



**ENVIRONMENTAL EARTH
SCIENCES**
CONTAMINATION RESOLVED

**CONTAMINATED LAND AUDIT OF
ASBESTOS IN SOIL – 77
LAKESIDE DRIVE, ALAWA,
NORTHERN TERRITORY
RAY LAURENCE CONSTRUCTIONS PTY LTD**

25 JULY 2022

721016

VERSION 1

25 July 2022

Ray Laurence Constructions Pty Ltd
6 Raphael Road,
Winnellie NT 0820

Attention: **Charlie Dickman**
Managing Director

Dear Charlie

**77 Lakeside Drive, Alawa – Contaminated Land Audit for the remediation of asbestos
in soil (excavation and disposal)**

Please find enclosed a copy of our report entitled as above. Thank you for the opportunity to undertake this work.

Should you have any queries, please do not hesitate to contact us on (07) 3852 6666.

For and on behalf of
Environmental Earth Sciences QLD



Project Director/Author
Mark Stuckey
Senior Principal Scientist and Contaminated
Land Auditor

Project Director / Internal Reviewer
Kat Spruth
Senior Environmental Scientist

721016 Ray Laurence Constructions EA

EXECUTIVE SUMMARY

This Environmental Audit Report (EAR) has been prepared in response to the requirement for an Environmental Audit (EA) in accordance with a request made by the Northern Territory Environment Protection Authority (NT EPA).

While a Pollution Abatement Notice (PAN) was never issued; an official request was made by NT EPA, that Ray Laurence Constructions Pty Ltd (RLC) engage an Auditor to oversee assessment, remediation and validation work at the site, required to adequately address the identified asbestos containing material (ACM) and possible friable asbestos (FA)/ asbestos fines (AF) contamination present in site soils. This level of oversight was necessary given the sensitivity of the proposed future site use (a Childcare Centre).

This Audit has been prepared in accordance with Section 53X of the superseded *Environment Protection Act 1970* [Victoria] and relevant sections of the *Environment Protection Act 2017* which came into effect as of 1 July 2021¹.

In accordance with the Environment Protection Authority of Victoria (EPAV) (September 2007) *Publication 1147 Environmental Auditor Guidelines – Provision of Environmental Audit Reports, Certificates and Statements*, a summary of the Environmental Audit (EA) is presented in in **Table 1**, below.

Table 1: Summary of Audit Information

EPA File Reference No.	N/A
Auditor	Mark Stuckey
Auditor term of appointment (under the Victorian <i>Environment Protection Act 2017</i>)	18 September 2021 – 17 September 2024
Name of person requesting audit	Charlie Dickman Managing Director Ray Laurence Constructions Pty Ltd (RLC)
Relationship to premises/location	Representative of the owner
Date of request	17/02/2021
Completion date of audit	25/07/2022
Reason for audit	Compliance with EPA directive
Description of activity	Management of asbestos-impacted soil
EPA region	Northern Territory
Lot on plan (dominant)	Part Lot 9260, Town of Nightcliff
Lot on plan (additional)	-

¹ The Environment Protection (EP) Act 1970 [Victoria] was superseded in 2017 by the Environment Protection Amendment Act 2017. Consequently, while the Victorian legislative and Environmental Audit process is in flux, during the ongoing transition period, this report has been prepared with regard to both the EP Act 1970 and the old Audit process (references to 53V audits), as well as regulatory updates/ changes brought about following the 2017 reform.

Site/premises name	-														
Building Complex/ Unit No.	-														
Street/Lot – Lower No,	77														
Street/Lot – Upper No	77														
Street Name	Lakeside														
Street type (road, court, etc)	Drive														
Street suffix (North, South etc)	-														
Suburb	Alawa														
Postcode	0810														
GIS co-ordinate of site centroid															
Latitude (GDA94)	-12.37603														
Longitude (GDA94)	130.87265														
Site area (ha)	0.318														
Plan of site/premises showing the audit site boundary attached	Yes														
Plan of site/premises showing the audit site boundary attached in spatial data format	No														
Members and categories of support team utilised	Dr Anna Sheldon (Principal Soil Scientist – CPSS CSAM) – document review Kat Spruth (Associate Environmental Scientist) – document review, field inspection, reporting														
Type of Audit	A 53X Environmental Audit in accordance with the Victorian Environmental Auditor Guidelines and <i>Victorian Environment Protection Act 1970</i> .														
Further work or requirements	N/A														
Nature and extent of continuing risk	None														
Outcome of Audit	Certificate of Environmental Audit														
Please indicate which of the protected beneficial uses of land are precluded due to pollution	<table border="1"> <thead> <tr> <th>Beneficial Use</th> <th>Precluded?</th> </tr> </thead> <tbody> <tr> <td>Maintenance of Ecosystems</td> <td>NO</td> </tr> <tr> <td>Human Health</td> <td>NO</td> </tr> <tr> <td>Buildings and structures</td> <td>NO</td> </tr> <tr> <td>Aesthetics</td> <td>NO</td> </tr> <tr> <td>Production of food, flora and fibre</td> <td>N/A</td> </tr> <tr> <td></td> <td></td> </tr> </tbody> </table>	Beneficial Use	Precluded?	Maintenance of Ecosystems	NO	Human Health	NO	Buildings and structures	NO	Aesthetics	NO	Production of food, flora and fibre	N/A		
	Beneficial Use	Precluded?													
	Maintenance of Ecosystems	NO													
	Human Health	NO													
	Buildings and structures	NO													
	Aesthetics	NO													
Production of food, flora and fibre	N/A														

The audit findings and recommendations are summarised in Section 12 and 13 and should be read in conjunction with other sections of this report including the limitations and uncertainties associated with the environmental auditing process described in Section 14.

This summary must be read in conjunction with the full EAR and the Certificate of Environmental Audit (CoEA) that has been issued for the site. The EAR provides more data and discussions that are not in the above summary table for reasons of space and clarity. All owners of the site, all occupiers and those made responsible for the management of the site (including any future subdivisions) should be provided with a copy of this CoEA.

The EAR is issued based on the site conditions at the time of issue. The EA cannot control future activities that may result in alteration of risk to land via emissions at or beyond the site.

*ENVIRONMENT PROTECTION ACT 1970 &
ENVIRONMENT PROTECTION AMENDMENT ACT 2017*

CERTIFICATE OF ENVIRONMENTAL AUDIT

I, Mark Stuckey of Environmental Earth Sciences, a person appointed by the Environment Protection Authority ('the Authority') under the *Environment Protection Act 1970* ('the Act') as an environmental auditor for the purposes of the Act; having

1. been requested by Ray Laurence Constructions Pty Ltd to issue a certificate of environmental audit in relation to the site located at Lot 9260 on S 86/303 at 77 Lakeside Drive, Alawa, NT ('the site') owned by Goodstart Early Learning;
2. had regard to, among other things:
 - (i) guidelines issued by the Authority for the purposes of Part IXD of the Act;
 - (ii) the beneficial uses that may be made of the site; and
 - (iii) relevant state environmental policies/ environmental reference standards/industrial waste management policies, namely:
 - o Victorian Government (May 2021) *Environment Reference Standard (2021)*²; and
 - o Victorian Government (June 2009) *Environment Protection (Industrial Waste Resource) Regulations 2009*.

in making a total assessment of the nature and extent of any harm or detriment caused to, or the risk of any possible harm or detriment which may be caused to, any beneficial use made of the site by any industrial processes or activity, waste or substance (including any chemical substance); and

3. completed an environmental audit report in accordance with section 53X of the Act, a copy of which has been sent to the Authority and the relevant planning and responsible authority.

HEREBY CERTIFY that I am of the opinion that the condition of the site is neither detrimental or potentially detrimental to any beneficial use of the site.

Other related information

In future anyone proposing to extract groundwater from beneath the site should engage a suitably qualified professional to complete a groundwater investigation (to assess its suitability for a specific use).

This Certificate forms part of the environmental audit report (*Environmental Earth Sciences, Contaminated land audit of asbestos in soil for 77 Lakeside drive, Alawa, Northern Territory Job Number: 721016, dated 25 July 2022*).

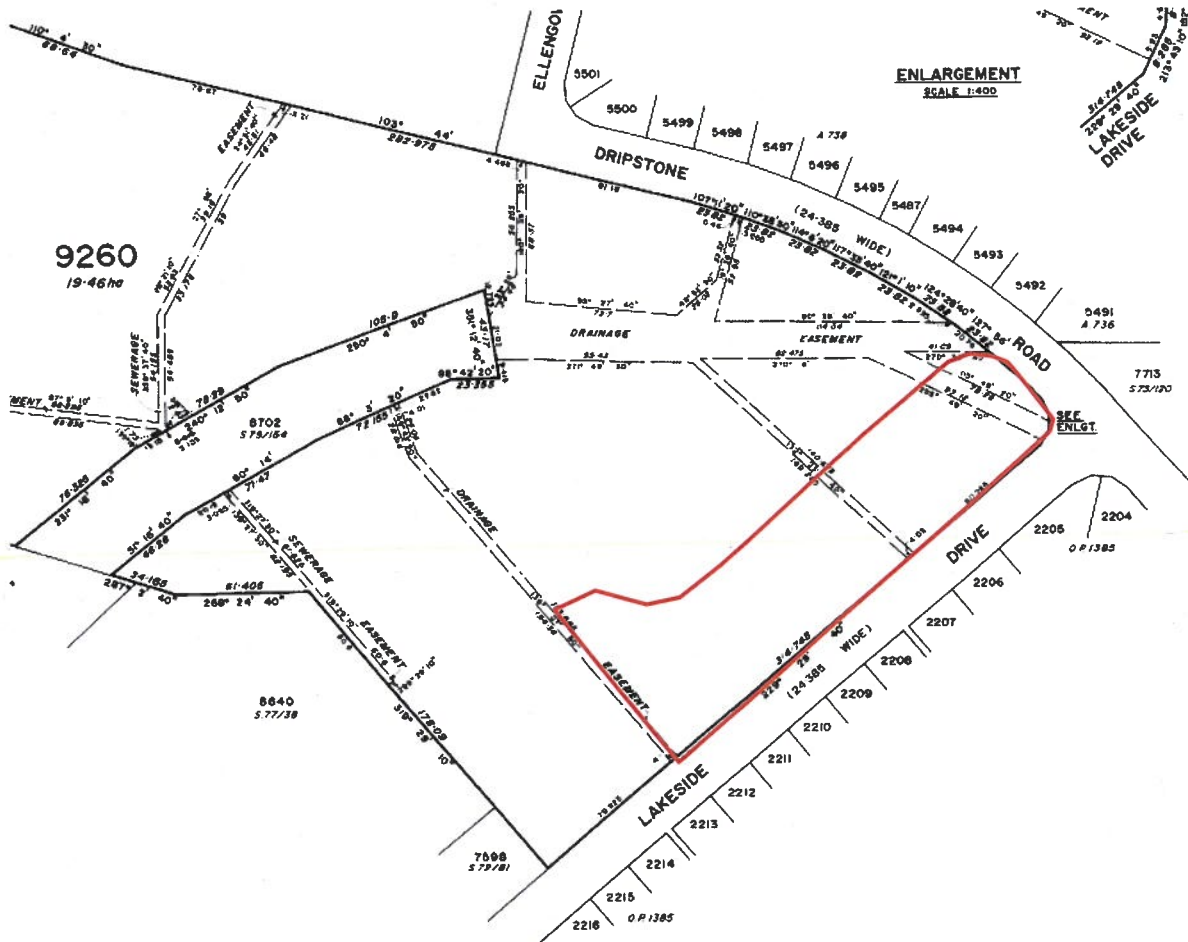
² Formerly Victorian Government State Environment Protection Policies (SEPP) and the prescribed environmental quality objectives: SEPP (*Air Quality Management*), SEPP (*Prevention and Management Contaminated Land*); SEPP (*Waters*); and SEPP (*Control of Noise from Commerce, Industry and Trade*).

Further details regarding the condition of the site may be found in the environmental audit report.

DATED: 25 July 2022

Signed: *Mark Stuckey*

Mark Stuckey of Environmental Earth Sciences
ENVIRONMENTAL AUDITOR
(appointed pursuant to the *Environment Protection Act 1970*)



77 Lakeside Drive, Alawa, NT; Victoria 53X Environmental Audit

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1 INTRODUCTION

On 17 February 2021, Ray Laurence Constructions Pty Ltd (RLC) (the “client”) requested Environmental Auditor (EA) (Mark Stuckey of Environmental Earth Sciences), undertake an Environmental Audit for the investigation and remediation of asbestos containing material (ACM) at 77 Lakeside Drive, Alawa, NT 0810.

The ACM was discovered by contractors engaged in preparatory works in 2019 and was later confirmed to be primarily sourced from partially buried corrugated ACM fence footings that had been disturbed during earthworks activities, resulting in ACM distribution across the site surface. Later, supplementary investigations identified two further corrugated ACM fence footings which were ultimately excavated and removed from the site along with ACM fragments removed from site surface, near surface and stockpiles generated during fence excavation activities. On completion of the remedial works the site was validated and rendered suitable for unrestricted use including the proposed future use (childcare centre).

Following the initial find in late 2019, all works at the site were ceased pending further investigation and management. The Northern Territory Environment Protection Authority (NT EPA) were notified of the find by RLC in accordance with the *NT Waste Management and Pollution Control Act 1998* on 12 December 2020.

In response to this notification, although the NT EPA did not issue a Pollution Abatement Notice (PAN), a directive was provided that an independent EA must be engaged to oversee investigations and the subsequent remediation and validation works at the site. Ultimately the EA was required to issue a Certificate or Statement of Environmental Audit (CoEA or SoEA) (if deemed justifiable to do so), to confirm the site’s suitability for future unrestricted use.

Accordingly, as per the NT EPA directive, RLC required the EA to review and endorse:

- historic and supplementary site investigations undertaken at the site with respect to asbestos and other chemicals of potential concern (CoPCs);
- a remediation action plan (RAP); and
- a remediation and validation report (RVR).

At the conclusion of the works the EA prepared this Audit Report and accompanying CoEA.

2 BACKGROUND

2.1 General

RLC are redeveloping 77 Lakeside Drive, Alawa (an approximate 3,180 m² vacant parcel of land, part Lot 9260, S86/303) into a single storey childcare centre with accessible gardens and a ground level car park. As the lot was vacant, the project required the clearing of the site of existing vegetation/ site surfaces (preparatory earthworks) prior to construction.

2.2 Initial investigation works (feasibility)

During the feasibility, planning and design phases of the project, environmental consultant Prensa was engaged to undertake a preliminary site investigation (PSI) to determine site condition with respect to CoPCs and therefore feasibility of redevelopment from a contaminated sites perspective (Prensa, 2019).

The results of the initial investigation determined the site was suitable for the proposed sensitive (childcare centre) land use in its current state, given:

- CoPCs (metals, TRH, BTEXN, and OC/OPs)³ did not exceed applicable human health and ecological guidance criteria for the low density residential (HIL A) land use scenario; and
- Asbestos (including asbestos containing material [ACM], friable asbestos [FA] and asbestos fines [AF]) were not detected.

During the feasibility assessment, several rounds of Geotechnical Assessment (Douglas Partners, 2019 and Want Geotechnics, 2020) were also undertaken which comprised drilling and *in-situ* testing from 5 boreholes (BH01 to BH05) and 2 test pits (TP1 and TP2). No visual (staining/ anthropogenic materials) and/or olfactory evidence of contamination was identified during either of the geotechnical field programs.

2.3 Preparatory Earthworks

Preparatory earthworks at the site commenced in late 2019. During these earthworks unexpected finds (ACM) were identified at the site surface adjacent to the south-eastern boundary of the site.

In response to the find, RLC ceased all works on the site and requested an environmental consultant (SLR Consulting [SLR]) provide advice with respect to:

- the source and extent of the impact; and
- provide recommendations with respect to management and remediation actions required, to render the site suitable for the proposed sensitive land use.

SLR completed a site inspection on 11 December 2020 to investigate the extent of asbestos contamination at the site. It was noted at this time that broken fragments of ACM were present at the surface in the south-eastern portion of the site, apparently originating from a corrugated asbestos sheet fence located along the south-eastern boundary (having been distributed across site surface, due to earthworks).

On SLRs recommendation, to minimise any potential exposure to site workers and adjacent land users via release of respirable fibres while further investigation was undertaken and

³ Total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN), organochlorine/ organophosphate pesticides (OC/OPs), metals: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), zinc (Zn) and mercury (Hg).

appropriate remediation planned, a geofabric layer was placed across the area of visible asbestos impact.

The NT EPA was notified of the asbestos find by RLC in accordance with the *NT Waste Management and Pollution Control Act 1998* on 12 December 2020. The NT EPA did not issue a PAN in response, but communicated that further investigation, remediation and validation by an appropriately qualified and experienced consultant would be necessary to render the site suitable for the proposed sensitive land use.

Furthermore, NT EPA requested that an EA would be required to oversee the investigation, and to review and endorse investigation outcomes, remediation planning activities and the remediation and validation of the site such that a CoEA or SoEA confirming site suitability for the proposed future use could be issued at the conclusion of the works.

2.4 Supplementary investigation and remediation activities

Following NT EPA notification, RLC engaged SLR to undertake a supplementary site investigation to confirm the nature and extent of asbestos across the site (site surface and subsurface soils). Accordingly, between 22 December and 21 January 2021 SLR completed further site investigation including the advancement of test pits across the site, collection and analysis of representative samples for quantitative analysis (AF/FA and ACM).

Based on the outcomes of the assessment (SLR, 2021a), it was concluded that the asbestos impacts at the site were primarily limited to fragments of ACM in the vicinity of the fence footing, extending to a maximum depth of 0.1 to 0.2 metres below ground surface (m bgs). However, SLR concluded there was a potential for some AF/ FA in the immediate vicinity of the former fence line both due to long-term weathering of ACM, and as a result of damage sustained to the fence during earthworks activities.

SLR concluded that the site was unsuitable for the proposed sensitive land use in its current state and that remediation would be required, likely including a combination of hand picking/ tilling and excavation of the impacted hotspot “fence line” with off-site disposal of impacted materials under the supervision of a qualified, licenced asbestos assessor.

SLR subsequently produced a remediation action plan (RAP) (SLR, 2021b) which supplied a detailed implementation strategy for the remediation of the site along with an appropriate validation strategy to confirm, at conclusion of the works, that the site had been rendered suitable for use.

The EA reviewed and provided comments on the SLR RAP (SLR, 2021b) in March 2021 (Environmental Earth Sciences, 2021a). However, shortly after, RLC engaged Prensa to undertake a further “Technical Review” of the SLR 2021 RAP (Prensa, 2021a). Based on the outcomes of the review, Prensa concluded that SLRs proposed remediation options were unfeasible and recommended a new RAP be prepared to detail an appropriate remedial strategy for the asbestos encountered at the site.

Prensa were subsequently engaged to prepare an updated RAP (Prensa, 2021b) which the EA reviewed and endorsed (Environmental Earth Sciences, 2021b), subject to supplied comments being addressed, in May 2021.

Remediation and validation activities were then undertaken in accordance with the RAP by a licenced asbestos removal contractor (LARC) under the direction and supervision of Prensa, between 24 June and 9 July 2021. During the remediation activities two further buried ACM fence footings were identified, carefully excavated and removed excavated from the site with the residual excavation surfaces (base and walls) validated following removal. Wider site surfaces and stockpiles generated from trench removal activities were also remediated and validated both visually and via quantitative analysis, on completion.

Additional “verification sampling” was also completed for non-asbestos CoPCs to augment the results of the Prensa PSI (Prensa, 2019) and meet Australian Standard sampling density for a site of this size.

This audit therefore addresses issues relating to the management (removal, excavation and disposal) of asbestos at the site based on the Victorian Audit Scheme⁴.

3 AUDIT DETAILS

3.1 Purpose and Objectives

The general purpose of the Environmental Audit (EA) is to assess the environmental condition of the site (and its beneficial uses), taking into account:

- the contamination status of the site (post remediation and validation);
- whether that contamination (if any) precludes the sites beneficial reuses; and
- whether the contamination (if any) that has been caused by onsite activities has precluded any offsite beneficial reuses.

The specific objective of this EA was to evaluate whether the site is suitable for the issue of a CoEA indicating that the site is suitable for any beneficial use. Should one or more beneficial uses be precluded, but the risk to receptors be acceptable based on compliance with conditions, a SoEA will be issued. The SoEA would detail that the site is suitable for its intended use, subject to compliance with the listed conditions contained within the SoEA.

3.2 Scope of works

The scope of the audit was to oversee investigations and subsequent remediation and validation works at the site in accordance with the requirements of the NT EPA, to confirm asbestos impacts at the site were adequately remediated, such that the site was rendered suitable for unrestricted land use.

⁴ The former Section 53X audit process.

Table 2: Audit scope

Audit Aspect	Scope
Activity audited	The activity audited is the remediation of asbestos impacts and validation that the site has been rendered suitable for unrestricted land use.
Components of the activity considered	The audit assessed the efficacy of investigation completed to quantify and delineate asbestos impacts at the site, the remediation/validation strategy adopted and its success (or otherwise) in rendering the site suitable for unrestricted land use.
Segment of the environment considered	The segment of the environment considered during the audit was the area of land from which the asbestos was removed, including the atmosphere at the site, groundwater beneath the site and any surface water on / nearby the site.
Elements of the environment considered	The elements of the environment considered include groundwater, surface water, land, atmosphere, including potential offsite migration of asbestos dust during excavation and relocation.
Beneficial uses considered	<p>The beneficial uses considered during the audit are those specified in the Victorian Government Environment Reference Standard (VIC Government, 2021):</p> <ul style="list-style-type: none"> • Ambient air; • Ambient sound; • Land; and • Water (groundwater and surface water). <p>The relevance and existence of beneficial uses are discussed in Section 7.</p>
Reporting	Prepare and issue of an Environmental Audit report and a Certificate of Environmental Audit (if justifiable to do so)
Period of time over which the audit was conducted	This audit was conducted between 17 February 2021 and 25 July 2022.

3.3 Regulatory framework

This audit has been prepared to be consistent with land and water protection obligations of relevant Northern Territory legislation. As the audit is being conducted by an auditor accredited in NT and Victoria, relevant Victorian legislation has also been considered.

A summary of the regulatory framework and key guidance documents applied is provided in **Table 3** below.

Table 3: Relevant key legislation and guidance documents

NATIONAL	
Legislation	Guidance
N/A – State-specific legislation used.	National Environment Protection (Assessment of Site Contamination) Measure 1999, amended 2013 (herein referred to as the ASC NEPM). PFAS National Environmental Management Plan (NEMP) Version 2. Heads of EPA Australia and New Zealand (HEPA). January 2020
NORTHERN TERRITORY	
Legislation	Guidance
Environmental Assessment Act (1982); Waste Management and Pollution Control Act (1998); Water Act (2011); Environment Protection Act (2019); Environment Protection Regulations (2020).	NT EPA Publication (2013) – Guidelines on conceptual site models; NT EPA Publication (2015) – Guideline for the preparation of an environmental management plan; NT EPA Publication (2015) – Guidelines to prevent pollution from building sites; NT EPA Publication (2016) – Guideline for Reporting on Environmental Monitoring; NT EPA Publication (2017) – Contaminated land guideline.
VICTORIA	
Legislation	Guidance
Environment Protection Act (1970); Environment Protection Amendment Act (2017); EPA Victoria Waste Management Policy No S264 (<i>Siting, Design and Management of Landfills</i>); Environment Protection (Industrial Waste Resource) Regulations (2009). S.R. No. 77/2009; Victorian Government Environment Reference Standard (2021) ⁵ <ul style="list-style-type: none"> • Ambient Air • Ambient sound • Land • Water (groundwater and surface waters) 	EPA Victoria Publication 759.3 (2015) – <i>Environmental Auditor (Contaminated Land) Guidelines for Issue of Certificates and Statements of Environmental Audit</i> ; EPA Victoria Publication 788.3 (2015) – Siting, design, operation and rehabilitation of landfills; EPA Victoria Publication 952.5 (2015) – Preparation of Environmental Audit Reports on Risk to the Environment.
OTHER	
Legislation	Guidance
N/A	Western Australia Department of Health (DoH) (2021) Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated sites in Western Australia.

⁵ Formerly Victorian Government State Environment Protection Policies (SEPP) and the prescribed environmental quality objectives: SEPP (*Air Quality Management*), SEPP (*Prevention and Management Contaminated Land*); SEPP (*Waters*); and SEPP (*Control of Noise from Commerce, Industry and Trade*).

3.4 Methodology

The audit comprised the following key tasks (not necessarily in order of completion):

- Notification to NT EPA of the request for audit;
- Familiarisation with the project objective, stages and progression;
- Completion of Environmental Audit site inspections (to confirm condition of the site, prior to the issue of the Environmental Audit report) on 22 July 2021 and 2 February 2022;
- Liaison with the NT EPA, the landowner (RLC) and the nominated primary consultant(s) (Paul Turyn [SLR] and later Stuart McKenzie [Prensa]) who were engaged by RLC to undertake tasks including environmental investigations, preparation of RAPs, provide technical advice and manage/supervise remediation and validation works at the site;
- Detailed review of documents pertaining to site assessments, remediation/validation strategy, implementation and outcomes (with regards to the completeness/adequacy of the environmental works undertaken and with particular regard to quality assurance/quality control [QA/QC]);
- Preparation of this Environmental Audit report (EAR); and
- Preparation and issue of a Certificate of Environmental Audit (CoEA).

3.5 Documentation reviewed

Table 4 lists the documentations provided by the client for consideration in this audit, including site investigations, RAPs, and the remediation/ validation report (RVR). Other information and resources reviewed during this audit are listed in **Section 16** (references).

3.6 Audit support team

No expert support team members were used during this audit.

3.7 Stakeholder involvement

This audit has involved liaison with the NT EPA, Ray Laurence Constructions, SLR and Prensa as the primary environmental consultants engaged to deliver this scope of works.

The Auditor did not directly liaise with any other specialist subconsultants/subcontractors during the delivery of the remediation/validation works. However, it is understood Prensa engaged Asbestos Solutions NT (ASNT) in support of the remediation program, to prepare an Asbestos Removal Control Plan (ARCP) and fulfil the role of Licenced Asbestos Removal Contractor (LARC) for the duration of the works. Prensa meanwhile, supplied competent parties to undertake airborne fibre monitoring for the duration of soil disturbance activities, undertake validation/verification sampling and undertake visual clearance inspections (and supplied clearance certificates, as appropriate), following asbestos removal activities.

Table 4: Documentation provided for review

No.	Document	Author	Date	Audit report reference	Location in audit report
Site investigation					
1	Report on Geotechnical Investigation. Proposed Child Care Facility, Lakeside Drive, Alawa. Project 91962.00. Rev 0.	Douglas Partners	6 June 2019	Douglas Partners (2019)	S2.2
2	Preliminary Site investigation Lot 9260, Town of Nightcliff, Northern Territory	Prensa	20 June 2019	Prensa (2019)	S2.2, S5.2, S8
3	Ground Investigation Report for the Proposed Early Learning Centre 77 Lakeside Drive, Alawa, Northern Territory. Project NTG20201603. Rev 1.	Want Geotechnics	7 October 2020	Want Geotechnics (2020)	S2.2
4	Site investigation and asbestos contamination assessment. 77 Lakeside Drive, Alawa NT. Project 680.30054.00000. Rev 0.1. DRAFT	SLR Consulting	10 January 2021	SLR (2021a)	S2.2, S5.2, S8
Remediation and validation					
5	Remediation Action Plan: 77 Lakeside Drive, Alawa NT. Project 680.30054.00000. Rev 0.1. DRAFT	SLR Consulting	10 March 2021	SLR (2021b)	S2.2, Appendix B
6	Document Review: ACM in Soil for the property located at 77 Lakeside Drive, Alawa, Northern Territory.	Prensa	16 April 2021	Prensa (2021a)	-
7	Remediation Action Plan: 77 Lakeside Drive, Alawa, Northern Territory. Job No: 93315B.	Prensa	May 2021	Prensa (2021b)	S2.2, Appendix B
8	Remediation Action Plan: 77 Lakeside Drive, Alawa, Northern Territory. Job No: 93315B.	Prensa	June 2021	Prensa (2021c)	S2.2, Appendix B
9	Asbestos Clearance Certificate – Asbestos remediation works conducted at 77 Lakeside Drive, Alawa, NT	Prensa	21 July 2021	Prensa (2021d)	-
10	Site remediation and validation report: 77 Lakeside Drive, Alawa, NT. Job No: 93315B	Prensa	November 2021	Prensa (2021e)	S9, S10, Appendix D
11	Site remediation and validation report: 77 Lakeside Drive, Alawa, NT. Job No: 93315B	Prensa	May 2022¹	Prensa (2022)	S9, S10, Appendix D

Notes:

During the project, the Auditor was provided with a number of versions of documents pertaining, remediation planning and remediation/site validation activities actually undertaken. While all versions are listed above for completeness, only the most recent (final/ final draft) versions of documents received, for which an official endorsement was provided by the Auditor are referenced in this report. Final/ final draft versions of these documents, which supply the most up to date design/ management information are presented in blue.

¹ An updated remediation/validation report prepared in response to auditor comments (Environmental Earth Sciences, 2021b) was received from Prensa in May 2022. However, is noted the date of issue (November 2021) was not updated from the initial document, received and reviewed in November 2021.

4 SITE IDENTIFICATION AND SETTING

4.1 Location and property description

The regional locality of the site, layout and pertinent site features are provided on **Figures 1** and **2** and site identification details provided in **Table 5**.

Table 5: Site identification details

Item	Details
Street address	77 Lakeside Drive, Alawa
Lot/plan or crown description	Part Lot 9260 on S86/303, Town of Nightcliff
Municipality	City of Darwin
Current land use	Public open space
Future land use	Childcare centre with ground level car park
Current and future zoning	Community purpose (CP) ^{1,2}
Latitude/ longitude (GDA94)	-12.37603, 130.87265
Site area	0.318 ha
Site location and layout	Figures 1

Notes:

¹ Source: NT Government (2019), NT Planning Scheme Map, Darwin. 1 February 2019.

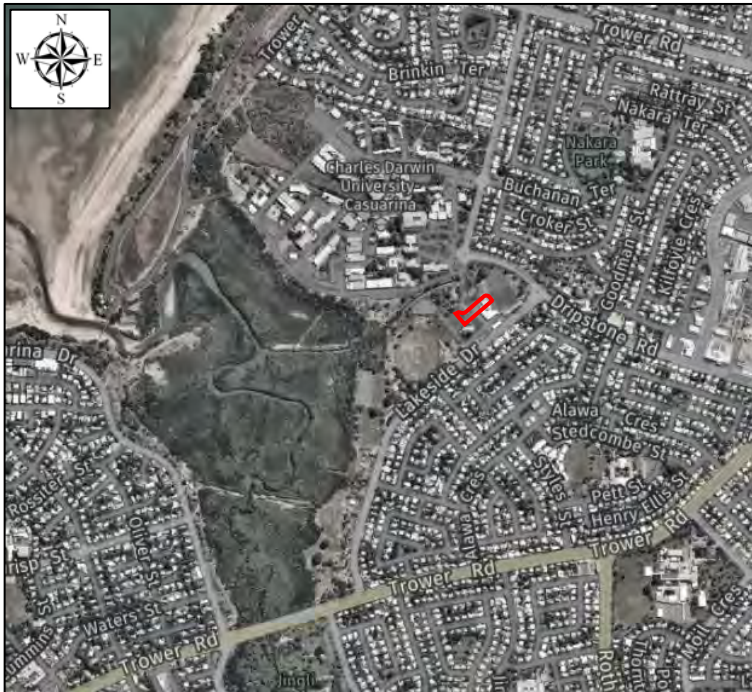
² The purpose of PS is to provide public areas for recreational activity.

4.2 Site description and surrounds


4.2.1 Site

At the time of the initial site inspection, alongside the NT EPA (22 July 2021), the site was a vacant, undeveloped, broadly rectangular plot of land. As preparatory earthworks and initial remedial activities (site clearance and excavation of identified corrugated ACM fencing) had commenced, the site comprised bare earth, with visible trenches where ACM fence footings had been excavated and removed along the south-eastern boundary, the centre point (running north-south) and the north-western boundary. Stockpiles of excavated materials (spoil from fence footing removal activities) were present atop geofabric, adjacent to the trench excavations.


The topography of the site was flat.





LEGEND

 Site boundary

SERVICES

 Live high voltage power line

 Stormwater pipe

 Communications cables


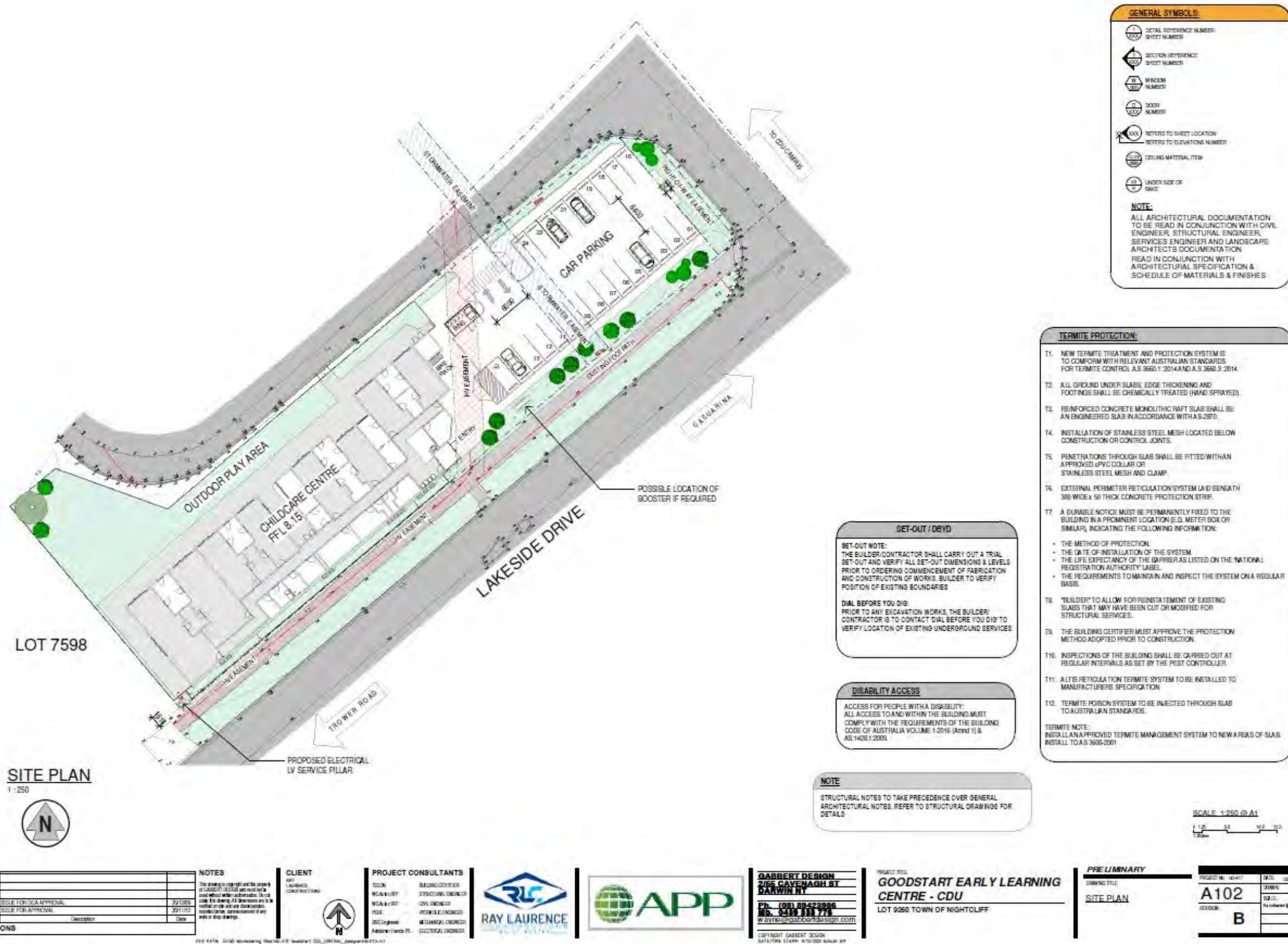
 Exclusion zones (services)

Figure 2: Proposed development Plan (Gabbert Design, December 2020)



4.2.2 Zoning and surrounding land use

With reference to the City of Darwin Planning Schedule, the site is zoned as Community Purpose (CP) (viewed 8 May 2022). The purpose of CP zones is to provide land for schools, community centres, emergency and community services, and places of worship.

