth of 0.2 m. The investigation comprised eight sampling points with a total of eight samples collected. Four samples were selected for analysis for COPCs.

The sampling pattern and density satisfied the minimum recommended number of sampling points for a square grid per the NSW Contaminated Land Guidelines. Given the narrow shape of investigation areas 1 and 3, a linear sampling pattern was adopted to provide suitable coverage across these areas. The investigation programme was also designed such that the number of samples collected from each investigation area satisfied the minimum recommend for stockpiles based on the inferred volume of backfill material per the NSW Contaminated Land Guidelines.

4.2 Soil Assessment Methodology

The following methodology was undertaken during the soil investigation fieldworks:

- A total of 16 test pits (A2_TP01 to A2_TP08 and A3_TP01 to A3_TP08) were excavated in Area 2 and Area 3 using a mechanical excavator to a maximum depth of 1.8 metres below ground level (m bgl).
- A total of five soil boreholes (A1_BH01 to A1_BH08) were drilled in Area 1 using a hand auger to a maximum depth of 0.5 m bgl.
- Soil samples were collected at intervals through backfill material where sample location depths were greater than 0.5 m bgl. At these sample locations, soil samples were collected at regular intervals (not exceeding 500 mm) throughout the backfilled material, including from the surface, at any identified major strata changes and at the maximum depth of backfill. At sample location depths less than or equal to 0.5 m bgl, soil samples were collected from the surface of the backfill material. This methodology of sample collection was utilised in order to provide an overall understanding of soil quality throughout the backfilled areas.

- For test pit samples, samples from the top 0.5 m were collected directly from the test pit wall, while deeper samples were collected from the middle of the excavator/ backhoe bucket.
- Soils were classified in the field in general accordance with the Unified Soil Classification System (USCS).
- Soils were inspected for the presence of anthropogenic material and sample appearance (colour, odour, and staining).
- All sample locations were inspected for anthropogenic materials, including for the presence of potential asbestos containing material (ACM). One representative 10 L bulk soil sample was collected from a distinct fill domain at Area 2 (at TP05). As no potential ACM was identified at any sample locations, TP05 in Area 2 was randomly selected as a representative sample. The bulk sample was spread on a contrasting colour material to assess for the presence of coarse suspected ACM fragments. A wetted 500 mL sample was also collected for subsequent laboratory determination of asbestos fines (AF) and/ or friable asbestos (FA).
- Field screening of samples was conducted for volatile compounds using a photo-ionisation detector (PID) with a 10.6 eV ultraviolet lamp.
- All reusable equipment used to collect soil samples (i.e., hand trowel) was decontaminated between sample locations by removing soil, washing with a solution of Liquinox©, rinsing with potable water and then rinsing with distilled water.
- Quality assurance/ quality control samples were collected in the form of soil replicate samples, trip blanks, and equipment rinsates.
- Samples were collected in new laboratory supplied containers and placed in a cooler with ice for transport under chain of custody procedures to the analytical laboratories.
- Samples were collected using nitrile gloves, which were changed and disposed after the collection of each sample to prevent cross-contamination.
- At completion of excavations, test pits were backfilled with soil of origin and track rolled for compaction. Drilling returns from the soil boreholes were used to backfill each individual test location.
- The position of each test location was recorded using a handheld Global Positioning System (GPS) unit.

In addition to the industry standard decontamination procedures to employed during sample collection activities, the following additional measures to minimise cross contamination of PFAS were implemented:

- The use of the following products that may contain PFAS were not worn or used during any stage of sampling (at site, during transport, etc.) where sample contamination could affect analytical results: *new clothing, footwear, PPE and treated fabrics, stain and water-resistant products, sunscreen, moisturisers, cosmetics, fast food wrappers, polytetrafluoroethylene (PTFE) materials (such as TeflonPP©PP), sampling containers with PTFE-lined lids, foil, glazed ceramics, stickers and labels, inks, sticky notes, waterproof papers, drilling fluids, decontamination solutions and reusable freezer blocks* (PFAS NEMP V2.0). The above products.
- Use of PFAS free equipment: use of field consumables, such as decontamination solutions, that have been confirmed to be PFAS-free. PFAS samples were collected in new laboratory supplied containers specific for PFAS analysis.
- Prior to sampling, sampling personnel washed their hands with plain soap and rinsed thoroughly in tap water before wearing a new pair of disposable nitrile gloves.
- Teflon®-coated materials and aluminium foil did not come into contact with the sample.

