Attachment C – LTEMP and Validation Report Auditor Endorsement - Environmental Audit Report

ENVIRONMENTAL EARTH SCIENCES
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CONTAMINATED LAND AUDIT OF ASBESTOS IN SOIL – RICHARDSON PARK, LUDMILLA, NORTHERN TERRITORY

NORTHERN TERRITORY GOVERNMENT: DEPARTMENT OF INFRASTRUCTURE, PLANNING AND LOGISTICS

17 MAY 2022
721048
VERSION 1

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

17 May 2022

Northern Territory Government
Department of Infrastructure, Planning and Logistics (DIPL)
GPO Box 4621
Darwin NT 0800

Attention: **Rohan Langworthy**
Program Manager | Land Development

Dear Rohan

Richardson Park, Ludmilla – Contaminated Land Audit for on-site containment of asbestos in soil

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

721048 DIPL Richardson Park_V1

EXECUTIVE SUMMARY

This Environmental Audit Report has been prepared in response to the requirement for an Environmental Audit in accordance with Pollution Abatement Notice (PAN) 2021/3, issued by the Northern Territory Environment Protection Authority (NT EPA).

This Audit has been prepared in accordance with Section 53V of the superseded Environment Protection Act 1970 [Victoria] and relevant sections of the Environment Protection Amendment Act 2017 which came into effect as of 1 July 2021[1].

A summary of the Environmental Audit is presented in **Table 1**.

Table 1: Summary of Audit Information

EPA File Reference No.	Pollution Abatement Notice (PAN) 2021/3
Auditor	Mark Stuckey
Auditor term of appointment (under the Victorian *Environment Protection Act 2017*)	18 September 2021 – 17 September 2024
Name of person requesting audit	Rohan Langworthy: Department of Infrastructure, Planning and Logistics (DIPL), Northern Territory Government (NTG)
Relationship to premises/location	Representative of the owner
Date of request	08/07/2021
Completion date of audit	17/05//2022
Reason for audit	Compliance with PAN 2021/3
Description of activity	Management of asbestos-impacted soil
EPA region	Northern Territory
Lot on plan (dominant)	Lot 8434, Town of Darwin
Lot on plan (additional)	-
Site/premises name	Richardson Park
Building Complex/ Unit No.	-
Street/Lot – Lower No,	40
Street/Lot – Upper No	40
Street Name	Richardson
Street type (road, court, etc)	Drive
Street suffix (North, South etc)	-

[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 bought about following the 2017 reform.

Suburb	Ludmilla
Postcode	0820
GIS co-ordinate of site centroid	
Latitude (GDA94)	-12.42519
Longitude (GDA94)	130.85308
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 53V Environmental Audit in accordance with the Victorian Environmental Auditor Guidelines and *Victorian Environment Protection Act 1970*, for assessment of asbestos in soil.
Outcome of Audit	Environmental Audit with recommendations regarding management of the site under a Long Term Environmental Management Plan
Further work or requirements.	Site to be managed according to the conditions outlined in the Long Term Environmental Management Plan

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 Environmental Audit Report that has been issued for the site. The Environmental Audit Report provides more data and discussions that are not in the above summary table for reasons of space and clarity.

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

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1 INTRODUCTION

On 8 July 2021, the Northern Territory Government (NTG) Department of Infrastructure, Planning and Logistics (DIPL) (the "client") requested Environmental Auditor (EA) (Mark Stuckey of Environmental Earth Sciences), undertake an Environmental Audit for the onsite management of asbestos containing material (ACM) at Richardson Park in Ludmilla.

The ACM was discovered during demolition works which commenced at the site in early 2021. As a result of the find, the Northern Territory Environment Protection Authority (NT EPA) issued Pollution Abatement Notice (PAN) 2021/3 on 24 August 2021 (**Appendix A**).

The final volume of ACM impacted soil requiring management was estimated to be 760 m^3 (1,214 tonnes). The chosen remedial method was on-site encapsulation.

As part of the PAN, NTG required an EA to review and endorse:

- a remediation action plan (RAP);
- the design and construction compliance of the containment cell, as well as an Environmental Management Plan (EMP) for placement of impacted soil material within the contaminant cell; and
- a long-term EMP (LTEMP) for the ongoing management and maintenance of the containment cell.

2 BACKGROUND

2.1 General

DIPL initiated the Richardson Park redevelopment project to create a community recreational green space, to be utilised by the surrounding community and the Ludmilla Primary School for rugby league and other sporting activities.

The project required the:

- demolition and removal of all existing buildings (grandstand, clubhouse and toilet block/ canteen, associated with the former rugby league club);
- the upgrade of the existing Richardson Park playing surface; and
- the extension of the existing Richardson Park Drive to Ludmilla Primary School.

2.2 Initial investigation works (feasibility)

During the feasibility, planning and design phases of the project, EcOz Environmental Consultants (EcOz) and EA Jean Paul Pearce of Australian Environmental Auditors Pty Ltd

(AEA) were commissioned by DIPL to undertake environmental investigations at the site (Richardson Park) and the wider area (Ludmilla Creek Drain). This work was performed to assess the feasibility of redevelopment from a contaminated land perspective.

Specifically, EcOz was engaged to undertake a detailed site investigation (DSI) as well as acid sulfate soil assessments (not provided for review), to determine the condition of the site with respect to chemicals of potential concern (CoPCs) associated with historic site activities, and off-site activities with the potential to influence site condition (e.g., mobile contamination originating from off-site sources).

The results of the initial investigations determined that the site was likely suitable for the proposed recreational land use in its current state, given:

- CoPCs (metals, TRH, BTEXN, PAH and PFAS) did not exceed applicable human health and ecological guidance criteria for the recreational land use scenario; and
- neither friable asbestos nor asbestos fines were detected.

Although asbestos was not identified in any of the initial soil samples, EcOz concluded there was a real (not remote) potential for ACM to be present at the site within historic buildings associated with the former rugby league club (clubhouse/ canteen/ grandstand) and/or as buried pipework.

2.3 Post demolition (PAN)

Demolition works at the site (removal of existing site buildings – former grandstand, toilet block, canteen and clubhouse) commenced in February 2021.

In March 2021, during the demolition of a retaining wall, ACM was identified in the vicinity of the former clubhouse at the southern end of the site. As a result of this find, DIPL requested their incumbent environmental consultant (EcOz) provide advice with respect to an appropriate remediation/ management strategy. Following assessment and engagement with NT EPA it was determined that on site encapsulation of the asbestos would be most appropriate and feasible. This would be managed under the provisions of a PAN (to be issued by NT EPA).

To meet the provisions of the PAN (2021/3) (final version issued on 24 August 2021), DIPL commissioned EcOz to manage remediation/ validation works and Byrne Consultants to design the encapsulation cell and prepare engineering design drawings. EA Mark Stuckey (Environmental Earth Sciences) was engaged on 8 July 2021 to review and endorse specified planning, design, investigation, validation, and management documents.

As part of the review process, the EA identified several data gaps with respect to site condition that would need to be addressed to confirm site suitability and inform the remedial design. In consideration of these data gaps, EcOz prepared a Sampling, Analysis and Quality Plan (SAQP) for supplementary investigation works (which were executed by subconsultant, Octief) to:

- delineate the asbestos-impacted area near the clubhouse and further investigate the balance of the site (particularly within the footprints of former buildings and the proposed

site of the asbestos encapsulation cell) to identify and quantify any further asbestos contamination; and

- further assess the condition of the site with respect to other CoPCs (non-asbestos) to determine site suitability or supplementary remediation/management actions required (particularly with respect to PFAS concentrations at depth).

The supplementary investigations completed at the site determined non-asbestos CoPCs were not of concern and that remediation/ management activities at the site could focus solely on the identified ACM. Consequently, following the advice of EcOz and Octief and in accordance with the PAN (2021/3) issued by NT EPA in August 2021, DIPL adopted the onsite encapsulation methodology, and an encapsulation cell was constructed in the eastern portion of the site in 2021.

This audit therefore addresses issues relating to the management and encapsulation of asbestos at the site based on the Victorian Audit Scheme[2].

3 AUDIT DETAILS

3.1 Objectives

The objective of the audit was to identify and (where possible) quantify the risk of any possible harm or detriment to a segment of the environment, caused by ACM identified in soil that was buried in a specifically designed containment cell on site.

Specifically, the EA works were required to verify that the works performed by the nominated environmental consultant(s) (EcOz and Octief):

- were undertaken in accordance with current best-practice methodologies, cognisant of and in accordance with applicable guidance and legislation; and

- to this end, the audit included a review of the completeness of the site risk assessment, reverification of the design of the containment cell and the emplacement and capping of the ACM affected soil.

3.2 Scope of works

The scope of the audit was to assess the management of ACM impacted soil with reference to the requirements of Pollution Abatement Notice (PAN) 2021/3 issued by NT EPA on 24 August 2021 (refer **Appendix A**).

[2] The former Section 53V audit process.

Table 2: Audit scope

Audit Aspect	Scope
Activity audited	The activity audited is the encapsulation of asbestos impacted soil.
Components of the activity considered	The audit assessed the design, construction and capping of the containment cell, with regards to historical assessments relevant to Richardson Park.
Segment of the environment considered	The segment of the environment considered during the audit was the area of land in which the asbestos is to be buried, 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 burial.
Beneficial uses considered	The beneficial uses considered during the audit are those specified in the Victorian Government Environmental Reference Standard (VIC Government, 2021): • Ambient air; • Ambient sound; • Land; and • Water (groundwater and surface water). The relevance and existence of beneficial uses are discussed in **Section 7**.
Risk assessment conducted	The auditor has updated the qualitative assessment of the significant risks associated with the asbestos impacted soil and encapsulation as part of this audit. Refer to **Section 10**.
Period of time over which the audit was conducted	This audit was conducted between 08 July 2021 and 17 May 2022.
Exclusion from the scope of the audit	This audit excludes all potential contaminants of concern, with the exception of asbestos in soil.

3.3 Regulatory framework

The 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) Measure1999, amended 2013 (herein referred to as the ASC NEPM). • PFAS National Management Plan 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 (*Siting, Design and Management of Landfills*);
• Environment Protection (Industrial Waste Resource) Regulations (2009). S.R. No. 77/2009;
• Victorian Government Environment Reference Standard (2021)[3]
  • Ambient Air
  • Ambient sound
  • Land
  • Water (groundwater and surface waters)
	• 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.

[3] 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):

- Familiarisation with the project objective, stages and progression;
- Completion of an Environmental Audit site inspection (to confirm condition of the site, prior to the issue of the Environmental Audit report) on 22 July 2021;
- Liaison with the NT EPA, the landowner (NTG-DIPL) and the nominated primary consultant (Brittany Crescentino of EcOz) who was engaged by DIPL to manage all environmental investigation, remediation and validation works at the site;
- Detailed review of documents pertaining to site assessments and other related documentation such as those pertinent to the design and construction of the cell and ACM impacted soil, emplacement methodology;
- Assessment of risk to beneficial uses of the segments concerned;
- Update of the auditor's assessment of risk to the environment;
- Detailed review of documents pertaining to long term site management (post asbestos-encapsulation); and
- Preparation of this Environmental Audit report.

3.5 Documentation reviewed

Table 4 lists the documentations provided by the client for consideration in this audit, including detailed site investigations, recommendations for contamination management, remediation action plan (RAP), design report and construction/environmental and aftercare management plans.

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, DIPL and EcOz as the primary consultant engaged to deliver this scope of works. See **Figure 1** for an organisation chart.

While the Auditor did not directly liaise with the various specialist subconsultants/ subcontractors engaged by EcOz to deliver this program, Audit comments pertaining to deliverables produced by third parties (such as supplementary site investigation works, containment cell design, construction and environmental management during construction and filling of the containment cell) were provided to and distributed by EcOz, as necessary.

Figure 1: Organisational chart (investigation and remediation program)

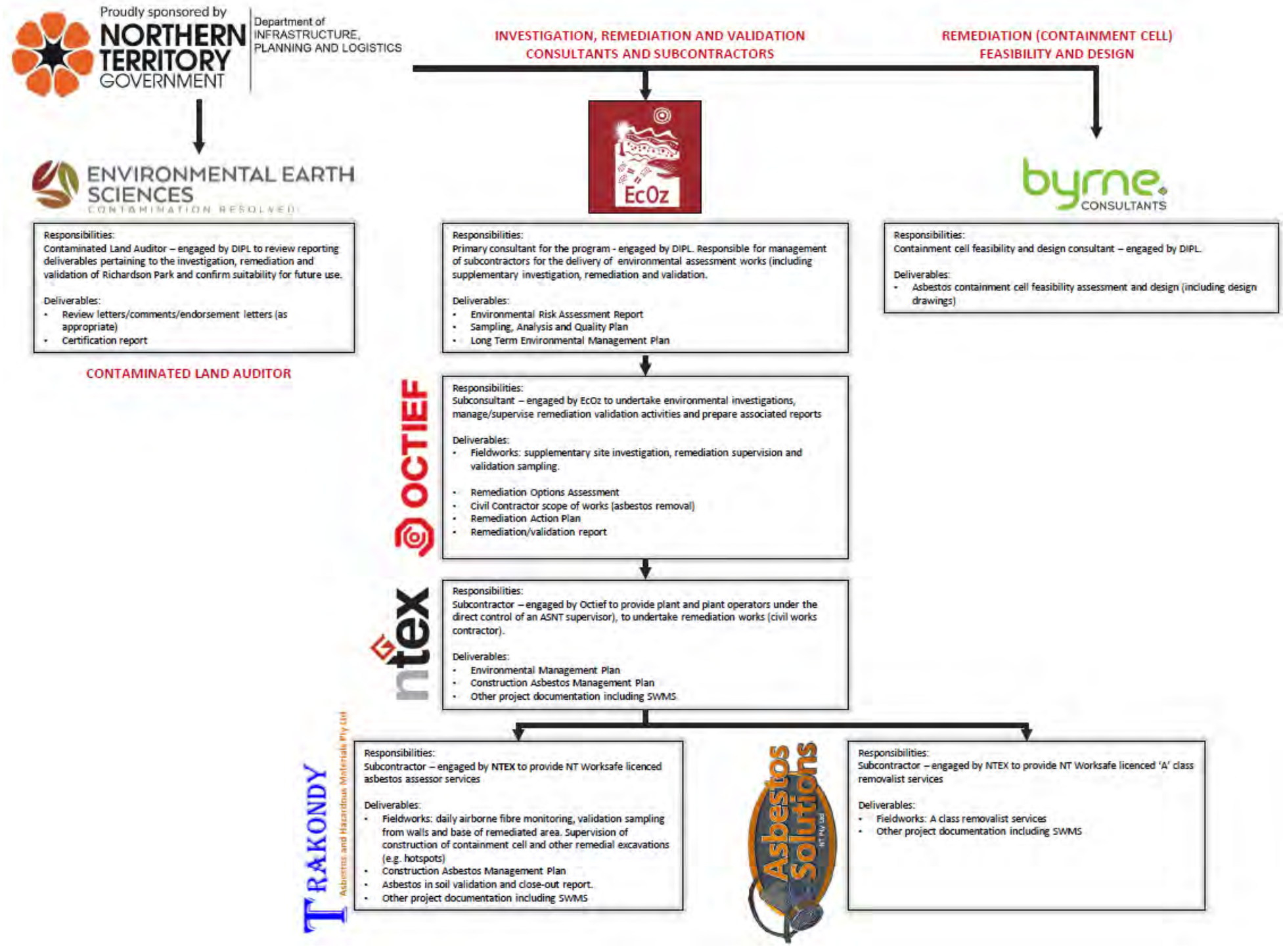

Table 4: Documentation provided for review

No.	Document	Author	Date	Audit report reference	Location in audit report
Regulatory					
1	Pollution Abatement Notice No. 2021/3	NT EPA	24 August 2021	NT EPA (2021)	Appendix A
Site investigation					
2	Geotechnical Investigation for the proposed redevelopment of Richardson Park, Ludmilla, Northern Territory	NT Geotechnics	26 October 2015	NT Geotechnics (2015)	-
3	Richardson Park Improvements Detailed Site Investigation	EcOz	21 March 2021	EcOz (2019)	Section 5.4, 8
4	Report on Geotechnical Investigation Spectator Mounds and Fill Areas Richardson Park., Ludmilla, NT. Revision 0	Douglas Partners	9 July 2019	Douglas Partners (2019)	-
5	Richardson Park concrete and surficial soil investigation	SLR	1 June 2020	SLR (2020)	Section 5.4, 8
6	Environmental Risk Assessment Report, Richardson Park Redevelopment Project. Revision 2	EcOz	12 January 2021	EcOz (2021a)	Section 5
7	Asbestos impacted soil – test-pit investigation, Richardson Park, Darwin, Northern Territory. Version 1	Octief	13 May 2021	Octief (2021a)	Section 5.4, 8
8	Sampling and Analysis Quality Plan, Richardson Park – Asbestos and PFAS. Revision 2	EcOz	6 August 2021	EcOz (2021b)	Appendix D
Remediation planning, containment cell design, HSE and management plans					
9	Environmental Management Plan, Richardson Park – Encapsulation of Asbestos Containing Materials On Site. Project T20-2110. Version 2.0	NTEX	12 January 2021	NTEX (2021a)	Section 9
10	Asbestos in soil remediation. Summary of works 30th March 2021. Richardson Park Richardson Drive, Ludmilla Northern Territory 0820	Trakondy	30 March 2021	Trakondy (2021a)	-
11	Richardson Park Re-Development Options Analysis of Asbestos Containment Cells. Revision A.	Bryne Consultants	28 June 2021	Byrne Consultants (2021a)	-
12	Remediation Action Plan, Richardson Park, Ludmilla, Darwin. Version 1, 6 July 2021	Octief	6 July 2021	Octief (2021b)	Appendix F
13	Richardson Park Re-Development Options Analysis of Asbestos Containment Cells. Revision B	Byrne Consultants	8 July 2021	Byrne consultants (2021b)	Section 9 and Appendices E and F
14	Safe Work Method Statement (SWMS), Asbestos Containment	NTEX	29 July 2021	NTEX (2021b)	
15	ACM Containment Cell – Locality Plan, Schedule of Drawings, Notes, Legend and Abbreviations. Drawing No. B21-7850	Byrne Consultants	1 August 2021	Byrne consultants (2021c)	
16	Safe Work Method Statement (SWMS) to move non friable asbestos. SWMS #001, Version 1.	Asbestos Solutions	3 August 2021	Byrne consultants (2021d)	
17	Project Control Plan, Richardson Park Asbestos Containment. Project T20-2110. Version 1.5	NTEX	4 August 2021	NTEX (2021c)	
18	Environmental Management Plan, Richardson Park – Encapsulation of Asbestos Containing Materials On Site. Project T20-2110. Version 2.1	NTEX	6 August 2021	NTEX (2021d)	
19	Construction Asbestos Management Plan, Richardson Park Asbestos Containment Cell, Richardson Drive, Ludmilla, Northern Territory 0820. Revision 0.2	Trakondy	6 August 2021	Trakondy (2021b)	
20	ACM Containment Cell – Locality Plan, Schedule of Drawings, Notes, Legend and Abbreviations. Drawing No. B21-7850. Revision 2.	Byrne Consultants	11 August 2021	Byrne consultants (2021e)	
21	Construction Asbestos Management Plan, Richardson Park Asbestos Containment Cell, Richardson Drive, Ludmilla, Northern Territory 0820. Revision 0.3	Trakondy	11 August 2021	Trakondy (2021c)	
22	Environmental Management Plan, Richardson Park – Encapsulation of Asbestos Containing Materials On Site. Project T20-2110. Version 2.2	NTEX	13 August 2021	NTEX (2021e)	
23	Safe Work Method Statement (SWMS), Richardson Park – Asbestos in Soils Relocation to Onsite Containment Cell	Trakondy	16 August 2021	Trakondy (2021d)	
24	Environmental Management Plan, Richardson Park – Encapsulation of Asbestos Containing Materials On Site. Project T20-2110. Version 2.3	NTEX	27 August 2021	NTEX (2021f)	Section 7
25	Construction Asbestos Management Plan, Richardson Park Asbestos Containment Cell, Richardson Drive, Ludmilla, Northern Territory 0820. Revision 0.4	Trakondy	27 August 2021	Trakondy (2021e)	Section 7

No.	Document	Author	Date	Audit report reference	Location in audit report
Site validation and long term (aftercare) management					
26	Asbestos in soil validation and close out report. Richardson Park Asbestos Containment Cell, Richardson Drive, Ludmilla, Northern Territory 0820. Version 1. Draft	Trakondy	30 September 2021	Trakondy (2021f)	Section 9
27	Asbestos in soil validation and close out report. Richardson Park Asbestos Containment Cell, Richardson Drive, Ludmilla, Northern Territory 0820. Version 1. Final	Trakondy	8 October 2021	Trakondy (2021g)	Section 9
28	Remediation and Validation Report. 40 Richardson Drive, Ludmilla, Richardson Park, NT. Version 2.	Octief	25 November 2021	Octief (2021c)	-
29	Remediation and Validation Report. 40 Richardson Drive, Ludmilla, Richardson Park, NT. Version 3	Octief	13 February 2022	Octief (2022)	Section 8 and Appendix G
30	Richardson Park Asbestos Containment Cell. Long Term Environmental Management Plan. Rev 1.	EcOz	29 November 2021	EcOz (2021c)	-
31	Richardson Park Asbestos Containment Cell. Long Term Environmental Management Plan. Rev 2.	EcOz	13 January 2022	EcOz (2022)	Section 10 and Appendix C

Notes: During the project, the Auditor was provided with a number of versions of documents pertaining to site investigation, containment cell design, construction, environmental and long term (aftercare) management. 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.