The land zoning and land uses for properties located immediately surrounding the site is provided in **Table 6**.

Table 6: Zoning and land use of surrounding land

Direction	Land use	Zoning	Zoning purpose
North-west	Charles Darwin University (CDU) Childcare Centre followed by vacant land and undeveloped vegetated areas	CP	Community purpose
North-east	University Drive followed by CDU commercial buildings including a gym.	LR and CP	Low residential, single dwelling, Community purpose
South-east	Lakeside Drive followed by single storey residential dwellings	LR	Low residential, single dwelling
South-west	Allotment comprising a community hall (the Alawa Scout hall) followed by a playground.	OR, PS and CP	Organised recreation and community purpose, followed by Public open space

4.3 Proposed site use

It is understood that the site is planned to be developed in a single storey childcare centre and associated ground level carpark (refer **Figure 2**) with garden beds along the perimeter of the site and grassed (AstroTurf) areas for outdoor children’s play.

5 SITE HISTORY

5.1 General

A site history was not provided in the remediation validation report (Prensa, 2021e). However, summary site history information was provided in the PSI (Prensa, 2019) which was reviewed by the EA for context. A summary of available and pertinent site history information obtained from Prensa (2019) is provided in **Table 7** below.

Table 7: Summary of historical information

Source	Findings
Historic Titles	<p>The site has been privately owned since the earliest available records (1983), by:</p> <ul style="list-style-type: none"> • Darwin City Council (between 1983 and 1995); • City of Darwin (Charles Darwin University) between 2015 and 2022.

Source	Findings
	No evidence of potentially contaminating activities occurring within the site boundary was identified during the Title search.
Aerial photographs	The site has remained undeveloped, vacant land since prior to 1944. No evidence of potentially contaminating activities occurring within the site boundary was identified during the aerial photo review.
Aboriginal sacred and Heritage listed infrastructure	There are no registered Aboriginal Sacred sites; or heritage listed sites under the <i>Heritage Act 2011</i> within the site boundary.

5.2 Previous environmental assessments

The site has been subject to several environmental assessments since 2019 to investigate site condition with respect to CoPCs. This commenced with a PSI (Prensa, 2019), followed by supplementary investigation, triggered by the unexpected identification of ACM at site surface during preparatory earthworks, in 2020.

A summary of pertinent historic information (investigations completed in support of site redevelopment between 2019 and 2021, prior to the commencement of remediation/validation activities is provided in **Table 8** below.

A timeline of site activities and pertinent dates relating to the investigation, remediation and validation of the site (including issue of reporting deliverables) is provided as **Figure 3**.

6 POTENTIAL FOR CONTAMINATION AND CONCEPTUAL SITE MODEL DEVELOPMENT

A conceptual site model (CSM) can be formed by considering the geophysical characteristics at play at the site, the contaminant source, potential receptors and the pathways to the receptors. The CSM, as required by the NEPC (2013), is an iterative process constantly being updated during the investigation process as more information becomes available.

6.1 Topography and drainage

The site sits at an elevation of approximately 5 metres Australian Height Datum (m AHD) and is flat. Stormwater drainage at the site is likely to comprise a combination of direct infiltration to the subsurface through the unsealed site surface and/or overland flow toward a drainage swale to the west of the site boundary which flows, in turn, to the north, toward Rapid Creek.

6.2 Hydrology and flooding

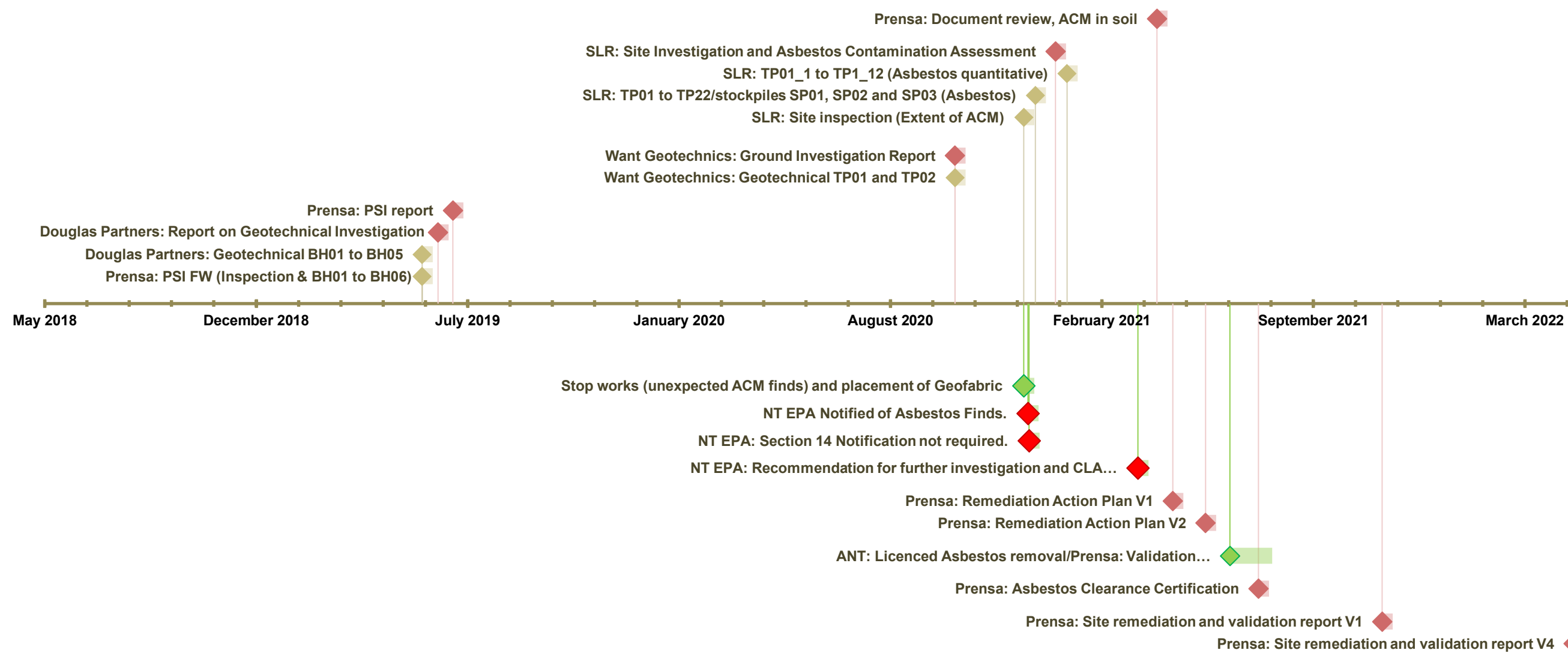
The closest hydrological feature to the site is a drainage feature located approximately, 218 m to the north of the site, which flows to the west, feeding to the tidally influenced Rapid Creek at a point approximately 680m to the West.

Table 8: Previous environmental investigations

Prensa (2019) Preliminary Site Investigation Lot 9260, Town of Nightcliff, Northern Territory	
Investigation Area	Portion Lot 8640 on S77/038 (proposed Lot 9260)
Objectives	Provide guidance on the potential for contamination to be present at the site, as a result of current and/or historical activities, that may pose a potential risk to future users of the site.
Scope	<ul style="list-style-type: none"> Brief site history review (title search and aerial photo review) Visual inspection of site condition Soil sampling and analytical program comprising <ul style="list-style-type: none"> advancement of 6 boreholes (BH01 to BH06) to a maximum depth of 1 m bgl and logging; field screening of soil samples for volatile organic compounds (VOCs) using a calibrated photo-ionisation detector (PID); collection and analysis of representative soil samples for CoPCs including metals, TRH, BTEXN and OC/Ops. Assessment of soil analytical results against appropriate guidance criteria and preparation of a PSI report.
Findings/ recommendations	<p>Findings: The relevant results of the assessment are as follows:</p> <ul style="list-style-type: none"> Soils encountered at the site were described as a natural sandy gravel layer overlying natural sandy clay. A maximum 0.2 m thickness of fill was encountered at BH06. No evidence of engineered cap, visual and/or olfactory evidence of contamination was encountered during the investigation. PID readings did not exceed 1 ppm. Soil chemical concentrations metals, TRH, BTEXN and OC/OPs, did not exceed applicable human health and/or ecological guideline criteria, thus it was deemed unlikely that gross contamination was present in soils assessed at the site, which could impact on the proposed future use. <p>Based on the results, it was considered appropriate that soils excavated as part of the proposed works could remain (be reused) on site or disposed off-site as clean fill.</p> <p>Recommendations: It was recommended that should personnel undertaking excavation work at the site observe any soil material containing staining, odours or landfill materials, that all excavation work be suspended immediately, and a suitable qualified environmental consultant be contacted.</p>
SLR (2021a) Site investigation and asbestos contamination assessment. 77 Lakeside Drive, Alawa NT. Project 680.30054.00000. Rev 0.1. DRAFT	
Investigation Area	Portion Lot 8640 on S77/038 (proposed Lot 9260)
Objectives	<ul style="list-style-type: none"> Assess the extent of ACM contamination across the site; and Provide advice as to what remedial actions may be required to render the site suitable for unrestricted land use.
Scope	<ul style="list-style-type: none"> Visual inspection (grid-based) of site condition to confirm extent of surface ACM impacts; Review of pertinent background information (aerial photography and historic environmental assessment reports); Soil sampling and analytical program comprising: <ul style="list-style-type: none"> excavation of 22 testpits (TP01-TP23) to a maximum depth of 1 m bgs across the site to visually assess presence/absence of ACM in soils; collection and analysis of representative soil samples for presence/absence of asbestos in soil and quantitative asbestos analysis in accordance with WA DoH (2009); collection of three stockpile samples (SP01 and SP02) for identification of asbestos in soil; and Air quality monitoring for asbestos fibres on site boundaries for the duration of the intrusive assessment. No further analysis for "other" CoPCs was undertaken, in consideration of the Prensa PSI results (Prensa, 2019) and known site history.
Findings/ recommendations	<p>Findings: The relevant results of the assessment are as follows:</p> <p>Site inspection/ site history and previous assessment review</p> <ul style="list-style-type: none"> Grid-based site inspection (11 December 2020) to visually assess the extent of ACM contamination across the site surface. Broken fragments of suspected ACM were identified in the south-east corner of the site, adjacent to a corrugated ACM fence uncovered during preparatory earthworks. It was suspected that ACM fragments had been distributed across the site due to vehicle movement. SLR completed an updated review of historic aerials available from the Northern Territory Aerial Photography Index. SLR identified a curved structure extending east and west of the site in the 1975 aerial photograph, apparently corresponding to the location of the corrugated ACM fence identified during site preparatory works, which may have been buried in soil/concealed by vegetation during the initial Prensa PSI. SLR completed a gap analysis of historic investigation reports and determined that given the size of the investigation area, the total number of investigation locations completed during the PSI was insufficient for a site here there is known or suspected asbestos and that the sampling method (boreholes rather than testpits) was insufficient to identify asbestos in soils, if present.

	<p>Visual observations and analytical results</p> <p>Soils encountered at the site were described as fill material consisting of fine to coarse grained sand and sub-angular to sub-rounded gravels overlying yellow-yellow/red sandy clay and sand. No staining or odorous soils were encountered in any of the test pits excavated on site. However, numerous suspected ACM fragments were identified across the site surface; particularly in the south-eastern portion of the site, in the vicinity of the corrugated ACM fence. SLR assumed the visible ACM debris had been generated during earthworks on site and plant/equipment movement impacting the fence as the incidence of visible ACM reduced with distance from this feature.</p> <ul style="list-style-type: none"> • 23 samples were analysed for presence/absence of asbestos – asbestos was not detected in any sample, with the exception of TP04_0.2 m bgs, adjacent to the ACM fence; • 12 samples were collected for quantitative identification of asbestos in accordance with the DoH guideline. Asbestos was not reported at a concentration above the health-based assessment criteria (0.001% W/W) in any of the samples analysed indicating no AF/FA present at the site. Although SLR acknowledged only half of the proposed sampling was achieved due to inclement weather conditions. • 2 of 3 stockpile samples contained asbestos. • 1 piece of ACM debris was collected during the investigation and analysed for asbestos – the results confirmed the ACM contained chrysotile fibres. • Airborne fibres above the detection limit were not reported for the duration of boundary monitoring. <p>Based on the results of the investigation, SLR concluded that ACM materials were generally limited to surface and near surface (max depth 0.2 m below ground surface) across the majority of the site and that while impacts across the majority of the site were likely limited to ACM debris only, areas in the vicinity of the fence line could be impacted with FA/AF which required further assessment.</p> <p>Recommendations:</p> <p>SLR concluded remediation of the site would be required to render the site suitable for unrestricted use and recommended the following remediation options be considered, with the final remediation option selected developed into a remediation action plan for consideration:</p> <ul style="list-style-type: none"> • Removal and disposal of visible ACM fragments via handpicking or tilling (site area outside the “hotspot” – the asbestos fence line) with a visual clearance inspection and certificate provided by a licenced asbestos assessor/environmental consultant at the conclusion of the works; and • Remediation of the hotspot via excavation by a licenced asbestos assessor/environmental consultant with asbestos contamination “chased out” and removal works validated. • SLR also indicated input would be required from an EA to confirm remedial requirements related to sign-off of the site and approval of spoil disposal/management as required.
<p>SLR (2021b) Remediation Action Plan: 77 Lakeside Drive, Alawa NT. Project 680.30054.00000. Rev 0.1. DRAFT</p>	
<p>Investigation Area</p>	<p>Part Lot 9260 on S 86/303</p>
<p>Objectives</p>	<p>To provide a structured approach to the remediation of asbestos contamination and subsequent validation such that the site is rendered suitable for the proposed land use.</p>
<p>Scope</p>	<ul style="list-style-type: none"> • Preparation of an appropriate remedial strategy to outline available localised remediation options to provide site suitability for the proposed land use; • Detail validation requirements to confirm success of the validation strategy (assign validation criteria); • Detail appropriate environmental safeguards required to conduct the remediation works in an environmentally acceptable manner; • Detail appropriate occupational hygiene and safety (OH&S) procedures required to conduct the remediation works in a manner that will not pose a threat to site workers and surrounding land uses.
<p>Prensa (2021c) Remediation Action Plan: 77 Lakeside Drive, Alawa NT. Job No: 93315B</p>	
<p>Investigation Area</p>	<p>Part Lot 9260 on S 86/303</p>
<p>Objectives</p>	<ul style="list-style-type: none"> • To provide a structured approach to the remediation of asbestos contamination and subsequent validation such that the site is rendered suitable for the proposed land use.
<p>Scope</p>	<ul style="list-style-type: none"> • Preparation of an appropriate remedial strategy to outline available localised remediation options to provide site suitability for the proposed land use; • Detail validation requirements to confirm success of the validation strategy (assign validation criteria); • Detail appropriate environmental safeguards required to conduct the remediation works in an environmentally acceptable manner; • Detail appropriate occupational hygiene and safety (OH&S) procedures required to conduct the remediation works in a manner that will not pose a threat to site workers and surrounding land uses.

Figure 3: Timeline of site investigation, remediation and validation activities (2019-2022)



- ◆ Investigation activities
- ◆ Reporting (Investigation/Remediation/Validation)
- ◆ Remediation activities and regulator involvement

Rapid Creek passes the site at a range of approximately 700 m, flowing to the north, where it eventually discharges to Beagle Gulf.

The site is not located within a storm surge zone and is therefore not likely to be impacted by either a 100-year average reoccurrence storm interval (ARI) or the secondary 1000-year ARI event.

6.3 Soil, landscape classes and vegetation

According to the NTG Department of Environment, Parks and Water Security (DEPWS) Natural Resource Maps (NR Maps) online mapping system one landscape class applies to the site. Pertinent landscape classification information is summarised in **Table 9** below.

Table 9: Landscape classification

Item	Description
Area/ approximate size (ha)	Entire site (0.318 ha)
Landscape class	Lateritic plains and rises
Landscape class description	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils.
Landform	Steep, dissected terrain forming the edge of the deeply weathered plateau.
Soil (original)	Shallow lithosols and gravelly yellow earths.
Soil (ASC)	Leptic Rudosols and gravelly yellow Kandosols.
Vegetation	Mid-high woodland over tropical tall grass.
Acid sulfate soils	No occurrence of acid sulfate soils. Refer Section 6.5

Notes: ASC: Australian Soil Classification system

6.4 Geology

Based on the *Darwin 1:250 000* Geological Map Series, Sheet SD52-4 (NT Department of Mines and Energy, 1988) the site is located on a combination of Quaternary-aged:

- Unconsolidated sand, clayey sand, ferruginous clayey sand and soil commonly containing limonite pisolites [Czs]; and
- Nodular concretionary, pisolitic and vermicular mottled laterite: ferricrete (*in-situ* and reworked remnants of a standard laterite profile) [Czl].

Based on the geological cross section, these Quaternary deposits overlie the Lower Cretaceous aged (100–145-million-year-old) Darwin Member of the Bathurst Island Formation, which is comprised of silicified, kaolinized and/ or ferruginised siltstone, claystone or sandstone with phosphorite nodules, and outcrops east and west of the site.

6.5 Acid Sulfate Soils

According to the Darwin Region 1:50,000 Acid Sulfate Soil Risk Map (NTG DEPWS, 2021), the site is not mapped within an area likely to be affected by acid sulfate soils (ASS).

6.6 Hydrogeology

6.6.1 Results of registered bore search

The NTG DEPWS – NR Maps online mapping system was used by the EA (2022) to search for registered bores in the vicinity of the site. The database indicated there are no current groundwater bores within 500 m of the site, but 7 within 1.2 km of the site boundary.

A summary of bore information is provided in **Table 10** below. The bore cards for the registered bores have been provided in **Appendix A**.

Table 10: Registered groundwater bore information

Bore ID (RN)	Total depth	SWL/ (yield)	Screened interval	Screened geology	Distance/ direction from site	Bore use and status
	m btoc	m btoc/ (L/s)	m btoc		m	
RN8467	9.3	NS	0-9.3	Sand/clay	1.09 km, north	NS
RN20328	51	1 (1 L/s)	5-51 (?)	Sand/clay/shale	1.1 km south-west	NS
RN27850	54.6	5 (2.15 L/s)	36.3-48.3	Siltstone/shale	908 m north-west	Production
RN039970	10	8.4 (0.05 L/s)	6-10	Silty clay	1.2 km north-east	Monitoring
RN039971	10	8.5 (0.05 L/s)	6-10	Silty clay	1.2 km north-east	Monitoring
RN039972	10	8.4 (0.05 L/s)	6-10	Silty clay	1.2 km north-east	Monitoring
RN039973	9.5	8.3 (0.05 L/s)	5.5-9.5	Silty clay	1.2 km north-east	Monitoring

Notes: NS: information not supplied.

6.6.2 Aquifers and aquitards

According to the NT Governments Natural Resource Maps (NR Maps), the aquifer in this area has been described as fractured and weathered rocks consisting of shale, greywacke and sandstone, with groundwater yields of 0.5 – 2.5 L/second. Groundwater flow direction is expected to be to the north/ north-west toward the tidally influenced Rapid Creek.

6.7 Climate

The regional meteorology of the site can be summarised using data from Darwin Airport (Station 0140154, approximately 4 km south) published on the Bureau of Meteorology website. Mean maximum and minimum monthly temperatures and mean monthly rainfall is presented in **Table 11**. Darwin has a tropical savanna climate, meaning the region experiences distinct wet and dry seasons with an average maximum temperature that

remains similar all year around. The dry season runs from around May to September/ October and the wet season running from November through to April.

Table 11: Average monthly weather statistics 1941-2022

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max temp (°C)	31.8	31.5	32.0	32.8	32.1	30.7	30.7	31.5	32.7	33.3	33.4	32.7
Min temp (°C)	24.9	24.8	24.6	24	22.2	20.0	19.3	20.3	23.0	24.9	25.3	25.3
Av rainfall (mm)	431.3	369.0	310.8	101.7	20.4	1.8	1.1	4.7	16.6	70.2	141.8	252.1

7 REGULATORY FRAMEWORK AND ASSESSMENT CRITERIA

7.1 General

The Victorian Environmental Audit process requires that the levels of contamination reported be assessed in the context of beneficial uses that need to be protected.

Accordingly, beneficial uses to be protected, relevant to the site, have been identified in consideration of the ASC NEPM, Northern Territory Water Act (2011) and the Victorian Government Environment Reference Standard [ERS] (Victorian Government, 2021a).

The ERS allows for a consistent approach to the prevention of contamination and clean-up of pollution by setting environmental quality indicators and objectives for each beneficial use identified. Specifically:

- Ambient air;
- Ambient sound;
- Land; and
- Water (groundwater and surface water).

The following sub-sections aim to address beneficial uses that are relevant to the proposed land-use at the site (public open space) with regard to the current status of the contaminated soil, that is, buried in a confined, engineered containment cell.

7.2 Air

Ambient air as a beneficial use has been considered in accordance with the ERS (Victorian Government, 2021). The ERS (Part 2-Ambient air). considers vapour and gas as a by-product of volatile and putrescible contaminants/ waste. A detailed assessment of the quality

of air at the site is not considered necessary given that the assessment of the contamination status of the site has not identified any major sources of impact to air quality.

Furthermore, the risk to human health or the environment in this scenario is secondary via the dispersant and potential inhalation of airborne asbestos fibres/ dust, which is ultimately a factor of land. The risk of dust generation presented to sensitive receptors will be discussed below.

7.3 Land

7.3.1 General

The ERS (Victorian Government, 2021) provides the framework for the protection of land and associated beneficial uses. The ERS (Part 4-Land) defines certain land-use categories and associated beneficial uses of land to be protected. The land-use categories and relevant beneficial uses to be protected are provided in **Table 12**, a replication of Table 4.2 from ERS (Part 4-Land). The land uses relevant to the site have been highlighted.

Table 12: Protected beneficial uses of land

Beneficial use	Land use						
	Parks and reserves	Agricultural	Sensitive use		Recreation / Open space	Commercial	Industrial
			High Density	Other (low density)			
Land dependent ecosystems and species							
Natural ecosystems	✓						
Modified ecosystems	✓	✓		✓	✓		
Highly modified ecosystems		✓	✓	✓	✓	✓	✓
Human health	✓	✓	✓	✓	✓	✓	✓
Buildings and structures	✓	✓	✓	✓	✓	✓	✓
Aesthetics	✓		✓	✓	✓	✓	
Production of food flora and fibre	✓	✓		✓			

All beneficial uses must be considered when undertaking an environmental audit and specifically, where suitability for “any” land use is being assessed, the beneficial land uses that are protected for a site include:

- maintenance of ecosystems (natural, modified and highly modified);
- human health;

- buildings and structures;
- aesthetics; and
- production of food, flora and fibre.

If the assessment determines that the site is protective of all beneficial uses, a CoEA may be issued, indicating that the site is in a suitable condition for unrestricted use.

These land-uses have been discussed further in **Table 13** and **Sections 7.3.2-7.3.5**, below.

7.3.2 Maintenance of modified and highly modified ecosystems:

The ERS states that contamination must not adversely affect the maintenance of relevant ecosystems (i.e., natural, modified and highly modified ecosystems). As stated in **Table 13**, any level of any indicator must therefore not be greater than any ecological investigation (or screening) level developed in accordance with the NEPM (NEPC, 2013).

The ecological investigation levels (EILs) assigned by the NEPC (2013) Schedule B5a - Guideline on Ecological Risk Assessment are adopted for this assessment. This guideline presents the methodology for deriving terrestrial EILs using both fresh and aged (i.e., > 2 years old) contamination for soil with the following land use types:

- areas of ecological significance;
- urban residential/ public open space; and
- commercial/ industrial.

The methodology has been developed to protect soil processes, soil biota (flora and fauna) and terrestrial invertebrates and vertebrates.

The EA is required to consider all potential future land-uses and their associated beneficial uses. However, realistically it is recognised this area is not currently and will never become an area of “ecological significance”. Therefore, for the purposes of this assessment, a realistic comparison with EILs for urban residential/ public open space has also been made, as this is the approved and proposed land use on the site.

Site-specific EIL are typically calculated from summing the ACL and the ambient background concentration (ABC) to derive the site-specific soil quality guideline (SQG) taking into account the effect caused by pH, exchangeable cations, iron (Fe) and total organic carbon (TOC) in soil that can affect concentration toxicity data.

The EA notes for the purposes of this assessment the consultant (Prensa, 2019/ Prensa, 2021f) did not obtain site-specific soil parameters to facilitate this calculation, instead using generic EILs based on total concentrations and fresh contaminants (where available) and applying the ACL as conservative ecological screening criteria, for the remainder (refer **Table 14**).

Table 13: Indicators and objectives for the land environment

Beneficial use	Indicators	Objectives
Land dependent ecosystems and species	Concentration of inorganic and organic contaminants set out in Appendix A of Schedule B2 of the NEPM; and Concentrations of any other contaminants present at the site as determined by the current use, or site history (assessed in accordance with the NEPM).	The objective for each indicator is the ecological investigation or screening level in the NEPM unless: There is no such investigation or screening level; or Due to site specific characteristics the more appropriate objective is: <ul style="list-style-type: none"> • The level derived using the risk assessment methodology described in NEPM; or • The background level determined in accordance with section 36 of the Act, In which case the objective for the indicator is (i) or (ii) as applicable.
Human health		The objective for each indicator is the health investigation or screening level in the NEPM unless: There is no such investigation or screening level; or Due to site specific characteristics the more appropriate objective is: <ul style="list-style-type: none"> • The level derived using the risk assessment methodology described in NEPM; or • The background level determined in accordance with section 36 of the Act, In which case the objective for the indicator is (i) or (ii) as applicable.
Buildings and structures	pH, sulfate, chloride, redox potential, salinity or any chemical substance or waste that may have a detrimental impact on the structural integrity of buildings and other structures.	Contamination must not cause the land to be corrosive to or adversely affect the integrity of structures or building materials.
Aesthetics	Any chemical substance or waste that may be offensive to the senses.	Contamination must not cause the land to be offensive to the senses of human beings.
Production of food, flora and fibre	Concentration of inorganic and organic contaminants set out in Appendix A of Schedule B2 of the NEPM; and Concentrations of any other contaminants present at the site as determined by the current use, or site history (assessed in accordance with the NEPM).	Contamination must not adversely affect produce quality or yield; and affect the level of an indicator in the food, fibre or flora produced at the site (or that may be produced) such that the level of that indicator is greater than that specified in the Australian and New Zealand Food Authority Standards Codes.

Table 14: Adopted Ecological Investigation Levels (mg/kg)

Analyte	Urban residential/ public open space
Arsenic	100
Chromium III	190 ¹
Copper	60 ¹
Lead	1100
Nickel	30 ¹
Zinc	70 ¹
Naphthalene	170
DDT	180

Notes: ¹Site specific soil criteria (pH, CEC, TOC and total iron) not obtained – value represents worst-case added contaminant limit (ACL) only and is therefore highly conservative in the absence of background soil concentrations

Ecological screening levels (ESLs) assigned by the NEPC (2013) were also used during this assessment (**Table 15**). For conservatism, values for coarse grained soils with a source depth of 0-1 metre below ground level (m bgl) (as relevant) were applied.

Table 15: Adopted Ecological Screening Levels (mg/kg)

Analyte	Soil HSL for vapour intrusion [0-<1m, sand]	ESL for TPH fractions, BTEX and Benzo (a) pyrene in soil (coarse)
	Low-high density residential	Urban residential/public open space
Benzene	0.5	50
Toluene	160	85
Ethylbenzene	55	70
Xylenes	40	105
Naphthalene	3	-
F1 C6-C10	45	180
F2 >C10-C16	110	120
F3 >C16-C34	-	300
F4 >C34-C40	-	2800
Benzo (a) pyrene	-	28

7.3.3 Human health

Schedule B(1) of the current version of the NEPM 2013 (NEPC, 2013) provides a range of investigation levels for the protection of human health, referred to as health investigation levels (HILs), and provides health screening levels (HSLs) for BTEX and petroleum hydrocarbons. HILs and HSLs are provided for four generic land use settings:

- **HIL A:** residential with garden / accessible soil (home grown produce <10% fruit and vegetable intake, (no poultry), also includes children’s day care centres, preschools and primary schools;
- **HIL B:** residential with minimal opportunities for soil access includes dwellings with fully and permanently paved yard space such as high-rise buildings and flats;
- **HIL C:** public open space such as parks, playgrounds, playing fields (e.g., ovals), secondary schools and footpaths. It does not include undeveloped public open space (such as urban bushland and reserves) which should be subject to a site-specific assessment where appropriate; and
- **HIL D:** commercial/industrial such as shops, offices, factories and industrial sites.

HIL A has been adopted for this assessment, as the most sensitive land use.

In addition to the above, NEPM 2013 (NEPC, 2013) provides HSLs for asbestos in soil also based on scenario-specific likely exposure levels which have been adopted from the WA DoH guidelines and reproduced in **Table 16** below. These guidelines (appropriate to residential A) were applied at both investigation and validation stages of the assessment.

Table 16: HSLs for asbestos contamination in soil

Form of asbestos	Health screening level (w/w)			
	Residential A	Residential B	Residential C	Commercial/ Industrial D
Bonded ACM	0.01%	0.04%	0.02%	0.05%
FA and AF (friable asbestos) ¹	0.001%			
All forms of asbestos	No visible asbestos for surface soil			

Notes:

¹ The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) only applies where the FA and AF are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres.

7.3.4 Buildings and structures

The ERS states that contamination at the site must not cause the land to be corrosive to or adversely affect the integrity of structures or building materials. This was assessed in consideration of site geology and presence of contaminants on site.

7.3.5 Aesthetics

The ERS states that contamination must not cause the land to be offensive to the senses of human beings. Aesthetic issues may include discoloured soil (stained from spills), solid inert waste (bricks, glass, steel, polyvinyl chloride [PVC] etc), fill with waste (demolition rubble, ash, coke, black carbon, foundry slag, etc) and offensive odours.

7.3.6 Production of food, flora and fibre

The ERS defers to the levels referenced in the Australian and New Zealand Food Authority Standards Codes for assessing the production of food, flora and fibre at a site. Realistically, based on the size of the site, its location and proposed development – food, flora and flora will never be produced at the site. The EA has therefore used the EILs (refer S7.3.2) as an initial screening level.

7.3.7 Assessment Criteria Considerations

For contaminant concentration to be considered acceptable for the respective land use criteria, the data set must conform to the following requirements, as adopted by the NEPM 2013 (NEPC, 2013):

- the 95% upper confidence limit (UCL) of the arithmetic mean of analytical results is below the site criteria;
- the arithmetic (or geometric in cases where the data is log normally distributed) mean is below the site criteria;
- the standard deviation is less than 50% of the site criteria; and
- no single sample analytical result is greater than 250% of the site criteria.

7.4 Groundwater

In the absence of gross soil contamination, known or suspected historic potentially contaminating activities at the site, the likelihood of groundwater contamination was deemed low. Furthermore, the proposed development did not require excavation or other ground disturbance to the depth of the groundwater table.

Consequently, no groundwater investigation was deemed necessary for the purpose of the development and the EA has not considered this environmental aspect any further.

7.5 Surface water

No surface water bodies are located on the site or in its immediate vicinity (the nearest surface water body is greater than 200 m away) nor are likely to be in the future, and no evidence of mobile contamination was identified during the initial investigation works. Consequently, consideration of surface water beneficial uses was not deemed necessary for the purposes of the development and the EA has not considered this environmental any further.

7.6 Environmental Auditor conclusion on assessment criteria

The EA is generally satisfied that the Assessor has adequately defined the regulatory framework for soil assessment.

The EA has therefore assessed the condition of the site through independent comparison of the soil data by the Assessor with the current NEPM (NEPC, 2013).

8 CONTAMINATION PRIOR TO REMEDIATION

In consideration of historic site use and potential sources of mobile contamination in the area, the key CoPCs deemed relevant and therefore investigated at the site included asbestos, TRH, BTEXN, PAHs, OC/OP pesticides and metals (As, Cd, Cr, Cu, Pb, Ni, Zn and Hg).

A summary of site condition pre-remediation, in relation to these CoPCs is provided in **Sections 8.1 and 8.2** below.

8.1 Asbestos in soil

8.1.1 Surface ACM

Preparatory earthworks at the site commenced in late 2019. During these earthworks unexpected finds (ACM) were identified at site surface adjacent to the south-eastern boundary of the site.

In response to the find, RLC ceased all works on the site and requested an environmental consultant (SLR) provide advice with respect to:

- the source and extent of the impact; and
- provide recommendations with respect to management and remediation actions required, to render the site suitable for the proposed sensitive land use.

SLR completed a site inspection on 11 December 2020 to investigate the extent of asbestos contamination at the site. It was noted at this time that broken fragments of ACM were present at site surface, in the south-eastern portion of the site, apparently originating from a corrugated asbestos sheet fence located along the south-eastern boundary (having been distributed across site surface, due to earthworks) (refer **Figure 4**)

On SLRs recommendation, to minimise any potential exposure to site workers and adjacent land users via release of respirable fibres while further investigation was undertaken and appropriate remediation planned, a geofabric layer was placed across the area of visible asbestos impact.

8.1.2 Site investigation (SLR, 2020/ 2021)

RLC engaged SLR to undertake a supplementary site investigation to confirm the nature and extent of asbestos in subsurface soils across the site (site surface and subsurface soils).. Accordingly, between 22 December and 21 January 2021 SLR completed further site investigation including the advancement of test pits across the site, collection and analysis of representative samples for quantitative analysis (AF/FA and ACM) (refer **Figure 5**).

Based on the outcomes of the assessment, SLR concluded that the asbestos impacts at the site were primarily limited to fragments of ACM across the site surface and in the vicinity of the corrugated fence extending to a maximum depth of 0.1 to 0.2 m bgs (refer Figure 4). However, minor asbestos impacts were also noted (refer **Figure 6**):

- at sampling location TP04 comprising fragments of ACM at approximately 0.2 m bgs; and
- within two of three existing stockpiles present on site at time of investigation (SP01 and SP02), also comprising fragments of ACM.

One sample of ACM debris was collected and submitted for analysis during the investigation. This sample was found to contain chrysotile asbestos.