- During sample processing and storage, the exposure of the sample to light was minimised.
- Chemical or gel-based coolant products (e.g. BlueIce®) to maintain samples at 4 °C following sample collection were not used.

Test pit and soil borehole sample locations are presented in Figure 3**.**

Figure 3: Soil Investigation Locations

Berrimah Freight Terminal
Export Drive, Berrimah, NT
Prepared for: Aurizon

Legend

- Soil Investigation Locations
- Area of Study
- Localities
- Recovery Sump

Areas of Remediation

- Area 1
- Area 2
- Area 3

agon ENVIRONMENTAL
Agon Environmental Pty Ltd
1/41 Jessop Crescent,
Berrimah
North Territary, 0828
agonenviro.com.au

0 10 20 m

N

Projection: Transverse Mercator
Horizontal Datum: GDA 94
Grid: GDA 94 / MGA Zone 52
Aerial Image: Nearmap, 2024

REVISION: 2
Date: 24/10/2024
Reference: JC1580
Prepared by Agon

4.3 Soil Analytical Program

Selected soil samples from each test pit/ soil borehole were analysed for the following COPCs:

- Metals (13 metals, including As, Be, B, Cd, Co, Cu, Hg, Pb, Ni, Mn, Se, Zn, Cr^{6+}).
- Total recoverable hydrocarbons (TRH) and total petroleum hydrocarbons (TPH).
- Benzene, toluene, ethylbenzene, xylenes, and naphthalene (BTEXN).
- Polycyclic aromatic hydrocarbons (PAH).
- Phenols.
- Organochlorine pesticides (OCP) and organophosphorus pesticides (OPP).
- Per and poly-fluoroalkyl substances (PFAS) – extended suite.

As per the SAQP, select samples were to be subject to a broad analyte suite per the NEPM 2013 Basic Suite (R20) plus volatile organic compounds (VOCs), selected on the basis of field observations and PID screening results. Given no specific visual or olfactory contamination indicators were noted during field observations and all PID readings measured less than 1 ppm (as discussed in Section 4.5.1), one sample from each Area was selected at random for a broad analyte screen. Three samples were randomly selected from each Area respectively and analysed for a broad analyte suite per the NEPM 2013 Basic Suite (R20) plus volatile organic compounds (VOCs).

One sample (A2_TP05_0) was analysed for the presence for fibrous asbestos (FA) and asbestos fines (AF) in soil as no bulk ACM was identified.

The laboratories used for the soil testing were Eurofins, Australian Laboratory Services (ALS) and Agon's Darwin Laboratory (for asbestos in soil analysis). The laboratories are registered by the National Association of Testing Authorities (NATA), and the analyses are conducted are within the NATA registration of laboratories.

Duplicate soil samples were sent to the primary laboratory (Eurofins) and the secondary laboratory (ALS) for quality assurance/ quality control (QA/ QC) purposes. Results of the QA/ QC analyses are discussed in detail in Section 3.5.

4.4 Assessment Criteria / Investigation Levels

Analytical results have been compared with criteria specified in the ASC NEPM, CRC Care, and the PFAS NEMP. The soil screening criteria have been derived on the basis of conservative assumptions relating to land use, receptor behaviour, site, building and soil characteristics. In this regard, as the site is currently and will continue to be used as a freight terminal, considered a commercial/ industrial land use setting. Therefore, the relevant exposure settings are:

- ASC NEPM:
    - Health Investigation/ Screening Levels for commercial/ industrial land use.
    - Ecological Investigation/ Screening Levels for commercial/ industrial land use.
    - Management Limits for petroleum-based compounds for commercial/ industrial land use.
- CRC Care HSL screening levels (CRC Care, 2011):
    - Health Screening Levels for Direct Contact for commercial/ industrial land use and intrusive maintenance worker scenarios.

- Health Screening Levels for Vapour Intrusion – or commercial/ industrial land use and intrusive maintenance worker scenarios.