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 2** and **3** and site identification details provided in **Table 5**.

4.2 Site description and surrounds

4.2.1 Site

At the time of the initial site inspection, the site was an undeveloped (grassed) broadly rectangular plot of land. All infrastructure formerly associated with the rugby league fields (grandstand, former clubhouse and toilet block/ canteen) had been demolished and removed.

The topography of the site was generally flat, with the exception of an inverted "L" shape of vegetated earthen mounds (former spectator mounds) curving around the north and eastern extents of the former rugby league pitch (refer **Figure 2**).

A fenced compound around an active remedial works area (where asbestos impacted soil excavation was in progress) had been established at the southern-most portion of the site in the vicinity of the former clubhouse.

Table 5: Site identification details

Item	Details
Street address	40 Richardson Drive, Ludmilla, NT 0820
Lot/plan or crown description	Lot 8434, Town of Darwin
Municipality	City of Darwin
Current land use	Public open space (the site has been vacant since ~2015)
Future land use	Public open space (playing fields and community open space)
Current and future zoning	Public open space (PS)[1,2]
Latitude/ longitude (GDA94)	-12.42519, 130.85308
Site area	5.97 ha
Site location and layout	**Figures 2 and 3**

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.

Figure 2: Site regional locality (EcOz, 2021a)

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Title:	Site layout Plan
Location:	Richardson Park, Ludmilla, NT

Client: DIPL | Drawn By: K. Spruth | Date: April 2022

Figure 3

4.2.2 Zoning and surrounding land use

With reference to the City of Darwin Planning Schedule, the site is zoned as Public Open Space (PS) (viewed 8 March 2019). The purpose of PS is to provide public areas for recreational activity.

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	Bushland followed by the Ludmilla Creek drain and mangroves. The Darwin International Airport (DIA) and RAAF base are located approximately 1.5 km to the north-east.	CN, CL,	Conservation, community living (Bagot community)
East	Ludmilla Primary School followed by Bagot Road. A Puma service station is located approximately 250 m to the south-east of the site.	CP	Community purpose
South	Residential properties	LR, SD	Low residential, single dwelling (Ludmilla)
West	Vacant bushland and residential properties. Darwin Racecourse and Ludmilla Wastewater Treatment Plant are located approximately 400 m west and 700 m north-west respectively.	PS, LR, OR	Public open space, organised recreation (Fannie Bay Racecourse)

5 SITE HISTORY

5.1 General

A site history was not provided in the remediation validation report (Octief, 2021d). However, summarised site history information was provided in earlier reports[4] which were reviewed by the EA for context.

While the site history information provided, was neither extensive or detailed, it was considered sufficient to inform the conceptual site model with respect to identifying areas of environmental concern (AECs) and CoPCs requiring further assessment. Thereby informing the design of appropriate sampling and testing regimes to determine suitability (or otherwise) of the site for the proposed recreational use or requirements for remediation, validation and management.

[4] Environmental risk assessment [EcOz, 2021a], Supplementary (Asbestos and PFAS investigation) SAQP [EcOz, 2021b]

A summary of available and pertinent site history information obtained from EcOz,2021a, EcOz, 2021b and Octief, 2022 is provided below.

5.2 Historic site use

Richardson Park was the home ground of the Darwin Rugby League Club (DRLC) from 1956 through to its dissolution. It was then leased to the NT Rugby League (NTRL) until 2015.

In 2015 Richardson Park was surrendered back to the NTG and has remained vacant ever since.

5.3 Aboriginal sacred and Heritage listed infrastructure

There are no registered Aboriginal Sacred sites; or heritage listed sites under the *Heritage Act 2011* within the site boundary.

5.4 Previous environmental assessments

Richardson Park and the neighbouring Ludmilla creek have been subject to ongoing environmental assessment since circa 2015 to investigate site condition with respect to CoPCs[5] and thereby facilitate the development of appropriate remediation/management strategies, to allow redevelopment works to proceed.

Whilst it is not the intent of this certification report to provide comprehensive information on all past activities undertaken at the site, a summary of pertinent historic information (investigations completed in support of site redevelopment between 2019 and 2021, relevant to the activities undertaken to fulfil the PAN) is provided below.

It is acknowledged a number of additional historic investigations/ management plans pertaining to acid sulfate soils and PFAS were completed/ prepared for the Ludmilla Creek Drain reinstatement between 2015 and 2019. However, these documents were not provided for review and therefore are not referenced in **Table 7**.

[5] The key CoPCs identified for Richardson Park are asbestos, per and poly fluorinated alkyl substances (PFAS), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN), organochlorine and organophosphate pesticides (OC/OPs) and metals including arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), Nickel (Ni), Zinc (Zn) and mercury (Hg).

Table 7: Previous environmental investigations

EcOz (2019) Richardson Park Improvements Detailed Site Investigation	
Investigation Area	Richardson Park (including part of Ludmilla Creek known as Ludmilla Creek Drain. (Approximately 7.4 ha)
Objectives	• Fulfil the requirements of the SAQP (prepared by EcOz in 2018, for the assessment of Richardson Park for future recreational land use) • Determine the extent of soil contamination for key CoPCs (asbestos, PFAS); and • Determine the need for further investigation and assessment.

Scope	• Soil sampling and analytical program comprising:
	  ◦ **Shoal Bay Stockpile:** Collection of 16 primary soil samples from stockpiled material located at Shoal Bay (material generated during Stage 1 Ludmilla Creek Drain reinstatement works). Analysis for PFAS (soil concentrations and ASLP leachability testing)
	  ◦ **Ludmilla Creek Drain:** Collection of 36 soil samples from 4 areas along the Stage 2 Ludmilla Creek Drain alignment (3 depths/ location), considered most likely to be impacted by runoff. Analysis for PFAS and PFAS leachability (ASLP pH5 and 7);
	  ◦ **Richardson Park:** Collection of 60 primary surface/near surface soil samples (0.1-0.2 m bgl) across Richardson Park and analysis for CoPCs (metals, TRH, BTEN, PAH and PFAS). Further analysis of selected samples for PFAS leachability (ASLP pH5 and 7);
	• Assessment of soil analytical results against appropriate guidance criteria and preparation of a DSI report.

Findings	The relevant results of the assessment are as follows:
	Richardson Park:
	• Asbestos free fibres were not identified in any of the samples analysed.
	  ◦ However, the DSI noted that potential asbestos containing materials (PACM) was present within site buildings and infrastructure (former canteen), buried PACM pipework could be present and the status of PACM within the former grandstand area was not known, as this area was not accessible during DSI sampling.
	• Soil chemical concentrations (non-asbestos) – metals, TRH, BTEXN, PAH, and PFAS, did not exceed applicable human health and/or ecological guideline criteria and thus the site was considered (with respect to non-asbestos CoPCs), suitable for the proposed recreational land use.
	  ◦ While leachability testing of 10 soils at a worst case pH5 indicated there is a potential for PFOS to leach from the soil profile, during rainfall events at concentrations exceeding applicable marine quality guidelines; the risk of leached PFAS impacting upon Ludmilla Creek 1 km to the north of the site was deemed low due to distance to this receptor, low migration rates (given presence of marine clays) and likely dilution/ attenuation factors. It was noted that soil amelioration would be required if soils were to be reused within the Richardson Park development.

SLR (2020) Richardson Park Concrete and Surficial Soil Investigation	
Investigation Area	Concrete rubble identified along the northern boundary of Richardson Park
Objectives	• Determine whether CoPCs were present within the stockpiled concrete and surficial soils directly beneath the stockpile.
Scope	• Excavation of channels through concrete rubble at intervals of approximately 10-15 m (total length of stockpile 100 m) to facilitate visual inspection of materials for ACM. • Collection of representative samples of exposed surface soil from beneath the stockpile and analysis for CoPCs (asbestos presence/absence, TRH, BTEXN, OCP/OPP and metals).
Findings	• Stockpiles comprised concrete with minor scrap metal and anthropogenic waste, with surficial soil underneath. • No asbestos was identified within the stockpile or underlying soil. • One fragment of ACM (containing chrysotile and amosite) was observed outside the stockpile footprint and was removed during the sampling event. No further fragments or debris were identified. • CoPCs (TRH, BTEXN, OCP/OPP and metals) were reported below laboratory limit of reporting and/or below applicable assessment criteria in all samples analysed. Asbestos was not detected.

Octief (2021a) Asbestos Impacted Soil – Testpit Investigation Richardson Park	
Investigation Area	Richardson Park – with particular focus on southern “asbestos area”
Objectives	• Confirm the extent of ACM and AF/FA in soil in the visually impacted area; • Characterise asbestos impacts in other areas requiring excavation for the development project and • Provide recommendations for management/remediation options for the site
Scope	Soil sampling and asbestos laboratory analysis including: • Advancement of 14 test-pits to a maximum depth of 1 metre below ground level, in the southern “visually” impacted area and other areas requiring excavation; • Collection of representative soil samples from depths of 0.1m, 0.5m, 1m bgl and at identified changes of subsurface lithology; • Analysis of selected samples for asbestos presence/absence and quantification (ACM, AF and FA).

Findings	**Analytical results:**
	• Surface fragments of ACM were identified on the south-east berm and both east and west access roads for the site within mulch material;
	• ACM, AF/FA were detected at concentrations exceeding the guideline criteria for recreational/open space land use in several samples at surface and, at approximate 0.5 m depth.
	Area/ volume of impact:
	• Based on visual observations and analytical results, the area of asbestos impact was estimated at approximately 650 m^3 and accounting for an additional buffer zone, the estimated volume of material requiring remediation was 510 m^3 (equating to 816 tonne based on a specific density of 1.6).
	• Octief suggested based on historic information (source not specified) approximately 50 m^3 (80 tonnes) had previously been removed from site, leaving an approximate 460 m^3 (736 tonnes) remaining.
	• It was noted that the contaminated fill layer was not fully delineated to the west. Thus, additional asbestos impacted soils may require remediation.
	Remediation Options
	• Octief completed a remediation options assessment (ROA) for remediation of asbestos impacted soils at the site. The ROA recommended
	  ◦ impacted soils in the southern portion of the site be excavated and disposed off site;
	  ◦ an emu pick of the north-east and south-east berms, roadways and any other areas on site where mulch material has previously been identified (including the former tree felling and mulching area), be completed by a licenced asbestos assessor prior to development disturbance, to remove residual ACM;
	  ◦ surface oils stockpiled from the area around test pit SP14 (north-east corner of the site) be stockpiled and tested for asbestos contamination to determine suitability for reuse, or requirement for offsite disposal.

6 POTENTIAL FOR CONTAMINATION AND CONCEPTUAL SITE MODEL DEVELOPMENT

A conceptual site model (CSM) of the site 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 slopes gently to the north and north-west, toward Ludmilla Creek, estuarine fringes and mangrove wetlands.

Some localised topographic variations (elevated spectator mounds) are present in the centre of the site bordering the north and eastern edges of the former rugby league playing field (refer **Figure 3**).

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 down slope, toward the mangrove wetlands and Ludmilla Creek drain, located to the north/ north-west of the site.

6.2 Hydrology and flooding

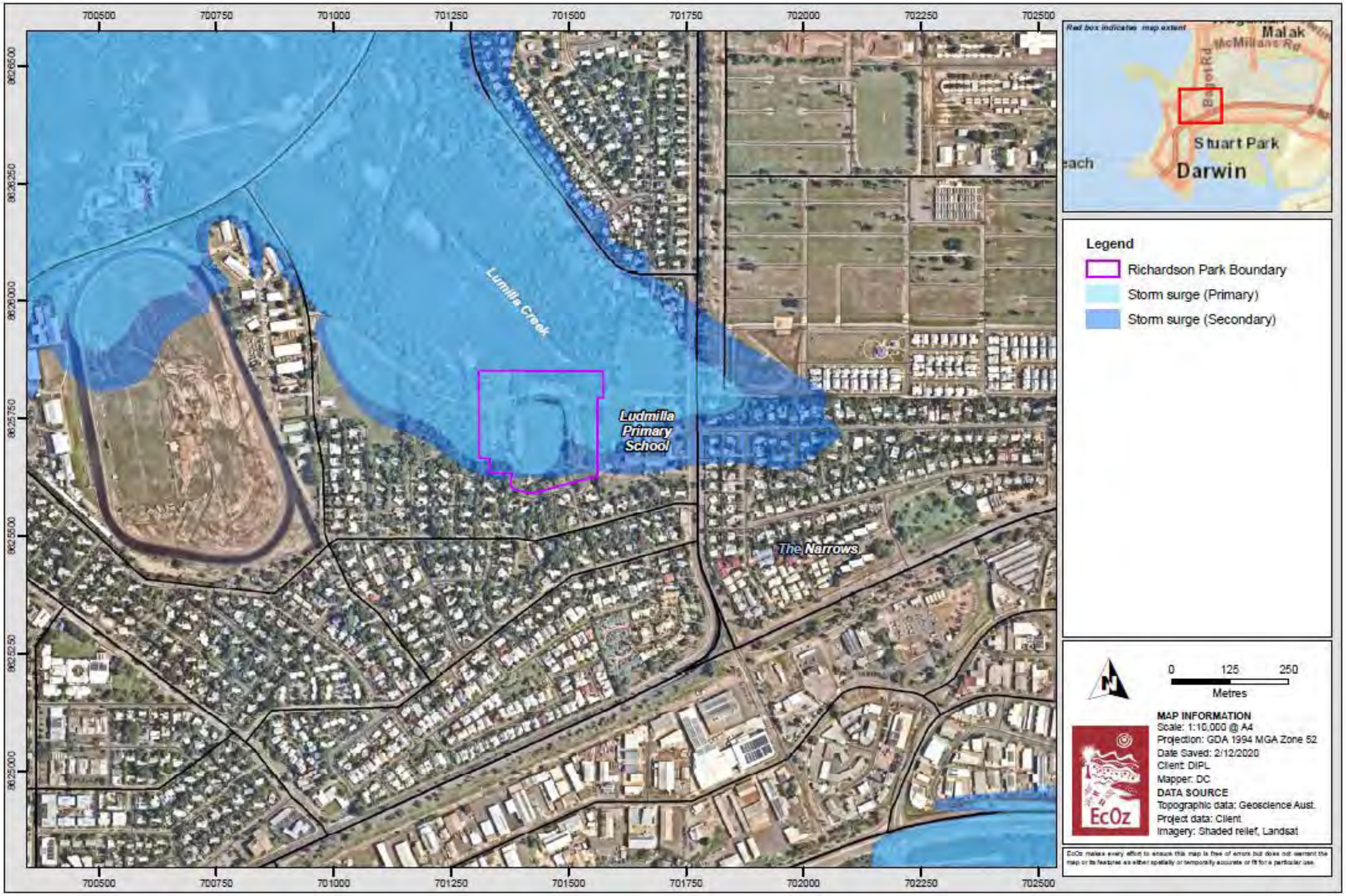
The closest hydrological feature to the site is the tidally influenced Ludmilla Creek, located approximately 1 km north-west of the site.

During high tide, water enters the mangrove wetland area to the north of the site, inundating the areas surrounding Ludmilla Creek Drain. High tide waters can reach the north and north-western boundaries of Richardson Park.

The majority of the northern portion of the site is also located within the storm surge zone for a 100-year average reoccurrence interval (ARI), with the balance of the site located within the secondary storm surge zone for a 1000-year ARI (see **Figure 4**).

The northern portion of the site is also located within the estimated highest astronomical tide (HAT) zone.

Figure 4: Storm surge modelling (EcOz, 2021a)



6.3 Soil, landscape classes and vegetation

According the NTG Department of Environment, Parks and Water Security (DEPWS) Natural Resource Maps (NR Maps) online mapping system two landscape classes apply to the site, these are summarised in **Table 8** below.

Table 8: Landscape classification

Item	Description	
	Area 1	**Area 2**
Portion of site/ approximate size (ha)	North-west corner of site (approx. 1 ha)	Remainder of site (approx. 5 ha)
Landscape class	Tidal flats	Lateritic plains and rises
Landscape class description	Tidal mudflats and coastal floodplains with channels and estuaries; subject to tidal inundation; poorly drained clays and muds	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils
Landform	Level tidal flats with channels and estuaries and minor dunes.	Steep, dissected terrain forming the edge of the deeply weathered plateau.
Soil (original)	Saline muds and grey cracking clays.	Shallow lithosols and gravelly yellow earths
Soil (ASC)	Supratidal and intertidal hydrosols.	Leptic Rudosols and gravelly yellow Kandosols.
Vegetation	Samphire, sedgeland or mangrove low closed forest	Mid-high woodland over tropical tall grass.
Acid sulfate soils	Common occurrence of acid sulfate soils on tidal flats, coastal floodplains and some coastal sandplains. Refer **Section 6.5**	No acid occurrence of acid sulfate soils. Refer **Section 6.5**

Notes: ASC: Australian Soil Classification system

6.4 Geology

Based on the *Darwin 1:100 000* Geological Map Series, Sheet 5073 (NT Department of Mines and Energy, 1983) 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, the 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), there is a high probability of occurrence of acid sulfate soils across the northern most portion of the land parcel and to the north of the site associated with mangrove wetlands and Ludmilla Creek. According to the map, potential acid sulfate soil (PASS) is likely to be present within the upper 1 metre of the soil profile, within the tidal zone, which is described as "*supratidal flats with halophytes (samphire), salt marsh and salt pans*".

This interpretation is supported by empirical data (ASS investigations) undertaken along Ludmilla Creek in 2015 and 2016 which confirmed the presence of ASS along the creek line (these investigations were not provided to the EA for review).

Acid sulfate soils are considered unlikely to be present across the remainder of the site.

6.6 Hydrogeology

6.6.1 On-site monitoring bore network

A shallow groundwater monitoring bore network, comprising 8 monitoring bores, was previously established at the site, with bores installed at the request of the Darwin Rugby League in 1982 to facilitate monitoring of the groundwater table. It is understood monitoring bores were installed to depths ranging from 3 to 20 metres below ground surface (m bgs) with static water levels (SWLs) recorded at between 0.2 and 1.1 m bgs. However no further information on construction details and/or lithological profiles encountered, is available.

It is understood the shallow monitoring bore network has since been backfilled and is no longer utilised. No evidence of these former bores was observed during the site inspection.

6.6.2 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 8 current registered bores within 500 m of the site boundary.

It is noted the majority of the bores were drilled in the 1980's for the purpose of stock and domestic use and have since been backfilled and are no longer in use.

A summary of bore information is provided in **Table 9** below, with locations provided on **Figure 5**.

Table 9: 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	
RN026893	21.5	SWL: not supplied (0.5 L/s)	NS	NS	428 m, south	Investigation
RN005197	12.2		NS	NS	137 m, south	NS
RN005198	12.2		NS	NS	168 m south	NS
RN040450	12		1-12	Gravelly soil and siltstone	306 m, north	Investigation
RN040451	12		1-12		453 m, north	Investigation
RN040335	12		1-12		264 m north-east	Investigation
RN040337	12		1-12		470 m north-east	Investigation
RN040468	10		1-10		237 m, east	Investigation

Notes: NS: information not supplied.

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 expected to be to the north/north-west reflective of surface topography, toward the tidally influenced mangrove wetlands and Ludmilla Creek. Accordingly, two bores (RN 040450 and RN040451) are considered hydraulically down-gradient of the site.

The bore cards for the registered bores detailed above have been provided in **Appendix B**.