On 21 January 2021 an additional twelve test-pits were completed and samples collected for quantitative identification of asbestos (ACM/ AF/ FA) in accordance with the DoH guideline.

Asbestos concentrations were not reported above applicable (HIL A) criteria.

The above notwithstanding, while AF/ FA was not identified during the investigation, SLR considered there was a potential for some AF/ FA in the immediate vicinity of the fence both due to long-term weathering of the material and as a result of damage sustained to the fence during earthworks activities. SLR concluded that the site was unsuitable for the proposed sensitive land use in its current state and that remediation would be required, likely including a combination of hand picking/tilling and excavation of the impacted hotspot “fence line” with off-site disposal of impacted materials under the supervision of a qualified, licenced asbestos assessor.

8.2 Other CoPCs

Other CoPCs (TRH, BTEXN, PAH and OC/OPs) were not reported above either the laboratory LOR or, applicable human health and/or ecological assessment criteria during the PSI (Prensa 2019). However, following review, noting that the number of samples collected and analysed did not meet Australian Standard, the EA and NT EPA requested Prensa undertake further assessment for “other CoPCs”, to augment the initial investigation.

Further “verification sampling” was undertaken during the remediation/validation campaign in June 2021 (refer **Section 9**).

The results of the assessment confirmed other CoPCs were not reported at the site above the laboratory LOR and/or above applicable assessment criteria and thus did not pose a risk to human health and/or ecological receptors.



LEGEND

- Visible ACM – site surface (SLR, 2020)
- Stockpile locations (SLR, 2020)
- Corrugated asbestos fence (identified during initial site clearance)

SERVICES

- Live high voltage power line
- Stormwater pipe
- Communications cables
- Exclusion zones (services)



LEGEND

- Visible ACM – site surface (SLR, 2020)
- ⊗ Testpit locations (SLR, 2020)
- “Investigation” Testpits (SLR, 2020) – visual assessment only
- Stockpile locations (SLR, 2020)
- ⊗ Testpit locations (SLR 2021) Supplementary sampling program
- Corrugated asbestos fence (identified during initial site clearance)

SERVICES

- Live high voltage power line
- Stormwater pipe
- Communications cables
- Exclusion zones (services)



LEGEND

- Visible ACM – site surface (SLR, 2020)
- “Investigation” Testpits (SLR, 2020)
– visual assessment only – no ACM identified
- ⊗ Testpit locations (SLR 2020/2021) – no ACM, AF or FA detected
- ⊗ Testpit locations (SLR 2020/2021) – asbestos detected (refer Table below)
- Stockpile locations (SLR 2020/2021) – asbestos detected (refer Table below)
- Corrugated asbestos fence (identified during site clearance)

SERVICES

- Live high voltage power line
- Stormwater pipe
- Communications cables
- Exclusion zones (services)

Sample Location	Depth mbgs	ACM fragments detected? Y/N	Asbestos in soil (AS4964-2004)	
			Detection	W/W% (<7mm)
NEPM screening level (AF/FA)				0.001
TP04_0.2	0.2	N	Y	-
SP01	0.3	N	Y	-
SP03	0.3	N	Y	-

Although one exceedance of the conservatively adopted “ACL” was reported for zinc in interlaboratory duplicate sample DUP01A (660 mg/kg), this exceedance was not deemed of concern given:

- (a): the ACL is not a true ecological criteria, having no regard to background conditions;
- (b) neither the primary (VER01) or intra-laboratory duplicate (DUP01) yielded concentrations of this magnitude;
- (c) realistically, the zinc concentration is unlikely to impact upon terrestrial ecosystems given the sampling location falls directly within the footprint of the proposed childcare centre building (refer **Figures 2** and **7**).

No exceedances of human health criteria were identified.

Given the above the assessor concluded (and the EA agreed) site condition with respect to “other CoPCs” did not preclude development of the site as a childcare centre (unrestricted use) and, on the basis of the combined 2019 and 2021 sampling results (refer **Figure 7**), no further assessment/ remediation or management of soils at the site with respect to “other CoPCs” was necessary.

9 REMEDIATION ACTIVITIES

9.1 General

Remediation was required to address asbestos-impacted soils identified during initial site preparatory works and subsequent site assessment (SLR, 2020/2021).

Remedial works were undertaken at the site between 24th June 2021 and 9 July 2021 in accordance with the approved RAP (Prensa 2021c).

Asbestos Solutions NT (ASNT) were engaged by Prensa to prepare an Asbestos Removal Control Plan (ARCP) and fulfil the role of Licenced Asbestos Removal Contractor (LARC) for the duration of the works. While Prensa supplied competent parties to undertake airborne asbestos fibre monitoring for the duration of soil disturbance activities, undertake validation/verification sampling and undertake visual clearance inspections (and supplied clearance certificates, as appropriate) once asbestos removal had been completed.

A summary of remediation activities undertaken is provided in **Table 17** below with trench excavation and stockpile locations, alongside final validation sample locations and results, shown on **Figures 8 to 10**.

9.2 Surface contamination (Emu-Pick and Tilling)

ACM fragments were observed across the site surface during the SLR 2020 investigation (SLR, 2021a). Consequently, it was necessary to remediate the entire site surface with respect to ACM.



LEGEND

- Soil sampling locations "other CoPCs". (Prensa, 2019)
- Supplementary soil verification sampling locations "other CoPCs". (Prensa, 2021)

Sample ID	Depth	Sampling date	HILA - Low density residential	HSLA (sand 0-1m)	EIL urban residential	ESL urban residential (coarse)	BH01		BH02		BH03		BH04		BH05		BH06		VER01	VER02	VER03	VER04		
							0.1	0.5	0.1	0.5	0.1	0.5	0.1	0.5	0.1	0.5	0.1	0.5	0.1	0.5				
							22/05/2019	22/05/2019	22/05/2019	22/05/2019	22/05/2019	22/05/2019	22/05/2019	22/05/2019	22/05/2019	22/05/2019	22/05/2019	22/05/2019	22/05/2019	22/05/2019	22/05/2019	5/07/2021	6/07/2021	6/07/2021
BTEXN	Benzene	0.5					-	-	-	-	<0.1	<0.1	-	-	<0.1	-	-	<0.5	<0.5	<0.5	<0.5			
	Toluene	160					-	-	-	-	<0.1	<0.1	-	-	<0.1	-	-	<0.5	<0.5	<0.5	<0.5			
	Ethylbenzene	55					-	-	-	-	<0.1	<0.1	-	-	<0.1	-	-	<0.2	<0.2	<0.2	<0.2			
	Xylenes	40					-	-	-	-	<0.3	<0.3	-	-	<0.3	-	-	<0.5	<0.5	<0.5	<0.5			
	Naphthalene	3	170				-	-	-	-	<0.5	<0.5	-	-	<0.5	-	-	<0.5	<0.5	<0.5	<0.5			
TRH	C6-C10 (F1)						-	-	-	-	<20	<20	-	-	<20	-	-	<10	<10	<10	<10			
	C10-C16 (F2)						-	-	-	-	<50	<50	-	-	<50	-	-	<50	<50	60	<50			
	C16-C34						-	-	-	-	<100	<100	-	-	<100	-	-	0	0	0	0			
	C34-C40						-	-	-	-	<100	<100	-	-	<100	-	-	<10	<10	<10	<10			
Metals	Arsenic	100	100				23	10	11	3.8	12	10	35	16	12	5.7	16	5.3	6	<5	<5	6		
	Cadmium	20					<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<1	<1	<1	<1		
	Chromium (total)	100	190*				160	78	98	47	73	130	75	140	93	56	86	54	30	20	56	53		
	Chromium (III)						100	-	-	-	-	-	-	130	-	-	-	-	-	-	-	-		
	Chromium (VI)	100	190*				<1	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-		
	Copper	6000	60*				13	9.6	6.2	7.6	7.4	15	7.8	6.1	24	13	24	14	8	6	7	16		
	Lead	300	1100				20	15	12	7.8	18	18	13	14	17	12	18	11	6	8	15	12		
	Nickel	400	30*				13	11	7	11	6.3	20	8.4	8.1	20	21	27	26	4	4	5	9		
PAHs	Mercury	40					<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
	Zinc	7400	70*				16	59	25	9.2	12	12	17	5.9	16	12	22	15	21	7	10	15		
	Benzo (a) pyrene	3		28			-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5			
PAHs (sum)	300					-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5				

Note: * Worst-case added contaminant limit (ACL) only - indicative only.



Centre-Charles
Darwin Uni



Sample ID	Location description	Depth	Type	Asbestos	
				Detection	W/W% (<7mm)
NEPM screening level (HIL A)				Y	0.001
TRENCH_01_01A	Base	1.2	Val	Y	0.022
TRENCH_01_01B	Base	1.2	Val	N	<0.001
TRENCH_01_01C	Base	1.2	Reval (01A, 01B)	Y¹	0.002
TRENCH_01_02	South wall	0.1-1.2	Val	N	<0.001
TRENCH_01_03	Base	1.2	Val	N	<0.001
TRENCH01_04A	South wall	0.1-1.2	Val	N	0.003
TRENCH01_04B	South wall	0.1-1.2	Val	N	<0.001
TRENCH01_04C	South wall	0.1-1.2	Reval (04A, 04B)	N	<0.001
TRENCH01_05A	Base	1.2	Val	N	0.004
TRENCH01_05B	Base	1.2	Val	N	<0.001
TRENCH01_05C	Base	1.2	Reval (05A, 05B)	N	<0.001
TRENCH02_01	Base	1.2	Val	N	<0.001
TRENCH02_02	Western wall	0.1-1.2	Val	N	<0.001
TRENCH02_03	Base	1.2	Val	N	<0.001
TRENCH02_04	Western wall	0.1-1.2	Val	Y²	<0.001
TRENCH02_05	Base	1.2	Val	N	<0.001
TRENCH03_01	Base	1	Val	N	<0.001
TRENCH03_02	Northern wall	0.1-1.2	Val	N	<0.001
TRENCH03_03	Base	1.2	Val	N	<0.001
TRENCH03_04	Northern wall	0.1-1.2	Val	N	<0.001
TRENCH03_05	Base	1.2	Val	N	<0.001

Note: 1 Asbestos present at concentrations less than the laboratory method detection limit of 0.1 g/kg.

LEGEND

- Trench excavation (removal of asbestos fencing)
- Validation samples (trench) - pass
- Validation samples (trench) – residual asbestos at depth (not of concern)



Stockpile ID	Volume (m ³)	Sample ID	Stockpile origin	Asbestos	
				Detection (ACM)	W/W% (AF/FA <7mm)
NEPM screening level (HIL A)				Y	0.001
SP01	11	-	Pre-existing – combined into SP04	-	-
SP03	11	-		-	-
SP04	22.5	SP04_01	Abatement SP01 and SP03	N	<0.001
		SP04_02			<0.001
		SP04_04			<0.001
SP05	27	SP05_1	Trench 1 (centre)	N	<0.001
		SP05_2			<0.001
		SP05_3			<0.001
SP06	13.5	SP06_01	Trench 1 (north-east portion)	N	<0.001
		SP06_02			<0.001
		SP06_03			<0.001
SP07	15	SP07_01	Trench 2	N	<0.001
		SP07_02			<0.001
		SP07_03			<0.001
SP08	16	SP08_1	Trench 3 (north-east portion)	N	<0.001
		SP08_2			<0.001
SP09	36	SP09_01	Trench 3 (central)	N	<0.001
		SP09_02			<0.001
SP10	22	SP10_1	Trench 3 (south-west portion)	N	<0.001
		SP10_2			<0.001
SP11	15	SP11_01	Trench 3 (central)	N	<0.001
		SP11_02			<0.001
		SP11_03			<0.001

LEGEND

- Trench excavation (removal of asbestos fencing)
- Validation samples (trench) - pass
- Stockpiles generated during remediation activities
- Stockpiles contaminated with asbestos



LEGEND

- Trench excavation (removal of asbestos fencing)
- Validation samples (trench) - pass
- Validation samples (trench) – residual asbestos at depth (not of concern)
- Validation samples wider site area – no asbestos

SERVICES

- Live high voltage power line
- Stormwater pipe
- Communications cables
- Exclusion zones (services)

Sample ID	Depth	Type	Asbestos	
			Detection (ACM)	W/W% (<7mm)
NEPM screening level (HIL A)			Y	0.001
VAL_01	Surface	Validation	N	<0.001
VAL_02	Surface	Validation	N	<0.001
VAL_03	Surface	Validation	N	<0.001
VAL_04	Surface	Validation	N	<0.001
VAL_05	Surface	Validation	N	<0.001
VAL_06	Surface	Validation	N	<0.001
VAL_07	Surface	Validation	N	<0.001
VAL_08	Surface	Validation	N	<0.001
VAL_09	Surface	Validation	N	<0.001
VAL_10	Surface	Validation	N	<0.001
VAL_11	Surface	Validation	N	<0.001
VAL_12A	Surface	Validation	N	<0.001
VAL_13	Surface	Validation	N	<0.001
VAL_14	Surface	Validation	N	<0.001

The remedial methodology adopted comprised (Prensa, 2021c):

- Emu pick and visual clearance of the entire site surface by the LARC and competent person; and
- Staged raking and tilling of the soil surface by mechanical and/or manual means (to minimise the potential for ACM breakage) under the direction and supervision of the LARC (spatial extent and depth) and competent person;
 - Dust suppression (application of a water spray) was undertaken for the duration of raking and tilling works to minimise the potential for dust generation and minimise potential inhalation risk.

On completion of the remediation works, validation was undertaken via:

- Visual clearance of the site surface to confirm full ACM removal and absence of residual fragments; and
- Collection of soil validation samples and analysis at a NATA accredited laboratory for AF/ FA presence/absence. Validation samples were collected from areas that were previously, visibly impacted by asbestos across the surface of the site at a rate of approximately 1 sample per 65 m².

9.3 In-situ corrugated ACM sheeting (fence footings)

During remedial works at the site a total of 3 buried ACM fence footings were identified in the western half of the site. The fence footings comprised corrugated ACM sheets broken at surface and left in situ to a maximum depth of 1.2 m bgl.

Fence footings were originally identified by RLC in 2019 during site preparatory works, along the south-eastern boundary, which triggered an asbestos investigation by SLR (SLR, 2021a). The additional two fence footings were identified during remedial activities undertaken by Prensa in 2021 (refer **Table 17**) – specifically, during subsurface excavations to excavate the initial fence footing.

In order to minimise damage to the footings and further contaminate surrounding soils, ACM sheeting was removed as per the following methodology (Prensa, 2021c):

- Careful excavation and exposure of subsurface asbestos material via mechanical excavation and manual digging under the supervision of the LARC and competent person;
- Stockpiling of excavated material adjacent to the fence line and visual assessment for ACM; and
- Removal of ACM by the LARC (wrapping in orange plastic and placement in skip bin for off-site disposal).

Table 17: Summary of Asbestos Remediation Activities

Date	Remedial Activity	Description
24/06/2021	Excavation – Trench01 Spoil – SP11	A 20-T excavator was used to excavate alongside in-situ ACM sheeting along the western portion of the southern boundary. Spoil generated was visually inspected and ACM fragments observed.
25/06/2021	Excavation – Trench01 and Trench02 Spoil – SP05	A 7T excavator was used to further excavate alongside in situ ACM sheeting along the southern boundary. Spoil generated was visually inspected and ACM fragments observed. A second ACM fence footing was observed in the central portion of the site adjacent to Trench01, running south to north.
26/06/2021	Tilling and Emu Picking (north- west)	The north-western portion of the site was tilled to 0.1 m bgl followed by emu-picking of visible ACM by the LARC. A third ACM fence footing was observed along the western boundary. Existing (historic) SP01 and SP03 were abated and stockpiled in the north-west corner of the site.
05/07/2021	Tilling and emu picking of western portion of site	SP11 moved. Stockpile adjacent Trench01 split into two stockpiles SP05 and SP06
06/07/2021	Tilling and emu picking of remainder of site	
07/07/2021	Excavation - Trench 02 Spoil – SP07	A 7T excavator was used to further excavate alongside in situ ACM sheeting along the central portion of the site.
08/07/2021	Excavation - Trench 03 Spoil – SP08, SP09 and SP10	A 7T excavator was used to further excavate alongside in situ ACM sheeting along the western portion of the northern boundary. To confirm the fence was removed in its entirety – trenches were excavated in a gridded pattern across the north-western portion of the site.
09/07/2021	Abatement of SP11 Vehicle decontamination Visual inspection and validation sampling	ACM impacted stockpile SP11 abated onto geofabric adjacent to SP05.

On completion of the remediation works, validation was undertaken via:

- Visual clearance of trench surfaces and surrounding soils to confirm full ACM removal and absence of residual fragments; and
- Collection of validation samples from walls and base of excavations to confirm absence of asbestos fines in residual soils (exposed surfaces).

9.4 Stockpiled soils

During trench excavation (for the removal of fence footings), excavated spoil material was inspected on a bucket-by-bucket basis to assess presence/absence of ACM.

Of the eight stockpiles generated from the trench excavations, three stockpiles were initially, visibly impacted by ACM and required abatement which comprised:

- The systematic transfer (bucket by bucket) of stockpiled material from its original location, to an adjacent area, whereupon it was spread out to allow ACM material to be visually identified and hand-picked from the stockpile.
- As the processed stockpile grew, suspected contaminated material was methodically deposited onto the processed stockpile in such a way that “new” material could be continually inspected by the LARC and competent person.
 - Dust suppression (application of a water spray) was undertaken for the duration of stockpile processing works to minimise the potential for dust generation and minimise potential inhalation risk.

Once soil had been successfully processed, inspected by the site hygienist as “visibly free of ACM” and analytical results confirmed the absence of AF/FA in soil, the stockpile was classified as “clean fill” and a clearance certificate issued to confirm the material was deemed fit for reuse on site or, disposal off-site as clean fill material

9.5 Airborne Fibre Monitoring

Airborne fibre monitoring was undertaken around the site perimeter for the duration of ground disturbance works to confirm no risks to adjacent receptors associated with asbestos fibre release. Air samples were processed through the NATA accredited Prensa laboratory using the PRLAB2003 Asbestos and Synthetic Mineral Fibre (SMF) counting Method. No fibres were detected in air samples collected during the remedial works.

9.6 Off-site disposal

During the remediation activities it is understood a total of 9.08 tonnes of asbestos waste (comprising complete ACM fencing panels and ACM fragments emu-picked from site surface/near surface (following tilling) and stockpiled soils, were removed from the site and disposed to landfill (Shoal Bay Waste Management Facility). No asbestos-contaminated soil was removed from the site during remediation activities.

10 SITE VALIDATION

10.1 General

Once remedial works were complete, the site was validated in accordance with the RAP (Prensa, 2021c). Validation activities comprised a combination of visual clearances (for ACM) by the LARC/hygienist, confirming complete removal of fragments from exposed surfaces/stockpiles and collection of representative samples for AF/FA quantitative analysis.

Sample collection was undertaken in accordance with NEPM (2013) and WA Guidelines 2009 (amended 2021), whereby a specialised 7 mm x 7 mm sieve was used to screen a nominal volume of soil (10L).

A summary of the validation methodologies adopted and validation outcomes are provided in **Sections 10.2 to 10.4** below. Validation sampling locations and results summaries are provided on **Figures 8 to 10**.

10.2 Surface contamination (site wide)

Following the removal of visible ACM via the methodology described in **Section 9.2**, Prensa completed visual clearance inspections of the residual site surface. Once confirmed visually free of ACM, validation samples were collected across the site surface targeting areas formerly visibly impacted by asbestos. A total of 14 surface validation samples were collected across the site (refer **Figure 10**) corresponding to a sample rate of close to 1 per 65 m³. Asbestos was not identified either visually (ACM) or as AF/ FA in validation samples submitted to and analysed by the laboratory.

10.3 Excavations (ACM fence footings)

Following the excavation and removal of ACM sheeting, excavation bases and walls were inspected. Once confirmed visually free of ACM, validation samples were collected at a rate of 1 sample per 10 linear metres (refer **Table 18**). During the validation program, suspected ACM greater than 7mm were identified in samples Trench01_01, Trench01_04 and Trench01_05 triggering the requirement for further excavation and revalidation.

Table 18: Trench Validation and revalidation

	Validation sample	Type	Result	Revalidation sample	Type	Result
TRENCH 01	Trench01_01A	Base	FAIL	Trench01_01C	Base	PASS
	Trench01_01B	Base	PASS			
	Trench01_02	Wall (south)	PASS	-	-	-
	Trench01_03	Base	PASS	-	-	-
	Trench01_04A	Wall (south)	PASS	Trench01_04C	Wall (south)	PASS
	Trench01_04B	Wall (south)	PASS			

	Validation sample	Type	Result	Revalidation sample	Type	Result
	Trench01_05A	Base	PASS	Trench01_05C	Base	PASS
	Trench01_05B	Base	PASS			
TRENCH 02	Trench02_01	Base	PASS	-	-	-
	Trench02_02	Western wall	PASS	-	-	-
	Trench03_03	Base	PASS	-	-	-
	Trench02_04	Western wall	PASS	-	-	-
	Trench02_05	Base	PASS	-	-	-
TRENCH 03	Trench03_01	Base	PASS	-	-	-
	Trench03_02	Northern wall	PASS	-	-	-
	Trench03_03	Base	PASS	-	-	-
	Trench03_04	Northern wall	PASS	-	-	-
	Trench03_05	Base	PASS	-	-	-

Notes:

FAIL: Soil sample containing several fragments of ACM above laboratory LOR. Further excavation and revalidation required.

PASS: Asbestos was present at concentrations less than the laboratory method detection limit of 0.1 g/kg (AS4964). Further excavation and revalidation were completed in all locations, with the exception of Trench02_04 western wall.

PASS: Asbestos was not reported above the adopted remedial criteria.

10.4 Stockpiles

Stockpiles generated during the excavation of ACM fence footings were temporarily stored on geofabric, before undergoing processing, which comprised manual ACM removal during bucket-by-bucket inspection (as per the process detailed in **Section 9.4**).

Once stockpiles were confirmed visually free of ACM, validation samples were collected at a rate of 3 samples per stockpile (based on a volume of 3 samples per 50 m^3) in accordance with NEPM 2013 (and IWRG 702) and analysed for AF/ FA quantification.

The EA notes a total of 6 samples were collected, collectively from SP08, SP09 and SP10 (a combined volume of 74 m^3) as these stockpiles were all sourced from Trench 03 and the material was deemed homogenous. It was therefore deemed appropriate and justifiable to sample the material as one combined volume.

10.5 EA Comments on Validation Program

The EA has reviewed the validation data and considers that the available dataset confirms that remediation of ACM at the site was completed successfully such that CoPCs were not reported at concentrations above applicable assessment criteria in residual site soils.

Specifically, all visible ACM was removed and AF/ FA fibres were not reported at concentrations above the applicable assessment criteria with the exception of one location (Trench01) at 1.2m depth where a residual asbestos concentration of 0.002 w/w % was recorded (**Figure 10**). On review of the laboratories CoA, Prensa (Prensa, 2022) determined that the exceedance was likely attributable to a bonded ACM fragment passing through the 7mm sieve thus not a true representation of AF/FA in the sample.

Further, given the marginal nature of the exceedance and its location (1.2 m bgs), at the base of a trench, beneath proposed landscaping, this minor detect was not deemed to pose a realistic risk to current or future site users.

Based on the validation results reported and the associated discussion, the EA agrees with the findings and therefore considers the site is suitable for the proposed land use.

11 EA BENEFICIAL USE ASSESSMENT

The sections below summarises the EAs assessment of the contamination status of the site, post remediation, and whether it precludes any beneficial use relevant to the site.

11.1 Risks to beneficial uses of land

The site is proposed to be developed into a childcare centre. Consequently, in order to issue the site with a CoEA, the EA must be satisfied the site is suitable for any future land use (refer **Section 7**). A review of the condition of the land (at the time of the completion of the EA) with respect to these beneficial uses is presented in **Table 19** below.

Table 19: Risks to beneficial uses of land – summary

Item	Description	Site suitable?
Maintenance of Ecosystems	Concentrations of CoPCs did not exceed adopted EILs/ESLs for urban residential and public open space.	Y
Human Health	The site was adequately remediated such that CoPCs were not reported at concentrations above applicable assessment criteria in residual site soils. Specifically, all visible ACM was removed and AF/FA fibres were not reported at concentrations above the applicable assessment criteria with the exception of one location (Trench01) at 1.2m depth where an asbestos value of 0.002 w/w % was recorded. On review of the laboratories CoA it was determined that the exceedance was likely attributable to a bonded ACM fragment passing through the 7mm sieve thus not a true representation of AF/FA in the sample. Further, given the marginal, nature of the exceedance and its location (1.2 m bgs), at the base of a trench, beneath proposed landscaping, this minor detect was not deemed to pose a realistic risk to current or future site users.	Y
Buildings and structures	In consideration of the geology and the concentrations of CoPCs present on site, ground conditions are not considered to pose a risk to site structures.	Y

Item	Description	Site suitable?
Aesthetics	Residual soil beneath the site has no aesthetic concerns such as odours or staining and all foreign materials (namely, ACM) were removed from the site during the remediation phase.	Y
Production of food, flora and fibre	Considering the proposed development does not allow for food, flora and fibre production this has not been considered in detail at the site. Nevertheless, soil results are below the adopted EILs and ESLs. It is noted however, this does not indicate that commercially viable yields will be maintained or impacted.	Y

11.2 Risks to beneficial uses of groundwater

As stated in Section 7.4 in the absence of gross soil contamination, known or suspected historic potentially contaminating activities at the site, the likelihood of groundwater contamination was deemed low. Furthermore, the proposed development did not require excavation or other ground disturbance to the depth of the water-table.

Consequently, no groundwater investigation was deemed necessary for the purpose of the development and this aspect was not considered in further detail.

11.3 Risks to beneficial uses of Surface water

As stated in Section 7.5, no surface water bodies are located on the site or in its immediate vicinity (the nearest surface water body is greater than 200 m away) and no evidence of mobile contamination was identified during the initial investigation works.

Consequently, this aspect was not considered in further detail.

11.4 Risks to beneficial uses of air

None of the data collected indicate that this environmental aspect is or was ever being negatively impacted by contamination at the site. Furthermore, the risk to human health or the environment in this scenario was considered secondary to the dispersant and potential inhalation of airborne asbestos fibres/ dust, which is ultimately a factor of land.

The risk of dust generation presented to sensitive receptors was addressed during the remedial activities detailed in Section 9 above and no residual risk, given the absence of asbestos on site, was considered to exist, post remediation and validation.

12 EVALUATION OF QUALITY AND COMPLETENESS

12.1 General

This section of the EA report details the QA/QC procedures and documentation undertaken by the assessor throughout their fieldwork program. This section also provides the EA's

conclusion on the adequacy of the assessor's QA/QC procedures (and whether the data can be relied upon for the purposes of the EA).

As the EA was engaged in 2021, after the initial PSI (Prensa, 2019) and site investigation (SLR, 2021a) had been completed, the EA was only able to review each RAP (incorporating validation/verification sampling requirements) prior to fieldworks being completed by the environmental consultant. Consequently, while the EA did review site investigation reports retrospectively, the evaluation completed below has been completed, primarily, in consideration of the remediation and validation works phase.

12.2 Findings

The findings of the QA/QC review are summarised in **Table 20**.

12.3 Dataset quality assurance

In addition to the field and laboratory QA/QC assessment already undertaken, the EA also considered the following elements (in making a conclusion on whether the data set can be relied upon):

- scope of works undertaken;
- geology (regional anticipated and actual encountered during intrusive works);
- topography (regional anticipated and actual encountered during site inspections); and
- the anticipated CoPC (derived from the desktop site history review) and the actual CoPC encountered during intrusive works.

Based on these considerations, the EA concluded the following:

- the scope of work undertaken was adequate;
- the site-specific geology and topography encountered during the Assessor's field work program (and confirmed during EA site inspections) is in agreement with the anticipated regional conditions;
- the CoPC encountered in soil during the Assessor's field work program were what was anticipated during the desktop site history review; and
- based on this, the data set is considered to be accurate, precise and representative of actual site conditions (and can be relied upon for the purpose of this EA).

Table 20: Quality Assurance and Quality Control Evaluation

Item	Comment	Adequate?
Work Plan	<ul style="list-style-type: none"> A work plan for the PSI (Prensa, 2019) or the supplementary asbestos investigation (SLR, 2021a) was not prepared for Auditor review prior to works being undertaken as the EA was not engaged at this time. <ul style="list-style-type: none"> The EA has since reviewed the scope of work and considers the scope completed appropriately, given additional verification sampling was completed as part of the remediation/validation phase. Two RAPs (SLR [2021b] and Prensa [2021e]) detailing proposed remediation activities and the validation/verification sampling plan were prepared for EA review and were approved prior to commencement of these work phases. 	YES
Data validation	The EA assessed the quality control and quality assurance program proposed and undertaken as part of the works and determined that the data collected can be relied upon.	YES
Qualifications of field staff	Prensa and SLR state that appropriately experienced or “competent” field staff undertook the fieldworks. Furthermore, an LARC was engaged in support of the remediation/validation phase.	YES
Sample preservation	<ul style="list-style-type: none"> Soil samples for asbestos were collected in accordance with relevant guidelines. Soil samples for “other CoPCs” were collected in laboratory supplied containers and transported in a chilled cooler box. 	YES
Laboratories used and COC documentation	<ul style="list-style-type: none"> NATA accredited laboratories were used for the laboratory analysis of soil samples (asbestos and “other CoPCs”) as well as airborne fibre samples. Samples were transported to the laboratories under chain of custody control. 	YES
Laboratory internal QC procedures	<p>Relevant only to “other” CoPCs:</p> <ul style="list-style-type: none"> A brief review of laboratory internal QC procedures was undertaken by the EA (covering such elements as duplicate sample RPD, surrogate sample variation, laboratory control sample recovery, matrix spike sampling density and matrix spike recovery). In summary the internal laboratory QA/QC program is adequate, and the data received by the laboratories can be relied upon. 	YES
Selection of soil investigation locations and sampling density	<ul style="list-style-type: none"> Asbestos: Asbestos sampling was undertaken following a grid-based site walkover of the site to identify ACM contamination on the surface. Given the identification of an asbestos fence along the south-eastern boundary considered to be the source of the ACM, distributed across site surface by earthworks machinery, a targeted sampling strategy was adopted. A total of 32 test-pits were advanced across the site to assess the distribution of asbestos which was deemed appropriate for a site of this size. Other CoPCs: A total of 10 samples were collected across the site for the assessment of other CoPCs. While the assessor notes this number of samples exceeds the Australian Standard minimum requirements for a site 0.3 ha in size; this standard refers to the detection of a hotspot, based on sampling in accordance with a systematic grid pattern; rather than random sampling; the strategy adopted here. However, the EA considers in the absence of any known or suspected potentially contaminating activities at the site and/or evidence of gross contamination; 10 samples is reasonable to assess a site of this size. 	YES

Item	Comment	Adequate?
	<ul style="list-style-type: none"> The validation sampling methodology and frequency was considered suitable to adequately validate residual site surfaces free of AF/FA. 	
Depth of investigation	<ul style="list-style-type: none"> Boreholes and testpits were advanced to a maximum depth of 1 m (a minimum 0.5 m into natural material) Validation samples were either collected at site surface (residual surfaces), or from excavation walls (0.1-0.5 m bgs) and base (1.2 mbgs) 	YES
Soil sampling method	<ul style="list-style-type: none"> Asbestos samples were collected using an appropriate methodology in accordance with WA DoH 2009 (amended in 2021). Soil samples for other CoPCs were also collected from boreholes or testpits during the investigation phase using an appropriate methodology. 	YES
Equipment calibration	A calibrated PID was used to screen for the presence of volatile organic compounds (VOCs) during the PSI phase. Calibration certificates are appended to the PSI (Prensa, 2019)	YES
Equipment decontamination	<p>The Prensa (2019) PSI report does not reference equipment decontamination directly. However, confirms works were undertaken in accordance with relevant technical documents that contain minimum standards for sample collection in this regard.</p> <p>The SLR (2021a) site investigation and Prensa (2022) remediation validation report confirms that sampling equipment was appropriately decontaminated between sample, sample location and prior to leaving the site.</p>	YES
Sample nomenclature	<p>All samples were given appropriate, unique sampling IDs. Boreholes and testpit samples were denoted BH01-BH06 and TP01-TP33 respectively, followed by depth.</p> <p>Validation sample nomenclature varied from stockpile e.g. "SP01", to trench "Trench01" to surface validation "VAL01-VAL14".</p>	YES
Soil logging	Soil logs for boreholes and testpits are provided in the respective assessors reports.	YES
Field screening/ observations	<ul style="list-style-type: none"> Field observations of fill types, soil texture, colour, moisture and PID readings were noted on lithological logs (as relevant). Field observations sections also stated that no visual or olfactory signs of contamination were observed. However, foreign material (ACM fragments at surface/within the soil profile) were recorded where identified. 	YES
Soil sampling depths	Samples were collected at appropriate sampling intervals (near surface, and 0.5 m depth intervals) during the investigation and at appropriate depths in consideration of ACM distribution (base and walls of excavation trenches and/or surface sampling) during the validation phase.	YES
Composites	N/A	YES
Analytical Schedule	Selected soil samples were analysed for a selection of analytes which included: metals, TRH, BTEXN, PAH, OC/OPs and asbestos (presence/absence/ID and quantification).	YES

Item	Comment	Adequate?
	The EA is of the opinion that the analytical program undertaken was generally sufficient to characterise CoPCs at the site and, validate the success (or otherwise) of remedial activities. However, the EA notes that additional analytes including pH, CEC, TOC and Fe would have been recommended, to calculate site specific EILs. These data gaps were not addressed. However, given no exceedances of either the generic EILs or the conservatively adopted “ACLs” were identified for urban residential and public open space land use (with the exception of zinc, in one inter laboratory duplicate), this shortcoming was not considered to be significant.	
QC Rinsate blank	One rinsate was collected and analysed for metals and BTEXN during the PSI (Prensa, 2019). The results were below the LOR and therefore acceptable. A rinsate sample was not collected during the verification works completed by Prensa in 2021. However, decontamination procedures are referenced in the report text. Given no exceedances of any CoPCs were identified, this is not considered to significantly impact the investigation findings.	No but not material
QC Trip Blank	One trip blank was collected and analysed for metals and BTEXN during the PSI (Prensa, 2019). The results were below the LOR and therefore acceptable. A trip blank sample was not collected during the verification works completed by Prensa in 2021. However, given no potential hydrocarbon sources were identified on site and, as BTEXN/ TRH were not reported above laboratory LOR during the initial phase of the investigation, this is not considered to significantly impact the investigation findings.	No but not material
QC field duplicate and split sample collection density	Of the 12 primary samples submitted for analysis during the PSI (Prensa, 2019), one intra-laboratory duplicate sample was analysed, which is sufficient to meet the requirements of AS4482.1 which specifies a minimum of one per 20 primary samples. The EA notes it would have been preferable to also collect and analyse an inter-laboratory duplicate. One intra laboratory duplicate and one inter laboratory duplicate were analysed during the verification sampling campaign in 2021 (Prensa, 2022) which is sufficient to meet the requirements of AS4482.1. Intra and inter laboratory duplicates were not collected for asbestos.	YES
QC field duplicate and split data precision	The QC soil field duplicate RPD results were generally below an RPD of 50% with the exception of total chromium (Prensa, 2019), arsenic, chromium, lead, nickel and zinc (Prensa, 2022). These RPD exceedances were attributed to variation in the fill material and therefore acceptable.	YES
Holding times	All samples were reported to have been received within acceptable holding times.	YES
Laboratories LOR	The assessor reported that the laboratories LOR was less than the adopted investigation criteria for all analytes. The EA notes for asbestos (AF/FA) quantitative a laboratory will notify if asbestos is identified at a concentration below the laboratory method detection limit of 0.1 g/kg. For the purposes of validation, Prensa (2022) adopted a precautionary approach where asbestos was identified in this manner (within trench samples) and undertook further excavation and revalidation in these locations.	YES

12.4 Environmental Auditor conclusion on quality assurance/ quality control and on the reliability of data

In conclusion, the Environmental Auditor is of the opinion that the data set is of sufficient quality and adequately characterises the status of contaminant indicators at the site. As such, the EA considers it can be relied upon for the purposes of this Environmental Audit.