- PFAS NEMP:
  - Health Investigation/ Screening Levels for commercial/ industrial sites (HIL-D).
  - Ecological direct and indirect exposure guidelines for soil.

Ecological and health screening levels and management limits are selected based on material type. The dominant soil type was sand. As such, as a conservative measure in the first instance, investigation exposure settings for sand and coarse soils were adopted (where applicable).

As no site-specific testing was undertaken to determine site-specific EIL criteria (as per the SAQP), generic EIL screening criteria for arsenic, lead, naphthalene and DDT were adopted from Table 1B(5) of the ASC NEPM. In order to determine EIL screening criteria for copper, chromium III, nickel and zinc, the most conservative values were adopted from Table 1B(1) to Table 1B(3) of the ASC NEPM.

4.5 Soil Investigation Results

4.5.1 Subsurface Conditions

Based on soil observations, generalised soil domains encountered within each investigation area are summarised in Table 2.

Soil conditions encountered in Area 1 generally comprised a 0.1 m layer of road base type fill, logged as greyish brown silty sands with asphalt inclusions throughout and placed over a geofabric layer. Underlying the geofabric was an approximate 0.2 m layer of rail ballast followed by compact road base type fill to 0.4 m bgl, with this material consistent with that encountered at the surface. Light brown to orange brown silty clayey sands were encountered underlying the road base type material, with these soils consistent with the previously validated soil surface conditions. Previously validated soil material was not encountered at the test location, A1_BH04, as shallow hand drilling refusal was encountered within the ballast material.

Soil conditions encountered in Area 2 generally comprised a surface layer of rail ballast material to 0.2 m bgl placed over a geofabric layer. Underlying the geofabric was compacted road base type fill, logged as dark brown silty sands with asphalt inclusions throughout. Light brown to orange brown silty clayey sands were encountered underlying the road base type fill, with these soils consistent with the previously validated soil surface conditions and encountered at depths ranging from approximately 0.2 m bgl (at A2_TP01 and A2_TP08) to 1.7 m bgl (at A2_TP02). The deepest encountered fill in Area 2 (at approximately 1.7 m bgl) was identified in the vicinity of the former diesel recovery sump location (as shown in Figure 3).

Soil conditions encountered in Area 3 generally comprised road base type fill, logged as greyish brown silty sands with asphalt inclusions throughout from the surface to a maximum depth of 0.5 m bgl. Light brown to orange brown silty clayey sands were encountered underlying the road base type fill, with these soils consistent with the previously validated soil surface conditions.

No staining or odours were observed and there were no PID readings > 1 ppm. No suspect asbestos containing material (ACM) was visually identified or recovered through bulk sampling and screening.

Soil logs are presented in Appendix A with photographs of soil conditions encountered presented in Appendix B. The PID calibration certificate is provided as Appendix C.

Table 2: Generalised Soil Conditions

Area	Domain ID	Approx. Depth (m bgl)	Description
1	Backfill Material	0 – 0.1	Road base like material comprising grey/ brown gravelly silty sands (fine to coarse sized gravels) with bitumen inclusions and underlain with 5 mm of geofabric material.
		0.1 – 0.3	Rail ballast material (0 – 0.2 m bgl) at BH05. Grey/ brown gravelly sand (fine to coarse sized gravels) (0.2 – 0.3 m bgl) at BH05.
		0.3 – 0.4	Road base like material comprising grey/ brown gravelly silty sands (fine to coarse sized gravels) with bitumen inclusions. Silty clayey sands with crushed rock (fine to coarse sized) inclusions (0.3 – 0.4 m bgl) at BH05.
	Previous Validated Surface Material	0.4 – 0.5	Light brown/ orange-brown silty clayey sands with crushed rock inclusions (fine to coarse sized).
2	Backfill Material	0.25 – 1.7	Rail ballast layer at surface to 0.2 m bgl, underlain with 5 mm of geofabric material. Dark brown silty sands with crushed rock and bitumen (fine to coarse sized) inclusions. 0.25 – 1.7 m bgl at A2_TP02.
	Previous Validated Surface Material	0.4 – 1.2	Light brown/ orange-brown silty clayey sands with crushed rock (fine to coarse sized) inclusions.
3	Backfill Material	0 – 0.5	Road base like material comprising grey/ brown gravelly silty sands (fine to coarse sized gravels) with bitumen inclusions.
	Previous Validated Surface Material	0.3 – 0.6	Light brown/ orange-brown silty clayey sands with crushed rock (fine to coarse sized) inclusions.