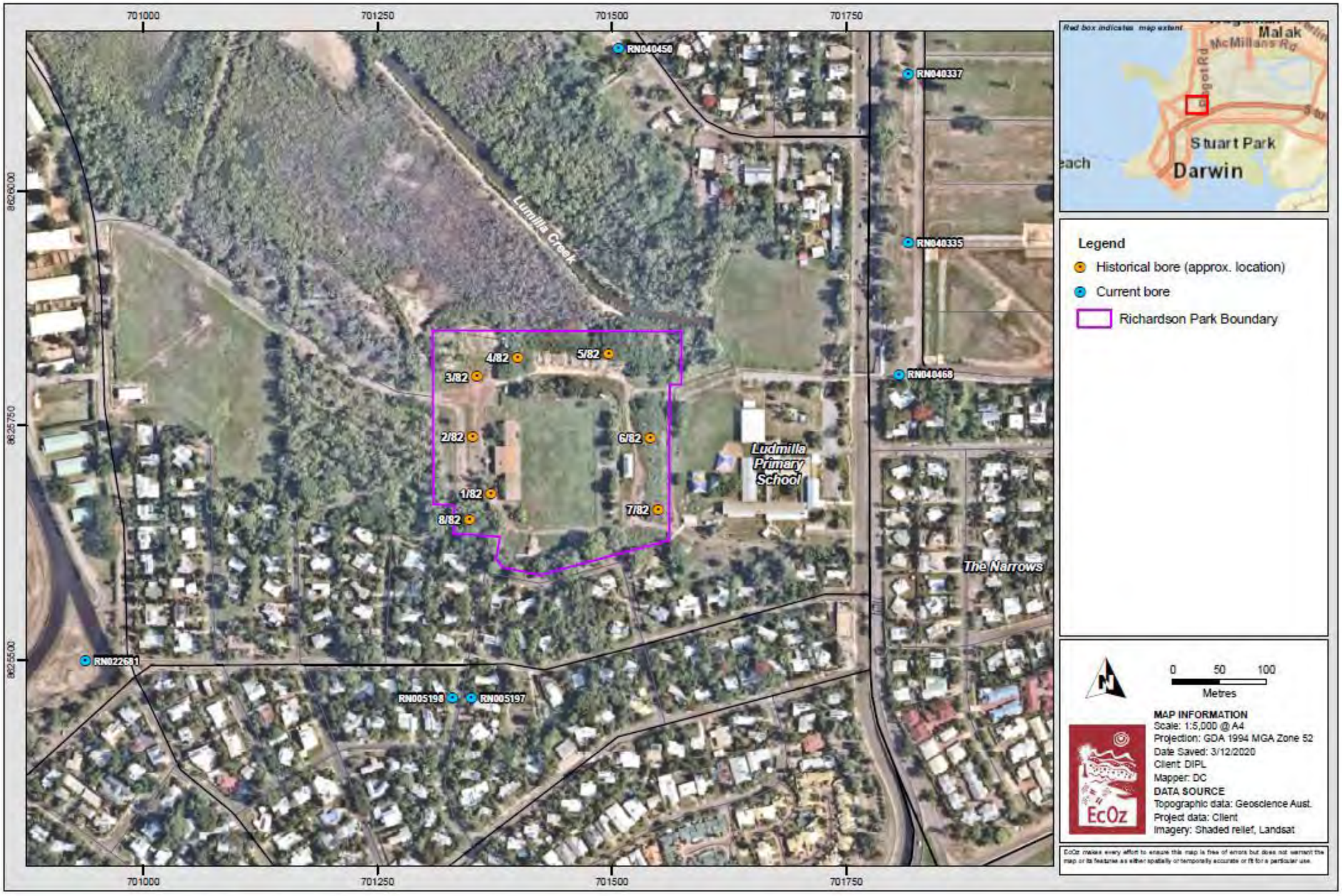
6.7 Climate

The regional meteorology of the site can be summarised using data from Darwin Airport (Station 0140154, approximately 1.5 km north-east) published on the Bureau of Meteorology website. Mean maximum and minimum monthly temperatures and mean monthly rainfall is presented in **Table 10**. 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 10: Average monthly weather statistics 1941-2019

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max temp (ºC)	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 (ºC)	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)	431.8	369.3	312.4	101.6	20.7	1.8	1.1	4.7	16.6	70.2	141.8	252.1

Figure 5: Historic and current bore locations (EcOz, 2021a)



Notes: RN026893 and RN040451 (refer **Table 9**) are not shown due to scale of Figure.

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, 2021).

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. As such, 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 11**, a replication of Table 4.2 from ERS (Part 4-Land). The land uses relevant to the site have been highlighted.

All beneficial uses must be considered when undertaking an environmental audit.

The Auditor has considered the beneficial uses requiring protection based on the proposed land-use at the site. Post redevelopment of the site, the current land-use and zoning will remain as public open space.

Table 11: Protected beneficial uses of land

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

As such, the land uses to be considered for the audit are: 'recreation/ open space', and the protected beneficial uses are therefore:

- Maintenance of modified and highly modified ecosystems;
- Human health;
- Buildings and structures; and
- Aesthetics.

These land-uses have been discussed further in **Table 12** and **Sections 7.3.2-7.3.5**, below.

7.3.2 Maintenance of modified and highly modified ecosystems:

There is no known harm to the environment caused from asbestos, therefore there is no unacceptable risk to ecosystems from within or outside the cell (i.e., the remaining areas of the site or off-site receptors).

Table 12: 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:
		  • 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:
		  • 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.

7.3.3 Human health

Identified potential risks to human health (on- and off-site) is via the inhalation of asbestos fibres released during excavation, temporary stockpiling and emplacement of the asbestos impacted soil. Dust control measures as well as airborne fibre monitoring, to monitor and mitigate risk to human health were implemented throughout the handling of the ACM impacted soil, as per the Construction Asbestos Management Plan (CAMP) (Trakondy, 2021e) and the Environmental Management Plan (NTEX, 2021f).

Upon completion of the encapsulation of the ACM impacted soil and sealing of containment cell, the potential for dust generation and subsequent risk to human health via the inhalation of asbestos fibres is negligible.

The potential for future exposure to the ACM impacted soil (i.e., future redevelopment and excavation of the site) has been managed by management of the site under a Long Term Environmental Management Plan (LTEMP, EcOz 2022 – **Appendix C**), and inclusion of a high visibility geotextile marker layer between contaminated and uncontaminated materials (base and sub-vertical containment cell walls) (Octief, 2021d).

The LTEMP will be lodged with NT EPA, as per Requirement 16 of the PAN.

7.3.4 Buildings and structures:

ACM is contained in a specially designed cell and does not have aggressive characteristics that could jeopardise the structural integrity of the encapsulation cell. The cell capping was designed to include a separation geotextile layer directly overlying the ACM, a layer of clean fill (300 mm), and then a high visibility geotextile layer over the clean fill to provide a marker layer. An additional 600 mm topsoil was compacted and rolled atop the containment cell allowing for vegetation establishment. This design is therefore not reliant on the topsoil layer for stability of the structure.

The LTEMP (EcOz, 2022 – **Appendix C**) outlines the inspection and management regime required to maintain the integrity of the containment cell. As a potential threat to the structure of the containment cell has been identified as erosion, the timing of inspections is prescribed during and after the wet season. The LTEMP outlines the actions to be taken if damage to the structure of the cell is identified, and the procedures for site maintenance of the portion of the site which includes the encapsulation cell. The risk is considered to be low and manageable.

7.3.5 Aesthetics

All asbestos impacted soil that was identified during works has been contained within the cell, according to the methodology outlined in the CAMP (Trakondy, 2021e) and as per design drawings supplied by Byrne Consultants (2021a, 2021b and 2021d).

Whilst contained within the cell, the ACM impacted soil is not visible.

7.4 Groundwater

The beneficial uses of groundwater have been determined in accordance with the NEPM. Under the NEPM Schedule B(6) “Groundwater is assessed on the basis of its suitability for current or realistic future use.”

Schedule B(6) of the NEPM specifies six environmental aspects:

- Aquatic ecosystems;
- Aquaculture and human consumers of food;
- Agricultural water (irrigation and stock water);
- Recreation and aesthetics;
- Drinking water; and
- Industrial water.

Risks to the above values are negligible based on the following reasoning:

- Asbestos is non-leachable, non-volatile and non-putrescible material and will not present an unacceptable risk to groundwater via leaching or vapour/ gas production.
- The risk of contaminated surface run-off during the handling of the ACM impacted soil was addressed in the CAMP (Trakondy, 2021e), and since buried, there is no risk associated with contaminated surface runoff.
- Asbestos only poses a risk to human health through respiration of airborne fibres.

7.5 Noise

Under the ERS (Par2 – ambient sound) (Victorian Government, 2021) the risk of noise to nearby receptors is irrelevant post construction and closure of the cell. Noise mitigation measures were addressed in the EMP and CAMP, which were implemented during construction, filling and closure of the cell (NTEX, 2021f and Trakondy, 2021e).

7.6 Surface water

The completed encapsulation cell is not considered to constitute a potential risk to surface water.

Asbestos is not considered to be a specific cause of environmental harm, however environmental media may provide mechanisms for transport of asbestos impacted material and its associated human health risk. During the construction phase of the project, bunds were constructed/maintained (as required) around the edges of work areas and other strategic locations to prevent stormwater run-off from carrying contaminated or potentially contaminated soil away from work areas (Trakondy, 2021e).

Following completion of the encapsulation cell, the most significant identified risk to the integrity of the cell is erosion of the cell capping via surface water flows. This is to be managed via regular inspections, and associated maintenance, as outlined in the LTEMP (EcOz, 2022 – **Appendix C**).

8 CONTAMINATION PRIOR TO REMEDIATION

8.1 General

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, PFAS 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 8.2 to 8.4** below.

8.2 Asbestos in soil

Asbestos impacted soils were identified in the southern portion of the site (in the vicinity of the former clubhouse), in March 2021 during the demolition of a retaining wall. The impacted soils were identified approximately 700 mm below ground surface in a layer approximately 300 mm thick. The layer was estimated to extend across an area of 550 m^2.

In order to inform remediation options and design, further investigation to delineate the impacts was considered necessary and further works to vertically and laterally delineate the asbestos impacts were undertaken over several phases of investigation, completed in 2021.

8.2.1 Testpit program (Octief, 2021a)

Octief, were engaged by EcOz to undertake a test pitting program around the southern area of asbestos impact in April 2021. This program (refer **Section 5.4** [**Table 7**] and **Figure 6**) comprised excavation of 14 test pits around the impacted area and qualitative laboratory assessment for ACM, friable asbestos and asbestos fines.

Based on the field observations and laboratory results, the assessment concluded:

- the asbestos impact covered an area of approximately 650 m^2; and
- the volume of impacted material requiring removal (including ACM debris and FA/ AF encountered at surface and at depth) was approximately 510 m^3 (816 tonnes [specific density of 1.6 T/m^3]).

Octief indicated at the time of reporting approximately 50 m^3 (80 tonnes) of asbestos impacted soil had already been removed from site, leaving an approximate 460 m^3 (736 tonnes) remaining which would require off-site disposal or encapsulation, contingent on the remediation option selected.

8.2.2 Supplementary investigation (Octief, 2022)

Following the EAs engagement in July 2021 and review of existing investigation data, it was acknowledged that further investigation works would be required to address key data gaps in the assessment completed to date. Specifically, further delineation of the asbestos impacted area in the southern portion of the site was deemed necessary as well as assessment of the balance of the site (particularly in disturbance areas and at depth) for asbestos and other CoPCs (refer Section 8.3 and 8.4 below).

The supplementary investigation was completed by Octief in August 2021 and comprised the excavation of 40 testpits across the site (refer **Figure 7**), collection and analysis of representative soil samples for identified CoPCs.

The results of the supplementary assessment confirmed the majority of asbestos impacts were in the vicinity of the previously identified southern impact area (**Figure 7** – asbestos remediation area). However, several hotspots were also identified (**Figure 7** – Trakondy hotspots) that would require remediation during the proposed remedial works program.

8.2.3 Summary

Following advice from EcOz and engagement with the NT EPA, DIPL decided to adopt the encapsulation methodology for the asbestos impacted soils at the site. Following issue of the PAN (2021/3) in August 2021 an encapsulation cell was constructed in the eastern portion of the site, adjacent to the site boundary with Ludmilla Primary School.

Further details on the containment cell are provided in **Section 9** below.

8.3 PFAS

8.3.1 DSI (EcOz 2019)

PFAS was not reported above applicable human health and/or ecological guideline criteria during historic assessments undertaken at the site (EcOz, 2019).

PFAS leachate analysis was completed for 10 samples under two pH scenarios (pH 5 – to replicate naturally acidic rainfall conditions, and pH 7 – neutral water.). The results of the assessment were compared against the 95% interim marine aquatic species protection criteria and the ASLP landfill acceptance criteria for unlined landfills and clay/ composite landfill cells.

The results of the assessment confirmed:

- 3 samples recorded concentrations exceeding the 95% interim marine aquatic species protection criteria for PFOS at pH 5 indicating that PFOS could leach from site soils at concentrations in excess of applicable criteria, under natural (acidic) rainfall conditions; and
- 4 samples recorded concentrations greater than the ASLP landfill acceptance criteria for PFOS + PFHxS, indicating soils may not be suitable for reuse on the development.

Figure 6: Testpit investigation (Octief 2021a)

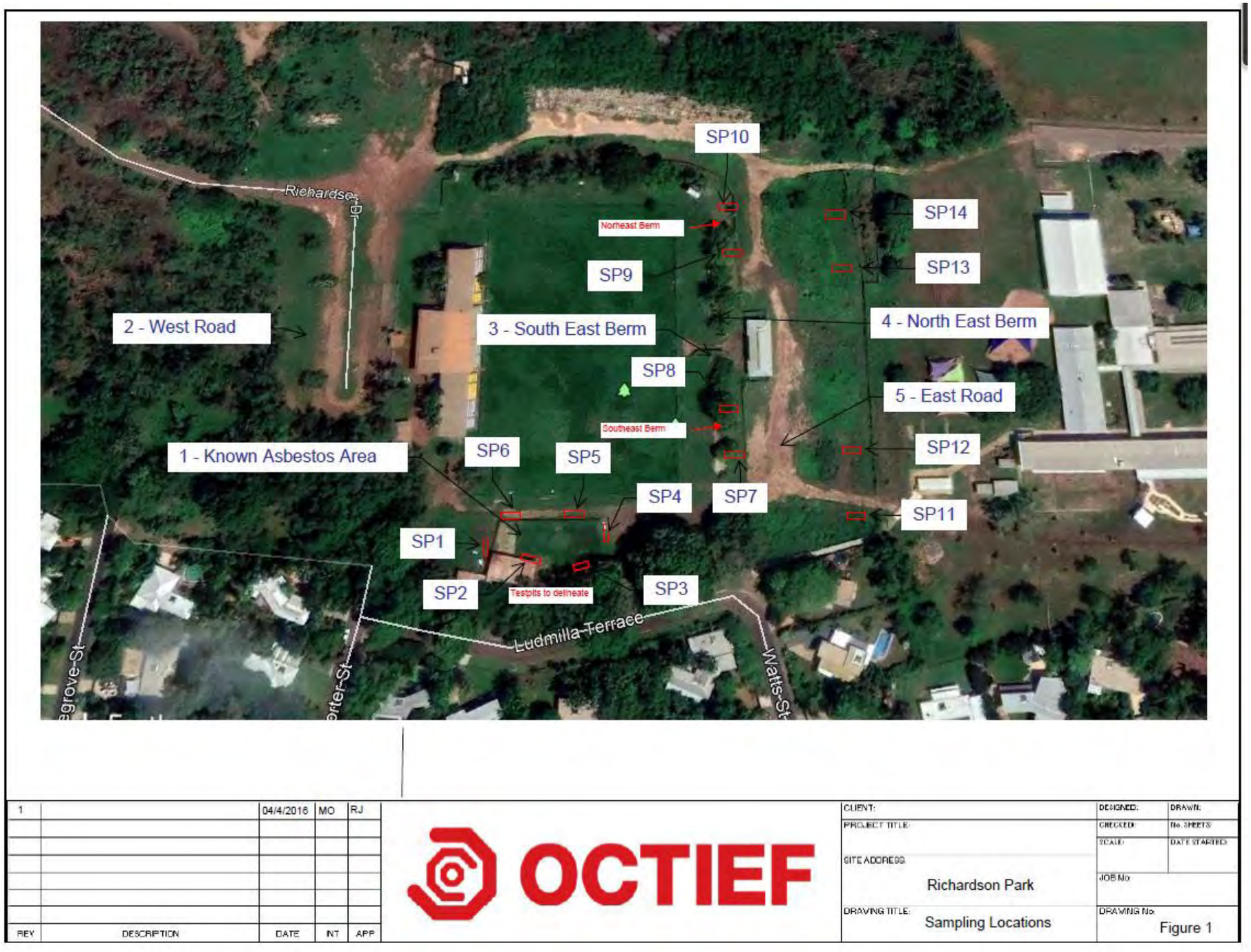


Figure 7: Supplementary investigation (test pit locations), Octief (2022)

The EA noted further assessment of PFAS concentrations within the known asbestos-impacted area and within the footprint of the proposed encapsulation cell would be required to adequately assess any potential PFAS leachability risks in the context of the proposed ACM management strategy.

8.3.2 Supplementary investigation (Octief, 2022)

As referenced in **Section 8.2.2**, Octief was engaged in late 2021 to complete a supplementary assessment at the site to address data gaps. Aside from the requirement to further delineate asbestos impacts (**Section 8.2.2**), the investigation was required to assess site condition, within the known southern asbestos impacted area, proposed encapsulation cell disturbance footprint and other areas of disturbance to confirm site condition with respect to “non asbestos CoPCs”; particularly PFAS.

Further PFAS assessment was deemed particularly important, given the results of the leachability assessment undertaken in 2019 (refer **Section 8.3.1**) and possible implications for remedial design, if PFAS risks were deemed high.

The results of the assessment confirmed:

- PFAS was not reported above applicable human health and/or ecological guideline criteria in any samples collected during the supplementary investigation; and
- PFAS was not reported above laboratory limit of reporting in any of the samples submitted for leachability (ASLP) analysis at pH 5 or pH 7.

Based on the above, PFAS risks associated with asbestos excavation, encapsulation construction and long-term storage were deemed low.

8.4 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 historic assessments at the site (EcOz, 2019).

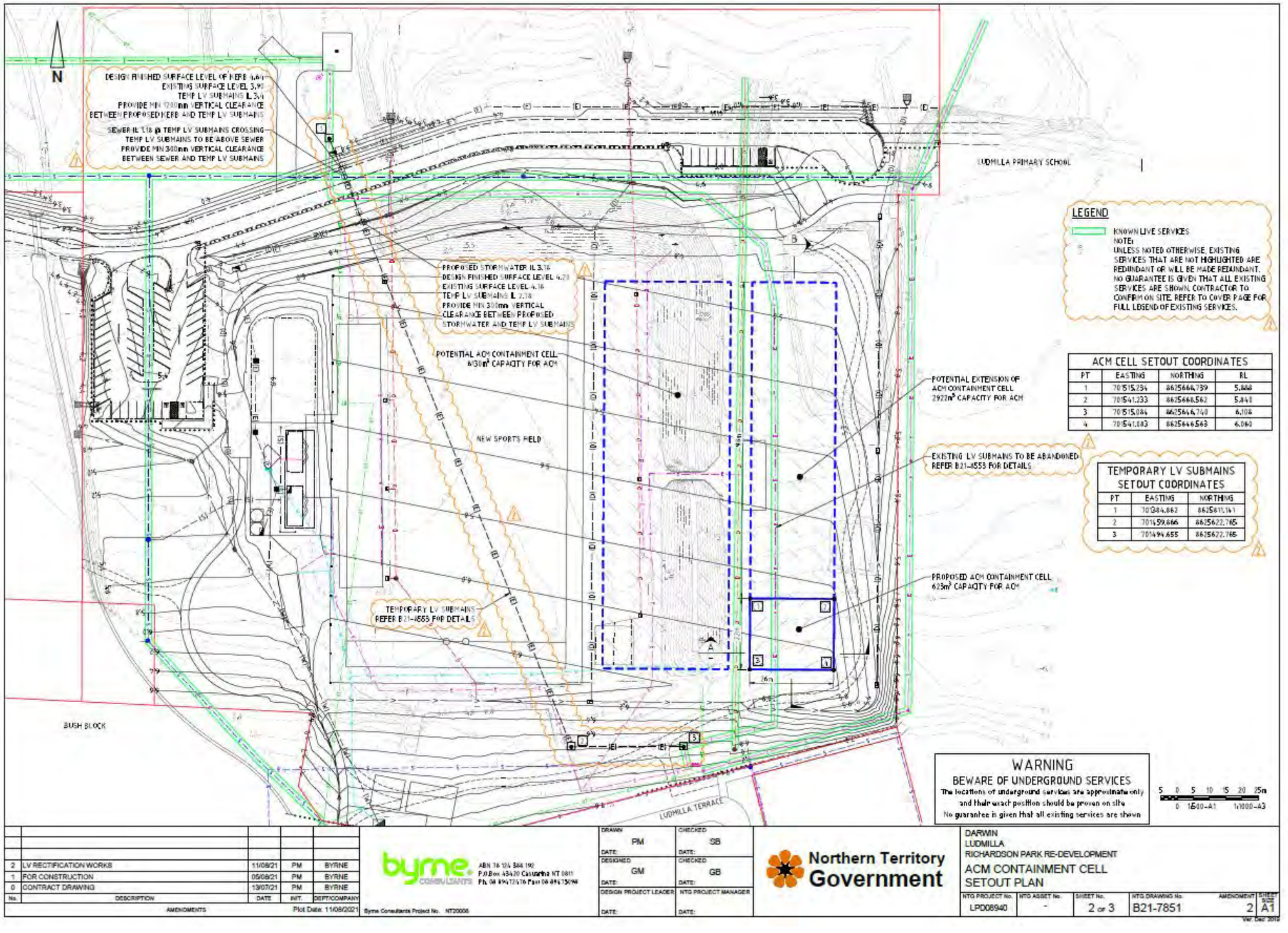
9 SOIL CONTAMINATION MANAGEMENT

9.1 General

Soil contamination management requirements related primarily to management of ACM impacted soils identified during initial demolition works and subsequent site assessments.

Th containment cell was constructed in the eastern portion of the site, adjacent to the site’s eastern boundary with Ludmilla Primary School, broadly consistent with proposed encapsulation cell Option D (Byrne Consultants, 2021b). The cell was intended to cover an initial footprint of 572 m^2 (storage capacity of 623m^3) with a potential for cell extension to provide an additional 2,922 m^3 storage capacity (additional footprint of up to 2,548 m^2) to account for unexpected finds, if required (refer **Figure 8**).