13 AUDIT CONCLUSIONS AND RECOMMENDATIONS

The EA's conclusions on the findings of the Environmental Audit are presented below.

13.1 Environmental Audit Outcome

The EA concludes that the site is suitable for the issue of a Certificate of Environmental Audit (CoEA). A copy of the CoEA is attached to the Executive Summary at the start of this Environmental Audit Report.

The CoEA states that the site is suitable for all beneficial uses associated with:

- parks and reserves;
- agriculture;
- sensitive use (high density);
- sensitive use (other);
- recreation/open space;
- commercial use; and
- industrial use.

13.2 Other related information

In the absence of gross soil contamination, known or suspected historic potentially contaminating activities at the site, the likelihood of groundwater contamination is deemed low. However, as no groundwater investigation was completed as part of these works (deemed necessary), it is recommended, in future anyone proposing to extract groundwater from beneath the site should engage a suitably qualified professional to complete a groundwater investigation (to assess its suitability for a specific use).

14 ENVIRONMENTAL AUDIT LIMITATIONS

This Statement of Environmental Audit has been prepared in accordance with the Environment Protection Amendment Act 2017 [Victoria], and with reference to the repealed Environment Protection Act 1970 (specifically Section 53X), and associated Publication 952.5 (EPA Victoria, 2015b). In preparing this report, Mark Stuckey and the audit team at Environmental Earth Sciences has considered the NT EPA requirements other relevant policies and documents, to provide an opinion on the suitability of the site for unrestricted land use. This has concluded with the preparation of a Certificate of Environmental Audit (provided at the front of this document).

Though the Environmental Auditor has inspected the site and viewed the reports, the Environmental Auditor is not responsible for opinions based on work that is later found to be false or misleading. The Environmental Audit in no way implies that the site will be free from risk but only that risk of harm to relevant receptors caused by the contaminated soil on the site as a whole, will not increase impact on beneficial users of land via the inhalation of asbestos fines.

This Environmental Audit Report has been prepared based on the condition of the land during the period of site audit and limited to the specific scope of this report. As such, the Environmental Auditor is not responsible to changes to the elements by the condition of this site after 25 July 2022.

The Environmental Auditor is not responsible for any change in state of the site from the date of the Environmental Audit Report, and for the compliance by site owners of any laws or regulations relating to the management of the site.

15 LIMITATIONS

This report has been prepared by Environmental Earth Sciences QLD ACN 109 442 284 in response to and subject to the following limitations:

1. The specific instructions received from Ray Laurence Constructions Pty Ltd;
2. The specific scope of works set out in in Section 3 (Scope of Work) of this report;
3. May not be relied upon by any third party not named in this report for any purpose except with the prior written consent of Environmental Earth Sciences QLD (which consent may or may not be given at the discretion of Environmental Earth Sciences QLD);
4. This report comprises the formal report, documentation sections, tables, figures and appendices as referred to in the index to this report and must not be released to any third party or copied in part without all the material included in this report for any reason;
5. The report only relates to the site referred to in the scope of works being located at 77 Lakeside Drive, Brinkin, NT (“the site”);

6. The report relates to the site as at the date of the report as conditions may change thereafter due to natural processes and/or site activities;
7. No warranty or guarantee is made in regard to any other use than as specified in the scope of works and only applies to the depth tested and reported in this report;
8. Fill, soil, groundwater and rock to the depth tested on the site may be fit for the use specified in this report. Unless it is expressly stated in this report, the fill, soil and/or rock may not be suitable for classification as clean fill if deposited off site;
9. This report is not a geotechnical or planning report suitable for planning or zoning purposes; and
10. Our General Limitations set out at the back of the body of this report.

16 REFERENCES

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ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services

The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. It cannot be relied on by any other third party for any purpose except with our prior written consent. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for. However, any party wishing to rely on this report should contact us to determine the suitability of this report for their specific purpose.

Data should not be separated from the report

A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change

Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated, or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Problems with interpretation by others

Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences QLD. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light we reserve the right to alter their conclusions.

Obtain regulatory approval

The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability

This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences QLD disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences QLD disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences QLD's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

APPENDIX A: REGISTERED BORES



RN008467
N.P.A. 181

Requestion 8.

THE NORTHERN TERRITORY OF AUSTRALIA

Control of Waters Ordinance

R.N. 8467.

FINAL STATEMENT OF BORE

I.N. 80/756.

From	To	Description of Strata	Name of Bore -
0m	2.4m	BROWN TOPSOIL.	LEP 74/11.
2.4m	4m.	YELLOW, DRY POWDERY SAND & SMALL STONES. LIGHT YELLOW SAND & CLAY.	Name of Property -
4m	9.3m.	SANDY, CLAYEY TO YELLOW CLAY MATERIAL	CASUARINA
			Description of Property -
			CROWN LAND.
			Name of Owner -
			C OF A.
			Name of Contractor -
			W.R.B.
			Name of Driller -
			W. BUTTERY.
			Date of Commencement -
			9.10.74.
			Date of Completion -
			10.10.74
			Total Depth -
			9.3 metres.
			Particulars of Casing -
			2" PVC 0m - 9.3m.
			Particulars of Perforations or Screens -
			3/8" PERFORATED. 2" PVC 0m - 9.3m.
Location of Bore (or supply sketch on back hereof) -			Water
.....Miles			1st Supply
(a)	N	NE	2nd Supply
	S	SE	3rd Supply
	E	NW	
	W	SW	
of (b) ROCKLANDS RD			Struck at
(SEE SKETCH)			8m.
(a) Circle appropriate direction.			Standing Water Level
(b) Use known point such as existing bore, homestead, outstation, etc.			-
Additional information of interest about the bore -			Pumping Supply : G.P.H.
MOIST MATERIAL BELOW 2m.			-
Samples of strata and water supplies have been* will be* left at the following trading place -			Duration of Pump Test
DARWIN			-
J. VERHOEVEN:			Water Level During Test
Signature			-
*Strike out which does not apply			Quality : Good, Fair or Bad.
For office use only -			GOOD

80/756

Date 9/1/74
Depth (m)

LEP 74/11

14:45 hrs 0-2

Dark brown surface covering
Yellow, dry powdery sand, and small stones
(Sample 0-2m)

2-2.4

Yellow sand (darker in colour). Slightly moist.

2.4-4

Light coloured sand & clay. Small stones
Very moist (Sample 2-4m)

4-5

Yellow clay; sticky and dry, but not crumbly.
Also some decomposed laterite
(Sample 4-5m)

5-6.5

Very muddy clay (light yellow to pink in colour)
Very moist (sweet water taste).
(Sample 5 to 6.5m)

Shut down for day

10/10/74

09:00 hrs 6.5-9.3

Sandy clayey material as before. Quite sticky & saturated.
(Sample 6.5-9.3m)

Struck water approx. 8m (tasted sweet)

Sample bottle N. 9

Temp 81°F

Scale 27 = 750 ppm NaCl

Total depth of hole 9.3m (unable to drill deeper,
as no flights left available).

Casing details 2" P.V.C. perforated from 0-9.3m

Department of the Northern Territory

WATER RESOURCES BRANCH

WATER ANALYSIS
WR4/1

LABORATORY REGISTER No.	74/2254
Date received in laboratory	12/11/74
BOTTLE No.	17
Time of sampling (hrs.)	0940
Date of sampling	7/11/74

LOCATION AND DETAILS

LEE POINT INVESTIGATION HOLE LEP 74/11 RN 8467 IN 80/756

3.5m

ANALYSIS - PHYSICAL

pH		Colour (Hazen units)	
Specific conductance (microsiemens / cm at 25°C)	1074	Turbidity (A.P.H.A. units)	
Total dissolved solids (mg /ℓ - by evaporation at 180°C)		Suspended solids (mg /ℓ)	

ANALYSIS - CHEMICAL (mg /ℓ)

Total dissolved solids (by summation)		Total alkalinity (as Ca CO ₃)	
Sodium chloride (calc. from chloride)	173	Total hardness (as Ca CO ₃)	
Chloride, Cl	105	Sodium, Na	
Sulphate, SO ₄		Potassium, K	
Nitrate, NO ₃		Calcium, Ca	
Bicarbonate, HCO ₃		Iron (total), Fe	
Fluoride, F		Silica, SiO ₂	

ANALYSED BY: M. DOBBE DATE 19 / 11 / 74

REMARKS:

**GUIDELINES TO WATER QUALITY:
1971 WORLD HEALTH ORGANISATION
INTERNATIONAL STANDARDS FOR DRINKING-WATER**

SUBSTANCE OR CHARACTERISTIC	HIGHEST DESIRABLE LEVEL	MAXIMUM PERMISSIBLE LEVEL
Colour (Hazen units)	5	50
Turbidity (A.P.H.A. Units)	5	25
pH range	7.0 to 8.5	6.5 to 9.2
Total dissolved solids (by evaporation at 180°C)	500 mg/l	1500 mg/l
Chloride, Cl	200 mg/l	600 mg/l
Sulphate, SO ₄	200 mg/l	400 mg/l
Calcium, Ca	75 mg/l	200 mg/l
Magnesium, Mg	30 mg/l	150 mg/l
Iron (total), Fe	0.1 mg/l	1.0 mg/l

Note:

IRON gives rise to taste, discolouration, deposits and growth of bacteria, and turbidity.

NITRATES in some circumstances have been shown to present a health hazard to infants and possibly older children when present in concentrations greater than 45 mg/l.

FLUORIDE concentrations in drinking water are recommended according to ranges of the annual average of maximum daily air temperatures. e.g., for range 26.3°C to 32.6°C the recommended limits are, lower 0.6 mg/l F, upper 0.8 mg/l F.

The annual average of maximum daily air temperatures for the following locations are:-

DARWIN 32.4°C — TENNANT CREEK 32.0°C — ALICE SPRINGS 28.3°C

RECOMMENDED LIMITS FOR STOCK WATERS IN THE NORTHERN TERRITORY

SUBSTANCE OR CHARACTERISTIC	LIMIT
pH range	5.5 to 9.0
Total dissolved solids	8000 mg/l
Sodium chloride (calc. from chloride)	Not more than 75% when total dissolved solids near limit
Sulphate, SO ₄	2000 mg/l
Nitrate, NO ₃	400 mg/l
Fluoride, F	5.0 mg/l
Magnesium, Mg	300 mg/l

Note: Stock limits are intended as a guide only

Department of the Northern Territory

WATER RESOURCES BRANCH

WATER ANALYSIS
WR4/1

LABORATORY REGISTER No. 74/2255

Date received in laboratory 12/11/74

BOTTLE No. 18 Time of sampling (hrs.) 0940 Date of sampling 7/11/74

LOCATION AND DETAILS

LEE POINT INVESTIGATION HOLE LEP 74/11 RN 8467 IN 80/756

4.45m

ANALYSIS - PHYSICAL

pH		Colour (Hazen units)	
Specific conductance (microsiemens /cm at 25°C)	903	Turbidity (A.P.H.A. units)	
Total dissolved solids (mg /ℓ - by evaporation at 180°C)		Suspended solids (mg /ℓ)	

ANALYSIS - CHEMICAL (mg /ℓ)

Total dissolved solids (by summation)		Total alkalinity (as Ca CO ₃)	
Sodium chloride (calc. from chloride)	140	Total hardness (as Ca CO ₃)	
Chloride, Cl	85	Sodium, Na	
Sulphate, SO ₄		Potassium, K	
Nitrate, NO ₃		Calcium, Ca	
Bicarbonate, HCO ₃		Iron (total), Fe	
Fluoride, F		Silica, SiO ₂	

ANALYSED BY: M. DOBBE DATE 19 / 11 / 74

REMARKS:

**GUIDELINES TO WATER QUALITY:
1971 WORLD HEALTH ORGANISATION
INTERNATIONAL STANDARDS FOR DRINKING-WATER**

SUBSTANCE OR CHARACTERISTIC	HIGHEST DESIRABLE LEVEL	MAXIMUM PERMISSIBLE LEVEL
Colour (Hazen units)	5	50
Turbidity (A.P.H.A. Units)	5	25
pH range	7.0 to 8.5	6.5 to 9.2
Total dissolved solids (by evaporation at 180°C)	500 mg/l	1500 mg/l
Chloride, Cl	200 mg/l	600 mg/l
Sulphate, SO ₄	200 mg/l	400 mg/l
Calcium, Ca	75 mg/l	200 mg/l
Magnesium, Mg	30 mg/l	150 mg/l
Iron (total), Fe	0.1 mg/l	1.0 mg/l

Note:

IRON gives rise to taste, discolouration, deposits and growth of bacteria, and turbidity.

NITRATES in some circumstances have been shown to present a health hazard to infants and possibly older children when present in concentrations greater than 45 mg/l.

FLUORIDE concentrations in drinking water are recommended according to ranges of the annual average of maximum daily air temperatures. e.g., for range 26.3°C to 32.6°C the recommended limits are, lower 0.6 mg/l F, upper 0.8 mg/l F.

The annual average of maximum daily air temperatures for the following locations are:-

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RECOMMENDED LIMITS FOR STOCK WATERS IN THE NORTHERN TERRITORY

SUBSTANCE OR CHARACTERISTIC	LIMIT
pH range	5.5 to 9.0
Total dissolved solids	8000 mg/l
Sodium chloride (calc. from chloride)	Not more than 75% when total dissolved solids near limit
Sulphate, SO ₄	2000 mg/l
Nitrate, NO ₃	400 mg/l
Fluoride, F	5.0 mg/l
Magnesium, Mg	300 mg/l

Note: Stock limits are intended as a guide only

Department of the Northern Territory

WATER RESOURCES BRANCH

WATER ANALYSIS
WR4/1

LABORATORY REGISTER No.	74/1907
Date received in laboratory	10/10/74
BOTTLE No.	9
Time of sampling (hrs.)	0900
Date of sampling	10/10/74

LOCATION AND DETAILS LEEPOINT INVESTIGATION HOLE LEP 74/11 7.9m

ANALYSIS - PHYSICAL

pH		Colour (Hazen units)	
Specific conductance (microsiemens / cm at 25°C)	1690	Turbidity (A.P.H.A. units)	
Total dissolved solids (mg /ℓ - by evaporation at 180°C)		Suspended solids (mg /ℓ)	

ANALYSIS - CHEMICAL (mg /ℓ)

Total dissolved solids (by summation)		Total alkalinity (as Ca CO ₃)	
Sodium chloride (calc. from chloride)	480	Total hardness (as Ca CO ₃)	
Chloride, Cl	291	Sodium, Na	
Sulphate, SO ₄		Potassium, K	
Nitrate, NO ₃		Calcium, Ca	
Bicarbonate, HCO ₃		Iron (total), Fe	
Fluoride, F		Silica, SiO ₂	

ANALYSED BY: J. E. ALCOCK DATE 18 / 10 / 74

REMARKS:

**GUIDELINES TO WATER QUALITY:
1971 WORLD HEALTH ORGANISATION
INTERNATIONAL STANDARDS FOR DRINKING-WATER**

SUBSTANCE OR CHARACTERISTIC	HIGHEST DESIRABLE LEVEL	MAXIMUM PERMISSIBLE LEVEL
Colour (Hazen units)	5	50
Turbidity (A.P.H.A. Units)	5	25
pH range	7.0 to 8.5	6.5 to 9.2
Total dissolved solids (by evaporation at 180°C)	500 mg/l	1500 mg/l
Chloride, Cl	200 mg/l	600 mg/l
Sulphate, SO ₄	200 mg/l	400 mg/l
Calcium, Ca	75 mg/l	200 mg/l
Magnesium, Mg	30 mg/l	150 mg/l
Iron (total), Fe	0.1 mg/l	1.0 mg/l

Note:

IRON gives rise to taste, discolouration, deposits and growth of bacteria, and turbidity.

NITRATES in some circumstances have been shown to present a health hazard to infants and possibly older children when present in concentrations greater than 45 mg/l.

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RECOMMENDED LIMITS FOR STOCK WATERS IN THE NORTHERN TERRITORY

SUBSTANCE OR CHARACTERISTIC	LIMIT
pH range	5.5 to 9.0
Total dissolved solids	8000 mg/l
Sodium chloride (calc. from chloride)	Not more than 75% when total dissolved solids near limit
Sulphate, SO ₄	2000 mg/l
Nitrate, NO ₃	400 mg/l
Fluoride, F	5.0 mg/l
Magnesium, Mg	300 mg/l

Note: Stock limits are intended as a guide only

DEPARTMENT OF THE NORTHERN TERRITORY
GEOLOGICAL SURVEY

GEOLOGICAL LOG OF WATER BORE

MN 1/21

LEP 74/11

1:250,000 SHEET	R.N. 8467	I.N. 80/756
GRID REFERENCE	LEASE NAME LEE POINT INVESTIGATION	

DEPTH INTERVAL		GEOLOGICAL DESCRIPTION
FROM	TO	

0	2 m	Fine sand with organic detritus.
2	4 m	Sandy coloured clayey sand; angular to sub-angular particles.
4	9.3 m	Fine, white to yellow coloured clay with occasional grit. Colour becoming darker, and grit content increasing with depth. Patches of darker clay formed from decomposed pieces of slate.

Plastic Property Test Results

		L.L. %	P.L. %	P.I. %	L.S. %
0	4 m	N.O.	N.O.	--	0.5
4	5 m	40	26	14	4.5
5	9.3 m	39	31	8	2.5



Regulation 8

THE NORTHERN TERRITORY OF AUSTRALIA

Control of Waters Ordinance

WR4/3

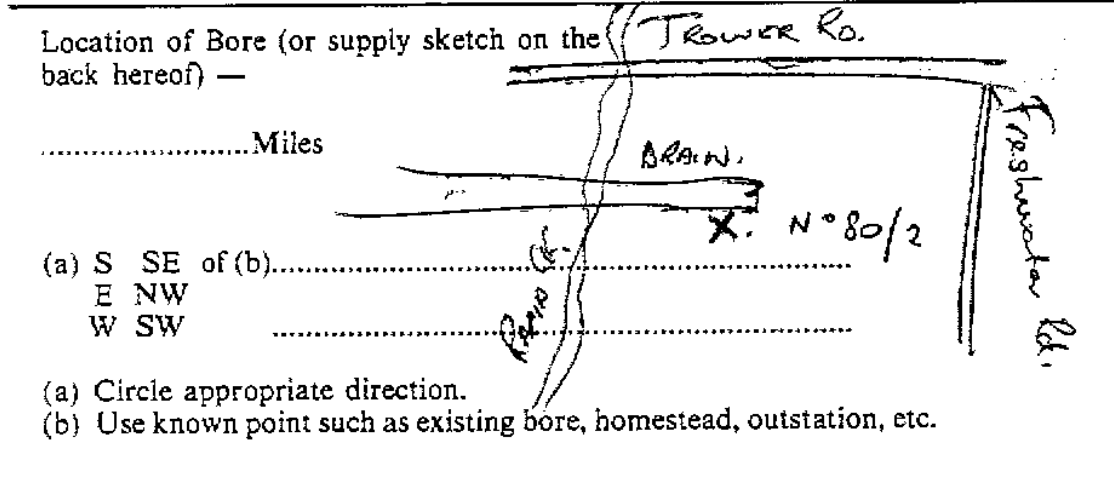
FINAL STATEMENT OF BORE

R.N. 20328

I.N. 80/1565

From	To	Description of Strata
0	1.5	Overburden + Porcellanite fragments
1.5	2.5	GREY + Cream CLAYS + SANDS
2.5	51	Grey MICASCHS. SHALES + QUARTZ

Name of Bore — RAPID CK 80/2
Name of Property — Rapid Creek Recreation Reserve
Description of Property — CROWN LAND
Name of Owner — N.T. GOVERNMENT
Name of Contractor — LEONDRILL P/L
Name of Driller — F. LEONHARDT



Date of Commencement — 11/6/80
Date of Completion — 12/6/80
Total Depth — 51M.

Additional information of interest about bore.

Grid Reference
Map Number
SEE ATTACHED MAP

Samples of Strata and Water Supplies
have been* ~~will be~~

left at the following place —
Bore Inspector

Signature *[Signature]*

*Delete non applicable

Particulars of Casing — 11m x 8" STEEL.			
Particulars of Perforations or Screens —			
Water	1st Supply	2nd Supply	3rd Supply
Struck at	2.5m CASED OFF	25 M	
Standing Water Level		1M.	

For Office use only —

27/6/80 *[Signature]*

Pumping Supply Litres/sec	1/4/5.
Duration of Pump Test	
Water Level During Test	
Quality: Good, Fair or Bad	SALT

WATER ANALYSIS

Department of Transport & Works
Water Division, Darwin NT

WR 4/1

Bottle No.
DH 85

Laboratory Register No. 80/1467

Date received in Laboratory 17.9.80

Time of Sampling Date of Sampling
12.8.80

LOCATION AND DETAILS
Rapid Creek - 80/2 - RN 20328 - AIRLIFT

RSP. 44 (misc.)

Proposed water use: — Domestic, Stock, Irrigation, other (specify)

80/1565

ANALYSIS — PHYSICAL

<input type="checkbox"/> pH	6.9	<input type="checkbox"/> Colour (Hazen units)
<input checked="" type="checkbox"/> Specific conductance (microsiemens/cm at 25° C)	16,000	<input type="checkbox"/> Turbidity (NTU's)
<input type="checkbox"/> Total dissolved solids (mg/l — by evaporation at 180° C)		<input type="checkbox"/> Suspended solids (mg/l)

ANALYSIS — CHEMICAL (mg/l)

<input type="checkbox"/> Sodium, Na		<input checked="" type="checkbox"/> Chloride, Cl	5978
<input type="checkbox"/> Potassium, K		<input type="checkbox"/> Sulphate, SO ₄	
<input type="checkbox"/> Calcium, Ca		<input type="checkbox"/> Nitrate, NO ₃	
<input type="checkbox"/> Magnesium, Mg		<input type="checkbox"/> Bicarbonate, HCO ₃	43
<input checked="" type="checkbox"/> Total Hardness (as CaCO ₃)	2530	<input type="checkbox"/> Carbonate, CO ₃	
<input type="checkbox"/> Total Alkalinity (as CaCO ₃)	35	<input type="checkbox"/> Fluoride, F	
<input type="checkbox"/> Iron, (total) Fe		<input type="checkbox"/> Orthophosphate, PO ₄	
<input type="checkbox"/> Silica, SiO ₂		<input checked="" type="checkbox"/> NaCl (calc. from chloride)	9852

ANALYSIS — ADDITIONAL (mg/l)

<input type="checkbox"/> Copper, Cu	<input type="checkbox"/> Lead, Pb	<input type="checkbox"/> Arsenic, As
<input type="checkbox"/> Manganese, Mn	<input type="checkbox"/> Zinc, Zn	<input type="checkbox"/> Cadmium, Cd

SAMPLE CHANGED TO LIMITED ANALYSIS AS SPECIFIC CONDUCTANCE TOO HIGH.

Analysed By: K. COOPER

Date 29/ 9 / 80

REMARKS

The sample as analysed is considered suitable for:—

Drinking Water — YES/NO NO
Irrigation — YES/NO NO

Stock watering — YES/NO NO
Other (specify) — YES/NO

Boxes marked thus indicate levels considered undesirable for drinking water by the Northern Territory Department of Health.

Note. — Advice and Water quality information can be obtained by contacting the Senior Engineer Water Quality, Darwin, Phone 89 6072.

1565

RECORDED LEVEL OF BORES - NORTHERN SUBURBS AREA

BORE NO.		REDUCED LEVEL
20328	4.239	Ground Level
	5.068	Top of Casing
20329	7.025	Ground Level
	7.118	Top of Cover
20330	4.054	Top of Cover
	4.054	Ground Level
20634	6.808	Ground Level
	6.989	Top of Concrete Base
	7.537	Top of 125mm Casing
	7.272	Top of 200mm Casing
	3.102	Zero on Gauge on Rapid Creek
20326	8.497	Ground Level
	8.950	Top of Cover
20544	10.287	Ground Level
	10.727	Top of Cover
20331	17.693	Ground Level
	18.241	Top of Cover
20562	17.443	Ground Level
	17.572	Top of Concrete Base
20563	15.632	Ground Level
20564	26.168	Ground Level
	26.395	Top of Cover
20773	26.154	Ground Level
	26.343	Top of P.V.C. Insert
	26.381	Top of 200mm Casing
20771	20.340	Ground Level
	20.558	Top of Concrete Base
	20.870	Top of Cover
20543	36.478	Ground Level
	36.906	Top of P.V.C. Insert
	36.614	Top of 200mm Casing
20635	24.073	Ground Level
	24.073	Top of Concrete Base
	24.37	Top of 200mm Casing

.../2

2.

20751	24.127	Ground Level
	24.378	Top of P.V.C. Insert
	24.417	Top of Casing

20752	24.334	Ground Level
	24.506	Top of P.V.C. Insert
	24.715	Top of 200mm casing.

WATER ANALYSIS

Department of Transport & Works
Water Division, Darwin NT

WR 4/1

Bottle No.
DM 15

Laboratory Register No. 80/1411

Date received in Laboratory 17.9.80

Time of Sampling Date of Sampling
12.6.80

LOCATION AND DETAILS
Rapid Creek - 2/80 - RN 20328 - AIRLIFT - RSP. 44 (misc.)

Proposed water use:— Domestic, Stock, Irrigation, other (specify)

ANALYSIS — PHYSICAL *80/1565*

<input type="checkbox"/> pH	7.2	<input type="checkbox"/> Colour (Hazen units)
<input type="checkbox"/> Specific conductance (microsiemens/cm at 25° C)	16,130	<input type="checkbox"/> Turbidity (NTU's)
<input type="checkbox"/> Total dissolved solids (mg/l — by evaporation at 180° C)		<input type="checkbox"/> Suspended solids (mg/l)

ANALYSIS — CHEMICAL (mg/l)

<input type="checkbox"/> Sodium, Na	<input checked="" type="checkbox"/> Chloride, Cl	5,880
<input type="checkbox"/> Potassium, K	<input type="checkbox"/> Sulphate, SO ₄	
<input type="checkbox"/> Calcium, Ca	<input type="checkbox"/> Nitrate, NO ₃	
<input type="checkbox"/> Magnesium, Mg	<input type="checkbox"/> Bicarbonate, HCO ₃	43
<input checked="" type="checkbox"/> Total Hardness (as CaCO ₃)	<input type="checkbox"/> Carbonate, CO ₃	2,470
<input type="checkbox"/> Total Alkalinity (as CaCO ₃)	<input type="checkbox"/> Fluoride, F	35
<input type="checkbox"/> Iron, (total) Fe	<input type="checkbox"/> Orthophosphate, PO ₄	
<input type="checkbox"/> Silica, SiO ₂	<input checked="" type="checkbox"/> NaCl (calc. from chloride)	9,690

ANALYSIS — ADDITIONAL (mg/l)

<input type="checkbox"/> Copper, Cu	<input type="checkbox"/> Lead, Pb	<input type="checkbox"/> Arsenic, As
<input type="checkbox"/> Manganese, Mn	<input type="checkbox"/> Zinc, Zn	<input type="checkbox"/> Cadmium, Cd

SAMPLE CHANGED TO LIMITED ANALYSIS AS SPECIFIC CONDUCTANCE TOO HIGH.

Analysed By: K. COOPER

Date 29/ 9 / 80

REMARKS

The sample as analysed is considered suitable for:—

Drinking Water	— <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Stock watering	— <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
Irrigation	— <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Other (specify)	— <input type="checkbox"/> YES <input type="checkbox"/> NO

Boxes marked thus indicate levels considered undesirable for drinking water by the Northern Territory Department of Health.

Note:— Advice and Water quality information can be obtained by contacting the Senior Engineer Water Quality, Darwin Phone 89 6072.

WATER ANALYSIS

Department of Transport & Works
Water Division, Darwin NT

WR 4/1

Bottle No.
DS 30

Laboratory Register No. 80/1410

Date received in Laboratory 17.9.80

Time of Sampling Date of Sampling 12.6.80

LOCATION AND DETAILS
Rapid Creek - 2/80 - RN 20328 - airlift

RSP. 44 (misc.)

Proposed water use:— Domestic, Stock, Irrigation, other (specify)

ANALYSIS — PHYSICAL

80/1565

<input type="checkbox"/> pH	7.4	<input type="checkbox"/> Colour (Hazen units)
<input type="checkbox"/> Specific conductance (microsiemens/cm at 25° C)	29,800	<input type="checkbox"/> Turbidity (NTU's)
<input type="checkbox"/> Total dissolved solids (mg/l — by evaporation at 180° C)		<input type="checkbox"/> Suspended solids (mg/l)

ANALYSIS — CHEMICAL (mg/l)

<input type="checkbox"/> Sodium, Na		<input checked="" type="checkbox"/> Chloride, Cl	12,397
<input type="checkbox"/> Potassium, K		<input type="checkbox"/> Sulphate, SO ₄	
<input type="checkbox"/> Calcium, Ca		<input type="checkbox"/> Nitrate, NO ₃	
<input type="checkbox"/> Magnesium, Mg		<input type="checkbox"/> Bicarbonate, HCO ₃	88
<input checked="" type="checkbox"/> Total Hardness (as CaCO ₃)	4,540	<input type="checkbox"/> Carbonate, CO ₃	
<input type="checkbox"/> Total Alkalinity (as CaCO ₃)	72	<input type="checkbox"/> Fluoride, F	
<input type="checkbox"/> Iron, (total) Fe		<input type="checkbox"/> Orthophosphate, PO ₄	
<input type="checkbox"/> Silica, SiO ₂		<input checked="" type="checkbox"/> NaCl (calc. from chloride)	20,430

ANALYSIS — ADDITIONAL (mg/l)

<input type="checkbox"/> Copper, Cu	<input type="checkbox"/> Lead, Pb	<input type="checkbox"/> Arsenic, As
<input type="checkbox"/> Manganese, Mn	<input type="checkbox"/> Zinc, Zn	<input type="checkbox"/> Cadmium, Cd

SAMPLE CHANGED TO LIMITED ANALYSIS AS SPECIFIC CONDUCTANCE TOO HIGH.

Analysed By: K. COOPER

Date 29 / 9 / 80

REMARKS

The sample as analysed is considered suitable for:—

Drinking Water — YES NO Stock watering — YES NO
Irrigation — YES NO Other (specify) — YES NO

Boxes marked thus indicate levels considered undesirable for drinking water by the Northern Territory Department of Health.

Note:— Advice and Water quality information can be obtained by contacting the Senior Engineer Water Quality, Darwin Phone 89 6072.

WATER ANALYSIS

Department of Transport & Works
Water Division, Darwin NT

WR 4/1

Bottle No.
DE 16

Laboratory Register No. 80/1409

Date received in Laboratory 17.9.80

Time of Sampling Date of Sampling 12.6.80

LOCATION AND DETAILS
Rapid Creek - 2/80 - RN 20328 - airlift

RSP. 44 (misc.)

Proposed water use: — Domestic, Stock, Irrigation, other (specify)

ANALYSIS — PHYSICAL

80/1565

pH 7.3 Colour (Hazen units)
 Specific conductance (microsiemens/cm at 25° C) 32,000 Turbidity (NTU's)
 Total dissolved solids (mg/l — by evaporation at 180° C) Suspended solids (mg/l)

ANALYSIS — CHEMICAL (mg/l)

Sodium, Na Chloride, Cl 12,642
 Potassium, K Sulphate, SO₄
 Calcium, Ca Nitrate, NO₃
 Magnesium, Mg Bicarbonate, HCO₃ 88
 Total Hardness (as CaCO₃) 4800 Carbonate, CO₃
 Total Alkalinity (as CaCO₃) 72 Fluoride, F
 Iron, (total) Fe Orthophosphate, PO₄
 Silica, SiO₂ NaCl (calc. from chloride) 20,834

ANALYSIS — ADDITIONAL (mg/l)

Copper, Cu Lead, Pb Arsenic, As
 Manganese, Mn Zinc, Zn Cadmium, Cd

SAMPLE CHANGED TO LIMITED ANALYSIS AS SPECIFIC CONDUCTANCE TOO HIGH.

Analysed By: K. COOPER

Date 29 / 9 / 80

REMARKS

The sample as analysed is considered suitable for:—

Drinking Water — YES/NO

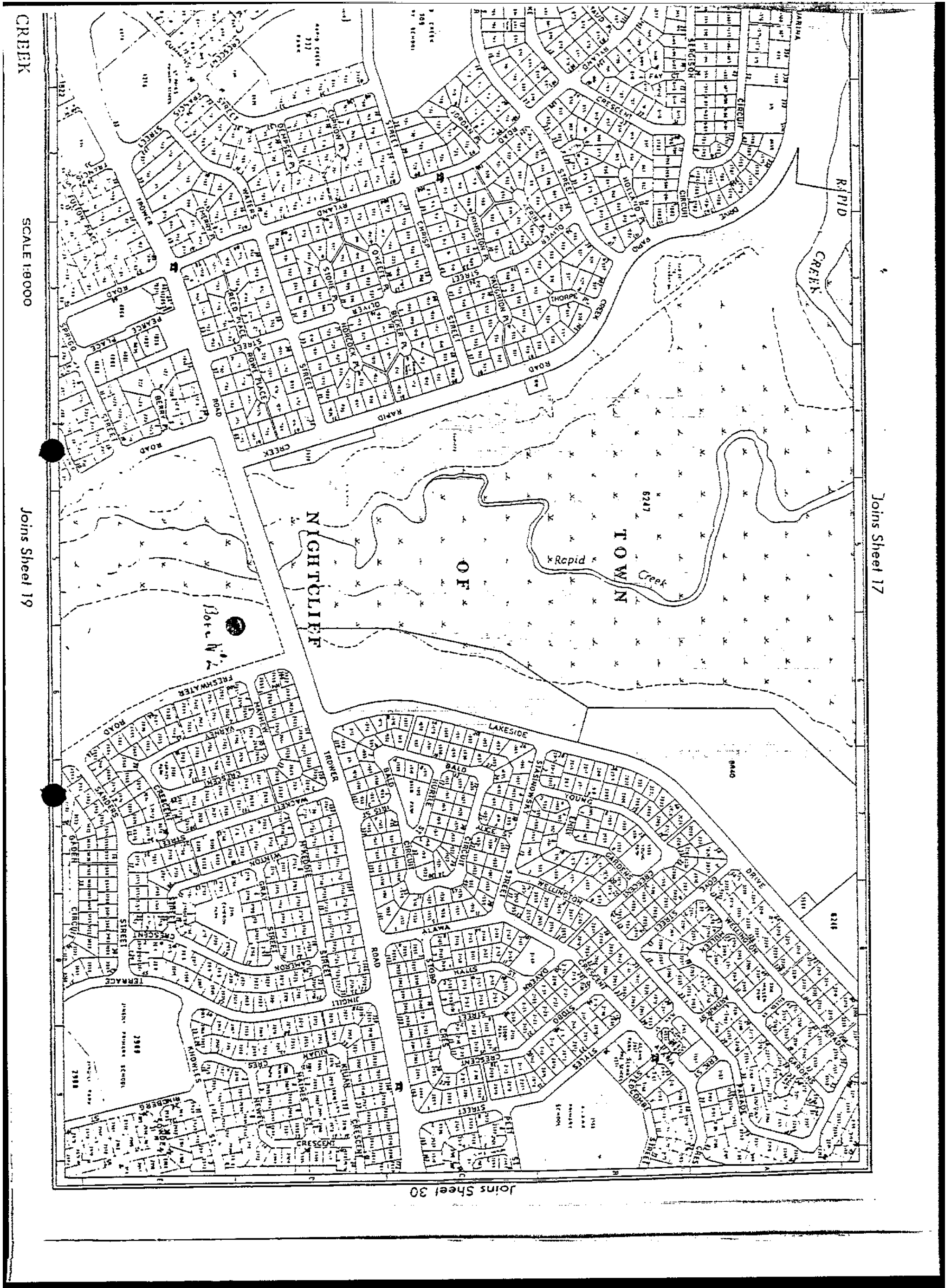
Stock watering — YES/NO

Irrigation — YES/NO

Other (specify) — YES/NO

Boxes marked thus indicate levels considered undesirable for drinking water by the Northern Territory Department of Health.