4.5.2 Analytical Results

Soil analytical results tables are presented in Appendix D. Chain of custody documentation and laboratory certificates of analysis are presented in Appendix E.

The following reported TRH concentrations from the location, A3_TP07_0 (sample collected from the surface), exceeded ESLs:

- C_{10} – C_{16} (without naphthalene) measured at 200 mg/kg and exceeded the 170 mg/kg ESL.
- C_{34} – C_{40} measured at 3, 800 mg/kg and exceeded the 3,300 mg/kg ESL.

Concentrations of several TRH fractions and several heavy metals were reported above the laboratory limits of reporting (LORs) at all remaining locations in the three investigation areas and at varying depths. However, apart from test location A3_TP07_0 (as discussed above), reported concentrations were below adopted assessment criteria (where available).

All concentrations of BTEXN, PAH, phenols, OCP, OPP, and PFAS were reported below LOR.

No ACM, FA or AF were detected in the soil sample, A2_TP05_0.

Reported TRH concentrations in comparison to depth and material type are summarised in the tables below.

Table 3: Area 1 Results Summary

Domain	Approx. Depth (m bgl)	Description	Concentration Range (mg/kg)			
			F1 TRH (C_{10}-C_{16})	F2 TRH (C_{10}-C_{16})	F3 TRH (C_{16}-C_{34})	F4 TRH (C_{34}-C_{40})
Backfill Material	0 – 0.1	Road base like material comprising grey/ brown gravelly silty sands with bitumen inclusions.	<50	<50	200 - 860	380 - 2,600
	0.1 – 0.3	Rail ballast material (0 – 0.2 m bgl at BH05). Grey/ brown gravelly sand (0.2 – 0.3 m bgl at BH05).	64 (BH05_0.2)	64 (BH05_0.2)	580 (BH05_0.2)	2,100 (BH05_0.2)
	0.3 – 0.4	Road base like material comprising grey/ brown gravelly silty sands with bitumen inclusions. Silty clayey sands with crushed rock inclusions (0.3 – 0.4 m bgl at BH05).	<50	<50	<100 - 750	<100 - 1,300
Previous Validated Surface Material	0.4 – 0.5	Light brown/ orange brown silty clayey sands with sandstone inclusions.	<50	<50	200	160

Table 4: Area 2 Results Summary

Domain	Approx. Depth (m bgl)	Description	Concentration Range (mg/kg)			
			F1 TRH (C_{10}-C_{16})	F2 TRH (C_{10}-C_{16})	F3 TRH (C_{16}-C_{34})	F4 TRH (C_{34}-C_{40})
Backfill Material	0 – 1.7	Rail ballast layer at surface underlain with 5 mm of geofabric material. Dark brown silty sands with crushed rock and bitumen inclusions. 0 – 1.7 m bgl at A2_TP02.	<50 - 61	<50 - 61	160 - 1,100	350 - 2,600
Previous Validated Surface Material	0.1 – 1.8	Light brown/ orange brown silty clayey sands with crushed rock inclusions. 1.7 – 1.8 m bgl at A2_TP02.	<50	<50	150 - 1,100	350 - 2,600
	0.4 – 1.2	Light brown/ orange brown silty clayey sands with crushed rock inclusions.	<50	<50	150 - 930	160 - 2,400

Table 5: Area 3 Results Summary

Domain	Approx. Depth (m bgl)	Description	Concentration Range (mg/kg)			
			F1 TRH (C_{10}-C_{16})	F2 TRH (C_{10}-C_{16})	F3 TRH (C_{16}-C_{34})	F4 TRH (C_{34}-C_{40})
Backfill Material	0 – 0.5	Road base like material comprising grey/ brown gravelly silty sands with bitumen inclusions.	<50 - 200	<50 - 200	190 - 1,100	500 - 3,800

4.6 Deviations From the SAQP

As mentioned in Section 3.3, the investigation was conducted in general accordance with the SAQP apart from minor deviations which are described below:

- Samples were collected from five test locations in Area 1 (four test locations were recommended in the SAQP.
- Samples were collected from eight test locations in Area 3 (three test locations were recommended in the SAQP).
- Soil samples were collected at regular intervals (not exceeding 500 mm) throughout the backfilled material at select test locations (test locations with depths greater than 0.5 m bgl – A2_TP01, A2_TP02 and A2_TP03), including from the surface, at any identified major strata changes and at the maximum depth of backfill. Soil samples were collected at the surface or subsurface only at test locations with depths 0.5 m bgl or less.
- Previous validated soil surface was not encountered at the test location A1_BH04 due to refusal occurring within the ballast materials.

The deviations are not considered to have detrimentally impacted the investigation with regard to the stated objectives, as the deviations have resulted in increased sample locations for characterising the chemical and physical qualities of the backfill material.

4.7 Quality Assurance / Quality Control

Soil samples were collected in accordance with methods described within the SAQP, including:

- Appropriate sample collection, labelling, preservation, storage and transport under chain of custody documentation in accordance with standard operating procedures by an experienced sampler.
- Laboratory-prepared soil jars preserved for the relevant analyses were used as sample containers. Soil samples were immediately placed in ice-filled coolers and stored and transported under these conditions to nominated laboratories within prescribed holding times.
- A photoionization detector (PID) was used to measure volatile organic compounds (VOCs) in soil during field investigations, supplied and calibrated by AirMet.
- Disposable nitrile gloves were used in transferring soil to the sample jars and were changed between each soil sample.
- Reusable sampling equipment (i.e. trowel) was decontaminated between sample locations.
- Every sample jar/ bag was clearly labelled and cross-referenced to a Chain of Custody (COC) form prior to submission to nominated laboratories.
- Nominated laboratories were NATA accredited for the analyses undertaken.

- Collection and analyses of field QA/ QC samples.
- Analysis of laboratory QA/ QC samples including matrix spikes, matrix spike duplicates, and surrogates.

The following subheadings detail the QA/QC analyses and consider the analytical data quality.

4.7.1 Internal Laboratory Quality Assurance

The results of the internal quality assurance programs of the laboratories are presented with the NATA test certificates in Appendix E. Agon has reviewed laboratory internal QC testing results provided by Eurofins and ALS, with the following findings:

- The laboratory reporting limit for all chemicals were less than respective adopted screening criteria and are acceptable to compare with relevant guidelines for the chemicals of concern.
- All samples were analysed within prescribed holding times.
- Accuracy (measured by laboratory spike and surrogate recovery samples) were within the acceptance limits apart from:
    - A Spike Recovery for total chromium at 73%, outside of the 75 - 125% acceptance limits. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference.
- Precision (measured by duplicate sample analysis) were within acceptance limits apart from:
    - A duplicate relative percentage difference (RPD) of 86% for TRH $C_{10} – C_{14}$ fraction, above the acceptance limit of 30%. The RPD reported passed Eurofins Environment Testing's QC - Acceptance Criteria.
    - A duplicate relative percentage difference (RPD) of 170% for TRH $C_{15} – C_{28}$ fraction, above the acceptance limit of 30%. The RPD reported passed Eurofins Environment Testing's QC - Acceptance Criteria.
- A minimum 95% completeness (measured by total number of analyses within acceptable limits) was achieved.

4.7.2 Field Duplicates

Field duplicate soil samples were submitted for analysis to the primary and secondary laboratories as summarised in Table 6.

Table 6: Soil Duplicate Analysis

Primary Sample	Field Duplicate – Primary Laboratory (Eurofins)	Field Duplicate – Secondary Laboratory (ALS)
A2_TP01_0	QC01 – TRH, BTEXN, PAH, Phenols, Metals, PFAS (full suite)	QC01A – TRH, BTEXN, PAH, Phenols, Metals, PFAS (short suite)
A3_TP07_0	QC02 – PFAS (full suite)	QC02A – PFAS (short suite)

The frequency of inter-laboratory soil duplicate analyses is within the frequency suggested in the NEPM of 1 per 20 analyses (5%), and the PFAS NEMP of 1 per 10 analyses (10%) for PFAS.