Figure 8: Containment Cell design (LTEMP, 2022)



All civil works associated with encapsulation cell construction, asbestos excavation and removal and final encapsulation cell were managed to prevent exposure to ACM. This included prevention of potential exposure of contractors and other site personnel during the works and includes the management of future potential harm to human health and the environment once the works are complete.

EcOz liaised with Byrne Consultants, Trakondy, NTEX and Asbestos Solutions to produce cell design drawings, health and safety documentation and management plans (asbestos, environmental and construction management) in order to comply with the PAN and therefore the BPEM (refer **Table 13** below).

Table 13: Cell design, HSE documentation and management plans

Design documents	• Byrne Consultants (2021b). Richardson Park Re-Development Options Analysis of Asbestos Containment Cells. Revision B. 8 July 2021. • Byrne Consultants (2021c). ACM Containment Cell – Locality Plan, Schedule of Drawings, Notes, Legend and Abbreviations. Drawing No. B21-7850. Revision 1, 1 August 2021. • Byrne Consultants (2021d). ACM Containment Cell – Locality Plan, Schedule of Drawings, Notes, Legend and Abbreviations. Drawing No. B21-7850. Revision 2, 11 August 2021.
SWMS	• Asbestos Solutions NT (2021). Safe Work Method Statement (SWMS) to move non friable asbestos. SWMS #001, Version 1, 3 August 2021. • Byrne Consultants (2021c) Safe Work Method Statement (SWMS) to move non friable asbestos. SWMS #001, Version 1. 3 August 2021. • NTEX (2021b). Safe Work Method Statement (SWMS), Asbestos Containment. 29 July 2021. • Trakondy (2021d). Safe Work Method Statement (SWMS), Richardson Park – Asbestos in Soils Relocation to Onsite Containment Cell. 16 August 2021. Report to NTEX.
Management plans	• NTEX (2021c). Project Control Plan, Richardson Park Asbestos Containment. Project T20-2110. Version 1.5, 4 August 2021. Report to DIPL. • Trakondy (2021e). Construction Asbestos Management Plan, Richardson Park Asbestos Containment Cell, Richardson Drive, Ludmilla, Northern Territory 0820. Revision 0.4, 27 August 2021. Report to NTEX. Referred to as the CAMP. • NTEX (2021f). Environmental Management Plan, Richardson Park – Encapsulation of Asbestos Containing Materials On Site. Project T20-2110. Version 2.3, 27 August 2021. Report to DIPL. • EcOz (2022). Richardson Park Asbestos Containment Cell. Long Term Environmental Management Plan. Revision 2. 13 January 2022. Report to DIPL.

9.2 Construction of ACM containment cell

9.2.1 Cell design and construction

The containment cell is located in the eastern portion of the site, covers an area of approximately 635 m^2 and was excavated to a depth of approximately 2.6 metres.

The details of containment cell design and design drawings of the cell are presented in the LTEMP (EcOz, 2021; Appendix C) and summarised in **Table 14** below.

Table 14: Containment Cell Design (EcOz, 2022)

Item	Key information
Location	The containment cell was constructed in the south-east portion of the site. GPS: • NW corner: 12° 25'32.330" S/ 130° 51'13.882" E • NE corner: 12° 25'32.341" S/ 130° 51'14.528" E • SE corner: 12° 25'33.244" S/ 130° 51'14.551" E • SW corner: 12° 25'33.257" S/ 130° 51'13.814" E
Dimensions	28.5 m (length) x 22.3 m (width) x 2.6 m (depth)
Basal and sidewall type/ construction	Walls: Constructed at 45-degree (1 in 1) angle.
Capping	The containment cell was capped as follows: • Layer 1: Geofabric cover over ACM material. • Layer 2: Clean fill (300 mm thickness) • Layer 3: High visibility geofabric cover (early warning) • Layer 4: Clean fill (600 mm thickness) compacted and rolled. The final height of the containment cell capping was 100 mm below existing ground level. Allowing for an additional 100 mm of topsoil to be applied for landscaping purposes during Stage 2 of the Richardson Park Development.
Filling period	27 August – 9 September 2021
Completion of containment cell capping	14 September 2021
Material placement	760 m^3 (1,214 tonnes) of excavated soil contaminated with ACM was placed into the containment cell.

9.2.2 Encapsulation and capping of ACM

As no CoPCs other than ACM were identified (refer Section 8), the cell was not designed to prevent infiltration of rainwater/prevent leaching. Therefore, geotextile liner on the base and sides of the cell was not deemed necessary. Rather, the capping design was developed both to provide a physical barrier to prevent exposure of site users to ACM and, to provide a high visibility marker layer for the interface between contaminated and uncontaminated soil.

Following construction of the containment cell to required specifications (refer **Table 13**), ACM was transferred into the cell via dump truck and/or 9-tonne articulated site dumper in two approximate 750 mm thick layers.

As per Octief (2022); soil containing ACM was relocated to the containment cell via dump truck and/or a 9-tonne articulated site dumper in two layers of approximately 750 mm thickness, each. After the first layer was deposited, a sacrificial layer of geofabric was laid, then the first layer rolled and compacted. The second layer was then deposited, levelled and rolled in the same manner.

Once both layers had been placed and adequately compacted a geo fabric capping layer was applied, followed by (in turn) a 300 mm layer of clean fill, then another geofabric layer (high visibility), followed by 600 mm of clean fill which was subsequently compacted and rolled.

9.3 Environmental Auditor (EA) inspections

The PAN did not require the EA to visit the site to inspect the final constructed encapsulation cell. Evidence of the completed cell was provided to the EA by the client in the form of dated photographs of the site.

The asbestos clearance certificates for the encapsulation cell works are included in the Asbestos in soil validation and close out report (Trakondy, 2021g).

10 RISK ASSESSMENT REVIEW

10.1 Risk methodology

In general, the Auditor's risk evaluation was undertaken in accordance with the methodology advised within ISO 31000:2009 – *Risk Management Principals and Guidelines* (Standards Australia, 2009) which is described in EPA Victoria Publication 788.3 – *Siting, Design, Operation and Rehabilitation of Landfills* (EPA Victoria, 2015a). The risk evaluation was conducted with consideration to the site assessments, encapsulation cell design and management plans provided to the Auditor for review.

The risk assessment was conducted to assess the risks associated with the completed cell, including management and maintenance of the cell into the future. Risk associated with the construction of the cell are considered to have been managed during the construction process.

10.2 Risk assessment

10.2.1 Objectives, outcomes and findings

The Auditor (Environmental Earth Sciences, 2021a) undertook a review of the cell design criteria and relative risk/ impacts, in regard to meeting the intent of the BPEM objectives and required outcomes. These have been replicated in **Tables 15 and 16** below.

- **Table 15** presents an initial screening review against the objectives of the BPEM and identifies whether the objectives are applicable, partially applicable or not applicable.
- **Table 16** looks at the potential impact of the asbestos against the required outcomes of the BPEM and provides discussion and recommendations on any further required management.

Table 15: Screening review – BPEM objectives

BPEM Objective	Aspect	Applicable	Partial	Not applicable	Comments
Best-practice siting considerations	Screening for potential landfill sites		✓		• Containment cell siting considerations (Byrne, 2021b) • Containment cell design aspects (Byrne, 2021a) • Environmental assessment – refer to Octief (2021a and 2021b), EcOz (2021a and 2021b), and Byrne (2021b)
Best-practice design	Environmental assessment		✓		
	Site layout		✓		
	Liner and leachate collection system		✓		
	Construction quality assurance	✓			
	Water management	✓			
	Groundwater management	✓			
	Landfill gas			✓	• Asbestos contaminated soils would generally have a low gas generation potential and is unlikely to decompose compared to municipal solid (in particular putrescible wastes) wastes where gas management is a key consideration.
	Odour, dust and air toxics	✓			• Addressed separately by relevant EMP documentation and WHS provisions for construction management and handling of asbestos materials (Asbestos Solutions NT 2021 and NTEX 2021a, 2021b and 2021c).
	Bioreactor landfills			✓	• Bioreactor landfills introduce moisture to the waste mass with the intention of increasing the rate of decomposition. Asbestos contaminated soils would generally have a low potential for decomposition and therefore this aspect is not applicable to the containment cell scenario.
	Noise	✓			• The proposed containment cell construction, filling and closure will be completed as part of the CAMP (Trakondy, 2021a) and SWMS (Asbestos Solutions NT 2021, NTEX 2021c and Trakondy 2021b).
	Traffic considerations	✓			• The proposed containment cell construction, filling and closure will be completed within the bounds of the site. A such, no special considerations for traffic management are considered to be required over and over the usual construction site traffic management provisions.
	Site security and fencing	✓			• The proposed containment cell construction, filling and closure will be completed within the bounds of the site. Site security and fencing is addressed separately in the EMP and SWMS.
Best-practice operation	Environmental management	✓			• Addressed separately in the Project Control Plan (PCP), EMP and SWMS.
	Financial assurance			✓	
	Waste minimisation			✓	
	Waste acceptance			✓	
	Waste pre-treatment			✓	
	Waste placement			✓	
	Waste cover			✓	
	Litter control			✓	

BPEM Objective	Aspect	Applicable	Partial	Not applicable	Comments
	Fires			✓	
	Contingency planning			✓	
	Management of chemicals and fuels			✓	
	Disease vector control			✓	
	Noxious weed control			✓	
	Performance monitoring and reporting		✓		
Best-practice rehabilitation and aftercare	Rehabilitation	✓			• To be managed by LTEMP.
	Aftercare management			✓	• To be addressed in separate provisions of the NT EPA Notice 2021/3.

Notes:

1. Applicable: All aspects are applicable to the assessment and are considered further in the assessment against the Required Outcomes in **Table 16**.
2. Partial: one or more of the aspects are not applicable to the assessment and is considered further in the assessment against the Required Outcomes in **Table 16**.
3. Not applicable: No aspects are applicable to the assessment, with discussion and justification provided in the 'comments' column.

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Table 16: BPEM required outcome review

Aspect	Required outcomes	Impact (NA, low, moderate, high)	Discussion	Recommendation
Best-practice siting considerations				
Screening for potential landfill sites	Ensure that the landfill is sited to protect groundwater, surface waters, and flora and fauna.	LOW	The purpose is to encapsulate soils that contain asbestos only and the cell is not intended to receive any soils with soluble contaminants that could dissolve in groundwater or surface water. Further, capping will be in place to protect flora and fauna; no uptake of contaminants into the capping vegetation (grass) is expected.	None
	All new landfills must deposit waste at least two metres above the long-term undisturbed depth to groundwater, unless the operator satisfies EPA Victoria that sufficient additional design and management practices will be implemented, and EPA determines that regional circumstances exist that warrant the new landfill.	LOW	This requirement is in place to prevent leachate entering groundwater and also to ensure the liner is not structurally compromised by rising groundwater levels. In this case, there is no leachate developed, hence there is no potential environmental impact to the groundwater. The base of the containment cell is not planned to be sealed, allowing groundwater to fluctuate within the cell without putting stress on any basal liner.	None
Best practice design				
Environmental assessment	Investigate water management requirements.	LOW	The purpose is to encapsulate soils that contain asbestos only and the cell is not intended to receive any soils with soluble contaminants that could dissolve in surface water or groundwater. During operation surface water management will be required to ensure runoff is limited to the dedicated asbestos work area(s), as to prevent the spread of contamination on the site. This will be achieved with interim control measures, such as mulch bunds. Surface water runoff within the cell will need to be treated as contaminated with asbestos and will need to be captured, treated and discharged accordingly. The cell may be formed partially beneath the water-table. During operation, groundwater will need to be considered contaminated with asbestos and will need to be captured, treated and discharged accordingly. There will be no leachate, as the contained soils do not have a soluble contaminant that could dissolve in water, either during operation or after closure. After closure all runoff will be treated as clean water.	Impacted surface and groundwater during operation is to be managed as per the EMP (NTEX, 2021b)
Liner and leachate collection system	Design and construction of the best liner and leachate collection system practicable to prevent contamination of groundwater.	LOW	The intent of the proposed containment cell is to provide a physical barrier only. Leachate will not be generated, hence the liner is not intended to prevent water ingress or enable the capture of leachate. The geofabric liner is designed so that the material in the cell will maintain moisture potential in equilibrium with the surrounding/ underlying geological media under fluctuating water-table conditions.	None
	Design and construct the landfill liner such that the appropriate maximum seepage rate shown in Table 6.1 is not exceeded.	LOW	Leachate will not be generated hence seepage rates do not apply. Seepage rates are expected to be similar to those in the surrounding lithology, in particular as hydraulic gradients will not be altered and material porosity and hydraulic conductivity are also expected to be similar.	None
	Implementation of the best practicable measures to meet all groundwater quality objectives contained in SEPP (Waters of Victoria) below the landfill liner.	LOW	Leachate will not be generated hence there will be no impact to groundwater.	None
	Geotechnically stable sub-base and liner.	LOW	The sub-base will be formed in excavated rock and the embankments formed from compacted fill. The embankment slopes have been designed as appropriate to the inferred geotechnical conditions of the fill material.	Excavation and embankment construction to be undertaken as Byrne (2021a)
Construction quality assurance (CQA)	Development and implementation of a Construction Quality Assurance (CQA) plan to ensure that the liner and leachate collection system meets the requirements of the specifications and drawings.	MODERATE	No liner or leachate system is proposed. Provision for a liner is provided in Byrne (2021a).	None

Aspect	Required outcomes	Impact (NA, low, moderate, high)	Discussion	Recommendation
	Development and implementation of a CQA plan to ensure that the stability of sub-base and liner are achieved.	MODERATE	The Contractor has a construction quality assurance plan in line with AS/NZS ISO 9001:2000 – Quality Management Systems. This sets out the Hold Point and Witness Point requirements for the civil earthworks / geotechnical and structural components of the containment cell.	Trakondy (2021a) is to be kept up to date, and hold points and witness points verified as appropriate
	The installation of geotextiles must meet the requirements of Section 4 of Appendix F of the BPEM.	MODERATE	The geotextiles in this design are for the purposes of identification of contaminated soils, rather than the typical function of protecting geomembranes or filtering drainage layers. The transport, handling and storage of the geotextile are to be as per the specifications in the construction quality assurance plan, which are considered appropriate for the usage of geotextile.	
	The CQA plan for geotextiles must address the issues raised in section 5 of Appendix F and should follow the suggestions unless an alternative provides an equivalent or better outcome.	MODERATE	The geotextiles in this design are for the purposes of identification of contaminated soils, rather than the typical function of protecting geomembranes or filtering drainage layers. The quality, strength and performance specified in the design are considered appropriate to the usage of the geotextile and will be monitored and tested as per the construction quality assurance plan.	Trakondy (2021a) is to be kept up to date, and hold points and witness points verified as appropriate
Water management	Segregation of stormwater, leachate and groundwater.	MODERATE	During operation, stormwater diversions are to be constructed to divert clean water away from the cell. All stormwater runoff within the cell will be treated as contaminated with asbestos and will be captured, treated and discharged accordingly. The cell may be formed partially beneath the water-table. During operation, groundwater will be considered contaminated with asbestos and will be captured, treated and discharged accordingly. There will be no leachate, as the contained soils do not have a soluble contaminant that could dissolve in surface or groundwater, either during operation or after closure.	Impacted surface and groundwater during operation (i.e., construction) is to be managed as per NTEX (2021b), and post-closure by the LTEMP.
	Assurance that waste discharges to surface waterways are minimised and do not cause water quality objectives to be breached.	MODERATE	All stormwater runoff within the cell will be treated as contaminated with asbestos and will be captured, treated and discharged accordingly. The cell may be formed partially beneath the water-table. During operation, the groundwater will be considered contaminated with asbestos and will be captured, treated and discharged accordingly.	
Groundwater management	Implement a groundwater monitoring program in accordance with Landfill licensing guidelines (EPA publication 1323).	LOW	No leachate is being generated, hence there will be no impact to the groundwater and therefore no requirement for monitoring bores.	None
	Ensure that the landfill liner cannot be damaged through groundwater pressure.	LOW	The intent of the proposed containment cell is to provide a physical barrier only. Leachate will not be generated, hence the liner is not intended to prevent water ingress or enable the capture of leachate. The geofabric liner is designed so that the material in the cell will maintain moisture potential in equilibrium with the surrounding/underlying geological media under fluctuating water-table conditions.	None
	Minimise risk to groundwater by siting landfill in accordance with BPEM section 6.2 (site layout) and utilising a liner and leachate collection system in accordance with section 6.3 (liner and leachate collection system).	LOW		
Best-practice rehabilitation and aftercare				
Rehabilitation	That the seepage through the landfill cap is no more than 75% of the anticipated seepage rate through a basal liner that meets best-practice requirements.	LOW	The containment cell capping is not designed to limit water seepage and is intended to act as a physical barrier only.	None
	Design and construction of the best cap practicable to prevent pollution of groundwater and degradation of air quality.	MODERATE	The capping solution includes 2 x geofabric components (including 1 high visibility fabric), compacted clean fill and topsoil layers (see Byrne, 2021a). The containment cell capping is not designed to limit water seepage and is intended to act as a physical barrier only.	None
	Design and construction of the most robust cap to ensure that the system will continue to protect the environment in the event of several components of the system failing.	MODERATE	The capping solution includes 2 x geofabric components (including 1 high visibility fabric), compacted clean fill and topsoil layers (see Byrne, 2021a).	Aftercare requirements for the cell are to be developed as per the LTEMP and PAN No. 2021/3.

A review of the risk factors with potential impact assessed as 'moderate' or 'high' are then further discussed in the context of the overall site risk and ongoing monitoring and management requirements.

10.2.2 BPEM assessment summary and recommendations

The required outcomes that were considered to have a moderate impact and thus require further management were identified under 'construction quality assurance' of 'best practice design' (**Table 16**).

As no leachate would be generated from the asbestos waste, these outcomes specifically relate to the geotechnical stability of the encapsulation cell.

10.3 Review of ongoing site management strategies

Requirements for ongoing site management are outlined in the LTEMP (EcOz 2022 – **Appendix C**), according to the requirements of the NT Contaminated Land Guidelines (NT EPA, 2017). The LTEMP details the relevant information about the cell construction, requirements for inspections and maintenance, and details for training, notification and record keeping for the site.

The proposed timing of inspections; mid-wet season and post-wet season, is considered to be a critical aspect of the inspection schedule.

10.4 Risk to beneficial uses

With reference to discussions made in Sections 10 and 11, the current status of the ACM contaminated soil at the site (that is, buried within an engineered containment cell with geotextile liner and marker layer) does not present an unacceptable risk to beneficial uses related to noise, groundwater, surface water or air quality management.

The risk to land beneficial uses is limited to human health via the inhalation of airborne asbestos fibres / dust. This is only possible in the event that the containment cell is accessed during potential future redevelopment of the site. In order to mitigate the risk of human exposure, an LTEMP has been prepared EcOz, 2022 – **Appendix C**) and is to be lodged with the NT EPA, as per Requirement 16 of the PAN.

11 AUDITOR VERIFICATION OF COMPLIANCE

The Auditor verifies that in the Auditor's opinion and having regard to the requirements of the PAN (2021/3), the BPEM and other relevant policies or documents, the LTEMP will be adequate to enable DIPL to be compliant with the PAN.

Auditor review, assessment and endorsement correspondence issued throughout the project has been provided in **Appendices D-G** of this report.

12 RECOMMENDATIONS

The Auditor considers that the site is suitable for its intended use in its current configuration which includes the engineered containment cell for encapsulation of asbestos impacted soil.

It is recommended that the site be managed in compliance with the LTEMP, particularly in relation to the requirement for twice annual monitoring and associated reporting (EcOz, 2022 – **Appendix C**).

13 AUDIT CONCLUSIONS

A PAN (2021/3) was issued by NT EPA in relation to the construction and management of the encapsulation cell. The process of cell design and asbestos management was completed by specialist subcontractors (refer **Section 3.7**, **Figure 1** and **Table 4**) and managed by EcOz for the duration of the project.

In accordance with Requirement 8 of the PAN, the cell was designed and constructed in order to comply with the intent of the BPEM Publication 788.3. The conditions of the PAN, and references to how each of the requirements are addressed is presented in **Table 17** below in the Tables Appendix of this report.

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 53V), 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 requirements of the PAN and other relevant policies and documents, to provide an opinion on potential risks posed by the ACM contaminated soil contained within the designed encapsulation cell to the relevant sensitive receptors on and off the site.

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 24 January 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 the Northern Territory Government – Department of Infrastructure, Planning and Logistics (DIPL)
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 40 Richardson Drive, Ludmilla (“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

Final, endorsed versions of each document referenced in the PAN are highlighted **in bold**, in the reference list below.

Asbestos Solutions NT (2021). *Safe Work Method Statement (SWMS) to move non friable asbestos*. SWMS #001, Version 1, 3 August 2021.

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ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

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.