Note: — Advice and Water quality information can be obtained by contacting the Senior Engineer Water Quality, Darwin Phone 89 6072.



DEPARTMENT OF THE NORTHERN TERRITORY
GEOLOGICAL SURVEY

GEOLOGICAL LOG OF WATER BORE

MN 1/21

1:250,000 SHEET	R.N. <u>20328</u>	I.N.
GRID REFERENCE	LEASE NAME	

DEPTH INTERVAL		GEOLOGICAL DESCRIPTION
FROM	TO	
0	3	Pale reddish brown clay, some poorly sorted qtz grains and conspicuous muscovite frags
3	6	Yellowish → less muscovite (pale red clay (argillaceous))
6	9	Multicoloured yellowish-brown gritty clay qtz to 20-25% rounded clear poorly sorted, ^{gen} 0.5mm muscovite frags common
9	12	Dk yellowish brown clay and common black earthy clay (mno?) can obs. rounded muscovite pebbles to 1cm across <u>base of K.</u>
12	15	reddish grey clay with obs chips of ^{qtz} 2mm, phylite canalysed chloritoid (chlorite). as large grains as obs very fine black grains canalysed finely qtz ^{gen} 20-25mm, when crushed in dark yellowish green probably chlorite → (+ pyrite and feldspar) frags. rounded clear qtz < 0.5mm common → ? ss + bed No change
15	18	

10-21 phyllite sst. med lt grey.
 qtz ~~30-60%~~ 50-60% redol, clay to slightly sandy, sub-angled
 size 0.5 to 10 um diam sst
 fine phyllite & fangs 40-50% (biot, musc and fine qtz)
 Some redol black soft green finely qtz varred
 sst crusts dk green - prob chlorite
 separates a med bedded phyll sst -> probably
 q'wke - fine white clay - after fangs
 to pyrite (very fine)

mass show
 bedding
 variance
 % of biot/musc c.

21-24 its alone

27-30 its alone

33-36 its alone - less phyllite material
 coarse grained. to 3 um diam
 to pyrite

41-45 its alone

48-51m
 sub-bedded quite + phyllite.
 q'wke -
 med grey phyllite and arg. sst. - phyllite con biot + musc + sst size qtz, fine
 white clay 30-40% of sst as clay qtz sub-angled to sub-gular
 20.1m to 5m. mainly in a context of phyllite material - i.e. q'wke,
 to chlorite.

NORTHERN TERRITORY DEPARTMENT OF MINES AND ENERGY
GEOLOGICAL LOGS OF WATER BORE

1:250 000 SHEET : _____ R.N. : 20328 I.N. : _____
1:100 000 SHEET : _____ GRID REFERENCE : _____

LEASE NAME : _____

GEOLOGICAL DESCRIPTION

DEPTH INTERVAL
FROM - TO

LITHOLOGY

0 - 3 m	Pale reddish brown clay, some poorly sorted quartz grains conspicuous limonite fragments.
3 - 6 m	Pale red clay - as above, less limonite.
6 - 9 m	Gritty clay, multicolored yellows and browns quartz rounded, clear, poorly sorted, generally less than 0.5mm in diameter 20-25%. Limonite fragments common.
9 - 12 m	Dark yellowish brown clay and common black earthy clay (MnO). Abundant rounded limonite pebbles to 1cm - Base of Cretaceous.
12 - 15 m	Medium dark grey clay with abundant small chips of muscovite and biotite phyllite commonly chloritised. Abundant fine black grains, very finely sevicite veined - dark green chlorite when crushed. Feldspar visible under polarising microscope - (Amphibole, Pyroxene, alteration). Trace of pyrite, rounded clear quartz less than 0.5mm common - ?originating from sandstone bed. Block earthy clay is common (?part of regolith).
15 - 18 m	As above - no black clay.
18 - 21 m	Medium light grey phyllite sandstone and phyllite quartz 50-60% of sandstone, clear to slightly smokey subrounded, generally 0.5 to 2.0mm in diameter. Small phyllite fragments 40-50% of sample composed of biotite and muscovite in white to clear siltsize quartz matrix and white clay. Some chlorite banding of micas evident. Chlorite as for 12-15m. Trace of pyrite - sample represents mica banded phyllite and greywecke; with white clay often ?feldspar. Trace of pyrite.
21 - 51 m	As above.

STRATIGRAPHY :

ORIGINALLY LOGGED BY : _____
DATE : _____

RELOGGED BY : Barry Pietsch

THE NORTHERN TERRITORY OF AUSTRALIA
Control of Water Act



RN027850*

FINAL STATEMENT OF BORE

NAME OF OWNER : <i>N.T.U. AQUACULTURE</i>				REGISTRATION No : <i>27850</i>			
NAME OF BORE :				INDEX/MAP No : <i>89/4273</i>			
INTENDED USE : <i>PRODUCTION.</i>				ADVICE No :			
LOCATION : <i>N.T.U</i>				PERMIT No :			

From	To	Particulars of strata	Name of Contractor <i>W.R.B / P.A.W.A.</i>			
<i>0m</i>	<i>18.60m</i>	<i>CLAY'S - MIXED COLOURID.</i>	Name of Driller <i>J McMASTERS</i>			
<i>18.60m</i>	<i>54.60m</i>	<i>GARY SILTSTONE / SHALE INTERBEDDED FORMATION WITH SOME S/SSTONE</i>	Date Commenced <i>1/10/91</i>			
			Date Completed <i>2/10/91</i>			
			Depth Drilled (m) <i>54.60</i>			
			Completion Depth (m) <i>54.30</i>			
METHOD OF DRILLING						
<input checked="" type="checkbox"/> Rot. <input type="checkbox"/> Rev. Circ. <input type="checkbox"/> Cable <input type="checkbox"/> Others						
HOLE DIAMETER						DRILLING FLUID
From	To	Diameter	Type			
<i>0m</i>	<i>5.60m</i>	<i>254mm</i>	<i>AIR</i>			
<i>5.60</i>	<i>54.60m</i>	<i>200.2mm</i>	<i>AIR</i>			

PARTICULARS OF CASING				PARTICULARS OF PERFORATIONS OR SCREEN STRINGS				
From	To	Diam (ID)	Type	From	To	Diam (ID)	Aperture	Type
<i>0</i>	<i>2.00m</i>	<i>203.2"</i>	<i>FIBREGLASS</i>	<i>36.30</i>	<i>48.30</i>	<i>150mm</i>	<i>SLOTTED</i>	<i>CLASS 9 P.V.C.</i>
<i>0m</i>	<i>36.30</i>	<i>150mm</i>	<i>CLASS 9 P.V.C.</i>					
<i>48.30</i>	<i>54.30</i>	<i>150mm</i>	<i>CLASS 9 P.V.C.</i>					

Casing Suspended <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		TOP OF PACKER SET AT : (m)	
Method :		LENGTH OF PACKER : (m)	
Casing above GL : <i>.65m x 150mm .15m x 200.2mm</i> (m)		METHOD OF PACKER CONNECTION :	

CEMENTING/GRAVEL PACKING			AQUIFERS (Water Bearing Strata)								
From	To	Type	Depth (m) From	To	Yield (L/s)	SWL (m)	Duration (Hr)	Quality	SC	pH	Bottle No.
<i>5.00m</i>	<i>54.30m</i>	<i>GRAVEL</i>	<i>18.60m</i>	<i>24.60m</i>	<i>SERRAVAL</i>			<i>SALT</i>	<i>22300</i>		
<i>0m</i>	<i>5.00m</i>	<i>CEMENT</i>	<i>24.60m</i>	<i>30.60m</i>	<i>0.5</i>			<i>"</i>	<i>22000</i>		
			<i>30.60m</i>	<i>36.60m</i>	<i>1</i>			<i>"</i>	<i>35400</i>		
			<i>36.60m</i>	<i>42.60m</i>	<i>2-2.5</i>			<i>"</i>	<i>44900</i>		
			<i>43.60m</i>	<i>45.60m</i>	<i>2</i>			<i>"</i>	<i>49500</i>		<i>PO 83 RF 77</i>

STRATA AND WATER SAMPLES		Completion Yield : <i>2.15</i> (L/s) Method : <i>AIR</i> Duration : <i>30 mins.</i>	
<input checked="" type="checkbox"/> Have been <input type="checkbox"/> Will be Left at : <i>2 1/2 MILE DEPOT</i>		Completion SWL : <i>5.00m</i> (m) Depth Lift : <i>36.00m</i> (m)	

LOCATION SKETCH OF BORE <div style="text-align: center;"> N </div>	LOCATION DESCRIPTION OF BORE m/Km <input type="checkbox"/> E <input type="checkbox"/> S <input type="checkbox"/> SE <input type="checkbox"/> NE <input type="checkbox"/> W <input type="checkbox"/> N <input type="checkbox"/> SW <input type="checkbox"/> NW OF : _____ _____ _____	
FINAL CONSTRUCTION STATUS <input type="checkbox"/> Capped <input type="checkbox"/> Casing pulled <input type="checkbox"/> Left for Observation <input type="checkbox"/> Abandoned <input type="checkbox"/> Equipped <input type="checkbox"/> Backfilled <input type="checkbox"/> Others ()		
ADDITIONAL INFORMATION OF BORE <div style="display: flex; justify-content: space-between;"> Signature of Licenced Driller Date / / </div>		
* FOR OFFICIAL USE ONLY		
HOW LOCATED : <input type="checkbox"/> GPS <input type="checkbox"/> TST <input type="checkbox"/> SURVEY <input checked="" type="checkbox"/> HAND PLOTTED <input type="checkbox"/> OTHER ()		
ELEVATION OF BORE AHD : (m) From <input type="checkbox"/> GL <input type="checkbox"/> TOC		
DESCRIPTION OF PROPERTY <input type="checkbox"/> Rural <input type="checkbox"/> VCL <input type="checkbox"/> Min <input type="checkbox"/> Pastoral <input type="checkbox"/> Reserve <input type="checkbox"/> SPL <input type="checkbox"/> EL <input checked="" type="checkbox"/> Other Lease No : Lot No : Hundred of : Portion No : <u>9198</u> Sect. No : Town of :		
CLASS OF BORE <input type="checkbox"/> TOWN <input type="checkbox"/> DOM <input type="checkbox"/> AGR <input type="checkbox"/> MIN <input type="checkbox"/> COMM <input type="checkbox"/> PAS <input checked="" type="checkbox"/> OTHER		
USE OF BORE <input type="checkbox"/> INV. <input checked="" type="checkbox"/> PROD. <input type="checkbox"/> OBS. <input type="checkbox"/> MON. <input type="checkbox"/> IRR. <input type="checkbox"/> EXC. <input type="checkbox"/> R/H <input type="checkbox"/> ROAD		
GRID REFERENCE <input checked="" type="checkbox"/> AMG <input type="checkbox"/> CLARKE Zone : <u>52</u> Scale : 1: <u>10,000</u>		
EASTING : <u>702725</u> NORTHING : <u>8631555</u>	LATITUDE : LONGITUDE :	MAP NAME : <u>DARWIN</u> MAP NUMBER : <u>08-07</u>
AWRC STREAM BASIN No : <u>815</u> TECTONIC UNIT NAME :		
GEOPHYSICAL LOG RUN YES / NO Date : / / Depth : (m) <input type="checkbox"/> Gamma <input type="checkbox"/> SP <input type="checkbox"/> Camera <input type="checkbox"/> Density <input type="checkbox"/> Point Res. <input type="checkbox"/> Caliper <input type="checkbox"/> Other ()		
Date Registered : <u>17 12 91</u> Plotted on the map : Yes / No		
Officer : <u>S. CLARKE</u> Signature :		
Remarks :		

	G.P.O. Box 1096, Darwin N.T. 0801 Telephone: (089) 82 6413 Facsimile: (089) 82 6410		Bottle No.: C	Lab Register No.: 94-95 0475
	Date Received in Lab: 2/11/94	Time Sampled:	Date Sampled: 26/10/94	
R/N No.: 27850	Depth (m):	Q:	Map:	Sampler:
G.S. No.:	G.H. (m):	Q:	G.R.:	
Location: N.T.U. RAW WATER AFTER AERATION			Field Temp °C:	Field pH:
			RSP: 44	Project No.: 48102D000006953

ANALYSIS - PHYSICAL

<input type="checkbox"/> pH [4500-H+B]	7.8	<input type="checkbox"/> Colour (Hazen units) [2120B]	
<input type="checkbox"/> Electrical conductivity (microsiemens/cm at 25°C) [2510B]	50,000	<input type="checkbox"/> Turbidity (NTU's) [2130B]	
<input checked="" type="checkbox"/> Total dissolved solids (mg L ⁻¹ - dried at 180°C) [2540C]	36,060	<input type="checkbox"/> Suspended solids (mg L ⁻¹) [2540D]	

ANALYSIS - CHEMICAL (mg L⁻¹)

<input checked="" type="checkbox"/> Sodium, Na [3111B]	10,700	<input checked="" type="checkbox"/> Chloride, Cl [4500-Cl ⁻ B]	20,000
<input type="checkbox"/> Potassium, K [3111B]	339	<input checked="" type="checkbox"/> Sulphate, SO ₄ [G]	2850
<input type="checkbox"/> Calcium, Ca [3111D]	447	<input type="checkbox"/> Nitrate, NO ₃ [4500-NO ₃ ⁻ B]	3
<input type="checkbox"/> Magnesium, Mg [3111B]	1349	<input type="checkbox"/> Bicarbonate, HCO ₃ [2320B]	112
<input type="checkbox"/> Iron, (total) Fe [3111B]	0.3	<input type="checkbox"/> Carbonate, CO ₃ [2320B]	<1
<input checked="" type="checkbox"/> Total Hardness (as CaCO ₃) Calculation [2340B]	6671	<input type="checkbox"/> Hydroxide, OH [2320B]	<1
<input type="checkbox"/> Total Hardness (as CaCO ₃) Titration [2340C]		<input type="checkbox"/> Fluoride, F [4500-F ⁻ C]	0.1
<input type="checkbox"/> Total Alkalinity (as CaCO ₃) [2320B]	92	<input type="checkbox"/> NaCl (calc. from chloride)	32,960
<input type="checkbox"/> Silica, SiO ₂ [4500-Si D]	15	<input type="checkbox"/> Dissolved Oxygen [4500-O-C]	

ANALYSIS - ADDITIONAL (mg L⁻¹)

<input type="checkbox"/> Copper, Cu [3111B]	<input type="checkbox"/> Manganese, Mn [3111B]	<input type="checkbox"/> Zinc, Zn [3111B]
<input type="checkbox"/> Lead, Pb [3111B]	<input type="checkbox"/> Nickel, Ni [3111B]	<input type="checkbox"/> Cobalt, Co [3111B]

- ❖ U/S DENOTES UNSUITABLE FOR ANALYSIS
- ❖ I/S DENOTES INSUFFICIENT SAMPLE
- ❖ F DENOTES FILTRATE ANALYSIS
- ❖ T DENOTES TOTAL ANALYSIS

This report relates specifically to the "sample tested as received".


The test methods used (denoted within brackets) refer to the 1992 18th edition of "Standard Methods for the examination of Water and Wastewater", A.P.H.A. Except [G] which refers to the method of R. Goguel, Anal. Chem. 1969, 41. 1034.

DATE: 25 NOV 1994

CHECKED: *[Signature]*

SIGNATORY: *[Signature]*

- Boxes marked thus indicate:
- Levels are within the limits as quoted in the "Guidelines for Drinking Water Quality in Australia". 1987 N.H. & M.R.C. and the A.W.R.C.
 - Levels exceed non-health related limits.
 - Levels exceed health related limits

 <p>POWER AND WATER AUTHORITY WATER RESOURCES</p>		G.P.O. Box 1096, Darwin N.T. 0801 Telephone: (089) 82 5413 Facsimile: (089) 82 6410		Bottle No.: A		Lab Register No.: 94-95 0477	
WATER CHEMISTRY LABORATORY		Date Received in Lab: 2/11/94		Time Sampled:		Date Sampled: 26/10/94	
R/N No.: 27850		Depth (m):		Q:		Map:	
G.S. No.:		G.H. (m):		Q:		G.R.:	
Location: N.T. University		Field Temp °C:		Field pH:		Field Cond µS/cm ¹ :	
		RSP: 44		Project No.: 481020000001953			

ANALYSIS - PHYSICAL

<input checked="" type="checkbox"/> pH	[4500-H ⁺ B]	6.2	<input type="checkbox"/> Colour (Hazen units)	[2120B]	
<input type="checkbox"/> Electrical conductivity (microsiemens/cm at 25°C)	[2510B]	72,200	<input type="checkbox"/> Turbidity (NTU's)	[2130B]	
<input checked="" type="checkbox"/> Total dissolved solids (mg L ⁻¹ - dried at 180° C)	[2540C]	54,800	<input type="checkbox"/> Suspended solids (mg L ⁻¹)	[2540D]	

ANALYSIS - CHEMICAL (mg L⁻¹)

<input checked="" type="checkbox"/> Sodium, Na	[3111B]	16,400	<input checked="" type="checkbox"/> Chloride, Cl	[4500-Cl ⁻ B]	30,250
<input type="checkbox"/> Potassium, K	[3111B]	514	<input checked="" type="checkbox"/> Sulphate, SO ₄	[G]	4,800
<input type="checkbox"/> Calcium, Ca	[3111D]	689	<input type="checkbox"/> Nitrate, NO ₃ ⁻	[4500-NO ₃ ⁻ B]	3
<input type="checkbox"/> Magnesium, Mg	[3111B]	2059	<input type="checkbox"/> Bicarbonate, HCO ₃ ⁻	[2320B]	160
<input checked="" type="checkbox"/> Iron, (total) Fe	[3111B]	20	<input type="checkbox"/> Carbonate, CO ₃ ⁻	[2320B]	<1
<input checked="" type="checkbox"/> Total Hardness (as CaCO ₃) Calculation	[2340B]	10,200	<input type="checkbox"/> Hydroxide, OH ⁻	[2320B]	<1
<input type="checkbox"/> Total Hardness (as CaCO ₃) Titration	[2340C]		<input type="checkbox"/> Fluoride, F ⁻	[4500-F ⁻ C]	0.1
<input type="checkbox"/> Total Alkalinity (as CaCO ₃)	[2320B]	131	<input type="checkbox"/> NaCl (calc. from chloride)		49,852
<input type="checkbox"/> Silica, SiO ₂	[4500-Si D]	20	<input type="checkbox"/> Dissolved Oxygen	[4500-O-C]	

ANALYSIS - ADDITIONAL (mg L⁻¹)

<input type="checkbox"/> Copper, Cu	[3111B]		<input type="checkbox"/> Manganese, Mn	[3111B]		<input type="checkbox"/> Zinc, Zn	[3111B]	
<input type="checkbox"/> Lead, Pb	[3111B]		<input type="checkbox"/> Nickel, Ni	[3111B]		<input type="checkbox"/> Cobalt, Co	[3111B]	

- ❖ U/S DENOTES UNSUITABLE FOR ANALYSIS
- ❖ I/S DENOTES INSUFFICIENT SAMPLE
- ❖ F DENOTES FILTRATE ANALYSIS
- ❖ T DENOTES TOTAL ANALYSIS

This report relates specifically to the "sample tested as received".

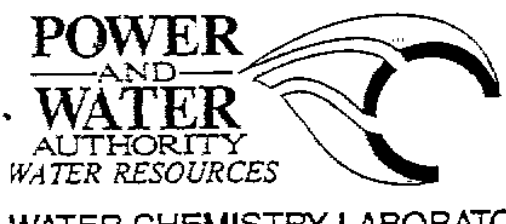
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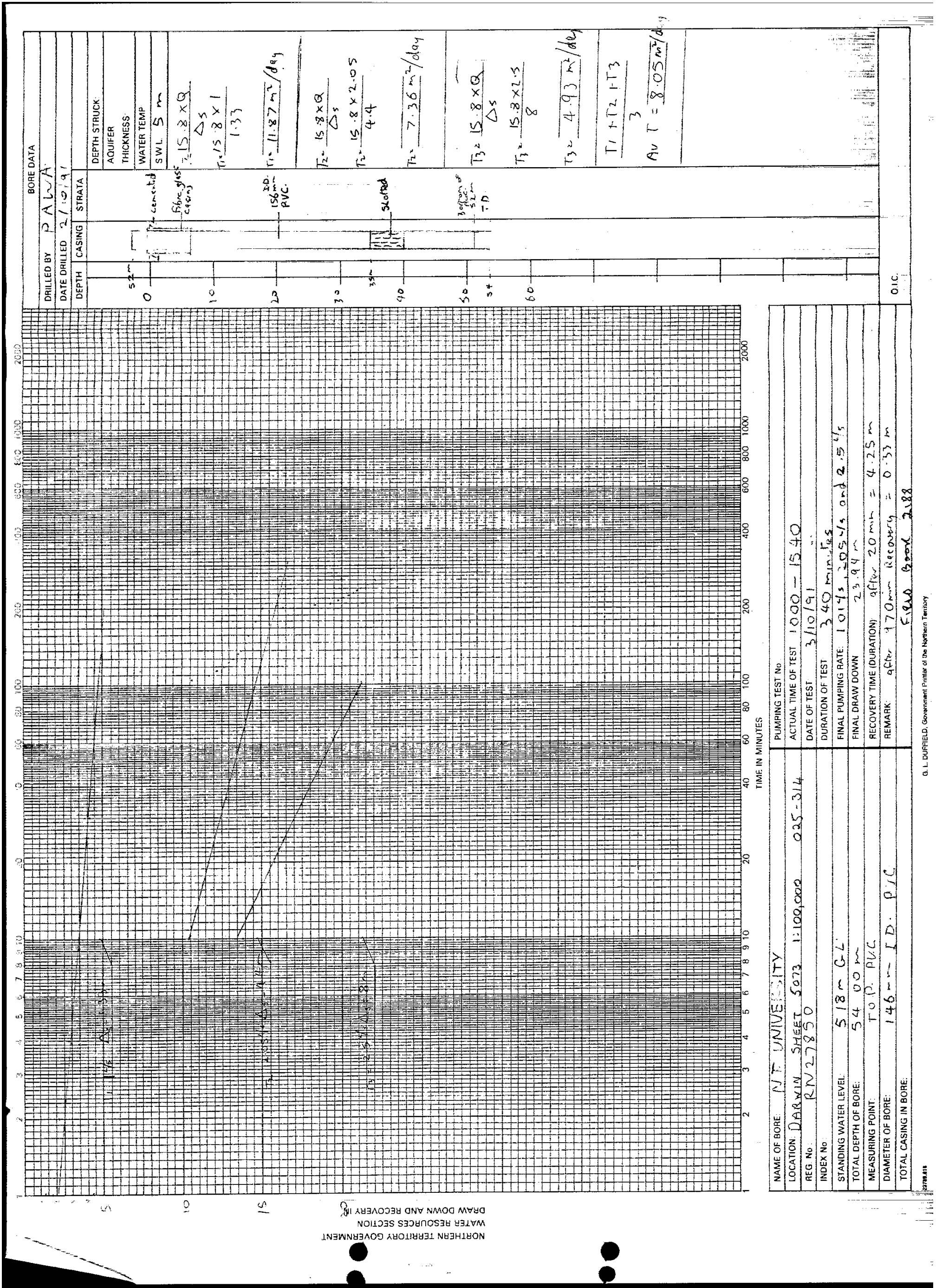
DATE: **25 NOV 1994**

CHECKED: *J. Owen*

SIGNATORY: *E. G. ...*

- Boxes marked thus indicate:
- Levels are within the limits as quoted in the "Guidelines for Drinking Water Quality in Australia". 1987 N.H. & M.R.C. and the A.W.R.C.
 - Levels exceed non-health related limits.
 - Levels exceed health related limits

		G.P.O. Box 1096, Darwin N.T. 0801 Telephone: (089) 82 6413 Facsimile: (089) 82 6410		Bottle No.: B	Lab Register No.: 94-95/0476
		Date Received in Lab: 2/11/94	Time Sampled:	Date Sampled: 26/10/94	
R/N No.: 27850	Depth (m):	Q:	Map:	Sampler: CHEN LEE	
G.S. No.:	G.H. (m):	Q:	G.R.:		
Location: N.T.U. RAW WATER AFTER 24 HRS			Field Temp °C:	Field pH:	Field Cond µS/cm ¹ :
Attraction			RSP: 44	Project No.: 48102D000006953	
ANALYSIS - PHYSICAL					
<input type="checkbox"/> pH	[4500-H ⁺ B]	7.9	<input type="checkbox"/> Colour (Hazen units)	[2120B]	
<input type="checkbox"/> Electrical conductivity (microsiemens/cm at 25°C)	[2510B]	69,200	<input type="checkbox"/> Turbidity (NTU's)	[2130B]	
<input checked="" type="checkbox"/> Total dissolved solids (mg L ⁻¹ - dried at 180°C)	[2540C]	52,280	<input type="checkbox"/> Suspended solids (mg L ⁻¹)	[2540D]	
ANALYSIS - CHEMICAL (mg L⁻¹)					
<input checked="" type="checkbox"/> Sodium, Na	[3111B]	15,600	<input checked="" type="checkbox"/> Chloride, Cl	[4500-Cl ⁻ B]	29,250
<input type="checkbox"/> Potassium, K	[3111B]	491	<input checked="" type="checkbox"/> Sulphate, SO ₄	[G]	4,350
<input type="checkbox"/> Calcium, Ca	[3111D]	650	<input type="checkbox"/> Nitrate, NO ₃	[4500-NO ₃ ⁻ B]	3
<input type="checkbox"/> Magnesium, Mg	[3111B]	1978	<input type="checkbox"/> Bicarbonate, HCO ₃	[2320B]	146
<input type="checkbox"/> Iron, (total) Fe	[3111B]	0.6	<input type="checkbox"/> Carbonate, CO ₃	[2320B]	<1
<input checked="" type="checkbox"/> Total Hardness (as CaCO ₃) Calculation	[2340B]	9,768	<input type="checkbox"/> Hydroxide, OH	[2320B]	<1
<input type="checkbox"/> Total Hardness (as CaCO ₃) Titration	[2340C]		<input type="checkbox"/> Fluoride, F	[4500-F ⁻ C]	0.1
<input type="checkbox"/> Total Alkalinity (as CaCO ₃)	[2320B]	120	<input type="checkbox"/> NaCl (calc. from chloride)		48,204
<input type="checkbox"/> Silica, SiO ₂	[4500-Si D]	19	<input type="checkbox"/> Dissolved Oxygen	[4500-O-C]	
ANALYSIS - ADDITIONAL (mg L⁻¹)					
<input checked="" type="checkbox"/> Copper, Cu	[3111B]		<input type="checkbox"/> Manganese, Mn	[3111B]	
<input type="checkbox"/> Lead, Pb	[3111B]		<input type="checkbox"/> Nickel, Ni	[3111B]	
<input type="checkbox"/> Zinc, Zn	[3111B]		<input type="checkbox"/> Cobalt, Co	[3111B]	
❖ U/S DENOTES UNSUITABLE FOR ANALYSIS ❖ I/S DENOTES INSUFFICIENT SAMPLE ❖ F DENOTES FILTRATE ANALYSIS ❖ T DENOTES TOTAL ANALYSIS			DATE: 25 NOV 1994 CHECKED: <i>[Signature]</i> SIGNATORY: <i>E. G...</i>		
This report relates specifically to the "sample tested as received". The test methods used (denoted within brackets) refer to the 1992 18th edition of "Standard Methods for the examination of Water and Wastewater", A.P.H.A. Except [G] which refers to the method of R. Goguel, Anal. Chem. 1969, 41, 1034.					
Boxes marked thus indicate: <ul style="list-style-type: none"> <input type="checkbox"/> Levels are within the limits as quoted in the "Guidelines for Drinking Water Quality in Australia", 1987 N.H. & M.R.C. and the A.W.R.C. <input checked="" type="checkbox"/> Levels exceed non-health related limits. <input checked="" type="checkbox"/> Levels exceed health related limits 					

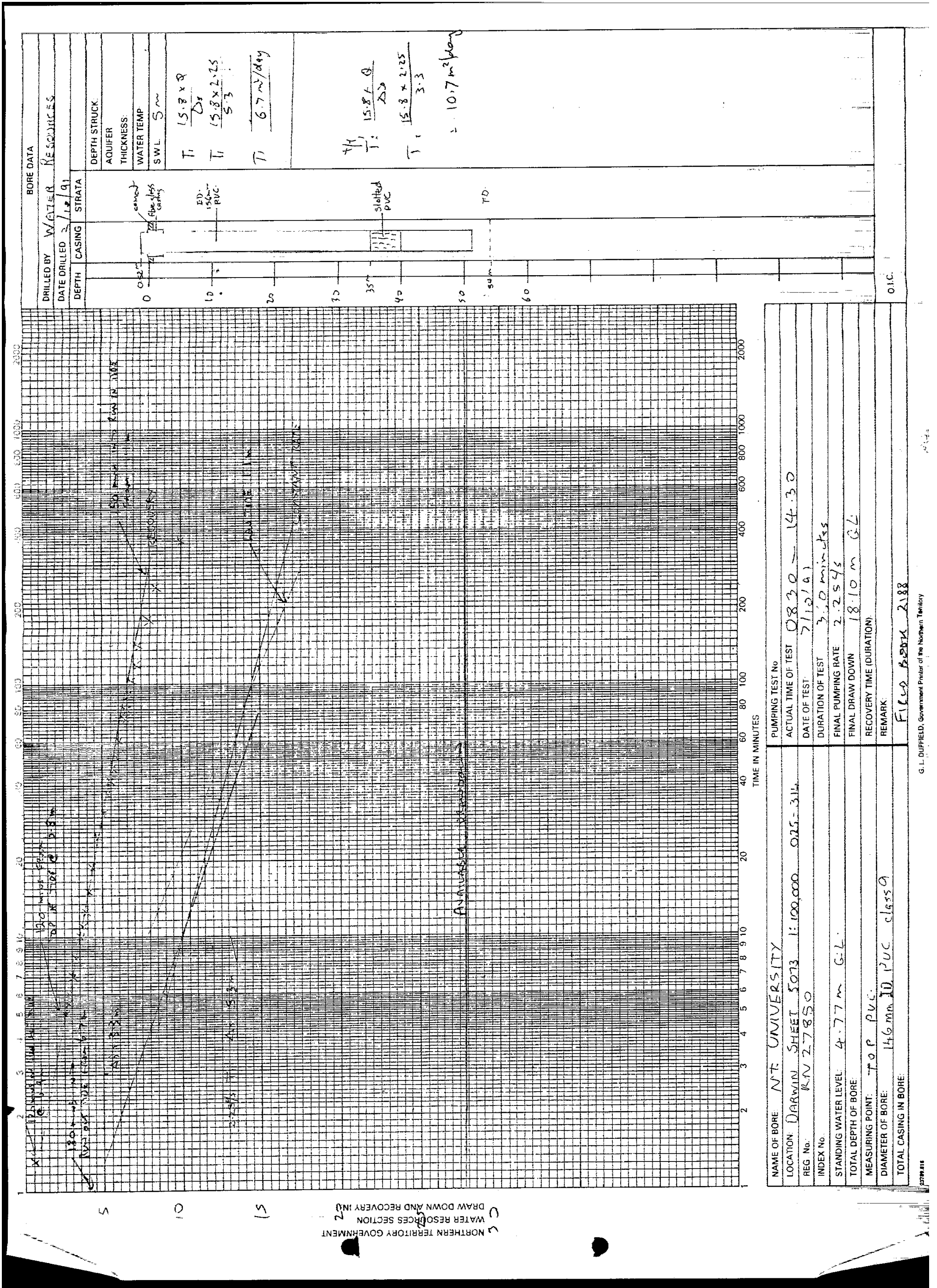


DEPTH	CASING	STRATA	DEPTH STRUCK	AQUIFER THICKNESS	WATER TEMP	SWL
0						5 m
10		concreted				15.8 x 9
20		156mm PVC				11.87 m ² /day
30						15.8 x 9
35		sloped				15.8 x 2.05
40						7.36 m ² /day
50		30mm PVC				15.8 x 9
54						15.8 x 2.5
60						4.93 m ² /day
						T1 + T2 + T3
						3
						Av T = 8.05 m ² /day

NAME OF BORE	NT UNIVERSITY
LOCATION	DARWIN SHEET 5073 1:100,000 025-314
REG No	RN27850
INDEX No	
STANDING WATER LEVEL	518 m G.L.
TOTAL DEPTH OF BORE	54.00 m
MEASURING POINT	T.O.P. PVC
DIAMETER OF BORE	146 mm I.D. PVC
TOTAL CASING IN BORE	
PUMPING TEST No	
ACTUAL TIME OF TEST	1000 - 1540
DATE OF TEST	3/10/91
DURATION OF TEST	340 minutes
FINAL PUMPING RATE	1014.205 l/s and 2.5 l/s
FINAL DRAW DOWN	23.94 m
RECOVERY TIME (DURATION)	after 20 min = 4.25 m
REMARK	after 470 min Recovery = 0.57 m
	FILED BOOK 2188

NORTHERN TERRITORY GOVERNMENT
WATER RESOURCES SECTION
DRAW DOWN AND RECOVERY

G. L. DURFIELD, Government Printer of the Northern Territory



BORE DATA	
DEPTH	DEPTH STRUCK
0	ACQUIFER
10	THICKNESS
20	WATER TEMP
30	SWL 5m
35	T1 15.8 x 8
40	T1 15.8 x 2.25
50	T1 6.7 m/day
54	T1 15.8 x 8
55	T1 15.8 x 2.25
56	T1 3.3
57	T1 10.7 m ² /day

NAME OF BORE	NT UNIVERSITY
LOCATION	DARWIN SHEET 5073 1:100,000 025-314
REG No.	RN 27850
INDEX No.	
STANDING WATER LEVEL	4.77 m G.L.
TOTAL DEPTH OF BORE	
MEASURING POINT	TOP PVC
DIAMETER OF BORE	146mm ID PVC class 9
TOTAL CASING IN BORE	
PUMPING TEST No.	
ACTUAL TIME OF TEST	0830 - 1430
DATE OF TEST	7/12/91
DURATION OF TEST	3.0 minutes
FINAL PUMPING RATE	2.254s
FINAL DRAW DOWN	18.10 m G.L.
RECOVERY TIME (DURATION)	
REMARK	FILED BOOK 2188



POWER AND WATER AUTHORITY
WATER RESOURCES
 WATER CHEMISTRY LABORATORY
 G.P.O. Box 1096, Darwin N.T. 0801
 Telephone: (089) 82 6413
 Telex: AA85644
 Facsimile: (089) 82 6410

SENT BY: PAWA LABORATORY 15-9-92 11:47AM 0898264109 4287850

A500 91/92 / 0544

Date Received in Lab. 9/10/91	Time Sampled 1430	Date Sampled 7/10/91
Location and Details DARWIN NTU Depth 32.5m ^{RMD SETTING}		
P/N RMD 8088 Sampler M. MOLINA		

R/N. 27850

RSP NO 44

ANALYSIS — PHYSICAL

<input type="checkbox"/> pH	[423]	6.1	<input type="checkbox"/> Colour (Hazen units)	[204A]	
<input type="checkbox"/> Electrical conductivity (microsiemens/cm at 25° C)	[205]	109000	<input type="checkbox"/> Turbidity (NTU's)	[214A]	
<input checked="" type="checkbox"/> Total dissolved solids (mg L ⁻¹ , dried at 180° C)	[209B]	59835	<input type="checkbox"/> Suspended solids (mg L ⁻¹)	[209C]	

ANALYSIS — CHEMICAL (mg L⁻¹)

<input checked="" type="checkbox"/> Sodium, Na	[303A]	17650	<input checked="" type="checkbox"/> Chloride, Cl	[407A]	30690
<input type="checkbox"/> Potassium, K	[303A]	580	<input checked="" type="checkbox"/> Sulphate, SO ₄	[G]	4320
<input type="checkbox"/> Calcium, Ca	[311C]	641	<input type="checkbox"/> Nitrate, NO ₃	[418A]	3
<input type="checkbox"/> Magnesium, Mg	[303C]	2252	<input type="checkbox"/> Bicarbonate, HCO ₃	[403]	198
<input checked="" type="checkbox"/> Total Hardness (as CaCO ₃)	[314B]	10836	<input type="checkbox"/> Carbonate, CO ₃	[403]	
<input type="checkbox"/> Total Alkalinity (as CaCO ₃)	[403]	163	<input type="checkbox"/> Fluoride, F	[413B]	0.1
<input checked="" type="checkbox"/> Iron, (total) Fe	[303A]	18	<input type="checkbox"/> NaCl (calc. from chloride)		50577
<input type="checkbox"/> Silica, SiO ₂	[425D]	19			

ANALYSIS — ADDITIONAL (mg L⁻¹)

<input type="checkbox"/> Copper, Cu	[304] [303A]		<input type="checkbox"/> Lead, Pb	[303A] [304]		<input type="checkbox"/> Arsenic, As	[303E]	
<input type="checkbox"/> Manganese, Mn	[303A] [304]		<input type="checkbox"/> Zinc, Zn	[304] [303A]		<input type="checkbox"/> Cadmium, Cd	[303A] [304]	
<input type="checkbox"/> Selenium	[303E]							

This report relates specifically to the "sample tested as received".

The test methods used (denoted within brackets) refer to the 16th edition of "Standard Methods for the examination of Water and Wastewater", A.P.H.A. Except [G] which refers to the method of R. Goguel, Anal.Chem. 1969, 41, 1034.

DATE: 18 OCT 1991

CHECKED: *J. Mahoney*
 SIGNATORY: *E. Goert*

Boxes marked thus indicate:

- Levels are within the limits as quoted in the "Guidelines for Drinking Water Quality in Australia", 1987 N.H. & M.R.C. and the A.W.R.C.
- Levels exceed non-health related limits.
- Levels exceed health related limits.



This Laboratory is registered by Testing Authorities, Australia. All analyses have been performed in accordance with registration. This document is valid.

SENT BY: PAWA LABORATORY

: 16- 9-92 11:49AM ;

289625410

410703: # 4



POWER AND WATER AUTHORITY
WATER RESOURCES
 WATER CHEMISTRY LABORATORY
 G.P.O. Box 1096, Darwin N.T. 0801
 Telephone: (089) 82 6413
 Telex: AA85644
 Facsimile: (089) 82 6410

RSY4 | 91/92/0546

Date Received in Lab. 9/10/91	Time Sampled 0900	Date Sampled 7/10/91
Location and Details DARWIN NTU 1:100,000		
P/N RMD 8088 Sampler M. Molina		

R/N 27850

RSP NO 44

ANALYSIS — PHYSICAL

<input type="checkbox"/> pH [433]	<input type="checkbox"/> Colour (Hazen units) [204A]
<input type="checkbox"/> Electrical conductivity (microsiemens/cm at 25° C) [205]	<input type="checkbox"/> Turbidity (NTU's) [214A]
<input checked="" type="checkbox"/> Total dissolved solids (mg L ⁻¹ - dried at 180° C) [209B] 58365	<input type="checkbox"/> Suspended solids (mg L ⁻¹) [209C]

ANALYSIS — CHEMICAL (mg L⁻¹)

<input type="checkbox"/> Sodium, Na [303A]	<input type="checkbox"/> Chloride, Cl [407A]
<input type="checkbox"/> Potassium, K [303A]	<input type="checkbox"/> Sulphate, SO ₄ [G]
<input type="checkbox"/> Calcium, Ca [311C]	<input type="checkbox"/> Nitrate, NO ₃ [418A]
<input type="checkbox"/> Magnesium, Mg [303C]	<input type="checkbox"/> Bicarbonate, HCO ₃ [403]
<input type="checkbox"/> Total Hardness (as CaCO ₃) [314B]	<input type="checkbox"/> Carbonate, CO ₃ [403]
<input type="checkbox"/> Total Alkalinity (as CaCO ₃) [403]	<input type="checkbox"/> Fluoride, F [413B]
<input type="checkbox"/> Iron, (total) Fe [303A]	<input type="checkbox"/> NaCl (calc. from chloride)
<input type="checkbox"/> Silica, SiO ₂ [425D]	

ANALYSIS — ADDITIONAL (mg L⁻¹)

<input type="checkbox"/> Copper, Cu [304] [303A]	<input type="checkbox"/> Lead, Pb [303A] [304]	<input type="checkbox"/> Arsenic, As [303E]
<input type="checkbox"/> Manganese, Mn [303A] [304]	<input type="checkbox"/> Zinc, Zn [303A] [304]	<input type="checkbox"/> Cadmium, Cd [303A] [304]
<input type="checkbox"/> Selenium [303E]		

T. D. S ONLY

This report relates specifically to the "sample tested as received".

The test methods used (denoted within brackets) refer to the 16th edition of "Standard Methods for the examination of Water and Wastewater", A.P.H.A. Except [G] which refers to the method of R. Goguel, Anal.Chem. 1969, 41, 1034.

DATE: 21 OCT 1991

CHECKED: *[Signature]*

SIGNATORY: *E. Goo*

Boxes marked thus indicate:

- Levels are within the limits as quoted in the "Guidelines for Drinking Water Quality in Australia", 1987 N.H. & M.R.C. and the A.W.R.C.
- Levels exceed non-health related limits.
- Levels exceed health related limits.



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48-477



WATER CHEMISTRY LABORATORY
 G.P.O. Box 1096, Darwin N.T. 0801
 Telephone: (089) 82 6413
 Telex: AA85644
 Facsimile: (089) 82 6410

Bottle No. <i>PT</i>	Lab. Register No. <i>91/92/0527</i>	<i>27,850</i>
Date Received in Lab. <i>1/10/91</i>	Time Sampled <i>1500</i>	Date Sampled <i>1/10/91</i>
Location and Details <i>N.T.U. R/N 27850 DEPTH</i>		
<i>54m SAMPLER D.KARP</i>		

R/N° ANRCA

RSP44

ANALYSIS — PHYSICAL

<input type="checkbox"/> pH [423]	<i>6.4</i>	<input type="checkbox"/> Colour (Hazen units) [204A]	
<input type="checkbox"/> Electrical conductivity (microsiemens/cm at 25° C) [205]	<i>68700</i>	<input type="checkbox"/> Turbidity (NTU's) [214A]	
<input checked="" type="checkbox"/> Total dissolved solids (mg L ⁻¹ - dried at 180° C) [209B]	<i>52080</i>	<input type="checkbox"/> Suspended solids (mg L ⁻¹) [209C]	

ANALYSIS — CHEMICAL (mg L⁻¹)

<input checked="" type="checkbox"/> Sodium, Na [303A]	<i>17740</i>	<input checked="" type="checkbox"/> Chloride, Cl [407A]	<i>27720</i>
<input type="checkbox"/> Potassium, K [303A]	<i>524</i>	<input checked="" type="checkbox"/> Sulphate, SO ₄ [G]	<i>3860</i>
<input type="checkbox"/> Calcium, Ca [311C]	<i>609</i>	<input type="checkbox"/> Nitrate, NO ₃ [418A]	<i>4</i>
<input type="checkbox"/> Magnesium, Mg [303C]	<i>1908</i>	<input type="checkbox"/> Bicarbonate, HCO ₃ [403]	<i>119</i>
<input checked="" type="checkbox"/> Total Hardness (as CaCO ₃) [314B]	<i>9346</i>	<input type="checkbox"/> Carbonate, CO ₃ [403]	
<input type="checkbox"/> Total Alkalinity (as CaCO ₃) [403]	<i>98</i>	<input type="checkbox"/> Fluoride, F [413B]	<i>0.1</i>
<input type="checkbox"/> Iron, (total) Fe [303A]	<i>* W/S</i>	<input type="checkbox"/> NaCl (calc. from chloride)	<i>45683</i>
<input type="checkbox"/> Silica, SiO ₂ [425D]	<i>12</i>		

ANALYSIS — ADDITIONAL (mg L⁻¹)

<input type="checkbox"/> Copper, Cu [304] [303A]	<input type="checkbox"/> Lead, Pb [303A] [304]	<input type="checkbox"/> Arsenic, As [303E]
<input type="checkbox"/> Manganese, Mn [303A] [304]	<input type="checkbox"/> Zinc, Zn [304] [303A]	<input type="checkbox"/> Cadmium, Cd [303A] [304]
<input type="checkbox"/> Selenium [303E]	<input type="checkbox"/>	<input type="checkbox"/>

* **UNSUITABLE FOR ANALYSIS**

This report relates specifically to the "sample tested as received".

The test methods used (denoted within brackets) refer to the 16th edition of "Standard Methods for the examination of Water and Wastewater", A.P.H.A. Except [G] which refers to the method of R. Goguel, Anal.Chem. 1969, 41, 1034.

DATE: **7 OCT 1991**

CHECKED: *J. B. Johnson*

SIGNATORY: *E. G. Goguel*

Boxes marked thus indicate:

- Levels are within the limits as quoted in the "Guidelines for Drinking Water Quality in Australia", 1987 N.H. & M.R.C. and the A.W.R.C.
- Levels exceed non-health related limits.
- Levels exceed health related limits.



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Bore Location: N.T.U.

Client: N.T.U.

Reference:

Purpose: AQUACULTURE.

Map: DARWIN 1:100,000 Sheet 5073.

Grid Reference: 025 - 314.

RECOMMENDATION. NB. THIS WATER IS NOT POTABLE.

Pumping Rate: 2 L/s. Pump Setting: 32 m. below Ground Level. General recommendations are given on the reverse side. The aquifer and bore cannot sustain higher pumping rates with deeper pump settings or for short periods in favourable seasons. Further advice can be obtained from: Water Resources. (In all correspondence please refer to bores RN number) Sasco House, DARWIN NT.

BORE DATA

Finished depth: 54.3 m. Completion Date: 2.10.91 Test Date: 7.10.91.
Standing Water Level: 5.18 m. on 3.10.91 Test Rate: 2.25 L/s.
Construction details: Test Duration: 6 hrs.

Interval	Description
0 - 2.00 m.	203 mm ID fibreglass casing.
0 - 36.30 m.	146 mm ID PVC Class 9 casing.
36.30 - 48.30 m.	146 mm ID PVC class 9 slotted casing.
48.30 - 54.30 m.	146 mm ID PVC Class 9 sump.

- Notes:
1. Top of casing as constructed was 0.7 m above ground.
 2. All depths are measured from natural ground level.
 3. Test rates are not indicative of safe long term pumping rates.

WARNING: MINIMUM INTERNAL BORE DIAMETER IS 146 mm.

COMMENTS

1. The above recommendations are based on a constant rate test at 2.25 L/s for 6 hrs and assume hydrological conditions remain constant.
2. Provision to monitor water levels and obtain water samples should be incorporated when equipping this bore.
3. Solar powered pumps may be set at 20 m. for rates up to 1 L/s.
4. Due to the high salinity, pumping equipment and reticulation should be corrosion resistant.

WATER ANALYSIS See water laboratory report Analysis No. 91/92/0544.
91/92/0545.
91/92/0546.

Prepared by: R. SETCHELL TO.2
21/10/91.

boredata

RN27850⁰ NI UNIVERSITY
 $AVT = 8.05 \text{ m}^2/\text{day}$

$$\frac{15.8 \times Q \times 4}{AVT} = \frac{15.8 \times 1 \times 4}{8.05} = 7.85 \text{ m}^2/\text{day}$$

GORMACK GRAPH PAPERS : CHRISTCHURCH N.Z. E331Y Log-log 3 cycles x 3 cycles

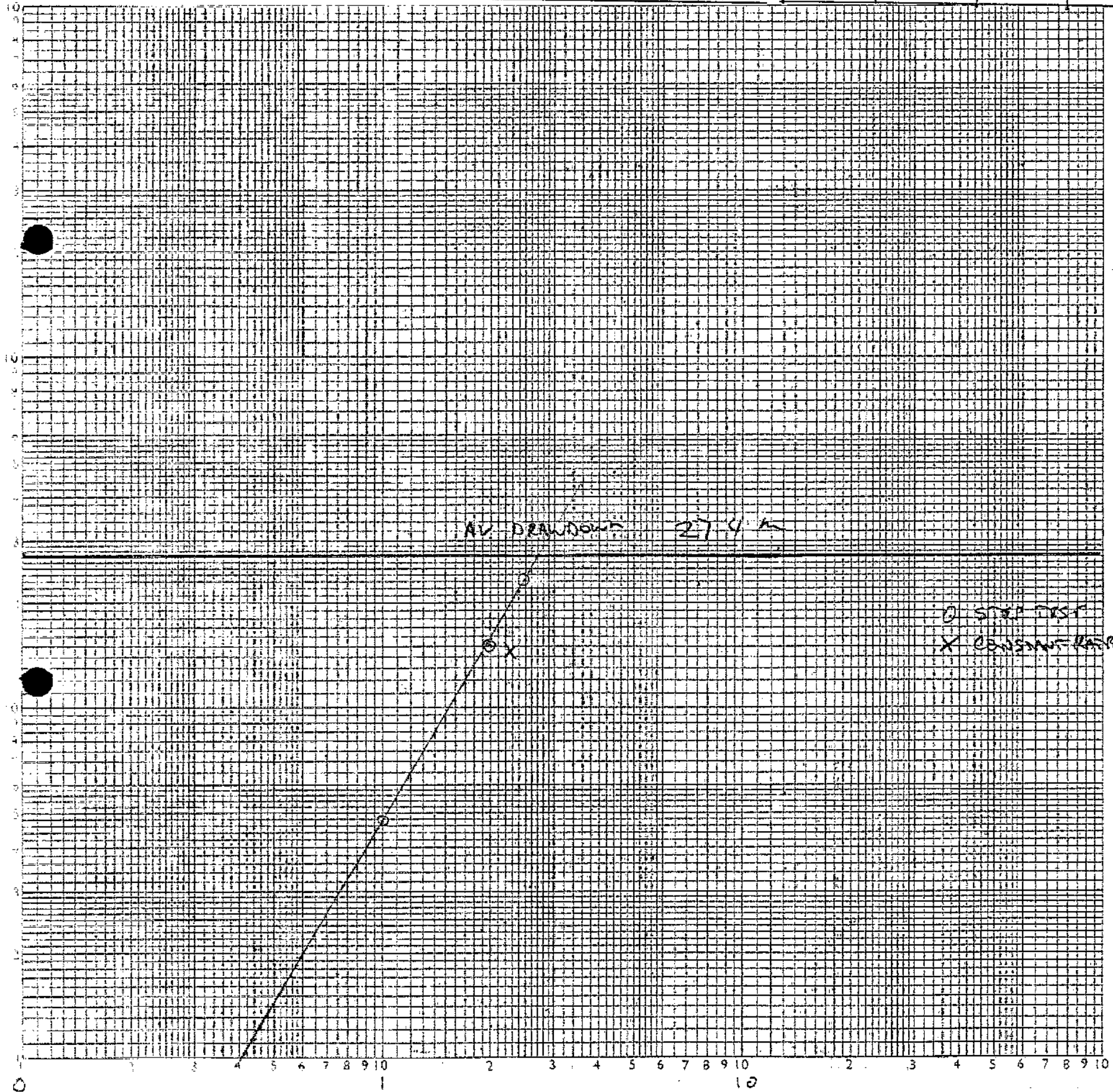
$$\frac{15.8 \times Q \times 4}{AVT} = \frac{15.8 \times 1.5 \times 4}{8.05} = 11.77 \text{ m}^2/\text{day}$$

$$\frac{15.8 \times Q \times 4}{AVT} = \frac{15.8 \times 2 \times 4}{8.05} = 15.70 \text{ m}^2/\text{day}$$

$$\frac{15.8 \times Q \times 4}{AVT} = \frac{15.8 \times 2.5 \times 4}{8.05} = 19.62 \text{ m}^2/\text{day}$$

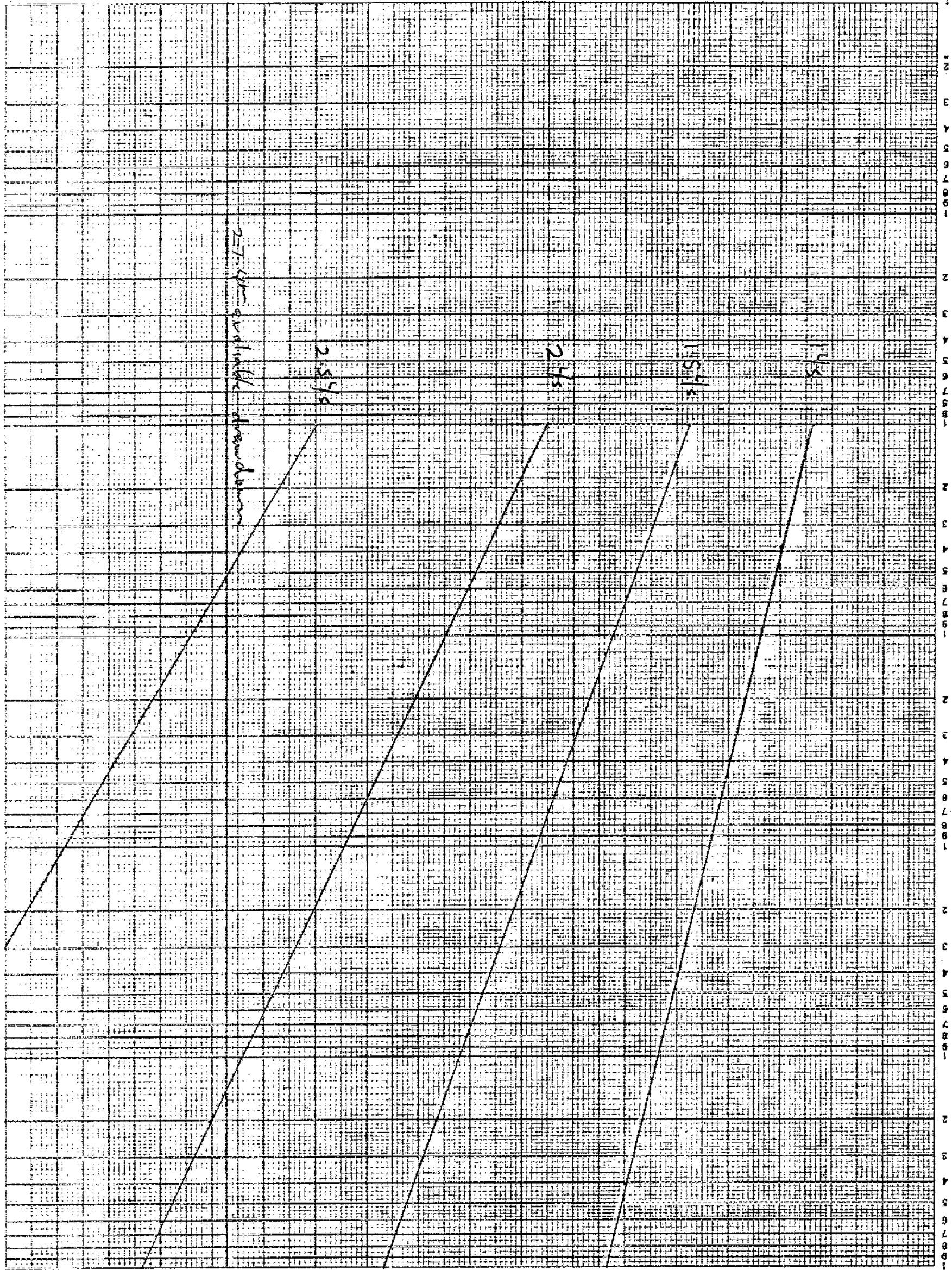
$$\frac{15.8 \times Q \times 4}{AVT} = \frac{15.8 \times 3 \times 4}{8.05} = 23.55 \text{ m}^2/\text{day}$$

Q	10^2	10^4	10^6
1	4.77	7.85	12.62
1.5	9.50	11.77	21.27
2	15.00	15.70	30.7
2.5	23.94	19.62	43.56
3	33.00	23.55	56.55



RETURN

2
4
6
8
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12
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22
24
26
28
30
32
34
36



10^1
 10^2 RN027850
 10^3
 10^4
 10^5
 10^6

WR 9/1

DRILLERS LOG

Power and Water Authority

Drilling

DATE 30/9/91

BORE No. RN 27850

Supervisor:

Driller: T. MASTERS

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details	BIT DATA				STRING DATA			MUD DATA	WATER SAMPLES				
					No.	Size	Type	Worn cond'n	Item	O.D.	Length		Prog. tally	No.	Depth		
1435				SET RIG UP ON SITE													
				1/10/91 TURS													
0740				TRAVEL TO SITE													
0810				PREPARE 10' BLADE & HAMMER					BIT & SUB			.93					
0849				COMMENCE DRILLING													
0921	5.60	5.60		DRILLED TO 6.60M - LT/BROWN-YELLOW CLAY/CLAYSTONE, IRONSTONE @ 1.00M TO 1.4M RAN 6.10M & 8 5/8" SURFACE CASING CASING SITTING OVER 1 SIDE TOO MUCH BOULDER STICKING OUT PRAM AWAY BOULDER & CLEAR TO T.D. DIL-RON 8 5/8" SURFACE CASING BACKILL ANNULUS WITH DIRT FIT 5315 HAMMER BIT & BODY TO KELLY HAMMER NOT WORKING PULLDOWN HAMMER BARREL & CLEAN UP PARTS (PISTON AROUND WRONG WAY) PUT HAMMER TOGETHER AGAIN (TEST O.K.) CONTINUE DRILLING HAMMER BIT & BODY 1.16 3 1/2 BOX 4 1/2 4.7 1.63 BIT & BODY 1.16 SUB 3.7 1.53 O/C 6 3/4 4.70 6.23 SUB SUB 4 1/2 BOX 3 1/2 BOX 2.0 6.43													
1023	7.86			LT/BROWN-YELLOW-WHITE-PURPLE CLAY BREAK OFF 4 1/2 BOX TO BOX SUB OFF HAMMER FIT 3 1/2 REG BOX TO 4 1/2 BOX SUB TO HAMMER ADD O/C													
1059	12.66	4.80		COMMENCE DRILLING MIXED COLOURED CLAYS, SOME CLAYSTONE @ 12-10M													

WR 9/1

DRILLERS LOG

Power and Water Authority

DATE 1/10/91

BORE No. RN 27850

Supervisor:

Driller: J. McMASTERS

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details	BIT DATA				STRING DATA				MUD DATA	WATER SAMPLES	
					No.	Size	Type	Worn cond'n	Item	O.D.	Length	Prog. tally		No.	Depth
				ADD D/P					① D/P 4 1/2	6.00	12.43				
				CONT DRILLING					BLACK						
1119	18.66	6.00		MIXED COLOURED CLAY'S & GRAY CLAYSTONE					SRIPAGE @ 15.00m						
				ADD D/P					② D/P 4 1/2	6.00	18.43				
				CONT DRILLING											
1127	24.66	6.00		ADD & GRAY INTERBEDDED SILTSTONE											
				* SUPPLY = RST 0.1										COND = 22300	
				ADD D/P					③ D/P 4 1/2	6.00	24.43				
				CONT DRILLING											
1148	30.66	6.00		GRAY INTERBEDDED GRAY SILTSTONE SHALE & SILTSTONE					④ D/P 4 1/2	6.00	30.43				
				ADD D/P					* SUPPLY = RST 0.5 L/S					CONDUCT = 22000	
				CONT DRILLING											
1219	36.66	6.00		AS ABOVE - BIT MORE GRAY S/STONE										COND = 35400	
				ADD D/P					⑤ D/P 4 1/2	6.00	36.43				
				CONT DRILLING											
1307	42.66	6.00		AS ABOVE - LESSER S/STONE										COND = 44900	
				ADD D/P					⑥ D/P 4 1/2	6.00	42.43				
				CONT DRILLING											
1315	48.66	6.00		STOPPED DRILLING @ 1334 HRS IN GRAY/BLACK SLATE FROM 43.66m TO 45.66m											
				AIRLIFT MADE = { SUPPLY MEASURED @ 2 L/S } COND = 49500										SAMPLES P1085 QF77	
				13.50 HRS.											
1435				CONTINUE DRILLING FROM 35.66m											
1504	35.66			GRAY SILTSTONE/SHALE											
				MEASURE SUPPLY = AS ABOVE										COND =	

WR 9/1

DRILLERS LOG

Power and Water Authority

DATE 1/10/91

BORE No. RN 27850

Supervisor:

Driller: J. H. MASTERS

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details	BIT DATA				STRING DATA			MUD DATA	WATER SAMPLES		
					No.	Size	Type	Worn cond'n	Item	O.D.	Length		Prog. tally	No.	Depth
	48.66														
				ADD D/P				⊕	DIA	42	6.00	48.43			
1515				CONT DRILLING											
1543	54.66-00			CARRY SILTSTONE / SHALE & SOME MEASURE SUPPLY = 2.5L/S AIRLIFT COX 10 MIN'S PULLOUT TOTAL STRING.					FILLITE LAST		1.00M				
				2/10/91 SWL 5.00M COND 78,000 P.H. 6.84											SAMPLES QG96 GA420

WR 9/1

DRILLERS LOG

Power and Water Authority

DATE 2/10/91

BORE No. RN 27850

Supervisor:

Driller: I. M. MASTERS

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details	BIT DATA				STRING DATA				MUD DATA	WATER SAMPLES		
					No.	Size	Type	Worn cond'n	Item	O.D.	Length	Prog. tally		No.	Depth	
0950				T.17 = 54.70M T.O.C - 8 1/8" CASING												
0950				S.N.L = 535M T.O.C - " "												
				BRACK OIL & WATER IN RIS - O.K.												
				BREAK DOWN HAMMER BIT & BODY.												
1029				COMMENCING RUNNING 6" P.V.C PIPE												
				1) 6.00" BLANK												
				2) 12.00 SLOTTED = 18.00												
				3) 36.00 BLANK = 94.00												
				4) .95 BLANK = 94 95												
				COMMENCED RUNNING 2MM GRAVEL PACK INTO ANNULUS												
				RAN RODS TO 36.00M												
1412				AIRLIFTED BARGE SUPPLY = 2 L/S												
1425				SUPPLY = 2.15 L/S CONDUCT = 79500												
				AIRLIFTED DOW 30 MINS.												
				PULLOUT STRING												
				T.D. = 54.30M TO GROUND LEVEL PLUS .65M ABOVE GROUND												
				PULLOUT 8 1/8" STEEL SURFACE CASING, BACKFILL ANNULUS TO 5.00M.												
				RAN 1 LENGTH D/P TO 4.50M												
				MIX 5 BAGS CEMENT + 10KG CALCIUM CHLORIDE												
				POUR CEMENT DOWN DRILL PIPE TO FILL 10" ANNULUS BACK TO SURFACE.												
				PULLOUT D/P & CLEAN UP GRAVE.												
1558				PACK UP & MOVE BACK TO DEPOT.												

2188

RN 27850

NTU AQUACULTURE
BORE

2188

BORE NAME AQUACULTURE BORERegistered Number RN 27850

Index Number _____

Location DARWIN SHEET 5073 1:100,000Total Depth 54 m 025-314

Depth Water Struck _____

Estimated Supply 2.5 l/s

Aquifer Material _____

Construction details casing screens, etc.

Interval	Size and description
<u>0-35 m</u>	<u>146 mm ID CLASS 9 PVC</u>
<u>35-40 m</u>	<u>146 mm ID CLASS 9 PVC - SLOTTED</u>
<u>40-54 m</u>	<u>200 mm OPEN HOLE</u>

Distance to production bore

Bore name	Distance

Pump test crew M MOLINA FAZW ARCHARD FAI7/10/91 M MOLINA, D GUMLEY FAZPump type Mono 640Powered by 3 cyl ListerPump setting 32.58 m G.L.Method measuring pump discharge 66 mm Pipe w/
platesList any other equipment used MAN 105 x 6.15 m Columes "3"1 x 0.55 m short pipe "3"1 x 2.30 m pump 6405 x 6.30 m 15 mm PVC3/10/91 Comments TD Before pumping 52.18 m GL8/10/91 TD after " " 54.20 m GL3/10/91 SWL Before pumping 5.18 m GL7/10/91 SWL 4.77 m GL3/10/91 AV DRAWDOWN 27.4 m4/10/91 Airlifted bore TD 54.20 m GL8/10/91 SWL 5.31 m GL

Pumped Bore: RN27850 OBS Bore:

Standing Water Level: 5.18 m

Available Drawdown: 27.40 m

Time Started: 1000

Date: 3/10/91

Time Stopped: 1140

Date: 3/10/91 01

Test Type: STEP TEST

Step No.: 1

Time C.S.T.	Time (min)	D/Down (m)	PZh (cm)	Orifice Plate Size	Q (l/s)	Water Sample Bot. No.	Water Sample Temp. (°C)	Comments	LOW FLOW 0810	HIGH FLOW 1329	3.6	4.4
10:01	1	1.70	25	30mm	1.01			clear & clear				
	2	2.20										
	3	2.55										
	4	2.79						salty taste				
	5	2.94										
	6	3.06										
	7	3.18						clear & clear				
	8	3.30	25	30mm	1.01							
	9	3.41										
10:10	10	3.46										
	12	3.55						clear & clear				
	15	3.68										
	20	3.86										
	25	4.01					30°C	PH 6.07	COND 130.5	MS/cm 200,000		
10:30	30	4.17	25	30mm	1.01							
	35	4.25										
	40	4.33						clear & clear				
	50	4.41										
11:00	60	4.49					30°C	PH 6.13	COND 79.1	MS/cm 200,000		
	70	4.55										
	80	4.63	25	30mm	1.01		29.9°C	PH 6.14	COND 81.6	MS/cm 200,000		
	90	4.70										
11:40	100	4.77					29.9°C	PH 6.11	COND 73.8	MS/cm 200,000		

INCREASING TIME

HEADS

Pumped Bore: RIN 27850

OBS Bore:

Standing Water Level: 5 18 m

Available Drawdown: 27.4 m

Time Started: 11:40

Date: 3/10/91

Time Stopped: 13:20

Date: 3/10/91 02

Test Type: STPP TEST

Step No.: 2

Time C.S.T.	Time (min)	D/Down (m)	PZh (cm)	Oriface Plate Size	Q (l/s)	Water Sample Bot. No	Water Sample Temp. (°C)	PH	COND	Comments
11:41	1	< adjust rate	29	40mm	2.05					
	2									
	3	9.87								
	4	10.27								clear & clean
	5	10.62								aerated clean
	6	10.99								
	7	11.20	29	40mm	2.05					aerated clean
	8	11.41								
	9	11.57								
11:50	10	11.74								aerated clean
	12	12.05					29.9°	PH	6.14	COND 61.9 / 115 cm 200,000
	15	12.34								clearing
12:00	20	12.72	29	40mm	2.05		29.9°	PH	6.13	COND 63.9 / 115 cm 200,000
	25	13.03								clear & clean
	30	13.28								
	35	13.52								
	40	13.70								clear & clean
12:30	50	14.03					29.9°	PH		COND 71.1 / 115 cm 200,000
	60	14.26	29	40mm	2.05		29.9°	PH		COND 48.9 / 115 cm 200,000
	70	14.51								clear & clean
13:00	80	14.68								COND 65.3 / 115 cm 200,000
13:10	90	14.88								clear & clean
13:20	100	15.09	29	40mm	2.05					COND 72.9 / 115 cm 200,000
										HIGH DR (HEAPS)

Pumped Bore: RN27850

OBS Bore:

Standing Water Level: 5.18 m

Available Drawdown: 27.4 m

Time Started: 13 20

Date: 3/10/91

Time Stopped: 15 40

Date: 3/10/91 03

Test Type: STEP - extended

Step No.: 3

Time C.S.T.	Time (min)	D/Down (m)	PZh (cm)	Orifice Plate Size	Q (l/s)	Water Sample Bot. No	Water Sample Temp. (°C)	Comments	High 1329 4.4	Low 2078 2.6
13 21	1	16.30	43	40mm	2.5			clear & clean		
	2	17.04								
	3	17.56								
	4	18.04								
	5	18.35								
	6	18.52	43	40mm	2.5			clear & clean		
	7	18.75								
	8	19.03								
	9	19.16								
13 30	10	19.29								
	12	19.55	43	40mm	2.5			clear & clean		
	15	19.76								
	20	20.10						COND 51/15cm		
	25	20.46						COND 51/200, 220		
	30	20.73								
	35	20.94	43	40mm	2.5			clear & clean		
14.00	40	21.27						COND 43/15cm		
	50	21.66						COND 43/200, 220		
	60	22.08						COND, PH meter		
	70	22.40	43	40mm	2.5		30.3°C	COND 75 9/200, 220		
	80	22.73						clear & clean		
	90	23.02					36.5°C	COND 74/15cm		
15.00	100	23.19						clear & clean		
15.20	120	23.54	43	40mm	2.5		30.2°C	COND 74, 300		
15.40	140	23.94					29.0°C	COND 74, 300		
							29.0°C	COND 75, 100		
						D249				