TABLES

Table 17: Pollution Abatement Notice 2021/3 Requirements

Item #	Requirement	Addressed?	Report reference
Remedial Requirements for the asbestos impacted area			
1	The asbestos impacted soils identified at the premises, as defined at point 5 in Attachment A of the PAN (PAN 2021/3) are to be managed in accordance with a Remedial Action Plan (RAP).	Y	
2	The RAP referred to in requirement 1 above must be reviewed and endorsed by an environmental auditor accredited under the New South Wales or Victorian environmental auditor schemes.	Y	Environmental Earth Sciences (2021a)
3	The asbestos impacted soils identified at the premises, as defined at point 45 in Attachment A of the PAN (PAN 2021/3) are to be placed within an appropriately constructed and engineered containment cell, in accordance with requirements 6 to 8 of the notice.	Y	
4	Validation of the asbestos impacted area, following the removal of asbestos impacted soils, must be undertaken in accordance with the RAP and results detailed in a validation report.	Y	
5	The validation report detailed in requirement 4, must be provided to the NT EPA via e mail to pollution@nt.gov.au and include formal endorsement of the remedial works and validation results by an environmental auditor, accredited under the NSW or Victorian environmental auditor schemes.	Y	Environmental Earth Sciences (2022) – this report
Containment cell construction requirements			
6	You must notify the NT EPA, 7 days prior to the commencement of any construction works covered by this notice via e mail to pollution@nt.gov.au.	Y	
7	Prior to commencing containment cell construction works, you must provide to the NT EPA (via e mail to pollution@nt.gov.au) the Design Documents for the containment cell, including, detailed plans, technical specifications, and a construction quality assurance plan to guide the construction of the containment cell.	Y	
8	The containment cell, referred to in Requirement 7, must be designed and constructed in accordance with the intent of the Victorian EPA Publication 788.3 titled “Best Practice Environmental Management: Siting, Design, Operation and Rehabilitation of Landfills “ (Landfill BPEM) dated August 2015, as amended.	Y	Environmental Earth Sciences (2021a)
9	The Design Documents referred to in Requirement 7 must include formal endorsement by an environmental auditor accredited under the New South Wales or Victorian environmental auditor schemes.	Y	
10	During construction of the containment cell, dust, noise (including vibration), odour and wastewater (including contaminated stormwater) must not be emitted or discharged beyond the boundary of the premises.	Y	
11	You must notify the NT EPA not more than 14 days after completion of construction works covered by this notice via e mail to pollution@nt.gov.au	Y	
Containment Cell Operational Requirements			
12	You must not commence placement of the asbestos impacted soils within the containment cell until the Design Documents, referred to in Requirement 7; (a) have been assessed and endorsed by an independent environmental auditor accredited under the NSW or Victorian environmental auditor schemes, as being appropriate for their purposes; and (b) the required endorsed documents have been provided to the NT EPA.	Y	(a) Environmental Earth Sciences (2021a) (b) Documents provided
13	Prior to the placement of any asbestos impacted soils within the containment cell, you must provide an Environmental Management Plan, endorsed by an environmental auditor accredited under the NSW or VIC environmental auditor schemes, to the NT EPA via e mail to pollution@nt.gov.au	Y	
14	The Environmental Management Plan referred to in requirement 13 must include, but not be limited to, detailed information on: (a) waste types to be accepted within the containment cell; (b) waste prohibited from placement within the containment cell; (c) waste placement methods; (d) dust control and monitoring’ (e) noise control and monitoring; (f) stormwater, surface water and groundwater management (as necessary); (g) decontamination measures; (h) signage and fencing to be established and maintained during works; (i) measures to ensure staff and contractors are aware of the requirements detailed in this pollution abatement notice; and (j) reporting requirements for potential contraventions of this pollution abatement notice.	Y	

Item #	Requirement	Addressed?	Report reference
Containment Cell Closure Requirements			
15	By no later than 3 months following completion of the containment cell, you must provide to the NT EPA a Close Out report detailing: (a) the exact boundary co ordinates of the containment cell and any associated infrastructure; (b) the final quantities of waste material placed within the containment cell; (c) the capping type and thickness used atop the waste materials in the containment cell; (d) any ongoing monitoring requirements for the capping of the containment cell; and (e) the Close Out report must be submitted to the NT EPA via e mail to pollution@nt.gov.au	Y	
16	For the purposes of requirement 15(d) a Long Term Environmental Management Plan (LTEMP), consistent with the Aftercare Management in Section 8.2 of the Landfill BPEM, must be provided to the NT EPA via e mail to pollution@nt.gov.au	Y	
17	The LTEMP referred to in requirement 16 must include formal endorsement by an environmental auditor accredited under the New South Wales or Victorian environmental auditor schemes.	Y	Environmental Earth Sciences (2022) – this report
18	The LTEMP referred to in requirement 16, should, at a minimum, contain the following: (a) An inspection regime of the cap to monitor for cracks or erosion; (b A Maintenance regime of the cap to remediate and restore depressions or seal cracks (as necessary); (c) restrictions on vegetation types to be grown in the area; and (d) parties responsible for any ongoing monitoring and maintenance of the cell.	Y	EcOz (2022)

APPENDIX A: POLLUTION ABATEMENT NOTICE

ntepa Northern Territory Environment Protection Authority

POLLUTION ABATEMENT NOTICE

No. 2021/3

(Issued pursuant to section 77 of the *Waste Management and Pollution Control Act 1998*)

ISSUED TO: Crown Lands Estate
care of
Department of Infrastructure, Planning and Logistics

OF: Level 5, Energy House, Cavenagh Street, Darwin NT, 0800

WHEREAS the Northern Territory Environment Protection Authority (NT EPA) is satisfied for the reasons stated in **Attachment A** to this notice, that the Department of Infrastructure, Planning and Logistics (DIPL):

(i) is the owner and/or occupier of land that is polluted

and situated at 40 Richardson Drive, Ludmilla, NT (Lot 8434, Town of Darwin) also referred to as 'Richardson Park' (the premises), as delineated in Blue in **Attachment C.**

NOW TAKE NOTICE that you are required to comply with each of the requirements specified in **Attachment B** to this notice on and from the date of issue of this notice or such later date as may be specified.

ISSUE DATE: 24/8/2021

.....
AMY DENNISON
EXECUTIVE DIRECTOR
ENVIRONMENTAL REGULATION
DELEGATE OF THE NT EPA

Important Notice

Failure to comply with this notice is an offence under section 80 of the *Waste Management and Pollution Control Act 1998* and may incur significant penalties and/or other statutory action.

This notice takes effect on the date on which it is served upon you. Pursuant to section 108 of the *Waste Management and Pollution Control Act 1998*, **you have the right to apply for a review of the decision to issue you with this Pollution Abatement Notice. If you intend to apply for a review, YOU MUST MAKE AN APPLICATION NOT LATER THAN 7 DAYS after the date you were served with this notice.** For information on how to lodge an application for review, contact the Northern Territory Environment Protection Authority, telephone 8924 4218.

Pursuant to section 112 of the *Waste Management and Pollution Control Act 1998* the person issued with this notice must fulfil certain obligations before selling, leasing, sub-leasing, giving or exchanging land, premises, a vehicle or business which is the subject of this Notice.

ATTACHMENT A

REASONS FOR ISSUING THIS POLLUTION ABATEMENT NOTICE

1. The Department of Infrastructure, Planning and Logistics (DIPL) acts as the controlling agency (the controller) on behalf of Crown Lands (the owner) for the property located at 40 Richardson Drive, Ludmilla, NT (Lot 8434, Town of Darwin) also referred to as 'Richardson Park' (the premises) and delineated in Blue in **Attachment C;**
2. DIPL is redeveloping the premises with the aim of creating a community purpose area in line with the current zoning of Organised Recreation (the project);
3. The project involves the demolition and removal of all buildings, upgrading of the existing Richardson Park playing surface to include redevelopment of surrounding grounds for recreational purposes and construction of toilet facilities and a visitor car parking area;
4. The project works will also involve an extension of Richardson Drive to enhance access to Ludmilla Primary School;
5. EcOz Pty Ltd (ACN 143 989 039) and OCITIEF Pty Ltd (ACN 163 772 478) were engaged as the environmental consultants for the project and conducted preliminary contaminated land investigations across the premises;
6. During preliminary works, an area of approximately 550m^2 of asbestos containing material (ACM) impacted soils were identified in the southern portion of the premises, as delineated in yellow in **Attachment D;**
7. Friable asbestos and asbestos fines (AF/FA) were identified in excess of the adopted site assessment criteria at several locations in the southern portion of the premises;
8. Additional investigation works were undertaken by the consultants, engaged for the project, to delineate the lateral and vertical extent of asbestos impacts at the premises;
9. The identified extent of asbestos impacted soils in the southern portion of the premises, was calculated at approximately 816 tonnes, with approximately 40 tonnes of impacted material already disposed off site at the Shoal Bay Waste Handling Facility;
10. An assessment of the management and disposal options for the impacted materials was undertaken, and in consultation with the contaminated land auditor engaged for the project, DIPL and NT EPA officers, the preferred remediation option was deemed to be the construction of an engineered containment cell on the premises; and
11. This pollution abatement notice details the requirements for the design, construction, operation, and close out including ongoing management of the containment cell.

ATTACHMENT B

POLLUTION ABATEMENT NOTICE REQUIREMENTS

Remedial Requirements for the Asbestos Impacted Area

1. The Asbestos impacted soils identified at the premises, as defined at point 5 in **Attachment A** to this notice are to be managed in accordance with a Remedial Action Plan (RAP);

2. The RAP referred to in requirement 1 above must be reviewed and endorsed by an environmental auditor accredited under the New South Wales or Victorian environmental auditor schemes;

3. The asbestos impacted soils identified at the premises, as defined at 5, in **Attachment A to** this notice, are to be placed within an appropriately constructed and engineered containment cell, in accordance with requirements 6 to 8 of this notice;

4. Validation of the asbestos impacted area, following the removal of asbestos impacted soils, must be undertaken in accordance with the RAP and results detailed in a validation report;

5. The validation report detailed in requirement 4, must be provided to the NT EPA via email to pollution@nt.gov.au and include formal endorsement of the remedial works and validation results by an environmental auditor, accredited under the NSW or Victorian environmental auditor schemes;

Containment Cell Construction Requirements

6. You must notify the NT EPA, 7 days prior to the commencement of any construction works covered by this notice via email to pollution@nt.gov.au;

7. Prior to commencing containment cell construction works, you must provide to the NT EPA (via email to pollution@nt.gov.au) the Design Documents for the containment cell, including, detailed plans, technical specifications and a construction quality assurance plan to guide the construction of the containment cell;

8. The containment cell, referred to in requirement 7, must be designed and constructed in accordance with the intent of the Victorian EPA Publication 788.3 titled "*Best Practice Environmental Management: Siting, Design, Operation and Rehabilitation of Landfills*" (Landfill BPEM) dated August 2015, as amended;

9. The Design Documents referred to in requirement 7 must include formal endorsement by an environmental auditor accredited under the New South Wales or Victorian environmental auditor schemes;

10. During construction of the containment cell, dust, noise (including vibration), odour and waste water (including contaminated storm water) must not be emitted or discharged beyond the boundary of the premises;

11. You must notify the NT EPA not more than 14 days after completion of construction works covered by this notice via email to pollution@nt.gov.au;

Containment Cell Operational Requirements

12. You must not commence placement of the asbestos impacted soils within the containment cell until the Design Documents, referred to in requirement 7:
    (a) have been assessed and endorsed by an independent environmental auditor accredited under the NSW or Victorian environmental auditor schemes, as being appropriate for their purpose; and
    (b) the required endorsed documents have been provided to the NT EPA;

13. Prior to the placement of any asbestos impacted soils within the containment cell, you must provide an Environmental Management Plan, endorsed by an environmental auditor accredited under the NSW or VIC environmental auditor schemes, to the NT EPA via email to pollution@nt.gov.au;

14. The Environmental Management Plan referred to in requirement 13 must include, but not be limited to, detailed information on:
    (a) waste types to be accepted within the containment cell;
    (b) waste prohibited from placement within the containment cell;
    (c) waste placement methods;
    (d) dust control and monitoring;
    (e) noise control and monitoring;
    (f) stormwater, surface water and groundwater management (as necessary);
    (g) decontamination measures;
    (h) signage and fencing to be established and maintained during works;
    (i) measures to ensure staff and contractors are aware of the requirements detailed in this pollution abatement notice; and
    (j) reporting requirements for potential contraventions of this pollution abatement notice;

Containment Cell Closure Requirements

15. By no later than 3 months following completion of the containment cell, you must provide to the NT EPA a Close Out Report detailing:
    (a) the exact boundary coordinates of the containment cell and any associated infrastructure;
    (b) the final quantities of waste material placed within the containment cell;
    (c) the capping type and thickness used atop the waste materials in the containment cell;
    (d) any ongoing monitoring requirements for the capping of the containment cell; and
    (e) the Close Out Report must be submitted to the NT EPA via email to pollution@nt.gov.au;

16. For the purposes of requirement 15(d) a Long Term Environmental Management Plan (LTEMP), consistent with the *Aftercare Management* in Section 8.2 of the Landfill BPEM, must be provided to the NT EPA via email to pollution@nt.gov.au;

17. The LTEMP referred to in requirement 16 must include formal endorsement by an environmental auditor accredited under the New South Wales or Victorian environmental auditor schemes; and

18. The LTEMP referred to in requirement 16, should, at a minimum, contain the following:
    (a) An inspection regime of the cap to monitor for cracks or erosion;
    (b) A maintenance regime of the cap to remediate and restore depressions or seal cracks (as necessary);
    (c) restrictions on vegetation types to be grown in the area; and

(d) parties responsible for any ongoing monitoring and maintenance of the cell.

ATTACHMENT C
THE PREMISES

ATTACHMENT D
ASBESTOS IMPACTED AREA

APPENDIX B: REGISTERED BORES

RN005197

N.T.A. WATER RESOURCES BRANCH

BORE DATA SHEET

NAME Porter St. Electrode Hole No. 1

INDEX No. 80/388

REG. No. ... 5197

FILE No. ...

LOCALITY

DEPTH 40ft 12.2m

CASINGS 40ft of 4" gal. water pipe

PERFORATIONS

SCREENS

LOCATION / / E N

SURFACE LEVEL R.L.

B M LEVEL R.L.

DATUM

CONTRACTOR F. Eggington

DRILLER O. Torres

DATE STARTED 3.12.65

DATE FINISHED 3.12.65

WATER

AQUIFERS				
DEPTH STRUCK				
AQUIFER THICKNESS..				
STANDING WATER LEVEL				
PUMP TEST G.P.H.				
DRAWDOWN LEVEL..				
PUMP LEVEL				
DURATION OF TEST HOURS ...				
R.L. S.W.L				
WATER TEMPERATURE °C				
TRANSMISSIBILITY				
STORAGE COEFF.....				
ANALYSES				
BINOMIAL CLASSIFICATION				
T.D.S.				
CONDUCTIVITY				
TOTAL HARDNESS				
CHLORIDE				
BICARBONATE				
CARBONATE				
SULPHATE.....				
NITRATE				
FLUORIDE.....				
SODIUM.....				
POTASSIUM				
CALCIUM				
MAGNESIUM				
REG. ANAL. No.....				

EQUIPMENT

STRATA SECTION

DEPTH FEET	CASING	AQU.	SEC.	STRATA
10				Porcilinite
20			21 6.4m	
				Sandy Clay
30				
40			40 12.2m	

RN005198

N.T.A. WATER RESOURCES BRANCH

BORE DATA SHEET

NAME PORTER ST. ELECTRODE HOLE NO. 2

LOCALITY

DEPTH 40ft 12.2 m

INDEX No. 80/389

REG. No. ... 5198

FILE No. ...

CASINGS 40ft of 4" gal. water pipe

PERFORATIONS

SCREENS

LOCATION / / E N | SURFACE LEVEL R.L. | B M LEVEL R.L. | DATUM

CONTRACTOR F. Eggington | DRILLER O. Torres | DATE STARTED 4.12.65 | DATE FINISHED 4.12.65

WATER				
AQUIFERS				
DEPTH STRUCK				
AQUIFER THICKNESS..				
STANDING WATER LEVEL				
PUMP TEST G.P.H.				
DRAWDOWN LEVEL..				
PUMP LEVEL				
DURATION OF TEST HOURS ...				
R.L S.W.L				
WATER TEMPERATURE °C				
TRANSMISSIBILITY				
STORAGE COEFF.....				
ANALYSES				
BINOMIAL CLASSIFICATION				
T.D.S.				
CONDUCTIVITY				
TOTAL HARDNESS				
CHLORIDE				
BICARBONATE				
CARBONATE				
SULPHATE.....				
NITRATE				
FLUORIDE.....				
SODIUM.....				
POTASSIUM				
CALCIUM				
MAGNESIUM				
REG. ANAL. No.....				

EQUIPMENT

STRATA SECTION

DEPTH FEET	CASING	AQU. SEC.	STRATA
10			Porcellinite
20			8.2m.
30			Sandy Clay
40			12.2m

PARTICULARS OF COMPLETED BORE/WELL

Registration No RN26893
Index No 80/3857
Advice No

20. Describe rock type, colour etc. any changes must be recorded.

From - To

0—3 BLACK TOPSOIL
3-5 LATERITE COPPER ROCK
5—34.6 RED BROWN CLAY
34.6—64.8 BROWN CLAYSTONE SILTSTONE
64.8—75.7 CLAYSTONE + SHST
75.7—77.3 GREEN SHALE
77.3—81.9 DARK SHALE
81.9—86.4 BLACK SHALE
86.4—91 SHALE WITH QUARTZ & SANDSTONE
91—100.2 SHALE.

TOP OF PACKER. 15mt
PVC CASING DAMAGED.

1. Name of Bore: DEPOT
2. Name of Property: WATER RESOURCES DEPOT
3. Owner of Property: DARWIN 30-24
4. Type of Lease:
5. Lease/Block No.: LOT 4990 T=DARWIN
6. Bore or Well: BORE
7. Name of Contractor: WATER RESOURCES
8. Name of Driller: A SOMMERFIELD J HOLLAR
9. Depth Recorded: 100.2
10. Depth Drilled: 100.2
11. Date Commenced: 18-4-90
12. Date Completed: 26-4-90
13. Proposed use of Bore: ☐ Domestic ☐ Pastoral ☐ Stock Route ☐ Irrigation ☐ Town Supply ☑ Observation ☑ Investigati
14. Bore has been drilled by ☑ Rotary ☐ Cable Tool ☐ Jetting ☐ Other
15. Bore Drilled Using ☑ Air ☑ Mud ☑ Foam ☑ Water ☑ Degradable Polymer
Size of drilling Bit 254 from 0 to 21.5
203/152 from 21.5 to 79/100.2
16. Casing Installed ☑ Steel ☐ ABS ☐ PVC ☐ Fibreglass ☐ Other.....
219 Dia from 0 to 21.5 STEEL
.....Dia from..... to ..... PVC.
Threaded (Welded) CLOED.
17. Screens ☑ None installed ☐ Staineless Steel ☐ Bronze ☐ PVC
Dia.....Slot Size.....From.... to....
Dia.....Slot Size.....From.... to....
Screens are Screwed connected by Pa
18. Perforation in casing ☐ Percussion Slotted ☐ Oxycut ☐ Drilled Other.....
Slot/hole size.....From..... to.....
Slot.hole size.....From..... to.....
19. Is any strata cemented off ☑ Yes ☐ No 0—21.5 mt
If so, give depth ..... to .....
21. Sample of strata and water (have been) will be left at (Darwin) Katherine Alice Springs Other.....

22. WATER	1st Supply	2nd Supply	3rd Supply	4th Supply	5th Supply	Remarks
Struck at	34.6 ~44.2					
Standing Water Level						
Discharge	.5 Lts					
Duration of						

RN026893

Please show boudaries of sections etc, and location of bore(s) within section. If more than one bore clearly identify each. Marked distance from boundaries if possible.

24. This bore has been constructed under by supervision and this report is true to the best of my knowledge.

Signature.....Driller Date.....

PLEASE NOTE THE FOLLOWING:-

1. UNITS If possible please use metric units (metres, Millimetres, litres per second). Old units are acceptable (feet, inches, gallons per hour) but make sure you make it clear which you are using.

2. WATER SAMPLES Asample of not less than one litre of each water supply encountered during the drilling is required. Suitable plastic bottles can be obtained from the Water Resources Branch. Please rinse out all bottle properly before sampling. Completely fill the bottle leaving no entrapped air. Please label the bottle with the bore name and depth of supply.

3. STRATA SAMPLES A sample of not less than 0.2 kilograms of each 3m of stratum encountered during drilling is required. Please label all samples with the hole name and interval drilled. Plastic bags and tags can be obtained from Water Division.

4. LOCATION Please describe the location as accurately as possible giving distances from one or more features (such as other bores, dams,etc.) within a close distance. Preferably give a sketch of the area.

26. OFFICE USE ONLY:

Map No: 1:10,000 SHEET 08:06 DARWIN Plotted on Map Date: 19/6/90

AMG Co-ordinates: 671365 - 8625020 Traced to Master Map Date:.....

Datum (A.H.D.) ZONE 52 S/B 815 Checked by:..... Date.....

Geological Basin:..... Signature (Bore Inspector) Date.....

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

Bottle No.	Lab. Register No.	
RI410	89/90/1372	26,893.