Pumped Bore: R# 27850

OBS Bore:

Standing Water Level: 5.18 m

Available Drawdown: 27.4 m

Time Started: 15 40

Date: 3-10-91

Time Stopped: 07.50

Date: 4-10-91 04

Test Type: RECOVERY

Step No.:

Time C.S.T.	Time (min)	D/Down (m)	PZh (cm)	Orifice Plate Size	Q (l/s)	Water Sample Bot. No	Water Sample Temp. (°C)	T/T'	Comments
15 41	1	14.42					34.1		
	1.5	11.66					22.7		
	2	9.70					17.1		OUT-GRINDING
	2.5	8.57					13.7		
	3	7.88					11.4		
	3.5	7.39					98.1		
	4	7.08					86		
	4.5	6.82					76		
15 45	5	6.62					69		
	6	6.28					57.6		
	7	5.96					49.5		
	8	5.72					43.5		
	9	5.52					38.7		
15.50	10	5.33					35		
	12	5.01					29.3		
	15	4.65					23.6		
16 00	20	4.25					18		
07 50	970	0.33					1.3	4-10-91	LOW FLOW 0945 3.0

Pumped Bore: RN27850

OBS Bore:

Time Started: 1430

Date: 8/10/91

Standing Water Level: 4.77m

Time Stopped: 0800

Date: 8/10/91 07

Available Drawdown: 27.81m

Test Type: RECOVERY

Step No.:

Time C.S.T.	Time (min)	D/Down (m)	PZh (cm)	Criface Plate Size	Q (l/s)	Water Sample Bot. No	Water Sample Temp. (°C)	$\frac{T}{T_0}$	Comments	LOW TIDE 1159 1.1	HIGH TIDE 1802 6.8
14.31	1	9.92									
	15	8.50						361			
	2	7.89						241			
	25	7.33						181			
	3	7.17						145			
	3.5	6.94						121			
	4	6.70						103.8			
	4.5	6.50						91			
	5	6.33						81			
	6	6.07						73			
	7	5.88						61			
	8	5.68						52.4			
	9	5.50						46			
14.40	10	5.31						41			
	12	5.07						37			
	15	4.75						31			
	20	4.39						25			
	25	4.14						19			
15.00	30	3.94						15.4			
	35	3.68						13			
	40	3.52						11.2			
	50	3.28						10			
15.30	60	3.06						8.2			
	70	2.87						7			
	80	2.74						6.1			
16.00	90	2.58						5.5			
								5			
0800	1050	0.54						1.34	8/10/91	HIGH TIDE	0604 6.9

4/10/91 Air lifted bore
9 X 615 = 55.35 m

TD after airlift 54.20 m GL

8/10/91 TD after pump test 54.20 m GL

BORE HAS BEEN FITTED
w/ standard steel Treaded cap

THE NORTHERN TERRITORY OF AUSTRALIA
APPROVED FORM 21 (25/01/2011)
STATEMENT OF BORE

As per Water Regulations (2009)

Name of Owner: WOOLWORTHS / CALTEX				Registration No.: RN039970							
Location/Address: 286 Traver road 283 Casuarina NT.				BC Permit No: _____							
Intended Use: MONITORING.											
GPS Location:		Zone: GDA94	Other: <input type="checkbox"/>	Specify: LRT/LOWA	Easting: 130°53'0"E	Northing: 12°22'19"S					
From	To	Particulars of Strata		Name of Drilling Company: J&S DRILLING							
0.0	2.0	SILTY CLAY SOME SAND (BROWN)		Name of Driller: JORDAN BEGER							
2.0	10.5	SILTY CLAY (RED).		Name of supervising driller: _____							
				Date Commenced: 27/09/16							
				Date Completed: 28/09/16							
				Depth Drilled: 10.5m (m)							
				Completion Depth: 10.0m (m)							
METHOD OF DRILLING											
Other <input type="checkbox"/>		Auger <input checked="" type="checkbox"/>		Rev. Circ. <input type="checkbox"/>		Rotary Air <input type="checkbox"/>					
						Rotary Mud <input type="checkbox"/>					
Specify: _____											
HOLE DIAMETER				DRILLING FLUID							
From (m)	To (m)	Dia. (mm)		Type							
0.0	10.5	200mm		NIL							
PARTICULARS OF CASING				PARTICULARS OF PERFORATIONS OR SCREEN STRINGS							
From	To	Dia (ID)	Type	From	To	Dia (ID)	Aperture	Type			
0.0	6.0	50mm	PVC CL18	6.0	10.0	50mm	0.5mm	PVC CL18 TURREADED			
Casing Suspended: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>				Top of Packer Set at: N/A (m)							
Method: _____				Length of Packer: _____ (m)							
Height of Casing above GL: 0.1m BELOW G.L (m)				Method of Packer Connection: _____							
CEMENTING/GRAVEL PACKING			WATER BEARING BEDS								
From	To	Type	Depth (m)	Yield (L/s)	SWL (m)	Duration (hr)	Quality	EC	pH	Bottle No.	
10.0	5.0	12-20 GRAVEL	9.5	10.0	0.05	8.4	1hr.				
5.0	0.0	BENTONITE CHIPS.									
STRATA / WATER SAMPLES			Completion Yield: 0.05 (L/s) Method: BAILEY				Duration: 1 (hr)				
Have been <input checked="" type="checkbox"/> Will be <input type="checkbox"/>			Completion SWL from GL: 8.4 (m)				Depth of Lift: 9.5 (m)				
Left at: TRACE ENVIRONMENTAL											

NOTE: No company advertising is to be imprinted on this certificate apart from where requested.

LOCATION SKETCH OF BORE RN: 039970	LOCATION DESCRIPTION OF BORE									
	0.5 km m/km									
	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:33%;">NW <input checked="" type="checkbox"/></td> <td style="width:33%;">North <input type="checkbox"/></td> <td style="width:33%;">NE <input checked="" type="checkbox"/></td> </tr> <tr> <td>West <input type="checkbox"/></td> <td style="text-align: center;"></td> <td>East <input type="checkbox"/></td> </tr> <tr> <td>SW <input type="checkbox"/></td> <td>South <input type="checkbox"/></td> <td>SE <input type="checkbox"/></td> </tr> </table>	NW <input checked="" type="checkbox"/>	North <input type="checkbox"/>	NE <input checked="" type="checkbox"/>	West <input type="checkbox"/>		East <input type="checkbox"/>	SW <input type="checkbox"/>	South <input type="checkbox"/>	SE <input type="checkbox"/>
	NW <input checked="" type="checkbox"/>	North <input type="checkbox"/>	NE <input checked="" type="checkbox"/>							
	West <input type="checkbox"/>		East <input type="checkbox"/>							
SW <input type="checkbox"/>	South <input type="checkbox"/>	SE <input type="checkbox"/>								
OF: CASUARINA SHOPPING CENTRE.										

FINAL CONSTRUCTION STATUS

Capped <input checked="" type="checkbox"/>	Casing Pulled <input type="checkbox"/>	Left for Obs. <input type="checkbox"/>	Abandoned <input type="checkbox"/>	Equipped <input type="checkbox"/>	Backfilled <input type="checkbox"/>	Other <input type="checkbox"/>
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ADDITIONAL INFORMATION ABOUT THE BORE: (Include any information which may assist for future reference)

Bore for monitoring of fuel tanks under ground.
 Bore under flush mount gate cover

Note: The holder of the NT licence shall submit the form to the Department within 28 days of completion of any works.

I certify that the information contained above is true and correct, and that I have complied with the bore licensing requirements and conditions of the Bore Construction Permit as issued if a Bore Construction Permit was required.

Name and licence number of driller: <u>JORDAN BEEG.</u>	Signature and licence number of licensed driller: 186	Date: 05/10/16.
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FOR OFFICIAL USE ONLY

How Located:	GPS <input checked="" type="checkbox"/>	TST <input type="checkbox"/>	Survey <input type="checkbox"/>	Hand Plotted <input type="checkbox"/>	Other <input type="checkbox"/>
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DESCRIPTION OF PROPERTY:

Rural <input type="checkbox"/>	Mineral <input type="checkbox"/>	Pastoral <input type="checkbox"/>	Reserve <input type="checkbox"/>	VCL <input type="checkbox"/>	Other <input checked="" type="checkbox"/>
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RECEIVED
 DATE 27/10/16 BY m.c.h.w.
 SERVICE STATION
 ENTER 7/12/16

Lease No:	Lot No: 9288	Hundred of:
Portion No:	Section No:	Town of: NIGHTCLIFF

Class of Bore:	Town <input type="checkbox"/>	Domestic <input type="checkbox"/>	Investigation <input checked="" type="checkbox"/>	Agriculture <input type="checkbox"/>	Mineral <input type="checkbox"/>	Pastoral <input type="checkbox"/>	Other <input type="checkbox"/>
Use of Bore:	Production <input type="checkbox"/>	Investigation <input type="checkbox"/>	Irrigation <input type="checkbox"/>	Observation <input type="checkbox"/>	Monitoring <input checked="" type="checkbox"/>	Roads <input type="checkbox"/>	None <input type="checkbox"/>

Grid Reference:	AMG <input checked="" type="checkbox"/>	Clark <input type="checkbox"/>	Zone: 52	Scale:
Easting: 704782	Latitude:	Map Name:		
Northing: 8631581	Longitude:	Index Map Number: 80/10402		

Date Registered:	Bore Plotted on the map? Yes <input type="checkbox"/> No <input type="checkbox"/>
Dept Officer:	Signature:

Remarks: S/B 0815



210029970

THE NORTHERN TERRITORY OF AUSTRALIA

APPROVED FORM 21 (25/01/2011)

STATEMENT OF BORE

As per Water Regulations (2009)

Name of Owner: <u>WOOLWORTHS / CALTEX</u>				Registration No.: <u>RN 039971</u>							
Location/Address: <u>286 TROWER ROAD</u> <u>CASUARINA NT.</u>				BC Permit No: _____							
Intended Use: <u>MONITORING</u>											
GPS Location:		Zone: <u>GDA94</u>	Other: <input type="checkbox"/>	Specify: <u>LRT/CONG</u>	Easting: <u>120°22'18" S</u>	Northing: <u>130°53'0" E</u>					
From	To	Particulars of Strata		Name of Drilling Company: <u>JFS DRILLING</u>							
<u>0.0</u>	<u>1.8</u>	<u>BROWN SILTY SAND</u>		Name of Driller: <u>JORDAN BEGG</u>							
<u>1.8</u>	<u>8.2</u>	<u>RED SILTY CLAY (DRY)</u>		Name of supervising driller: _____							
<u>8.2</u>	<u>10.0</u>	<u>YELLOW/GREY SILTY CLAY.</u>		Date Commenced: <u>28/09/16</u>							
				Date Completed: <u>28/09/16.</u>							
				Depth Drilled: <u>10.0m</u> (m)							
				Completion Depth: <u>10.0m</u> (m)							
METHOD OF DRILLING											
Other		Auger		Rev. Circ.		Rotary Air	Rotary Mud				
<input type="checkbox"/>		<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>				
Specify: _____											
HOLE DIAMETER				DRILLING FLUID							
From (m)	To (m)	Dia. (mm)		Type							
<u>0.0m</u>	<u>10.0m</u>	<u>200mm</u>		<u>NIL.</u>							
PARTICULARS OF CASING				PARTICULARS OF PERFORATIONS OR SCREEN STRINGS							
From	To	Dia (ID)	Type	From	To	Dia (ID)	Aperture	Type			
<u>0.0</u>	<u>6.0</u>	<u>50mm</u>	<u>PVC CLIB</u>	<u>6.0</u>	<u>10.0</u>	<u>50mm</u>	<u>0.5mm</u>	<u>PVC CLIB THERMADED.</u>			
Casing Suspended: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>				Top of Packer Set at: <u>N/A.</u> (m)							
Method: <u>REVERSE</u>				Length of Packer: _____ (m)							
Height of Casing above GL: <u>0.1m Below G.L.</u> (m)				Method of Packer Connection: _____							
CEMENTING/GRAVEL PACKING			WATER BEARING BEDS								
From	To	Type	Depth (m)	Yield (L/s)	SWL (m)	Duration (hr)	Quality	EC	pH	Bottle No.	
<u>5.0</u>	<u>10.0</u>	<u>12-20 GRAVEL</u>	<u>8.5</u>	<u>10.0</u>	<u>0.05</u>	<u>8.4</u>	<u>1</u>				
<u>0.0</u>	<u>5.0</u>	<u>BENTONITE CEMENT</u>									
STRATA / WATER SAMPLES			Completion Yield: <u>0.05</u> (L/s) Method: <u>BAILER.</u> Duration: <u>1</u> (hr)								
Have been <input checked="" type="checkbox"/> Will be <input type="checkbox"/>			Completion SWL from GL: <u>8.5</u> (m)				Depth of Lift: <u>9.5</u> (m)				
Left at: <u>TRACE ENVIRONMENTAL</u>											

NOTE: No company advertising is to be imprinted on this certificate apart from where requested.

LOCATION SKETCH OF BORE RN: 039971	LOCATION DESCRIPTION OF BORE									
	<p style="text-align: right;">0.5km m/km</p> <table style="width:100%; border-collapse: collapse;"> <tr> <td style="width:33%;">NW <input checked="" type="checkbox"/></td> <td style="width:33%;">North <input type="checkbox"/></td> <td style="width:33%;">NE <input checked="" type="checkbox"/></td> </tr> <tr> <td>West <input type="checkbox"/></td> <td style="text-align: center;"></td> <td>East <input type="checkbox"/></td> </tr> <tr> <td>SW <input type="checkbox"/></td> <td>South <input type="checkbox"/></td> <td>SE <input type="checkbox"/></td> </tr> </table> <p>OF: CASUARINA SHOPPING CENTRE.</p>	NW <input checked="" type="checkbox"/>	North <input type="checkbox"/>	NE <input checked="" type="checkbox"/>	West <input type="checkbox"/>		East <input type="checkbox"/>	SW <input type="checkbox"/>	South <input type="checkbox"/>	SE <input type="checkbox"/>
NW <input checked="" type="checkbox"/>	North <input type="checkbox"/>	NE <input checked="" type="checkbox"/>								
West <input type="checkbox"/>		East <input type="checkbox"/>								
SW <input type="checkbox"/>	South <input type="checkbox"/>	SE <input type="checkbox"/>								

FINAL CONSTRUCTION STATUS

Capped <input checked="" type="checkbox"/>	Casing Pulled <input type="checkbox"/>	Left for Obs. <input type="checkbox"/>	Abandoned <input type="checkbox"/>	Equipped <input type="checkbox"/>	Backfilled <input type="checkbox"/>	Other <input type="checkbox"/>
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ADDITIONAL INFORMATION ABOUT THE BORE: (Include any information which may assist for future reference)

BORE FOR MONITORING OF FUEL TANKS UNDER GROUND.
 BORE UNDER FUSU MOUNT GATIC COVER.

Note: The holder of the NT licence shall submit the form to the Department within 28 days of completion of any works.

I certify that the information contained above is true and correct, and that I have complied with the bore licensing requirements and conditions of the Bore Construction Permit as issued if a Bore Construction Permit was required.

Name and licence number of driller: <u>JORDAN BEGG</u>	Signature and licence number of licensed driller: <u>[Signature] 186.</u>	Date: <u>05 / 10 / 16.</u>
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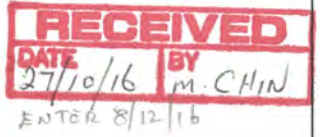
FOR OFFICIAL USE ONLY

How Located:

GPS <input checked="" type="checkbox"/>	TST <input type="checkbox"/>	Survey <input type="checkbox"/>	Hand Plotted <input type="checkbox"/>	Other <input type="checkbox"/>
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DESCRIPTION OF PROPERTY:

Rural <input type="checkbox"/>	Mineral <input type="checkbox"/>	Pastoral <input type="checkbox"/>	Reserve <input type="checkbox"/>	VCL <input type="checkbox"/>	Other <input checked="" type="checkbox"/>
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Lease No: _____ Lot No: 9288 Hundred of: _____
 Portion No: _____ Section No: _____ Town of: NIGHTCLIFF

Class of Bore:

Town <input type="checkbox"/>	Domestic <input type="checkbox"/>	Investigation <input checked="" type="checkbox"/>	Agriculture <input type="checkbox"/>	Mineral <input type="checkbox"/>	Pastoral <input type="checkbox"/>	Other <input type="checkbox"/>
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Use of Bore:

Production <input type="checkbox"/>	Investigation <input type="checkbox"/>	Irrigation <input type="checkbox"/>	Observation <input type="checkbox"/>	Monitoring <input checked="" type="checkbox"/>	Roads <input type="checkbox"/>	None <input type="checkbox"/>
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Grid Reference: AMG Clark Zone: S2 Scale: _____

Easting: 704788 Latitude: _____ Map Name: _____
 Northing: 8631592 Longitude: _____ Index Map Number: 80/10403

Date Registered: _____ Bore Plotted on the map? Yes No

Dept Officer: _____ Signature: _____

Remarks: _____

S/B 0815



1755555555

THE NORTHERN TERRITORY OF AUSTRALIA

APPROVED FORM 21 (25/01/2011)

STATEMENT OF BORE

As per Water Regulations (2009)

Name of Owner: WOOLWARTUS / CALTEX				Registration No.: RN 039972							
Location/Address: 756 TRAWER ROAD CASUARINA NT				BC Permit No: _____							
Intended Use: MONITORING											
GPS Location:		Zone: GDA94	Other: <input checked="" type="checkbox"/>	Specify: LAT/LONG	Easting: 12° 22' 19" S	Northing: 130° 53' 11" E					
From	To	Particulars of Strata		Name of Drilling Company: J&S DRILLING							
0.0	2.0	BROWN SILTY SAND		Name of Driller: JORDAN BEGG							
2.0	8.4	RED SILTY CLAY (DRY)		Name of supervising driller: _____							
8.4	10.0	YELLOW/GREEN SILTY CLAY		Date Commenced: 29/09/16							
				Date Completed: 29/09/16							
				Depth Drilled: 10.0m (m)							
				Completion Depth: 10.0m (m)							
METHOD OF DRILLING											
Other		Auger		Rev. Circ.		Rotary Air					
<input type="checkbox"/>		<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>					
Specify: _____											
HOLE DIAMETER				DRILLING FLUID							
From (m)	To (m)	Dia. (mm)		Type							
0.0m	10.0	200		NIL.							
PARTICULARS OF CASING				PARTICULARS OF PERFORATIONS OR SCREEN STRINGS							
From	To	Dia (ID)	Type	From	To	Dia (ID)	Aperture	Type			
0.0	6.0	50mm	PVC U8	6.0	10.0	50mm	0.5mm	PVC U18 THREADED			
Casing Suspended: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>				Top of Packer Set at: N/A (m)							
Method: HEAVY				Length of Packer: _____ (m)							
Height of Casing above GL: 0.1m below G.L (m)				Method of Packer Connection: _____							
CEMENTING/GRAVEL PACKING			WATER BEARING BEDS								
From	To	Type	Depth (m)	Yield	SWL	Duration	Quality	EC	pH	Bottle No.	
5.0	10.0	12-20 GRAVEL PACK	8.4	10.0	0.05	8.4	1				
0.0	5.0	BENTONITE CURPS									
STRATA / WATER SAMPLES			Completion Yield: 0.05 (L/s) Method: BAILEY				Duration: _____ (hr)				
Have been <input checked="" type="checkbox"/> Will be <input type="checkbox"/>			Completion SWL from GL: 8.4 (m)				Depth of Lift: 9.5 (m)				
Left at: TRACE ENVIRONMENTAL											

NOTE: No company advertising is to be imprinted on this certificate apart from where requested.

LOCATION SKETCH OF BORE RN: 039972	LOCATION DESCRIPTION OF BORE									
	<p style="text-align: center;">0.5 km m/km</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td>NW <input checked="" type="checkbox"/></td> <td>North <input type="checkbox"/></td> <td>NE <input checked="" type="checkbox"/></td> </tr> <tr> <td>West <input type="checkbox"/></td> <td style="text-align: center;"></td> <td>East <input type="checkbox"/></td> </tr> <tr> <td>SW <input type="checkbox"/></td> <td>South <input type="checkbox"/></td> <td>SE <input type="checkbox"/></td> </tr> </table> <p>OF: CASUARINA SHOPPING CENTRE</p>	NW <input checked="" type="checkbox"/>	North <input type="checkbox"/>	NE <input checked="" type="checkbox"/>	West <input type="checkbox"/>		East <input type="checkbox"/>	SW <input type="checkbox"/>	South <input type="checkbox"/>	SE <input type="checkbox"/>
NW <input checked="" type="checkbox"/>	North <input type="checkbox"/>	NE <input checked="" type="checkbox"/>								
West <input type="checkbox"/>		East <input type="checkbox"/>								
SW <input type="checkbox"/>	South <input type="checkbox"/>	SE <input type="checkbox"/>								

FINAL CONSTRUCTION STATUS

Capped <input checked="" type="checkbox"/>	Casing Pulled <input type="checkbox"/>	Left for Obs. <input type="checkbox"/>	Abandoned <input type="checkbox"/>	Equipped <input type="checkbox"/>	Backfilled <input type="checkbox"/>	Other <input type="checkbox"/>
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ADDITIONAL INFORMATION ABOUT THE BORE: (Include any information which may assist for future reference)

BORE FOR MONITORING OF FUEL TANKS UNDERGROUND
BORE UNDER FUSH MOUNT GATIC COVER.

Note: The holder of the NT licence shall submit the form to the Department within 28 days of completion of any works.

I certify that the information contained above is true and correct, and that I have complied with the bore licensing requirements and conditions of the Bore Construction Permit as issued if a Bore Construction Permit was required.

Name and licence number of driller: JORDAN BEER	Signature and licence number of licensed driller: 186	Date: 06 / 10 / 16
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FOR OFFICIAL USE ONLY

How Located:	GPS <input checked="" type="checkbox"/>	TST <input type="checkbox"/>	Survey <input type="checkbox"/>	Hand Plotted <input type="checkbox"/>	Other <input type="checkbox"/>
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DESCRIPTION OF PROPERTY:

Rural <input type="checkbox"/>	Mineral <input type="checkbox"/>	Pastoral <input type="checkbox"/>	Reserve <input type="checkbox"/>	VCL <input type="checkbox"/>	Other <input checked="" type="checkbox"/>
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Lease No:	Lot No: 9288	Hundred of:
Portion No:	Section No:	Town of: NIGHTCLIFF

Class of Bore:	Town <input type="checkbox"/>	Domestic <input type="checkbox"/>	Investigation <input checked="" type="checkbox"/>	Agriculture <input type="checkbox"/>	Mineral <input type="checkbox"/>	Pastoral <input type="checkbox"/>	Other <input type="checkbox"/>
Use of Bore:	Production <input type="checkbox"/>	Investigation <input type="checkbox"/>	Irrigation <input type="checkbox"/>	Observation <input type="checkbox"/>	Monitoring <input checked="" type="checkbox"/>	Roads <input type="checkbox"/>	None <input type="checkbox"/>

Grid Reference:	AMG <input checked="" type="checkbox"/>	Clark <input type="checkbox"/>	Zone: 52	Scale:
Easting: 704793	Latitude:	Map Name:		
Northing: 8631567	Longitude:	Index Map Number: 80/10404		

Date Registered:	Bore Plotted on the map? Yes <input type="checkbox"/> No <input type="checkbox"/>
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Dept Officer:	Signature:
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Remarks: S/B 0815

CLINIC PARKING ONLY



RN039972

LOCATION SKETCH OF BORE RN: 039973	LOCATION DESCRIPTION OF BORE									
<p>BOB JANE TMARLT.</p> <p>CALTEX WOOLWORTHS SUDS</p> <p>FUEL BANKS</p> <p>BORE LOCATION</p> <p>TRANSER ROAD</p> <p>CASUARINA SHOPPING CENTRE (CARPARK).</p> <p>N ↑</p>	<p>0.5 km m/km</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td>NW <input checked="" type="checkbox"/></td> <td>North <input type="checkbox"/></td> <td>NE <input checked="" type="checkbox"/></td> </tr> <tr> <td>West <input type="checkbox"/></td> <td style="text-align: center;">↔</td> <td>East <input type="checkbox"/></td> </tr> <tr> <td>SW <input type="checkbox"/></td> <td>South <input type="checkbox"/></td> <td>SE <input type="checkbox"/></td> </tr> </table> <p>OF: CASUARINA SHOPPING CENTRE.</p>	NW <input checked="" type="checkbox"/>	North <input type="checkbox"/>	NE <input checked="" type="checkbox"/>	West <input type="checkbox"/>	↔	East <input type="checkbox"/>	SW <input type="checkbox"/>	South <input type="checkbox"/>	SE <input type="checkbox"/>
NW <input checked="" type="checkbox"/>	North <input type="checkbox"/>	NE <input checked="" type="checkbox"/>								
West <input type="checkbox"/>	↔	East <input type="checkbox"/>								
SW <input type="checkbox"/>	South <input type="checkbox"/>	SE <input type="checkbox"/>								

FINAL CONSTRUCTION STATUS

Capped <input checked="" type="checkbox"/>	Casing Pulled <input type="checkbox"/>	Left for Obs. <input type="checkbox"/>	Abandoned <input type="checkbox"/>	Equipped <input type="checkbox"/>	Backfilled <input type="checkbox"/>	Other <input type="checkbox"/>
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ADDITIONAL INFORMATION ABOUT THE BORE: (Include any information which may assist for future reference)

BORE FOR MONITORING OF FUEL TANKS UNDER GROUND
BORE UNDER FLUSH MOUNT GATIC COVER.

Note: The holder of the NT licence shall submit the form to the Department within 28 days of completion of any works.

I certify that the information contained above is true and correct, and that I have complied with the bore licensing requirements and conditions of the Bore Construction Permit as issued if a Bore Construction Permit was required.

JORDAN BERT
Name and licence number of driller: *Jordan Bert* 186 Signature and licence number of licensed driller: Date: 06 / 10 / 16

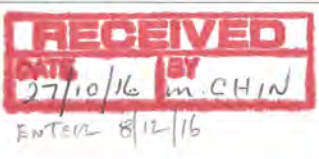
FOR OFFICIAL USE ONLY

How Located: GPS TST Survey Hand Plotted Other

DESCRIPTION OF PROPERTY:

Rural <input type="checkbox"/>	Mineral <input type="checkbox"/>	Pastoral <input type="checkbox"/>	Reserve <input type="checkbox"/>	VCL <input type="checkbox"/>	Other <input checked="" type="checkbox"/>
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Lease No: Lot No: 9288 Hundred of: Town of: NIGHTCLIFF



Class of Bore:	Town <input type="checkbox"/>	Domestic <input type="checkbox"/>	Investigation <input checked="" type="checkbox"/>	Agriculture <input type="checkbox"/>	Mineral <input type="checkbox"/>	Pastoral <input type="checkbox"/>	Other <input type="checkbox"/>
Use of Bore:	Production <input type="checkbox"/>	Investigation <input type="checkbox"/>	Irrigation <input type="checkbox"/>	Observation <input type="checkbox"/>	Monitoring <input checked="" type="checkbox"/>	Roads <input type="checkbox"/>	None <input type="checkbox"/>

Grid Reference: AMG Clark Zone: 52 Scale:

Easting: 704813 Latitude: Map Name:

Northing: 8631593 Longitude: Index Map Number: 80/10405

Date Registered: Bore Plotted on the map? Yes No

Dept Officer: Signature:

Remarks: s/B 0815



RNO39972

APPENDIX B: EA REVIEW: REMEDIATION ACTION PLANS

29 March 2021

Ray Laurence Constructions

6 Raphael Road
Winnellie NT 0820

Attention: **Tom Cairns**
Project Manager

Dear Tom,

Contaminated Land Auditor (CLA) review of the Remediation Action Plan for 77 Lakeside Drive, Alawa, NT

Please find attached our comments (in **Table 1**) following review of the report:

- SLR Consulting (SLR) (2021). *Remediation Action Plan, 77 Lakeside Drive, Alawa, NT, DRAFT*, dated 10 March 2021. Reference 680.30054.00000-R02-v0.1.

In summary, the RAP omits crucial background information as to the requirement for remediation works on site, and has several inconsistencies with the findings of the site investigation report. In my view once these have been addressed the plan can be finalised.

It is recommended that consideration be given to review of the contents and structure of the RAP against statutory guidelines such as:

- NT EPA (2017) *Northern Territory contaminated land guideline*. Appendix F: Remediation reporting checklist. Version 1.0, June 2017.
- NSW EPA (2020) *Contaminated land guidelines: consultants reporting on contaminated land*. Table 2.5: Remedial action plan. Updated 5 May 2020.
- National Environment Protection Council (NEPC) (2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999*. Policy Framework. 16 May 2013.

If you have any queries concerning this correspondence, please contact the undersigned on (07) 3852 6666.

For and on behalf of
Environmental Earth Sciences QLD

Mark Stuckey CPSS CSAM
Contaminated Land Auditor

Dr Anna Sheldon CPSS CSAM
Auditor's Assistant

721016 Lt1



Table 1: Report Comments

Item	Section(s) in report	Environmental Earth Sciences Comments
1	Executive Summary	Mark Stuckey is from Environmental Earth Sciences, not Australian Environmental Auditors. Perhaps the Executive Summary could benefit from a brief summary of the findings of the assessment, and the chosen remedial method/s?
2	Table of Contents	This section appears to have the incorrect heading (“Document References”).
3	Figures	Figures have not been supplied (or listed in the table of contents), despite being referenced in the text.
4	1. Introduction	Paragraph 1 says that Figure 2 shows the “area of remediation”, but figures have not been provided (or listed other than Figure 1). Some of the language in the document is unclear. For example, line three of paragraph 3 states “...to assess the presence of ACM in subsoil surface across the Site.” Do you mean soil surface, or the surface of the subsoil layer (i.e. top of B-horizon)?
5	2. Background information	The RAP does not provide adequate background information as to why remediation is required. Minimal information is provided as to the presence, source and distribution of asbestos materials at the site (i.e. development of the preliminary conceptual site model [CSM]). The RAP should provide sufficient information regarding the CSM, site history and extent of contamination to clearly establish the remediation requirements.
6	2.2.2 Sub-surface infrastructure	The sentence ending “ Appendix B are for reference only...” appears incomplete?
7	3. Remediation Strategy	Remediation criteria are not provided, and remediation objectives and targets (including in a table) as required by NT EPA (2017, Appendix F) not discussed or listed. Guidelines relevant to the remediation works are not included. The structure of this entire section could be revisited. For example, should goals be discussed up-front, and the extent of remediation is discussed prior to options and methodology. It is recommended that NT EPA (2017, Appendix F), NSW EPA (2020, Table 2.5) and NEPC (2013, Policy Framework, Principle 16) be considered.
8	3.2 Extent of remediation	The description of the remediation areas outlined as the ‘hotspot’ and ‘remainder of site’ do not match the observations of asbestos occurrence described in the site investigation. They also do not match the occurrence of asbestos indicated in Figures 3 and 4 of the investigation report.



Item	Section(s) in report	Environmental Earth Sciences Comments
9	3.2 Extent of remediation	<p>The site investigation report describes surface impacts of broken asbestos to the upper 0.2 m of soil across a large portion of the site.</p> <p>The site investigation also identifies the potential for asbestos fines to be present due to breakdown of asbestos pieces, and the potential for ground disturbance to result in further breakdown of asbestos fragments. With consideration of the current distribution of asbestos fragments and intended site use, it is expected that the emu bob may not provide adequate asbestos removal to depth, and that tilling may result in further breakdown and spreading of asbestos fragments.</p> <p>Further consideration of the distribution of asbestos impact to the surface and selective excavation of impacted surface soils is recommended.</p>
10	3.4 Remediation options	<p>The remediation options assessment indicates that any option that involves leaving asbestos on site, via encapsulation or other means, as not permissible, however no explanation for this is given.</p> <p>The site development includes a building and carpark – and therefore a substantial area of hardstand which would provide a barrier against asbestos exposure. Please provide further information as to why containment is unacceptable.</p>
11	3.4 Remediation options	<p>The remediation options assessment does not include a comparison between the emu pick/ tilling method for clearance of the site surface and excavation and removal (or encapsulation) of this material.</p> <p>The emu pick/ tilling option also ignores the potential for incomplete removal of asbestos from the surface picked area.</p>
12	4 Remediation methodology	<p>A meeting with site stakeholders held on 18 February 2021 indicated conducting site works (tilling/ raking) during times that the neighbouring childcare centre was not occupied. Does this remain a consideration?</p> <p>At the time of this meeting it was also indicated that no soil was to be taken off site. How has this changed regarding the remediation strategy regarding the 'hotspot' and stockpiles? And is this the main driver for the hand pick/ tilling method?</p>
13	4 Remediation methodology	<p>The remediation methodology should outline the sequencing of the various remediation components more clearly.</p> <p>The methodology for tilling and handpicking describes the option for excavation of discrete areas, however no methodology for this option is provided.</p>
14	4.1.2 Hand picking	<p>Suggest that vegetation removal or management is an essential step in ensuring the effectiveness of an emu bob on the site. Consideration should be given as to whether vegetation cover will allow an emu bob to be conducted, and whether sufficient vegetation clearance can be conducted safely.</p>
15	4.1.4 Excavation procedure	<p>Regarding the 'hotspot' excavation – this section is the first mention of the remnants of the fence. Explanation for the presence of the fence and requirement for remediation should be included earlier in the RAP.</p> <p>The description of this section indicates that it could be considered to be removal of residual asbestos containing infrastructure, rather than a 'hotspot'. None of the borelogs in the site investigation report indicate the presence of asbestos at depth.</p>



Item	Section(s) in report	Environmental Earth Sciences Comments
16	4.1.6 Air monitoring	Reference missing in final paragraph. As the site is a long, thin rectangle, placement of the air monitors should consider the work area and potential receptors, rather than be returned to the same positions.
17	Table 8 Soil sampling methodology	Please confirm that all wall validation samples will be analysed for presence/ absence. The presence of residual asbestos fines in the emu bob/ tilled surface is considered high risk due to the potential for breakdown of asbestos fragments.
18	Other monitoring and site controls	Other air monitoring and site controls listed in the RAP are considered appropriate, however the RAP is missing a range of the standard controls around work times, noise, odour, dust, complaints, unexpected finds etc.
19	6 References	Is the Douglas Partners 2019 John Stokes Square redevelopment reference relevant? What is the rest of the reference for Nott <i>et. al.</i> 1983? The ASTM 2014 reference does not appear to be used in the report. No reference for the SLR site investigation, or the Douglas Partners and WANT Geotechnics investigations. Relevant OHS guidelines not referenced – air monitoring etc.
20	Figure 3	Test pit 4 is indicated to contain asbestos, but is outside the indicated remediation area. What is the explanation for this?
21	Figures 3 and 4	These figures show test pits TP01 – TP21, and TP01-1 – TP12-1 respectively. Figure 3 shows five additional 'Investigation test pits' which are unlabelled. The site investigation report includes one set of borelogs for TP1 – TP19. Which do these refer to, and where are the remaining logs?

ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services

The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. It cannot be relied on by any other third party for any purpose except with our prior written consent. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for. However, any party wishing to rely on this report should contact us to determine the suitability of this report for their specific purpose.