Date Received in Lab.	Time Sampled	Date Sampled
16/5/90	1250	18/4/90

Location and Details WATER RESOURCES DEPOT DARWIN

R/N 26893 BORE DEPTH 44.2m Q 0.5 LPS

TEMP 29°C pH 6.42 COND 45 SAMPLER: P. WEIR

D/N° DCM 21 RSP 44 MISC

ANALYSIS — PHYSICAL

☒	pH	[423]	4.7	☐	Colour (Hazen units)	[204A]	
☐	Electrical conductivity (microsiemens/cm at 25° C)	[205]	40	☐	Turbidity (NTU's)	[214A]	
☐	Total dissolved solids (mg L^{-1} - dried at 180° C)	[209B]	25	☐	Suspended solids (mg L^{-1})	[209C]	

ANALYSIS — CHEMICAL (mg L^{-1})

☐	Sodium, Na	[303A]	4	☐	Chloride, Cl	[407A]	7
☐	Potassium, K	[303A]	1	☐	Sulphate, SO_4	[G]	3
☐	Calcium, Ca	[311C]	<1	☐	Nitrate, NO_3	[418A]	2
☐	Magnesium, Mg	[303C]	<1	☐	Bicarbonate, HCO_3	[403]	1
☐	Total Hardness (as $CaCO_3$)	[314B]	<1	☐	Carbonate, CO_3	[403]	
☐	Total Alkalinity (as $CaCO_3$)	[403]	1	☐	Fluoride, F	[413B]	<0.1
☐	Iron, (total) Fe	[303A]	* U/S	☐	NaCl (calc. from chloride)		12
☐	Silica, SiO_2	[425D]	14				

ANALYSIS — ADDITIONAL (mg L^{-1})

☐	Copper, Cu	[304] [303A]		☐	Lead, Pb	[303A] [304]		
☐	Manganese, Mn	[303A] [304]		☐	Zinc, Zn	[304] [303A]		
☐	Selenium	[303E]		☐			☐	

☐	Arsenic, As	[303E]
☐	Cadmium, Cd	[303A] [304]
☐		

* 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: 12 JUN 1990

CHECKED: J. M. Hume

SIGNATORY: E. Gole

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.

NATA

$Avt = 1.50 m^3/day$

$S = \frac{15.8 \times 4 \times Q}{Avt}$

GORMACK GRAPH PAPERS : CHRISTCHURCH N.Z.

E331Y Log-log 3 cycles x 3 cycles

$S_1 = \frac{15.8 \times 4 \times 0.28}{1.50}$

$S_1 = 11.80$

$S_2 = \frac{15.8 \times 4 \times 0.55}{1.50}$

$S_2 = 23.17$

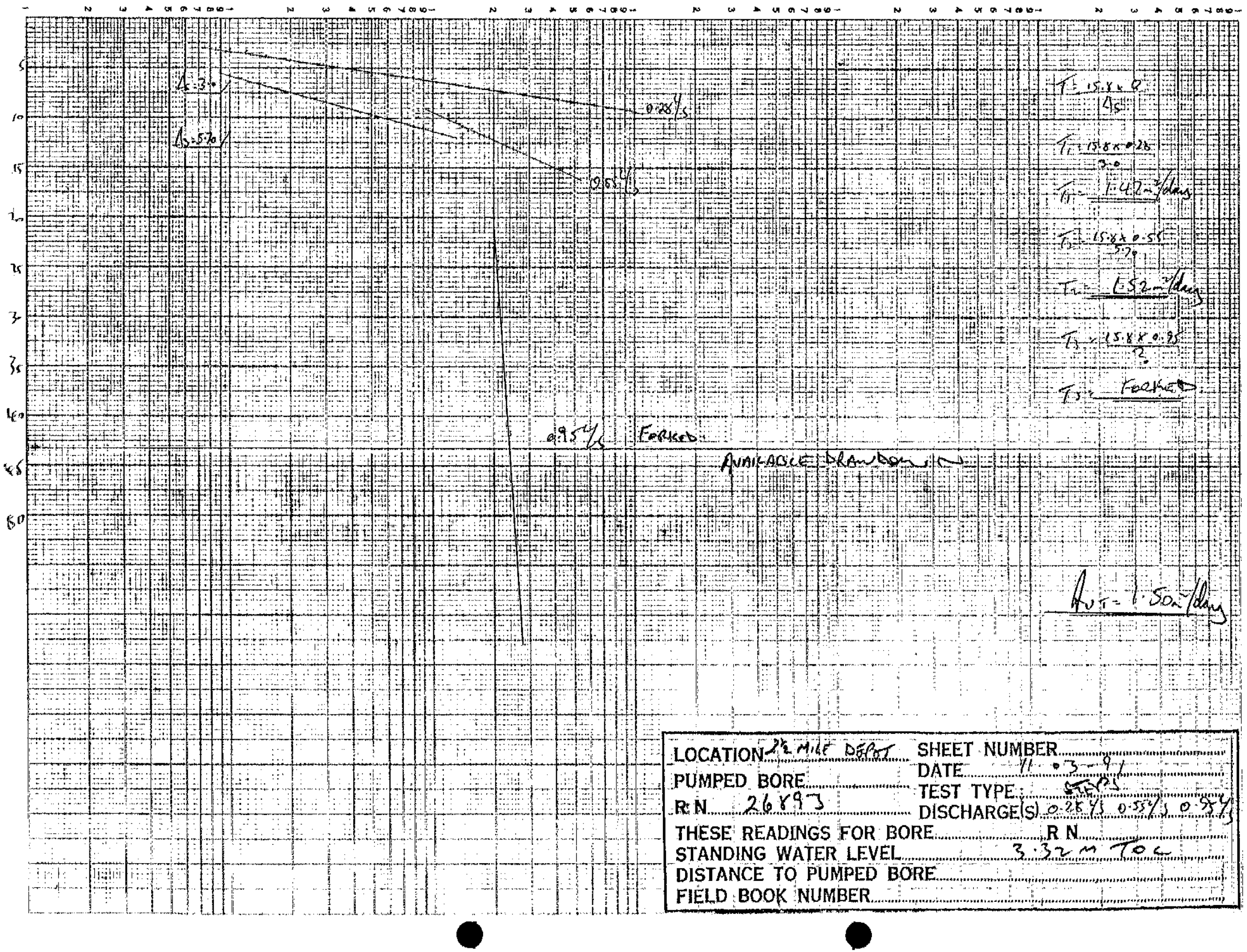
R 26893

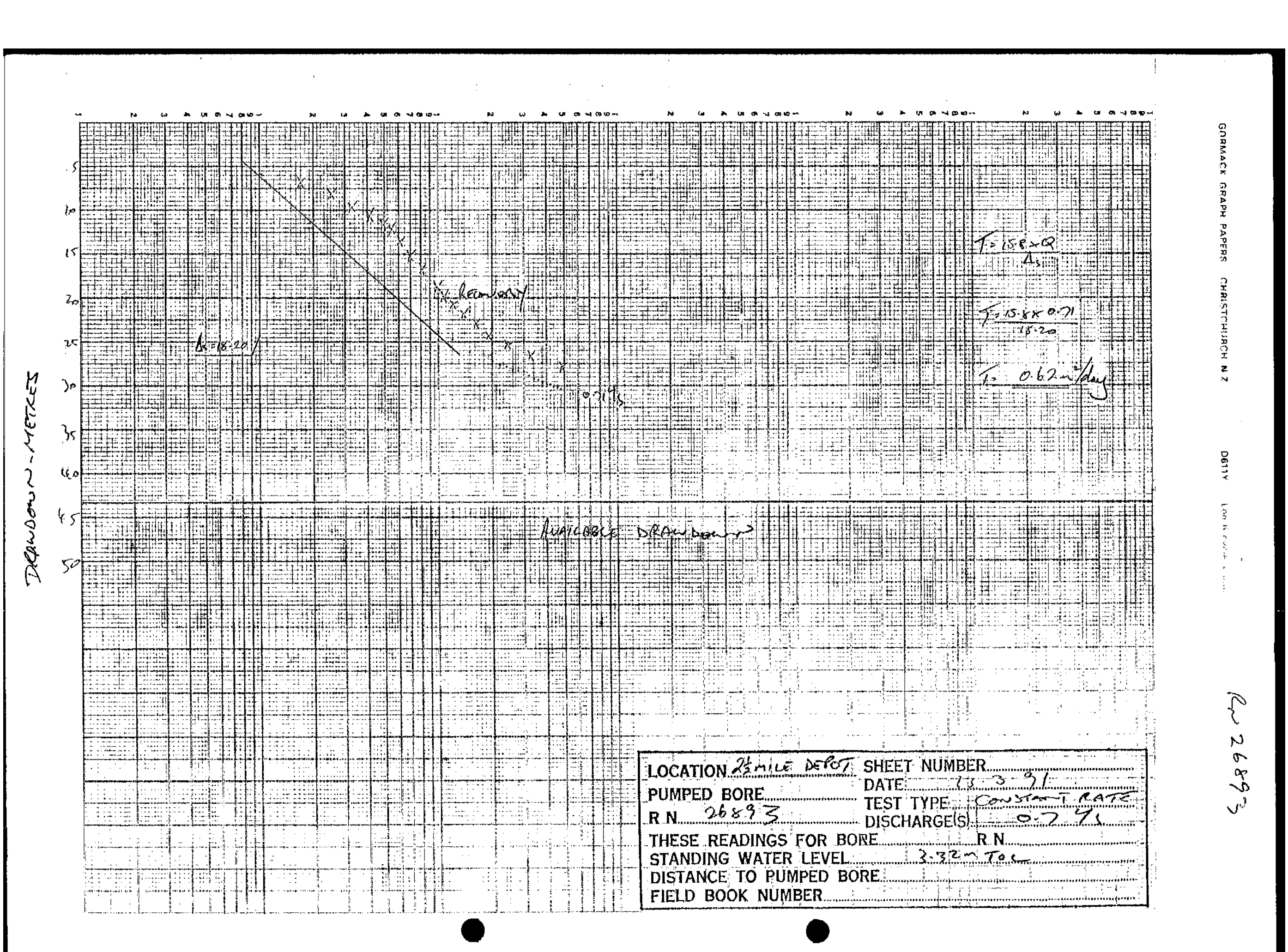
$Q4_s$	10^2	4_{4x}	10^6
0.28	601	11.80	17.81
0.55	12.04	23.17	35.21

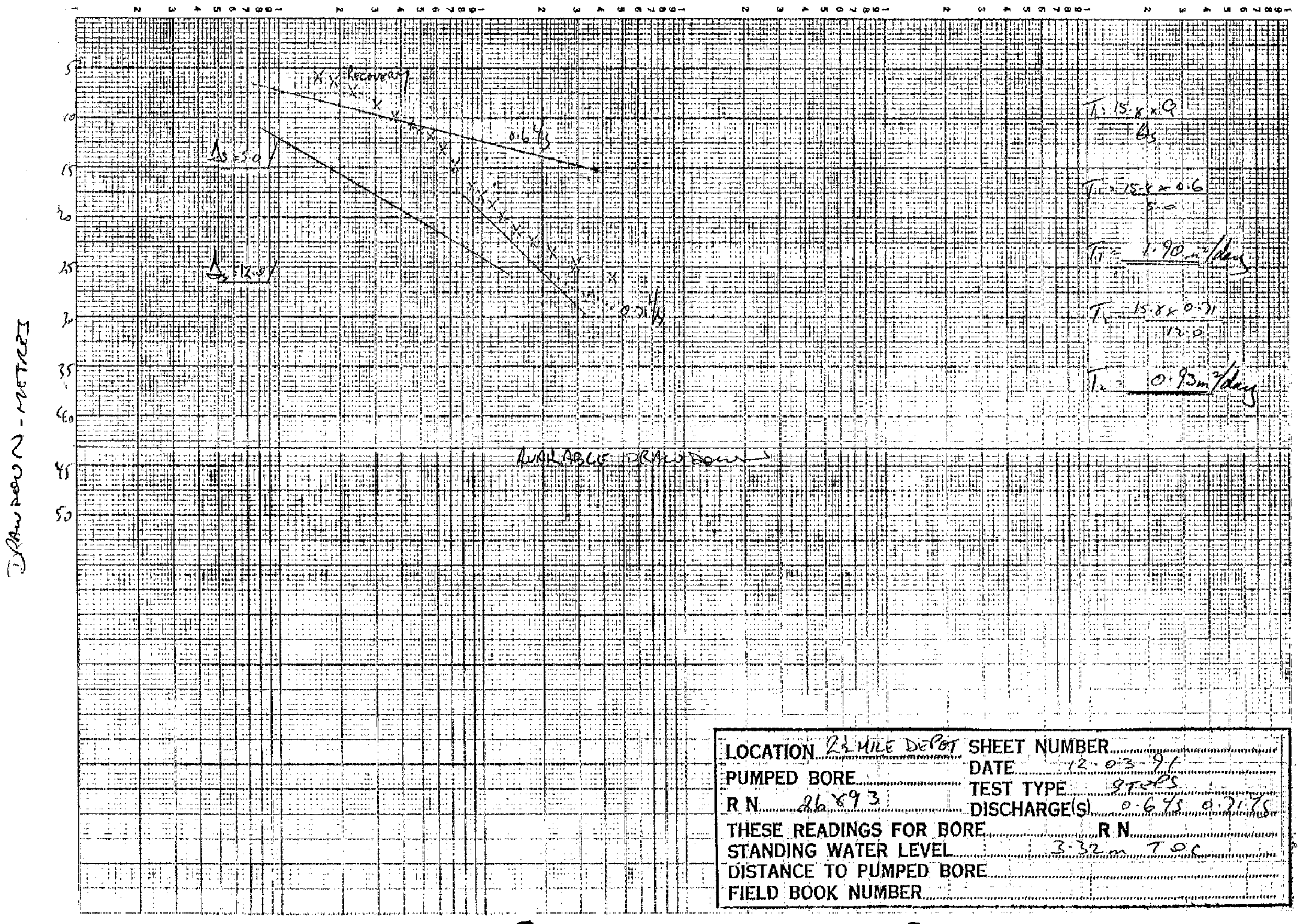
AVAILABLE DRAWDOWN

LOCATION 1/2 Mile Arbor SHEET NUMBER
PUMPED BORE DATE 1 2 21
R N 26893 TEST TYPE STEP 3
DISCHARGE(S) 0.28 l/s 0.55 l/s 0.85 l/s
THESE READINGS FOR BORE R N
STANDING WATER LEVEL 3.32 m TOC
DISTANCE TO PUMPED BORE
FIELD BOOK NUMBER

$Q4_s$







$T = \frac{15.8 \times Q}{\Delta s}$

$T = \frac{15.8 \times 0.6}{5.0}$

$T = 1.90 m^2/day$

$T = \frac{15.8 \times 0.71}{12.0}$

$T = 0.93 m^2/day$

LOCATION 2½ MILE DEPOT SHEET NUMBER
PUMPED BORE DATE 12-03-91
R N 26893 TEST TYPE STEPS
DISCHARGE(S) 0.695 0.715
THESE READINGS FOR BORE R N
STANDING WATER LEVEL 3.32 m TOC
DISTANCE TO PUMPED BORE
FIELD BOOK NUMBER

RN26893

WR 9/1

DRILLERS LOG

DATE 18-4-96 WED. BORE No. RN 26893 DEPOT Supervisor: S HERIOT Driller: A SOMMERFIELD

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details	BIT DATA No.	Size	Type	Worn cond'n	STRING DATA Item	O.D.	Length	Prog. tally	MUD DATA	WATER SAMPLES No.	Depth
				SET UP + JUMP START COMP			DRAG		BIT	10"	.90	.90			
0819				PUT ON DRAG BIT. 0—.3 BLACK TOPSOIL											
				.3—.5 HARD LATORITE COFFEE ROCK												
				DRAG BIT GOING NO WHERE			T/T		HAMMER	10"	1.32				
0830				STOP + TAKE OF DRAG BIT			3½	4½	SUB	5½	.15	1.47			
				+ MAKE UP 10" HAMMER T17											
902				COMMENCE DRILLING .5 — 2wt											
915.				COFFEE ROCK. STOP + TAKE OFF BIT											
				RUN 2.47 mA FIBRO 8" CASING T15 HAMMER						6"	1.32	1.32			
0929				PUT ON T15 6" HAMMER 2—5 AS ABOVE											
				MULT. COLOURED. 5— 6.3. MOIST RED CLAY											
0958	6.3			ADD ROD ① + CONT 6.3— 10.8 BROWN	①				DP	4½	4.57	5.81			
				+ RED CLAY STOP + PULL OFF ROD					BIT		1.32				
1016				ADD 5½ COLLAR BIT ABIT STICKY					COLLAR	5½	5.90	7.22			
				CLEAN OUT TO 10.8 + DRILL TO 12.2					① DP	4½	4.57	11.79			
1048	12.2			ADD DRILL PIPE ② + CONT					② DP	4½	4.57	16.36			
1104				12.2 — 16.79 CLAY USE FOAM.					③ DP	4½	4.57	20.93			
				ADD ROD ③ + CONT 16.79 — 21.3											
1122				CLAY ADD ROD ③ + CONT 21.3 — 25.9											
				AS ABOVE. ADD ROD NO ④					④ DP	4½	4.57	25.50			
1144				+ CONT 25.9 — 27.3 FIRM CLAY 27.3											
				SOFTER CLAY TO 30.5					⑤ DP	4½	4.57	30.07			
				ADD ROD ⑤ + CONT 30.5 — 34.6											
1218				REDDISH CLAY ADD ROD ⑥ + CONT					⑥ DP	4½	4.57	34.64	36.64		
		.2	*	SEPARATE 34.6 — 39.6 ADD ROD ⑦ + CONT					⑦ DP	4½	4.57	39.21			
		.5	*	39.6 — 44.2 BROWN CLAY CONT											

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WR 9/1 **DRILLERS LOG**

DATE 18-4-90 BORE No. RN26893 DEPOT

Supervisor: S HERIOT

Driller: A SOMMERFIELD

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details	BIT DATA No.	Size	Type	Worn cond'n	STRING DATA Item	O.D.	Length	Prog. tally	MUD DATA	WATER SAMPLES No.	Depth
				HOSE LEAKING OIL STOP TANKS								39.24			
				WATER SAMPLE + TEST	COND			45	RS 410						
1255				TRIP OUT + TAKE OFF	TH			6.42							
				HOSE BUY NEW ONE	TEMP			(8)	DP	4½	45643.78				
				+ REFIT											
1401				START UP RIG + CHECK FOR LEAKS.				(9)	DP	4½	454835				
				TRIP IN. RUN COMPRESSON +											
1415				ADD KELLY + START 44.2 — 48 BROWN											
1436				CLAY STONE ADD ROD (9) +	CONT			(10)	DP	4½	45[illegible]92	52.92			
				48 — 53.3 BROWN WEATHERED	SILTSTONE										
1456				+ CLAYSTONE. ADD ROD (10) +	CONT.										
				53.3 — 57.9 AS ABOVE CLEAR HOLE				(11)	DP	4½	4.57549				
1529				ADD ROD (11) + CONT. 57.9 — 62.49											
				BROWN SILTSTONE CLEAR HOLE											
1537				ADD ROD 12 + CONT SOFT AT				(12)	DP	4½	4.57626.06				
				64.8 CLAYSTONE + SHIST. 67.06											
				AS ABOVE CLEAR HOLE TRIP OUT											
				HAVE TROUBLE HOLE NOT CLEAR											
				ADD KELLY + USE STIFF FOAM											
1620				TRIP OUT + PACK UP. + KNOCK OFF											

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WR 9/1

DRILLERS LOG

DATE 19-4-90 THURS BORE No. RN26893 Supervisor: S HERIOT

DEPOT Driller: A SOMMERFIELD

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details
				SERVICE RIG + COMP NEEDS
0815				OIL. START UP + TRIP IN.
				BRIDGED AT 44-9 CLEAN OUT
				TO BOTTOM. LOTS OF CLAY
				JST LOTS FORM CONT CLEANING.
901				PUT ON ROD 7 CLEAN TO 67 mt
904				+ START DRILLING 67 — 68.2
				CLEAR HOLE.
914				HD ROD (8) + CONT 68-2 — 72.7
				BROWN SILTSTONE CLAY STONE.
				ADD ROD (9) + CONT 72.7 - 75.7
				AS ABOVE 75-7 — 77.3
				GREEN SHALE. ADD ROD 10 + CONT.
				77-3 — 81.9 SHALE DARKER.
1020				ADD ROD (11) 81.9 — 86.49 BLACK SHALE
				ADD ROD (12) 86.4 — 91 SHALE SOME
				QUARTZ SANDSTONE AT 90.
				ADD ROD (13) + CONT 41 — 95.6 SHALE
1124				ADD ROD (14) + CONT 95.6 — 100.2
				HALE WITH SILTSTONE FROM ABOVE.
1141				STOP + CLEAR HOLE
1148				TRIP OUT RUN OUT COLLAR
				PULL OUT FIBRO CASING +
				MAKE UP SIZE 10" HOLE OPENER.
				TRY DRILLING HAMMER WON'T WORK

BIT DATA				STRING DATA				MUD DATA		WATER SAMPLES	
No.	Size	Type	Worn cond'n	Item	O.D.	Length	Prog. tally			No.	Depth
				Hammer	6"	1.32	1.32				
				COLLAR	5½	5.90	7.22				
				4 x DP	4½	24.00	31.22				
				6 x DP	4½	27.42	58.64				
				(7) DP	4½	4.57	63.21				
				(8) DP	4½	4.57	67.78				
				(9) DP	4½	4.57	72.35				
				(10) DP	4½	4.57	76.92				
				(11) DP	4½	4.58	81.49				
				(12) DP	4½	4.58	86.06				
				(13) DP	4½	4.57	90.63				
				(14) DP	4½	4.57	95.20				