Data should not be separated from the report

A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change

Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated, or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Problems with interpretation by others

Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences QLD. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light we reserve the right to alter their conclusions.

Obtain regulatory approval

The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability

This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences QLD disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences QLD disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences QLD's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

27 May 2021

Ray Laurence Constructions

6 Raphael Road
Winnellie NT 0820

Attention: **Tom Cairns**
Project Manager

Dear Tom,

Contaminated Land Auditor (CLA) review of the Remediation Action Plan (RAP) for 77 Lakeside Drive, Alawa, NT

Please find attached our comments (in **Table 1**) following review of the report:

- Prensa (2021). *Remediation Action Plan, 77 Lakeside Drive, Alawa, NT*, DRAFT, dated May 2021. Reference 93551B.

In summary, the CLA considers that the RAP requires some amendment (refer **Table 1**) in order to detail an appropriate methodology for the remediation of asbestos contamination, such that the site may be rendered suitable for the proposed future use.

Specifically, further consideration is required with respect to:

- the appropriateness of “emu picking and raking” and visual validation alone for asbestos contamination where there is a potential for asbestos fines to be present due to the breakdown of asbestos pieces (and for this breakdown to be exacerbated by use of raking tools); and
- validation sampling for both asbestos fines (AF) /friable asbestos (FA) and chemicals of potential concern (CoPCs) namely metals, TRH, BTEXN, PAH, OCPs and OPPs, which to date have not been investigated to sufficient density to confidently conclude the site is suitable for its proposed end use.

Furthermore, it is recommended that the content and structure of the document is reviewed against statutory guidelines to ensure all relevant and required sections are included in the final report document, namely:

- NT EPA (2017) *Northern Territory contaminated land guideline*. Appendix F: Remediation reporting checklist. Version 1.0, June 2017.
- NSW EPA (2020) *Contaminated land guidelines: consultants reporting on contaminated land*. Table 2.5: Remedial action plan. Updated 5 May 2020; and



- National Environment Protection Council (NEPC) (2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999*. Policy Framework. 16 May 2013.

If you have any queries concerning this correspondence, please contact the undersigned on (07) 3852 6666.

For and on behalf of
Environmental Earth Sciences QLD

Mark Stuckey CPSS CSAM
Contaminated Land Auditor

Kat Spruth
Auditor's Assistant

721016 Lt2

Table 1: Report Comments

Item	Section(s) in report	Environmental Earth Sciences Comments
1	General	Throughout: A number of spelling and grammatical errors (e.g. plural agreement/ sense) have been identified. Please review and amend as necessary.
2	Figures	<p>Please provide the following additional figures:</p> <ul style="list-style-type: none"> ● Site regional locality (site location figure). ● Site layout/ features plan: this figure should include key site features pertinent to the remediation effort including the asbestos cement fence, stockpile locations and asbestos observed at surface. ● Historic investigation location and exceedances plan: this figure should clearly demonstrate where contamination (both surface and in-ground) has been identified thereby providing clarity on the remediation proposed to be completed at the site. ● Sampling location figure(s) showing proposed validation locations for AF/ FA following remediation works and additional validation/ site characterisation samples for additional CoPCs namely metals, TRH, BTEXN, PAH, OCP and OPPs which, to date, have not been investigated to sufficient density to confidently conclude the site is suitable for its proposed end use. <p>Figure 1 (appended):</p> <ul style="list-style-type: none"> ● Figure 1: While it is acknowledged this Figure is provided to define an overall remediation area, this figure is unclear. What is the intended difference between “remediation zone” and “asbestos removal work” – do these two activities not both represent asbestos remediation (noting the “asbestos removal work” appears to encompass areas where emu picking of surface fragments, a form of remediation, is intended)? Consider updating both figure and accompanying legend for clarity. <p>It is the CLAs opinion that Figure 1, in the absence of historic information, does not adequately demonstrate that the remediation areas defined will be adequate to remove all asbestos contamination at the site. Inclusion of information with respect to surface ACM observations and asbestos exceedances is required.</p> <p>Please ensure figure references are included in the Table of Contents.</p>
3	3 Contaminated land auditor	<ul style="list-style-type: none"> ● General: This section appears wholly out of place when considered alongside the provided subsections that have no relevance on this first paragraph. Please review for sense and logical flow. Is it possible that this is meant to be a sub-section? <p>Section 3.1</p> <ul style="list-style-type: none"> ● General: Again, this section appears out of place and may be better placed in the site description section? With tabulated details of the site address/ lotplan/ size and so on. It is recommended sections 1 to 5 are reviewed for logical content, order of presentation and clarity. ● It would be worthwhile referring to a Figure (see comment 2 above) to better demonstrate location and lateral extent of asbestos impacts at the site. ● Plate 1: Please ensure all “in text” figures have a north arrow, scale bar (or “not to scale”) and legend.

Item	Section(s) in report	Environmental Earth Sciences Comments
4	3.4 Interpretation of previous investigations	<ul style="list-style-type: none"> <p>Paragraph 7 (bottom of p5): The CLA disagrees with this statement. To date, insufficient sampling for chemicals of potential concern (non-asbestos) has been completed to confidently characterise site condition. Further assessment for CoPCs other than asbestos during site remediation/ validation activities is deemed necessary to adequately validate site condition. Note this requirement has previously been discussed and agreed with NT EPA (meeting 18/02/2021).</p> <p>Please incorporate an appropriate soil sampling program (methodology, sampling frequency and analytical schedule) for further site characterisation (to be undertaken alongside remediation/validation activities) in an appropriate section.</p> <p>Also please note a program of validation sampling to confirm for AF/ FA (particularly in areas where surface ACM, broken and transported from the existing asbestos fence) will be required as part of site validation activities (refer to commentary below).</p> <p>Paragraph 8 (bottom of p5 and on to p6): <i>“high degree of confidence that the asbestos contamination is confined to bonded ACM in surficial soils at the site.... the method of dispersion across the site being surficial mechanical works associated with the clearance of vegetation across the site.”</i></p> <p>If ACM sourced from the fence is deemed likely to have been spread across the site by mechanical means, does it not stand to reason that AF could also be present in these areas as a result not only of the initial breakage/ degradation of the fence structure, but also due to the act of mechanical dispersion?</p> <p>In consideration of both the source and inferred transport/ dispersal pathway, the CLA does not concur that sufficient evidence is currently available to confirm asbestos impact is restricted to bonded ACM in surface soils. Consequently, it is considered that remediation solely by emu-picking and visual validation may not provide sufficient asbestos removal to depth nor provide sufficient confidence that all potential asbestos impacts have been removed.</p> <p>The CLA considers that emu picking followed by targeted shallow surface scrapes corresponding to mapped areas of “surface ACM” impacts would be preferable, to provide greater confidence that asbestos impacts are removed. Validation sampling for AF/ FA should also then be undertaken in these areas.</p>
5	6.2 Adopted assessment criteria	<p>General structural query: What is the purpose of having a separate “adopted assessment criteria” and “remediation validation criteria” for the site? The RAP should establish clear remedial targets (and therefore validation criteria) with details of their derivation supplied (with reference to site specific risk assessment/ investigation reports).</p> <p>As per comment 4 above, the CLA does not agree with the assertion that “...based on the site history assessment, the presence of FA/AF is unlikely. As such FA/AF is not considered a CoPC and no assessment criteria has been adopted.” (Section 6.2 p10).</p> <p>The CLA notes the SLR site investigation report describes surface impacts of broken asbestos to the upper 0.2 m of soil across a large portion of the site and identifies the potential for asbestos fines to be present due to breakdown of asbestos pieces, and the potential for ground disturbance to result in further breakdown of asbestos fragments. Furthermore, FA/AF was only assessed in 12 soil samples.</p> <p>Given the above AF/FA should be considered a potential CoPC, particularly in areas where extensive surface ACM has been identified which may have been broken/ damaged <i>in-situ</i> and/or damaged during transport across the site.</p> <p>Consequently, appropriate assessment criteria should be defined and a validation sampling regime to confirm absence of AF/FA (particularly focused in and around areas where surface ACM has been identified) should be included in an appropriate section.</p>
6	7 Estimated extent of contamination	Please refer to comment 2 with respect to required Figures and required overlays for clarity.

Item	Section(s) in report	Environmental Earth Sciences Comments
7	8 Conceptual site model	<p>The conceptual site model (CSM) does not adequately address risks associated with the potential presence of asbestos fines due to the degradation of asbestos pieces (particularly in areas where multiple surface ACM fragments have been detected having been mechanically dispersed offsite) and/or the potential for further ground disturbance to further break down these pieces.</p> <p>This is a potentially complete pathway which the remediation should address, and which the nominated validation activities should confirm is no longer a risk. It is the CLAs opinion this can only be achieved by a combination of visual validation for ACM fragments and asbestos presence/ absence testing to confirm no release of fibres. The potential risk of fibre release to soils disturbed during site activities is as important as the potential for fibre releases to air.</p>
8	8.1 Asbestos removal work area and remediation zones	Please refer to comment 2 with respect to the adequacy of Figure 1, additional information and additional figures required.
9	9 Remediation Goals	<p>While emu-picking is considered a suitable remediation method for fragments of ACM identified at surface, the CLA notes that the SLR investigation report (Section 4.2.1 p16) describes that “<i>numerous suspected ACM debris were scattered on surface across the Site</i>” and identifies the potential for asbestos fines to be present due to breakdown of asbestos pieces “<i>generated during earthworks onsite and plant/ equipment impacting the fence line</i>”, and the potential for ground disturbance to result in further breakdown of asbestos fragments.</p> <p>With consideration of the current distribution of asbestos fragments and intended site use, it is considered that an emu bob may not provide adequate asbestos removal to depth, and that raking may result in further breakdown and spreading of asbestos fragments.</p> <p>Further consideration of the distribution of asbestos impact to the surface and selective excavation of impacted surface soils is recommended. For example, a reasonable approach could be to use the “mapped” surface ACM fragments to identify areas for targeted surface scrapes of topsoil, thereby removing any ACM and any associated break-down products. This would ensure both surface ACM and any associated fines are adequately removed. These areas should then be validated visually (for ACM) and via an appropriate AF/FA sampling and analysis program.</p> <p>Please update this section to include an appropriate validation strategy for AF/FA, additional site characterisation sampling for other CoPCs and include suitable validation criteria for all of the above.</p>
10	9.2 Imported materials criteria	In the event that a certificate of clean fill is not supplied, on what basis will a report by a SQP be provided to confirm the suitability of material for reuse? Please provide information with respect to appropriate imported material validation (i.e. visual inspection, sampling regime including frequency and analytical suite).
11	13 Remediation Procedures	This section appears out of place – referencing remediation preparatory items already discussed earlier in the document. For example – if site establishment and air monitoring is considered a “remediation procedure” should details of the activities/ methodology to be employed not be incorporated into the “remediation procedures” section? Please review the order of the document for logic and clarity.
12	13.1 Stockpile abatement	While the CLA recognises that mechanical sorting and hand-picking is a reasonable strategy for removing visible ACM from a stockpile or ground surface, hand-picking may not provide adequate asbestos removal if fines are present. Further, it is possible the act of using a shaker bucket may result in further breakdown of asbestos. As a result, visual inspection alone is considered insufficient, and validation sampling for AF/ FA to confirm asbestos status should be included to confirm “clean fill” classification and suitability for onsite reuse.



Item	Section(s) in report	Environmental Earth Sciences Comments
13	13.2 Surface contamination (Emu Pick)	<ul style="list-style-type: none"> Refer to comment 9 above regarding emu picking. What is the current site condition with respect to vegetation? Suggest that vegetation removal or management is an essential step in ensuring the effectiveness of an emu bob on the site. Consideration should be given as to whether current vegetation cover will allow an emu bob to be conducted, and whether sufficient vegetation clearance can be conducted safely. Note: A meeting with site stakeholders held on 18 February 2021 indicated conducting site works (raking) during times that the neighbouring childcare centre was not occupied. Does this remain a consideration? If so – this requirement should be specified.
14	13.3 In-situ corrugated cement sheeting	Visual validation alone is unsuitable to determine impacts (or otherwise) of a stockpile following excavation of soils in the vicinity of the fence. Given its age, noted fragments breaking from the fence and the potential for AF/FA materials to be present (either a result of degradation with age, or damage during removal activities), validation sampling will also be required. An AF/FA validation program of remaining soils should also be completed to provide sufficient confidence that no asbestos impacts remain.
15	13.5 Dust suppression	The CLA considers use of water for dust suppression should be sufficient. If Prensa suggests a contractor should use surfactant/ foam then strict requirements for selection and use should be provided to prevent further contamination to site surface.
16	14 Validation/ clearance inspections	<p>General: As discussed above, remediation via emu picking and raking followed by visual validation of the site surface is insufficient to confirm all asbestos contamination has been removed from the site. Please incorporate a validation sampling regime for AF/FA and other CoPCs.</p> <p>Please also review and amend as necessary with respect to commentary on targeted surface scrapes in the vicinity of ACM fragments identified at surface, to provide confidence that any associated fines have been removed.</p>
17	14.1 Stockpile Abatement	<p>How is emu picking and visual validation considered suitable for the remediation of the potentially impacted stockpile generated during fence removal activities? This method will only confirm removal of asbestos contamination from the stockpile surface? Please refer to comment 12 regarding stockpile abatement procedures.</p> <p>Please provide information with respect to validation under the stockpile.</p>
18	14.2 Surface remediation	As per comment 17 above, given ACM has been distributed across the site surface, there remains a potential for AF at site surface and in shallow soils. Visual validation alone is insufficient – an AF/FA validation sampling program (in areas where surface ACM has been identified) is required.
19	14.3 In-situ corrugated cement sheeting	Given ACM has broken from the corrugated fence and subsequently been distributed across site surface, there remains a potential for AF at site surface and in shallow soils. Visual validation alone is insufficient – an AF/FA validation sampling program along the fence line, once removed, is required to provide sufficient confidence that all asbestos impacts have been removed.
20	15.1 Soil and sediment control	Please review this section for sense and clarity. Is this section intended to provide information on erosion and sediment control (it is noted a specific, brief erosion/ sediment control section is provided as section 12.5)? Or soil management for onsite reuse/ off-site disposal? This section is unclear.
21	Additional section	Please provide further information with respect to remediation activities proposed within the “exclusion zones” previously identified by SLR due to presence of underground services.



Item	Section(s) in report	Environmental Earth Sciences Comments
22	Additional sections (refer NT EPA, 2017)	<p>The report is missing key components as required by NT EPA (2017). Please review report content and structure against statutory guidelines, specifically NT EPA (2017) and NSW EPA (2020) and update as necessary.</p> <p>For example (note this may not be an exhaustive list):</p> <ul style="list-style-type: none">• Remedial options assessment including available options, evaluation, reference to preferred remediation hierarchy and summary of rationale for <i>remediation</i> approach selected.• Remediation Plan/ remediation procedures: Please include reference to all relevant licences and approvals (local/ state government), documentation of discussion with stakeholders (noting information pertaining to agreements with NT EPA during the meeting held on 18/02/2021).• It is also noted that site management information appears to be incomplete. Further detail with respect to site management procedures including (but not necessarily limited to the following) should be documented:<ul style="list-style-type: none">• Any noise control requirements,• operating hours (noting potential restrictions associated with the neighbouring childcare centre hours of operation),• stormwater management/ erosion sediment control,• remediation schedule,• contingency actions (to respond to site incidents/ should areas fail validation).
23	References	Please include a complete and up to date reference list including relevant statutory guidelines, relevant legislation and previous consultant reports used in the preparation of this RAP.

ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

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Subsurface conditions change

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Problems with interpretation by others

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Obtain regulatory approval

The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability

This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences QLD disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences QLD disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences QLD's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

APPENDIX C: EA PROVISIONAL CONSTRUCTION APPROVAL

28 July 2021

Ray Laurence Constructions

6 Raphael Road
Winnellie NT 0820

Attention: **Charles Dickman**
Managing Director

Dear Charles,

Contaminated Land Auditor (CLA) Provisional Construction Approval, 77 Lakeside Drive, Alawa, NT

1 Introduction

Please find below (Sections 2.1 and 2.2) our comments based on site inspection observations (completed 22 July 2021) and a review of the following reports and supporting data supplied with respect to asbestos remediation and verification activities for chemicals of potential concern (CoPCs) at 77 Lakeside Drive, Alawa, Northern Territory (the site):

- Prensa (2019). Preliminary Site Investigation, Lot 9260, Town of Nightcliff, Northern Territory (20 June 2019);
- SLR (2021a). Site Investigation and Asbestos Contamination Assessment, 77 Lakeside Drive, Alawa, NT (10 January 2021);
- SLR (2021b). Remediation Action Plan, 77 Lakeside Drive, Alawa, NT (10 March 2021);
- Prensa (2021a). Document review, ACM in Soil for the property located at 77 Lakeside Drive, Alawa, Northern Territory (16 April 2021);
- Prensa (2021b). Draft Remediation Action Plan, 77 Lakeside Drive, Alawa Northern Territory, prepared for Ray Laurence Constructions, June 2021;
- Prensa (2021c). Asbestos Clearance Certificate – Asbestos Remediation Works conducted at 77 Lakeside Drive, Alawa, NT (21 July 2021); and
- ALS Environmental (2021). Certificate of Analysis, report ES2124684 (15 July 2021).



2 Summary of findings

2.1 Site inspection

The CLA's assistant completed a site inspection of the final, remediated site surface on 22 July 2021 alongside representatives of the Northern Territory Environment Protection Authority (NT EPA) and Ray Laurence site representative (Charles Dickman).

The observations of the inspection confirmed all asbestos containing material (ACM) associated with the former corrugated cement sheet fencing had been removed from site. No evidence of residual ACM fragments, either in the vicinity of trenching (fence removal), within spoil stockpiles (generated during fence removal excavations), or across site surface, was observed.

Based on the site inspection observations, it is the opinion of the CLAs assistant that remediation works, asbestos validation and verification sampling has been completed in accordance with the endorsed RAP (Prensa, 2021b) and relevant legislation and guidance.

It is noted that additional remediation works (chase-out and removal of additional ACM fencing that was identified during initial fence removal activities) and shallow trenching on a high-density grid basis to verify absence of ACM, within the proposed outdoor play area, was completed as per correspondence (email/ phone conversations) with the CLA.

2.2 Remediation and verification activities

2.2.1 Asbestos remediation and validation activities

Asbestos remediation activities were undertaken at the site between 24 June and 9 July 2021, comprising the excavation and removal of former corrugated cement sheet fencing, raking and associated surface impacts. It is understood air monitoring for the duration of works, ACM removal supervision, emu picking, raking and tilling, visual validation activities (for ACM) and validation sampling (for asbestos fines/ fibres [AF]) were undertaken by a suitably qualified, occupational hygienist.

Based on a review of the Asbestos Clearance Certificate (Prensa, 2021c), correspondence with Prensa and Ray Laurence during remedial works and the results of the CLA assistant's site inspection, the CLA is comfortable that all works were undertaken in accordance with the approved RAP and relevant legislative requirements.

Consequently, the CLA concurs with Prensa's conclusions that:

- The asbestos removal works conducted by ANT Asbestos Solutions (ANT)¹ (under Prensa's supervision) were undertaken to a reasonable and practical level.

¹ ANT is licenced to remove friable (Class A, friable) and bonded asbestos (Class B, bonded) as approved under the *Work Health and Safety Regulation 2011* by the Work Cover Authority of the Northern Territory of Australia.

2.2.2 Verification sampling (other CoPCs)

As per the CLA and NT EPAs requests, additional sampling for non-asbestos CoPCs (verification sampling) was completed at the site on 5 July 2021. A total of 4 soil samples (VER01 to VER04) were collected across the site to augment the soil sampling program completed during the preliminary and detailed site investigation (PSI and DSI) phases (Prensa 2019 and SLR 2021a) and submitted to a NATA accredited laboratory (ALS) for a broad range of CoPCs².

The results of the verification sampling (ALS, 2021) were consistent with those of the DSI, confirming CoPCs were less than adopted assessment criteria and/or laboratory limit of reporting (LOR) and thus do not pose a human health and/or ecological risk and do not preclude the sites redevelopment as a childcare centre.

2.2.3 Summary

Given the above, the CLA considers with respect to asbestos (ACM and AF) that following remediation, the site has been rendered suitable for the proposed future use. That is, no potential human health and/or ecological risk associated with either asbestos or other CoPCs currently exists at the site, that would preclude development as a childcare centre.

3 Conclusions and recommendations

In conclusion, based on observations made during the site inspection (22 July 2021) and review of available site data, **the CLA approves commencement of the proposed construction activities at the site** (contingent on co-approval from NT EPA).

Construction activities must comply with the provisions of the RAP (Prensa, 2021b) particularly with respect to occupational health and safety requirements and environmental controls (e.g., erosion/ sediment control) and unexpected finds protocols (UFPs).

While it is acknowledged that the full remediation and validation report has yet to be issued by Prensa and thus a full Site Audit Report cannot yet be prepared, the CLA considers (contingent on NT EPA agreement) that sufficient evidence is currently available to approve commencement of construction in the interim (while official reporting deliverables are prepared in the background).

The CLA considers this is both a scientifically justifiable (based on a detailed review of the available data) as well as a pragmatic approach, noting the critical timeline for construction activities, accounting for the impending wet season.

Note: This approval is provided on the understanding that a full remediation and validation report detailing all asbestos remediation and verification activities will be prepared by Prensa by the end of August 2021 or thereabouts (actual date of submission to be confirmed) for

² Total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN), polycyclic aromatic hydrocarbons (PAHs), metals (arsenic, cadmium, chromium, copper, lead, nickel, mercury and zinc), and organochlorine and organophosphate pesticides (OC/OPs).

CLA review, and following this review and approval, a full Site Audit Report will be prepared for submission to the NT EPA endorsing the works completed.

4 Closing

If you have any queries concerning this correspondence, please contact the undersigned on (07) 3852 6666.

For and on behalf of
Environmental Earth Sciences QLD

Mark Stuckey CPSS CSAM
Contaminated Land Auditor

Kat Spruth
Auditor's Assistant

721016 Lt3

ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

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Obtain regulatory approval

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To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

APPENDIX A: SITE INSPECTION PHOTOGRAPHS (22 JULY 2021)



Plate 1: Site surface (view south-west)



Plate 2: Trenching to remove corrugated asbestos fencing, southern site boundary.



Plate 3: Trenching to remove additional corrugated asbestos fencing, identified along the northern site boundary.



Plate 4: Proposed outdoor play area (south-west corner of the site). Additional, shallow trenching on a grid basis to confirm absence of ACM completed in this area following identification and removal of additional corrugated sheet fencing



Plate 5: Processed "clean" stockpiles generated during trenching activities, stored on geofabric.

APPENDIX D: EA REVIEW: REMEDIATION/ VALIDATION REPORT

16 December 2021

Ray Laurence Constructions

6 Raphael Road
Winnellie NT 0820

Attention: **Charles Dickman**
Managing Director

Dear Charles,

Contaminated Land Auditor (CLA) review of the Site Remediation and Validation report, 77 Lakeside Drive, Alawa, NT

Please find attached our comments (in **Table 1**) based on a review of the following report:

- Prensa (2021) *Site Remediation and Validation Report, 77 Lakeside Drive, Alawa, NT*. For Ray Lawrence Constructions. Ref 93551B. Dated November 2021.

In summary, the CLA concurs (pending acceptance of the comments provided) with the findings of the remediation and validation report that:

- Asbestos impacts (ACM) and asbestos fines (AF)/ friable asbestos (FA) historically identified on site was adequately delineated during the investigation phase and has been appropriately remediated via a combination of emu picking (with tilling), excavation and off-site disposal in accordance with the endorsed remediation action plan (RAP, Prensa, 2021). This is supported by validation results (visual validation and analytical results for AF/ FA).
 - While it is understood one validation sample reported an AF /FA exceedance (0.002 w/w %/ criteria: 0.001 w/w%) and remains on site; on review of the laboratory analytical certificate, this exceedance was deemed attributable to a bonded ACM fragment passing through the 7mm sieve. On this basis (the material was bonded, rather than free fibres) and, given the material is located at the base of a remediation trench, buried beneath clean material; this minor exceedance is not considered to represent a risk to current and/or future site users; and
- Sufficient investigation of non-asbestos chemicals of potential concern (CoPCs)¹ has now been completed (Prensa, 2019 [PSI] augmented by additional verification sampling Prensa, 2021d) to confidently conclude there is no risk posed to current and future site users associated with exposure to soil at the site.

¹ Namely total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN), polycyclic aromatic hydrocarbons (PAHs), metals and organochlorine/ organophosphate pesticides (OCP/ OPPs)



Consequently, the CLA concurs that the site has been successfully remediated and validated and agrees that the site has been rendered suitable for the proposed future use (childcare centre).

If you have any queries concerning this report, contact the undersigned on (07) 3852 6666.

For and on behalf of
Environmental Earth Sciences QLD

Mark Stuckey
Contaminated Land Auditor

Kat Spruth
Auditor's Assistant

720016 Lt4

References

Prensa (2019). *Preliminary Site Investigation, Lot 9260, Town of Nightcliff, Northern Territory* (20 June 2019);

SLR (2021a). *Site Investigation and Asbestos Contamination Assessment, 77 Lakeside Drive, Alawa, NT* (10 January 2021);

SLR (2021b). *Remediation Action Plan, 77 Lakeside Drive, Alawa, NT* (10 March 2021);

Prensa (2021a). *Document review, ACM in Soil for the property located at 77 Lakeside Drive, Alawa, Northern Territory* (16 April 2021);

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Prensa (2021c). *Asbestos Clearance Certificate – Asbestos Remediation Works conducted at 77 Lakeside Drive, Alawa, NT* (21 July 2021); and

Prensa (2021d) *Site Remediation and Validation Report, 77 Lakeside Drive, Alawa, NT*. For Ray Laurence Constructions. Ref 93551B. Dated November 2021.

Table 1: Report Comments

Item	Section(s) in report	Environmental Earth Sciences Comments
1	General	<p>The remediation and validation report generally provides a clear, logical and stepwise narrative to the works completed at the site to remediate asbestos containing materials (ACM) and asbestos fines. However, it is important to note that the supplementary assessment completed for other contaminants of potential concern (CoPCs) to “top up” the original sampling frequencies to Australian Standard is an important component of the overall works package. Reference to this item/requirement should therefore be included in the project objectives.</p> <p>Also note, as this was “supplementary” sampling – when discussing results, it is important not only to discuss those samples collected during the supplementary works package, but also the historic investigation results upon which reliance is placed (Prensa PSI, 2019), to achieve the Australian Standard Density for these non-asbestos CoPCs. Please revisit the Section 14 discussion, the Tables section and Figures with this in mind – providing a complete dataset.</p>
2	Figures	<p>The Figures appended to the report should be sufficient to “tell the story” of the remediation and validation program. Presenting site condition (pre remediation) which essentially triggered the remediation requirements, then showing the phased remediation and validation activities completed thereafter. Consequently, please revisit this section and provide adequate figures to support the text. (Refer to the RAP as some Figures could potentially be repurposed, here).</p> <p>Particularly:</p> <p>Pre remediation site condition/setting the scene:</p> <ul style="list-style-type: none"> ● Site layout/ features plan: this figure should include key site features pertinent to the remediation effort including the asbestos cement fence, stockpile locations and asbestos observed at surface. ● Asbestos: Site condition pre-remediation. This should include historic investigation locations and exceedances clearly demonstrating where contamination (both surface and in-ground) was previously identified and thereby providing clarity on the remediation proposed to be completed at the site. <p>Supplementary Investigation (other CoPCs):</p> <ul style="list-style-type: none"> ● Other CoPCs: A figure should be provided showing historic and current investigation locations for “other CoPCs” (TRH, BTEXN, PAH, OCPs, OPPs) to clearly demonstrate that an appropriate sampling frequency/site coverage for other CoPCs was achieved. <p>Remediation/ validation:</p> <ul style="list-style-type: none"> ● It would be useful to provide a series of figures showing the phased remediation and validation activities completed at the site rather than trying to put everything on one figure. Particularly as actual remediation completed, varied from that which was proposed due to the identification of additional asbestos fencing in-ground that required removal. <p>In addition:</p> <ul style="list-style-type: none"> ● The text indicates one AF/FA exceedance (0.0002 w/w%) was present at depth following validation – this should be shown on the figure.

Item	Section(s) in report	Environmental Earth Sciences Comments
		<ul style="list-style-type: none"> Section 3.1.1 suggests some stockpiles were visually abated, and some were subject to validation sampling. Please ensure a figure is provided which shows which stockpiles were visually cleared and which were sampled (for those sampled, sampling locations should be shown). showing stockpile sampling locations. <p>Figure 2 (and other stockpile figures):</p> <ul style="list-style-type: none"> Please ensure stockpile IDs are clearly presented on the Figure, particularly as the former consultant, SLR, identified several stockpiles on site prior to Prensa's involvement, that were not associated with the asbestos excavation and remediation activities.
3	Executive Summary	Please review and update (as required) in relation to comments provided on report body, below.
4	3 Objectives	Please update the objectives to include reference to verification sampling and purpose for this assessment
5	3.1 Scope of work	<ul style="list-style-type: none"> Should this be Section 4? For clarity, please expand upon "other contaminants of concern" in this section. (i.e., reference to TRH, BTEXN, PAH, metals OCP/ OPPs).
6	4. CSM	<ul style="list-style-type: none"> Please include a sentence that effectively states "as other contaminants of potential concern were not identified at the site above LOR/ assessment criteria, no viable exposure pathways are considered to exist and thus have not been included in the CSM provided" Table 1 – Include Stockpile designations for clarity.
7	6.1.2 Site location...	<ul style="list-style-type: none"> Surrounding land uses: South?
8	NEW	Please include (or expand Section 6.1.2) to include typical site condition and surrounding environment information (e.g. soils, geology).
9	7 Identified Contamination	<ul style="list-style-type: none"> Consider re-naming to "Site condition – pre remediation". As per comment 2, please provide and reference a specific figure/figures showing historic distribution of surface ACM and AF/FA w/w% information. A summary of previous results in tabulated format may be useful and limit the requirement for lengthy additional description. While the Auditor notes references to Appendices are included, it is preferable to include key, relevant information in the report text.
10	9 Remediation Option	<ul style="list-style-type: none"> To improve the logical flow of the document, it would be worth moving Section 9 – Remediation option, before remediation objectives/ criteria.
11	10.1 Surface contamination	<ul style="list-style-type: none"> Please ensure all asbestos surface clearance and decontamination inspection certificates are included in an appendix and cross-referenced from this section. Please include brief supporting rationale for the validation sampling frequency (1 per 65 m³).

Item	Section(s) in report	Environmental Earth Sciences Comments
		<ul style="list-style-type: none"> • Please tabulate laboratory analytical data for asbestos validation samples and present in the Tables section. • Was asbestos fibre monitoring completed during raking and tilling? Please provide information, include fibre monitoring results in an appendix and cross-reference.
12	10.2 Stockpile Abatement	<ul style="list-style-type: none"> • For clarity it would be preferable to tabulate the data provided per Stockpile. Headings could include: <ul style="list-style-type: none"> • Stockpile ID, • volume, • Validation type (visual/sampled), • Clearance certificate reference/ date (where visual validation was completed) • Number of samples (where samples collected) • Fate (off-site disposal/ reuse). • Refer comment 2 regarding figures.
13	10.3 <i>In-situ</i> Corrugated cement sheeting	<ul style="list-style-type: none"> • Please ensure all asbestos surface clearance and decontamination inspection certificates are included in an appendix and cross-referenced from this section. • Please tabulate laboratory analytical data for asbestos validation samples and present in the Tables section. • Refer comment 2 regarding Figures
14	11.4 Airborne Fibre monitoring	<ul style="list-style-type: none"> • Consider if Section 11.4 could be combined with Section 13.1 in some way. Both appear to present the same information, with the latter more detailed (including dates).
15	12 Validation sampling	<ul style="list-style-type: none"> • Section 12 validation sampling and Section 13 Validation results discussion appear a little muddled and repetitive – perhaps revisit the structure here and see if it is possible to alter the order/combine sections without affecting the logical flow of the document. For example: <ul style="list-style-type: none"> • Section 12.2 and Section 13.2 both discuss visual clearance inspections to varying level of detail; • Section 13.3 is intended to discuss validation sampling results and particularly, validation failures. Yet the Table summarising validation pass/fails is provided in Section 12.1 “validation sampling methodology while these results are referenced from the overarching Section 12 Validation Sampling section. • Perhaps try and amend the structure so the validation sampling plan information is kept in Section 12 – sampling method, sampling frequency and types only, then all information pertaining to assessment findings/laboratory/monitoring data discussion and validation pass/ failures/ extra remediation and validation requirements is presented in Section 13.

Item	Section(s) in report	Environmental Earth Sciences Comments
16	14 Verification sampling	<ul style="list-style-type: none"> Please expand Section 14 to include more specific reference to previous investigation data for non-asbestos contaminants of potential concern including an update of Table 8 to include reference to historic data, the Tables Appendix and associated Figures. <p>This is particularly important as the 4 supplementary samples (VER01-VER04) were collected for the purpose of ensuring the dataset for non-asbestos CoPCs met Australian Standard density, therefore for completeness, the entire dataset must be included and referenced here.</p>
17	14.2 Adopted verification criteria	<ul style="list-style-type: none"> Please update references to include EILs and ESLs. While the focus of the assessment was to confirm no risks to human health, please provide assessment against ecological assessment criteria for completeness.
18	15 QA/QC	<ul style="list-style-type: none"> Please include sentence confirming whether or not rinsate or trip blank/trip spike samples were collected during the verification sampling campaign and justification as to why/ why not. Please include commentary to confirm stance with respect to QA/QC samples for asbestos (The CLA concurs these are not necessary, but please include a sentence to bottom out this item).
19	Tables	<p>Table A1:</p> <ul style="list-style-type: none"> Please update to include all non-asbestos CoPC sample results (including historic) to demonstrate minimum sampling frequencies have been met. Please include duplicate and triplicate results in Table A1. Please update to include EILs/ESLs (discussion of soil contamination in text should be updated to include this information for a site suitable for “any use” Were any other QA/QC samples (rinsates/ trip blanks/ spikes) collected as part of the supplementary “other CoPC” assessment program? If so, please tabulate. <p>General – additional:</p> <ul style="list-style-type: none"> While it recognised Table 7 (in text) provides a summary of validation sampling data, please provide tables (similar to the “Table 1”) clearly presenting laboratory data against adopted assessment/ validation criteria. This should include asbestos presence/ absence and asbestos fines w/w% data. Preferably such tables should also include a column indicating, phase of investigation/type of sample collected to allow activities described in the text, to be traced back to tabulated data, which, in turn, is clearly presented on accompanying Figures (refer comment 2). <ul style="list-style-type: none"> e.g. Sample types/investigation phases could include: Historic/ pre-remediation, validation phase 1/ phase 2/ phase 3. It may also be useful to include a table clearly demonstrating visual validation events and to which areas this pertains. May even be worth showing this in a Figure for clarity.
20	Appendices	Appendix headers – check spellings (Appendix C – remediation typo).

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Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences QLD. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light we reserve the right to alter their conclusions.

Obtain regulatory approval

The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability

This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences QLD disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences QLD disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences QLD's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.