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WR 9/1

DRILLERS LOG

DATE 19/4/90 THURS BORE No. RN26893 DEPOT Supervisor: SHERROT Driller: A SOMMERFIELD

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details	BIT DATA No.	Size	Type	Worn cond'n	STRING DATA Item	O.D.	Length	Prog. tally	MUD DATA		WATER SAMPLES No.	Depth
BR				BREAK DOWN HAMMER. OIL UP												
				+ PUT BACK TO GETHER STILL WONT												
				WORK PULL DOWN PUT IN BLANK												
				CHOCK + NEW ORING + CHOKE ASSEMBLY												
				PUT BACK TOGETHER WORKS A LITTLE												
				BETTER BUT WONT DRILL					HAMMER	10"	1-32					
1446				STOP + TAKE OFF HAMMER					SUB	5½	.15	1-47				
				PUT ON T17 10" HAMMER				COLLAR		5½	5.90	7.37				
1425				+ START REAMING REAM TO	6.4			①	DP	4½	4.57	11.94				
				ADD 5½ COLLAR. + REAM TO	12.3			②	DP	4½	4.57	16.51				
				ADD DRILL PIPE No ① + REAM TO 16.9												
				ADD ROD ② + REAM TO 21.5 + CLEAR												
1513				HOLE. TRIP OUT. PREPARE TO /												
				RUN 8⅝ CASING. CASING WONT												
				GO PAST TABLE JIGGLE DOG COLLARS												
				AROUND. CAN'T LINE UP CASING												
				TAKE OFF CASING + CHECK OUT												
				WHY TABLE WONT GO ALL THE												
				WAY BACK												
1616				PACK UP + KNOCK OF												

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WR 9/1

DRILLERS LOG

DATE 20-7-90 BORE No. RN 26893 Supervisor: S HERIOT

Driller: J HOLLER

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details	BIT DATA No.	Size	Type	Worn cond'n	STRING DATA Item	O.D.	Length	Prog. tally	MUD DATA		WATER SAMPLES No.	Depth
07:30				SERVICE RIG & REMOVE BOLTS												
				FROM DRIVE SHAFT OF TABLE. SHAFT												
				NOT PROBLEM. ~~BOLT~~ MOUNTING BOLTS OF TABLE												
				IN THE WAY OF RETRACT PATH. CHANGE BOLTS. DEPTH HOLE 21.45M												
08:30				CONT RUNNING CASING AND WELD. CASING												
				WONT GO PAST TABLE DOG COLLAR HITTING												
				TABLE JUGGLE COLLARS AROUND & CONT.												
				ADD LAST PIECE OF 8" CASING JUGGLE COLLARS												
				AROUND AND WELD. RUN CASING TO BOTTOM LIFT UP 0.5M												
				AND PREPARE CEMENT AND TREMMIE PIPE.												
10:20				HOLE OPEN BELOW 8" CASING. BACK FILL TO CREATE PLUG												
				FOR CEMENT												
11:00				START POURING CEMENT.												
11:30				LIFT CASING TO ALLOW CEMENT TO COME UP OUTSIDE CASING												
				CASING WONT GO BACK TO BOTTOM, SO PUSH DOWN WITH KELLY												
				AND CENTRALIZE CASING.												
11:45				STOP RIG AND BEGIN CLEANING UP												
12:30				REDIG TRENCHES. GET ANOTHER T17 FROM STORE. TAKE OTHERS												
				BACK.												
3:00				STOP WORK AT SITE AND CLEAN UP.												

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WR 9/1

DRILLERS LOG

DATE 23-4-90 MON

BORE No. RN26893

DEPOT

Supervisor: S HERLOT

Driller: J HOLLOR

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details	BIT DATA No.	Size	Type	Worn cond'n	STRING DATA Item	O.D.	Length	Prog. tally	MUD DATA		WATER SAMPLES No.	Depth
				SERVICE L.C + COMP				Hamma	7 3/8	1.48	1.48					
				CUT TO FF 85/8 CASING STARTER				15	DP	4½	13.71	15.19				
				CEMENT 15.2 POT ON TIT	Hamma			(4)	DP	4½	4.57	19.76				
				TRY BREAKING DOWN TO HARD				(5)	DP	4½	4.57	24.33				
949				LEAVE BIT ON + TRY TO	1			(6)	DP	4½	4.57	28.90				
				CLEAN OUT CEMENT FROM 16 mt TO 20.2.												
				ADD ROD (4) + CONT DRILL CEMENT TO												
				21.7 + START REAMING HOLE TO												
1025				26.7 ADD ROD (5) + CONT REAMING												
				SMALL CAVITY AT 28.3 MORE WATER.												
10.38				ADD ROD (6) + CONT REAM TO 33.9 WATER DROPS OFF												
				ADD ROD (7) + CONT REAM TO 38.4				(7)	DP	4½	4.57	33.47				
				ADD ROD (8) + CONT REAM TO 43.				(8)	DP	4½	4.57	38.04				
				ADD ROD (9) + CONT 44 BIG INCREASE				(9)	DP	4½	4.57	42.61				
				IN WATER + SILT. CONT REAM BIT												
				GOING EASY TO 47.6				(10)	DP	4½	4.57	47.18				
11.32				ADD ROD (10) + CONT REAM EASY TO 52.1												
11.47				ADD ROD (11) + CONT REAM EASY TO 56.7				(11)	DP	4½	4.57	51.75				
1.55				ADD ROD (12) + CONT REAM												
12.12				ADD ROD (13) + CONT				(12)	DP	4½	4.57	56.32				
				ADD ROD (14) + CONT REAM TO 70.4												
				ADD ROD (15) + CONT REAM TO 76.8				(13)	DP	4½	4.57	60.89				
				ADD ROD NO (14) OBTAIN + CONT												
1305				FINISH ROD AND AIR LIFT FROM 76.5				(14)	DP	4½	4.57	65.45				
				mt US FOAM TO CLEAR. HOLE				(E)	DP	4½	6.00	71.45.				
1325				AND CONT AIR LIFTING												

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WR 9/1

DRILLERS LOG

DATE 23-4-90 MON BORE No. RN26893 Supervisor: S HEALOT

DEPOT Driller: J HOLLICK

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details	BIT DATA No.	BIT DATA Size	BIT DATA Type	BIT DATA Worn cond'n	STRING DATA Item	STRING DATA O.D.	STRING DATA Length	STRING DATA Prog. tally	MUD DATA	WATER SAMPLES No.	WATER SAMPLES Depth
1331				STOP AIRLIFTING + TRIP OUT											
				DEPTH HOLE BACK FILLED TO	46.8										
				FLOPPER DROPS OFF END OF TAPE											
1444				PUT ON MAGNET + TRIP IN					MAGNET	5½	45	.45			
									SUB	4½	.51	.96			
								10x	DP		45.7	46.66			
1600	0 to 53			Run magnet to 53 mts - no luck				(11)	DP	4½	45.7	57.23			
1620	0			Run roller bit to 76 mts to -											
				push down to bottom.											
				PACK UP GEAR AND CLEAN UP.											
						7 7/8	Rock Roller			0.22					
									SUB	0.15					
									SUB	0.95.82					
								10x	DP.		45.70	46.52			

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WR 9/1 **DRILLERS LOG**

DATE Tues 22/4.90 BORE No. RW. 26893 Depot. Supervisor: P. GIRLING

Driller: J. HOLMER

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details	BIT DATA No.	Size	Type	Worn cond'n	STRING DATA Item	O.D.	Length	Prog. tally	MUD DATA	WATER SAMPLES No.	Depth
800	0			Push steel mud down to 76.8mts		7⅞	Rock		Roller		.22		AIR & Foam		
				Using air + Foam.											
1000	76.8			no problems - 80 Foam							.15				
											.45	.82			
				Hook up mud lines - mud pump. etc				10x	DP		45.70	46.52			
				mix mud and circulate to bottom.				(11)	DP		4.57				
								(12)	DP		4.57				
1315	79.mts			Clean hole to 79.mts with mud.				(13)	DP		4.57	60.52			
								(14)	DP		4.57				
								(15)	DP		4.57	69.37			
1400	0			Start running 150mm P.V.C				(16)	DP		4.57	73.94			
				Bottom of P.V.C 22.mts					Kelly			78.9 mts			
				From Bottom - that is ~~1.0~~ ok Bottom →											
				Continue to push P.V.C casing											
				Place 180 LTS cement Between									Biogel		
				73.mts to 79.mts	150mm P.V.C casing										
				Push P.V.C down									3x 2 Drums		
				Packer stopped at 15.mts	150mm	58.70 mts									
1730				Bottom of P.V.C at 74.mts	Coupling	.15									
				TRY DEPTHING HOLE MUD HOLDING	Packer	.15									
				UP WEIGHT.		59.00 mts							3x Cement 180 LTS.		

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WR 9/1

DRILLERS LOG

26.893

DATE 26-4-90 Titus

BORE No. RN26893

Supervisor: S HERLOT

Driller: S HOLLER

Time	Depth	Metres drilled	Mins lapsed	Drillers remark, casing details	BIT DATA No.	Size	Type	Worn cond'n	STRING DATA Item	O.D.	Length	Prog. tally	MUD DATA		WATER SAMPLES No.	Depth
				GO TO UNION MEETING												
				SERVICE RIG + COMS DEPTH PACKER 15 mt					BIT	5 1/2	.12	.12				
									SUB	4 1/2	.45	.57				
906				TRIP IN + CLEAN OUT HOLE												
				BIT WONT GO PAST 15.1 mt CASING				3x	DP	4 1/2	13.71	14.28				
				MAYBE SQUASHED. TAKE OFF (1) ROD				7x	DP	4 1/2	31.99	46.27				
				+ TRY TO PUSH THROUGH. WET BIT				(11)	DP		4.57	50.84				
				THROUGH PACKER AND CONT RUNNING DOWN (9) Rods					DP		4.57	55.41				
				AND START TO CLEAN HOLE. NO BATTERIES				(13)	DP		4.57	59.98		—		
				FOR COMPRESSOR				(14)	DP		4.57	64.55				
								(15)	DP		6.00	70.55				
				P.V.C casing damaged from				(16)	DP		6.00	76.55				
				63.4 to				(17)	DP		6.00	82.55			78.29	
				CONT CLEANING OUT BACK FILL				(18)	DP		6.00	88.55			83.98	
				CLEAN OUT TO 99.5 AIRLIFT USE				(19)	DP		6.00	94.55			89.98	
				FOAM CLEAN OUT BORE + CLEAN DOWN												
1354				RIG. TRIP OUT + CLEAN UP ALL THREADS												
				AS WE GO.												

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PARTICULARS OF COMPLETED BORE/WELL

RN26893

Index No 80/3857

Advice No

20. Describe rock type, colour etc. any changes must be recorded.

From - To

0—3 BLACK TOPSOIL
3-5 LATERITE COFFEE ROCK
5—34.6 RED BROWN CLAY
34.6—64.8 BROWN CLAYSTONE SILTSTONE
64.8—75.7 CLAYSTONE & SILTST
75.7—77.3 GREEN SHALE
77.3—81.9 DARKER SHALE
81.9—86.4 BLACK SHALE
86.4—91 SHALE WITH QUARTZ & SANDSTONE
91 — 100.2 SHALE.

TOP OF PACKER. 15mt
PVC CASING DAMAGED.

1. Name of Bore: DEPOT
2. Name of Property: WATER RESOURCES DEPOT
3. Owner of Property: BLAKE PROPERTY GROUP PTY LTD DARWIN 30-2C
4. Type of Lease:
5. Lease/Block No.: LOT 4990 T=DARWIN
6. Bore or Well: BORE
7. Name of Contractor: WATER RESOURCES
8. Name of Driller: A SOMMERFIELD & HOLLOW
9. Depth Recorded: 100.2
10. Depth Drilled: 100.2
11. Date Commenced: 18-4-90
12. Date Completed: 26-4-90
13. Proposed use of Bore: ☐ Domestic ☐ Pastoral ☐ Stock Route ☐ Irrigation ☐ Town Supply ☑ Observation ☑ Investigati
14. Bore has been drilled by ☑ Rotary ☐ Cable Tool ☐ Jetting ☐ Other
15. Bore Drilled Using ☑ Air ☑ Mud ☑ Foam ☑ Water ☑ Degradable Polymer
Size of drilling Bit 254 from 0 to 21.5
203 (152) from 21.5 to 79 (100.2)
16. Casing Installed ☑ Steel ☐ ABS ☐ PVC ☐ Fibreglass ☐ Other.....
219 Dia from 0 to 21.5 STEEL
.....Dia from..... to ..... PVC.
Threaded (Welded) CLOSED.
17. Screens ☑ None installed ☐ Staineless Steel ☐ Bronze ☐ PVC
Dia.....Slot Size.....From.... to....
Dia.....Slot Size.....From.... to....
Screens are Screwed connected by Pa
18. Perforation in casing ☐ Percussion Slotted ☐ Oxycut ☐ Drilled Other.....
Slot/hole size.....From..... to.....
Slot.hole size.....From..... to.....
19. Is any strata cemented off ☑ Yes ☐ No 0 — 21.5 mt
If so, give depth ..... to .....
21. Sample of strata and water (have been) will be left at (Darwin) Katherine Alice Springs Other.....

22. WATER	1st Supply	2nd Supply	3rd Supply	4th Supply	5th Supply	Remarks
Struck at	34.6 ~44.2					
Standing Water Level						
Discharge	.5 Lt/s					
Duration of						

RN026893

RN 26893

Please show boudaries of sections etc, and location of bore(s) within section. If more than one bore clearly identify each. Marked distance from boundaries if possible.

24. This bore has been constructed under by supervision and this report is true to the best of my knowledge.

Signature.....Driller Date.....

PLEASE NOTE THE FOLLOWING:-

1. UNITS If possible please use metric units (metres, Millimetres, litres per second). Old units are acceptable (feet, inches, gallons per hour) but make sure you make it clear which you are using.

2. WATER SAMPLES A sample of not less than one litre of each water supply encountered during the drilling is required. Suitable plastic bottles can be obtained from the Water Resources Branch. Please rinse out all bottle properly before sampling. Completely fill the bottle leaving no entrapped air. Please label the bottle with the bore name and depth of supply.

3. STRATA SAMPLES A sample of not less than 0.2 kilograms of each 3m of stratum encountered during drilling is required. Please label all samples with the hole name and interval drilled. Plastic bags and tags can be obtained from Water Division.

4. LOCATION Please describe the location as accurately as possible giving distances from one or more features (such as other bores, dams,etc.) within a close distance. Preferably give a sketch of the area.

26. OFFICE USE ONLY:

Map No: 1:10,000 SHEET 08:06 DARWIN

Plotted on Map Date: 19/6/90

AMG Co-ordinates: 671365 - 8625020

Traced to Master Map Date:.....

Datum (A.H.D.) ZONE 52 S/B 815

Checked by:..... Date.....

Geological Basin:.....

Signature (Bore Inspector) Date.....

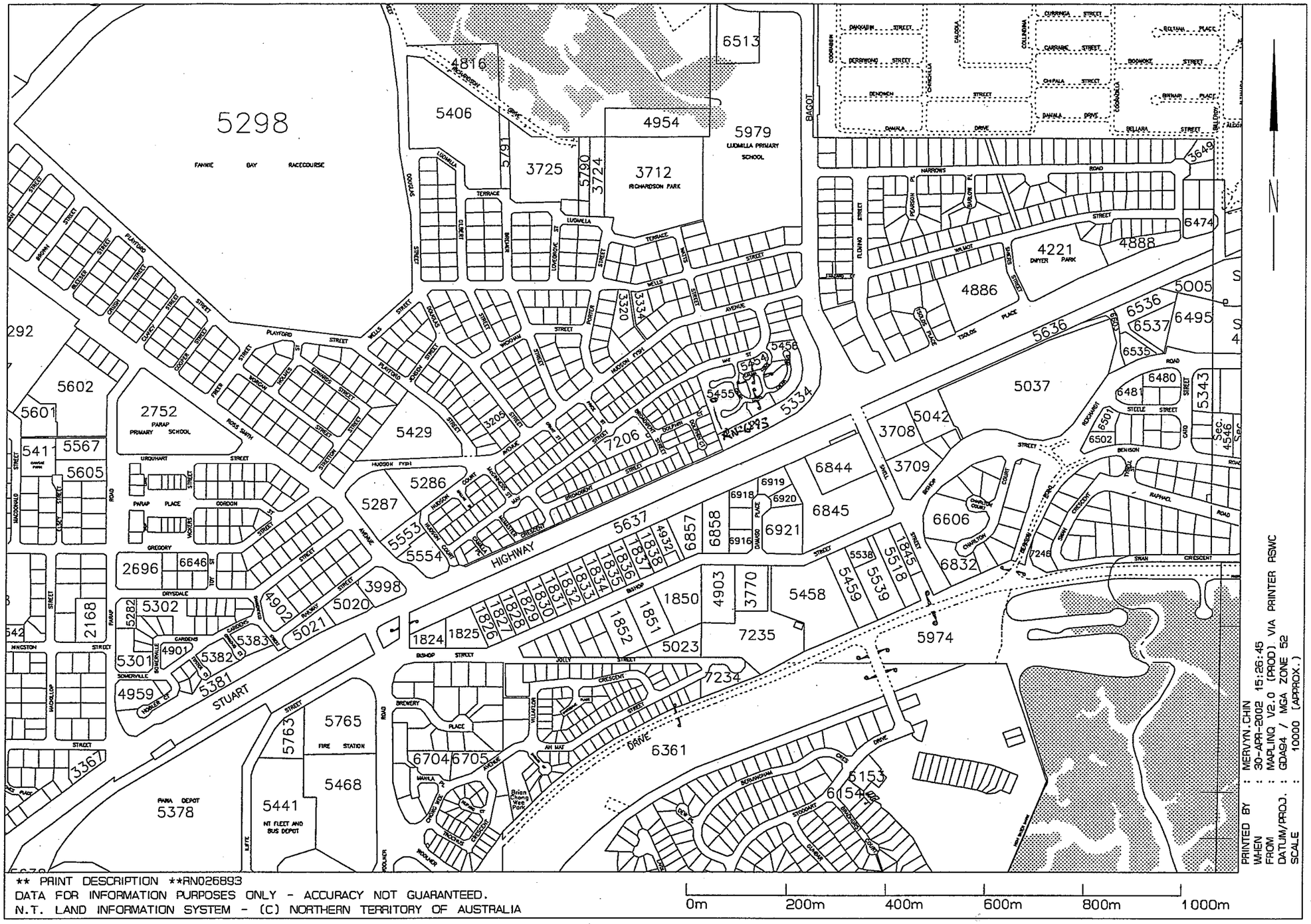
E: 701360 701488 MGA94

N: 8625020 8625180

DARWIN 0806 SCALE 1:10000

ZONE 52

S/B 0815


5298
FANNIE BAY RACECOURSE
5406
4816
6513
4954
5979
LUDMILLA PRIMARY SCHOOL
3725
3712
RICHARDSON PARK
5790
3724
5791
LUDMILLA
TERRACE
DOUGLAS
STREET
BACOT
HARROWS ROAD
6474
4888
4221
DWYER PARK
4886
5005
6536
6537
6495
6535
5636
6480
6481
5343
5037
5042
3708
3709
6844
6845
6606
6832
6921
6919
6920
6918
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PARAP PRIMARY SCHOOL
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STUART
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5765
FIRE STATION
5468
5441
NT FLEET AND BUS DEPOT
5378
PARA DEPOT
3367
5763
6649
5343
Sec 4546
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WHEN : 30-APR-2002 15:26:45
FROM : MAPLINQ V2.0 (PROD) VIA PRINTER RSWC
DATUM/PROJ. : GDA94 / MGA ZONE 52
SCALE : 10000 (APPROX.)
** PRINT DESCRIPTION **RN026893
DATA FOR INFORMATION PURPOSES ONLY - ACCURACY NOT GUARANTEED.
N.T. LAND INFORMATION SYSTEM - (C) NORTHERN TERRITORY OF AUSTRALIA
0m
200m
400m
600m
800m
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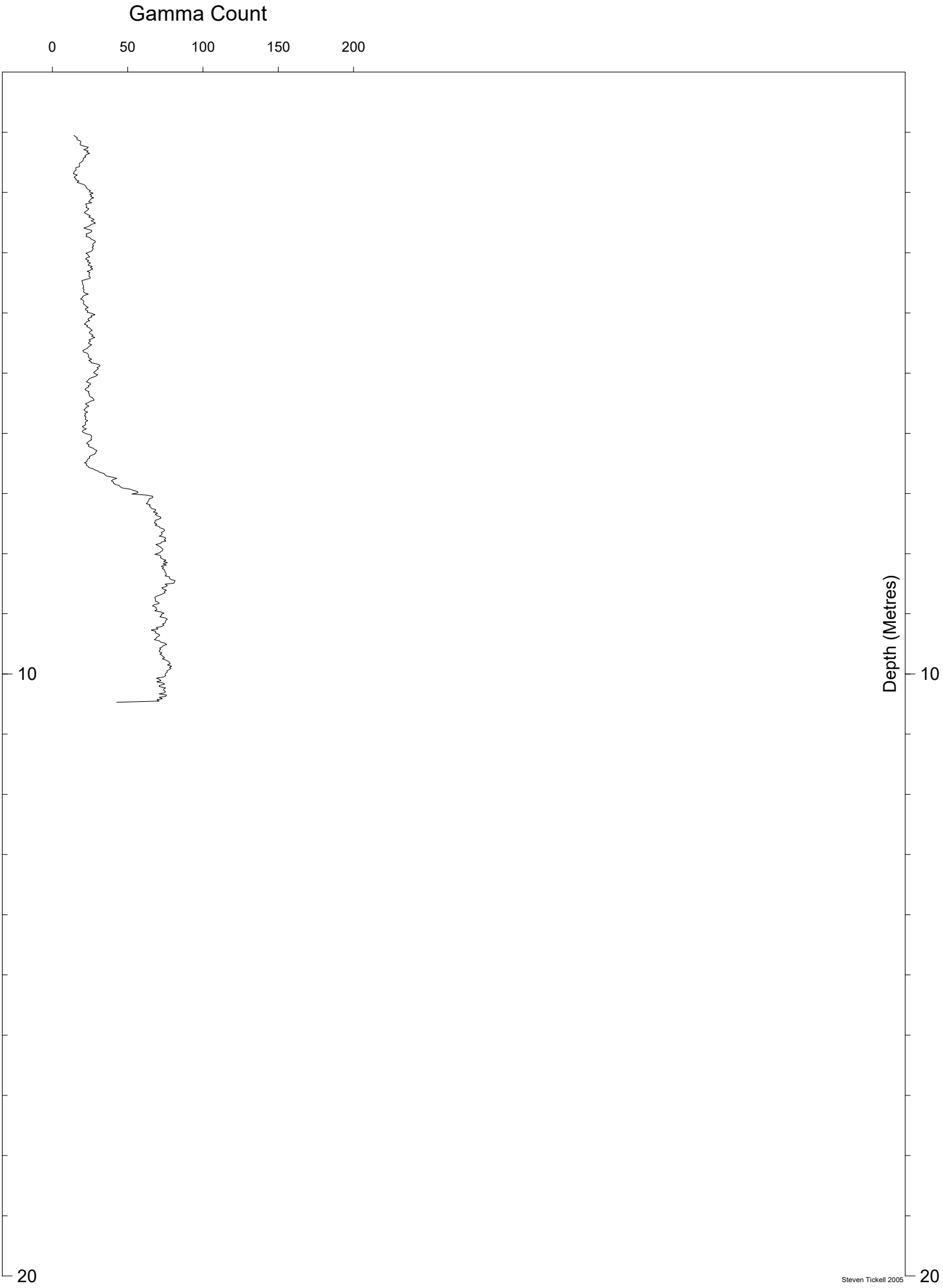
RN26893G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50
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150
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Depth (Metres)
10
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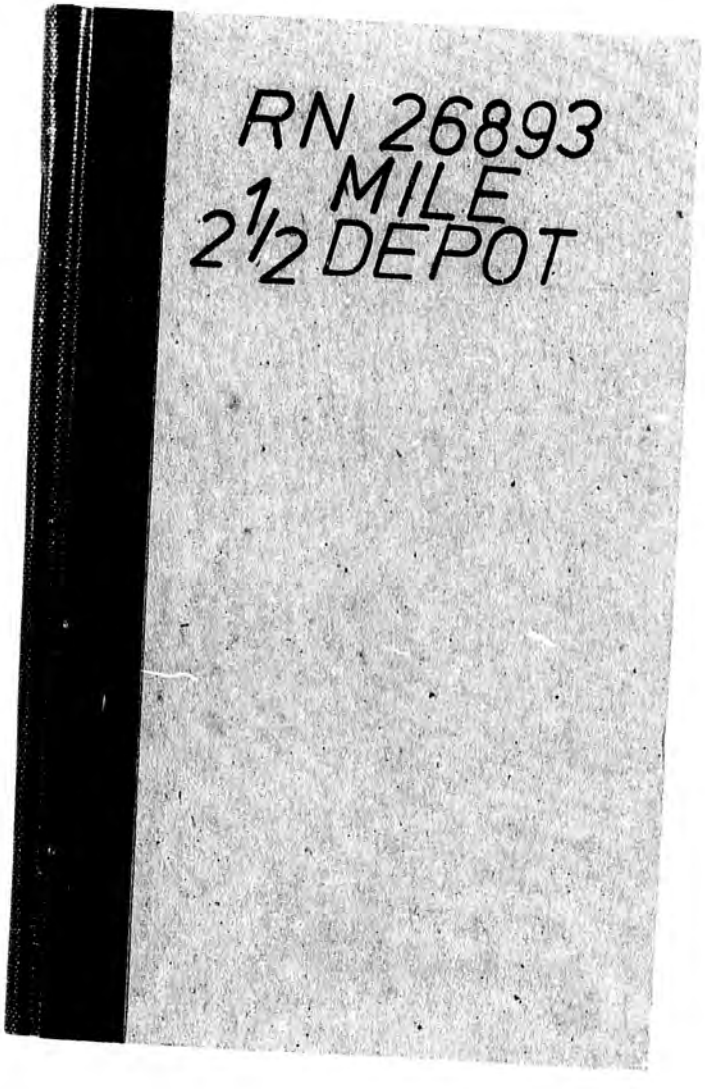
Steven Tickell 2005


RN 26893
1 MILE
2 1/2 DEPOT

2107

BORE NAME DEPOT

Registered Number 26893

Index Number

Location ½ MILE

Total Depth 100.2m

Depth Water Struck 34.6m

Estimated Supply 0.5 l/s

Aquifer Material SHALE WITH QUARTZ SANDSTONE

Construction details casing screens etc.

Interval	Size and description
0 – 21.5m	203mm ID STEEL CASING

Distance to production bore

Bore name	Distance

Pump test crew D LOW
M. MOLINA
D. GUMLEY

Pump type MONO 620

Powered by 3 CYLINDERS LISTER

Pump setting 46.66m

Method measuring pump discharge ROLLS BUCKET/SPLASH

List any other equipment used
LENGTHS OF (3 x 50mm) FIBREGLASS MONO COLUMN
MONO HEAD 1:1 RATIO

Comments T.D. BEFORE 8.3.91 98.5m SWL
T.D. AFTER
SWL 3.32m
AD 48.34m
CAG 0.40m

TOP OF PACKER 5 metres
PVC CASING DAMAGED.

INDEX

Pumped Bore: 26893 OBS Bore:

Standing Water Level: 3.32m

Available Drawdown: 43-34 —

Time Started: 1025 Date: 11 3.91

Time Stopped: 1205 Date: 11 3.91 01

Test Type: STEPS Step No.: 1

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)	Comments
1026	1	0.52						
	2	0.98	72sec/20cms		0.28			Discharge discoloured some fines
	3	1.33						
	4	—						
	5	2.07						(slapping noise)
	6	2.30						
	7	2.49						
	8	2.66						
	9	2.91	72sec/20cms		0.28			Discharge clearing some fines
1035	10	3.04						
	12	3.40						
1040	15	3.80						Still slapping noise.
	20	4.26						
	30	4.90						Discharge discoloured some silt
	40	5.37						
	50	5.63	72sec/20cms		0.28			
1125	60	5.78						No more slapping noise.
	70	5.85						
	80	5.91						Increase in silt. Discharge dirty
	90	5.96						
1205	100	6.01	71sec/20cms		0.28			

Pumped Bore: 26893 OBS Bore:

Standing Water Level: 3.32

Available Drawdown: 43.34

Time Started: 1205 Date: 11. 3 91

Time Stopped: 1345 Date: 11. 3. 91 02

Test Type: STEPS Step No.: 2

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
1206	101	6.44						
	102	6.83	36cm	20mm	0.55			Discharge silty
	103	7.12						
	104	7.44						
	105	7.72						
	106	8.01						Discharge silty
	107	8.19						
	108	8.37						
	109	8.57						
1215	110	8.75						
	112	9.02	36cm	20mm	0.55			Discharge silty
	115	9.39						
	120	9.84						
1235	130	10.28						
	140	10.80						
	150	11.14						Discharge silty
1305	160	11.40						
	170	11.59						
	180	11.80	36cm	20mm	0.55			Discharge clearing
	190	11.91						
1345	200	12.04						

Pumped Bore: 26893 OBS Bore:

Standing Water Level: 3.32~

Available Drawdown: 43.34~

Time Started: 1345 Date: 11.3.91

Time Stopped: 1425 Date: 11.3.91 03

Test Type: STEPS Step No.: 3

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)	Comments
1346	201	13.05	↑					
	202	14.4						Discharge dirty Silty
	203	15.25		ADJUST	RATE			
	204	16.75	↓					
1350	205	19.57						
	206	-	21Sec/20cms		0.95			Discharge dirty - Silty
	207	21.44						
	208	22.55						
	209	23.70						
1355	210	24.39						
	215	26.26	21Sec/20cms		0.95			Discharge silty
	215	28.95						
1405	220	32.60						
	230	38.00						
1425	240	41.85	21Sec/20cms		0.95			Discharge silty
1435	250							
	260							
	270							
	280							ADJUST RATE DOWN TO 0.25, TO DEVELOP UP BORE.
	290							
	300							

Pumped Bore: 26893 OBS Bore:

Standing Water Level: 3.32m

Available Drawdown: 43.34m

Time Started: 0750 Date: 12.3.91

Time Stopped: 0930 Date: 12.3.91 04

Test Type: STEPS 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
0751	1	1.82						SWL 0.67m STILL TO RECOVERED
	2	2.55						
	3	3.16	33cm	20mm	0.6			Discharge dirty (silty)
	4	3.84						
	5	4.35						
	6	4.83						Discharge dirty (silty)
	7	5.25						
	8	5.69						
	9	6.02						Discharge dirty (silty)
0800	10	6.34	33cm	20mm	0.6			
	12	6.93						
	15	7.67						Discharge clearing
0810	20	8.54						
	30	9.75						
0830	40	10.44						Discharge clearing
	50	10.88						
	60	11.27	33cm	20mm	0.6			
0900	70	11.57						
	80	11.84						
	90	11.97						
0930	100	12.12						

Pumped Bore: 26893 OBS Bore:

Standing Water Level: 3.32m

Available Drawdown: 43.34m

Time Started: 0930 Date: 12.3.91

Time Stopped: 1510 Date: 12.3.91 05

Test Type: STEPS Step No.: 2

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
0931	101	12.51	↑					
	102	12.91						
	103	—	↕	MEASURE ARTE				
	104	13.80	↓					
	105	14.15	28sec/20LTS		0.71			Discharge discoloured slug
	106	14.50						
	107	14.82						
	108	15.06						
	109	15.39	25sec/20LTS		0.71			
0940	110	15.68						Discharge clearing
	112	16.16						
	115	16.79	28 sec/20LTS		0.71			
0950	120	18.11						Discharge discoloured (silty)
1000	130	20.33						
	140	21.91						
	150	22.99						
1030	160	23.74						Discharge discoloured
	170	24.32						
	180	24.77						
1100	190	25.05	28sec/20LTS		0.71			
	200	25.30						Discharge discoloured
1130	220	25.81						
1150	240	26.30						Silty still
1210	260	26.69						
1230	280	27.02						
1250	300	27.30						Discharge clearing
	320	27.62						
	340	27.79	25sec/20LTS		0.71			

Pumped Bore: 26893 OBS Bore:

Standing Water Level: 3.32 m TOC

Available Drawdown: 47.34 m

Time Started: 0930 Date: 12.3.91

Time Stopped: 1510 Date: 12.3.91

Test Type: STEPS - EXTENDED 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)	Comments
1350	360	27.98	28cm	20mm	0.71			Discharge discoloured
1410	380	28.25						Fairly Steady
1430	400	28.49						
1450	420	28.78						Discharge discoloured
1510	440	29.03						

Pumped Bore: 26893 OBS Bore:

Standing Water Level: 3.32 m TOC

Available Drawdown: 43.34 m

Time Started: 1510 Date: 12.3.91

Time Stopped: 1540 Date: 12.3.91

Test Type: Recovery Step No.: 07

Time C.S.T.	Time (min)	D/Down (m)	Depth (cm)	Orifice Plate Size	Q (l/S)	Water Sample Bot. No.	Water Sample Temp. (°C)	Comments
1511	441	26.0	441					
	441½	24.81	294.3					
	442	23.54	291					
	442½	22.30	177					
	443	21.19	147					
	443½	19.98	126					
	444	18.80	111					
	444½	17.58	97.8					
	445	16.92	89					
	446	14.78	74.3					
	447	13.15	63.9					
	448	11.92	56					
	449	11.20	49.9					
1520	450	10.85	45					
	452	9.91	37.7					
	455	8.79	30.3					
1530	460	7.45	23					
	465	6.41	18.6					
1540	470	5.83	15.7					

Pumped Bore: 26893 OBS Bore:

Standing Water Level: 3.32m TOC

Available Drawdown: 43.34m

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
0741	1	2.14						Rec 0.96m Still to recovered
	2	3.03						Discharge discoloured
	3	3.91						
	4	4.70						
	5	5.40						Discharge discoloured Some silt
	6	6.01						
	7	6.59						
	8	7.10						
	9	7.58						
0750	10	8.01	27sec/20LTS		0.74			Discharge clearing Some silt
	12	8.84						
	15	9.87						
0800	20	11.16						
	30	13.88						
	40	16.70						
0830	50	18.65	27sec/20LTS		0.74			Discharge clearing Silty
	60	20.20						
	70	21.49						
0900	80	22.50						
	90	23.20						
0920	100	23.84						Discharge discoloured
0940	120	24.86						Still some silt
1010	150	26.07	28sec/20LTS		0.71			
1100	200	27.19						Discharge clearing
	220	27.46						
	240	27.96						
1200	260	28.08						
	280	28.19						

Time Started: 0740 Date: 13.3.91

Time Stopped: 1540 Date: 13.3.91 08

Test Type: CONSTANT RATE Step No.:

Pumped Bore: 26893 O.S Bore:

Standing Water Level: 3.32m TOC

Available Drawdown: 43.38m

Time Started: 0740 Date: 13.3.91

Time Stopped: 1540 Date: 13.3.91 09

Test Type: CONSTANT RATE 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)	Comments
1240	300	28.43						
1700	320	28.87	28sec/20LTS		0.71			Discharge discoloured
	340	29.17						
	360	29.42						
1400	380	29.78						Discharge clearing
	400	29.90						still some silt
	420	29.95						
1500	440	30.04	28sec/20LTS		0.71			
1520	460	30.20						
1540	480	30.46						

Pumped Bore: 26893 OBS Bore:

Standing Water Level: 3.32m TOC

Available Drawdown: 43.34m

Time Started: 1540 Date: 13.3.91

Time Stopped: 1610 Date: 13.3.91

Test Type: Recovery Step No.: 10

Time C.S.T.	Time (min)	D/Down (m)	Q/s (l/s)	Orifice Plate Size	Q (l/S)	Water Sample Bot. No.	Water Sample Temp. (°C)		Comments			
1541	481	27.80	481									
	481½	26.51	321									
	482	25.25	241									
	482½	24.02	193									
	483	22.96	161									
	483½	21.78	138.1									
	484	20.74	121									
	484½	19.80	107.7									
	485	18.76	97									
	486	16.68	81									
	487	15.10	69.6									
	488	13.50	61									
	489	12.15	54.3									
1550	490	11.56	49									
	492	10.66	41									
	495	9.54	33									
1600	500	8.28	25									
1610	510	6.95	17									

MW145

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

STATEMENT OF BORE

As per Water Regulations (2009)

Name of Owner: Contracted by Coffey
Location/Address: RAAF Base Darwin Winellie
Intended Use: MONITORING ONLY

Registration No.: 040335
BC Permit No:

GPS Location: Zone: 52 GDA94 ☐ Other: ☐ Specify:
Easting: 701816 Northing: 8625945

From	To	Particulars of Strata
0	1.2	Gravelly soil/laterite, Red/Brown Dry
1.2	6	Siltstone, Red/Brown, Dry
6	12	Siltstone, Red/Brown, moist.

Name of Drilling Company: PROACTIVE DRILLING
Name of Driller: MARIUS WEATHERALD
Name of supervising driller

Date Commenced: 2/8/2017
Date Completed: 2/8/2017

Depth Drilled: 12 (m)
Completion Depth: 12 (m)

METHOD OF DRILLING

Other	Auger	Rev. Circ.	Rotary Air	Rotary Mud
☐	☐	☐	☑	☐

Specify:

HOLE DIAMETER

From (m)	To (m)	Dia. (mm)
0	12	115

DRILLING FLUID

Type:

PARTICULARS OF CASING

From	To	Dia (ID)	Type
0	1	50mm	PVC

PARTICULARS OF PERFORATIONS OR SCREEN STRINGS

From	To	Dia (ID)	Aperture	Type
1	12	50mm	0.4mm	PVC

Casing Suspended: Yes ☐ No ☑
Method: N/A
Height of Casing above GL: (m)

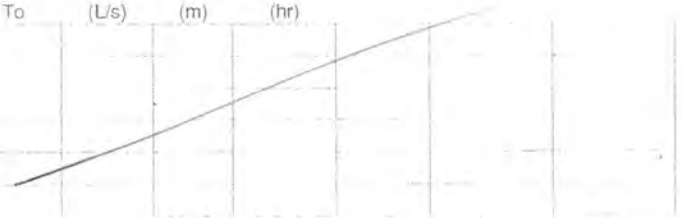
Top of Packer Set at: N/A (m)
Length of Packer: (m)
Method of Packer Connection: N/A

CEMENTING/GRAVEL PACKING

From	To	Type
0	0.3	Cement
0.3	0.6	Bentonite
0.6	12	Gravel

WATER BEARING BEDS

Depth (m) From	Depth (m) To	Yield (L/s)	SWL (m)	Duration (hr)	Quality	EC	pH	Bottle No.



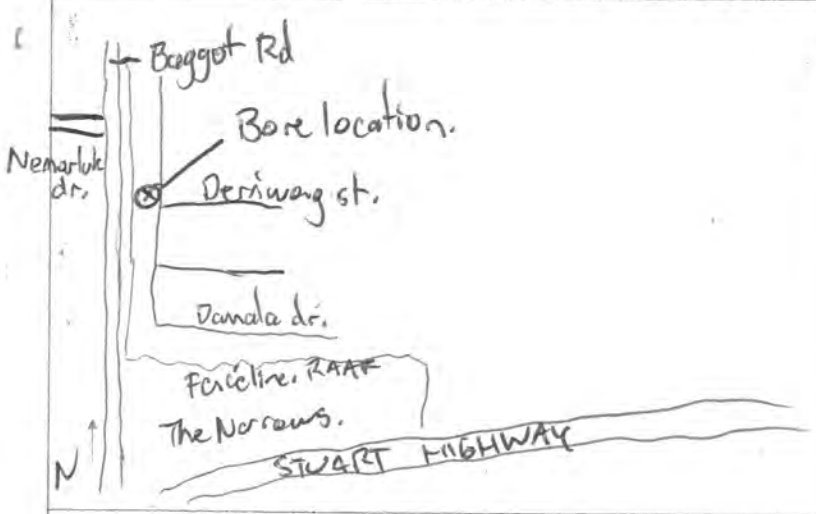
STRATA / WATER SAMPLES
Have been ☐ Will be ☐
Left at:

Completion Yield: (L/s) Method: Duration: (hr)
Completion SWL from GL: (m) Depth of Lift: (m)

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

MW145

LOCATION SKETCH OF BORE RN: 040335



LOCATION DESCRIPTION OF BORE

250 m/km

NW ☐ North ☐ NE ☐
West ☐ East ☐
SW ☐ South ☑ SE ☑

OF Intersection of Baggot Rd & Nemarluk dr.

FINAL CONSTRUCTION STATUS

Capped	Casing Pulled	Left for Obs.	Abandoned	Equipped	Backfilled	Other
☑	☐	☐	☐	☐	☐	☐

ADDITIONAL INFORMATION ABOUT THE BORE: *(Include any information which may assist for future reference)*

MONITORING ONLY

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.

MARWS WEATHERALD DL1010
Name and licence number of driller: Signature and licence number of licensed driller: Date: 12 9 2017

FOR OFFICIAL USE ONLY

How Located: GPS ☑ TST ☐ Survey ☐ Hand Plotted ☐ Other ☐

DESCRIPTION OF PROPERTY

Rural	Mineral	Pastoral	Reserve	VCL	Other
☐	☐	☐	☑	☐	☐

RECEIVED DATE 31/10/17 BY M.CHIN

Lease No: Lot No: Hundred of BAGOT
Portion No Section No. 5730 Town of
ENTER 8/10/17

Class of Bore	Town	Domestic	Investigation	Agriculture	Mineral	Pastoral	Other
	☐	☐	☑	☐	☐	☐	☐

Use of Bore	Production	Investigation	Irrigation	Observation	Monitoring	Roads	None
	☐	☐	☐	☐	☑	☐	☐

Grid Reference AMG ☑ Clark ☐ Zone: 52 Scale
Easting: 701816 Lattitude: Map Name:
Northing: 8625945 Longitude: Index Map Number: 80/10617
Date Registered: Bore Plotted on the map? Yes ☐ No ☐
Dept Officer: Signature:
Remarks

S/B 0815

MW147

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

STATEMENT OF BORE

As per Water Regulations (2009)

Name of Owner: Contracted by Coffey
Location/Address: RAAF Darwin Winellie
Intended Use: MONITORING ONLY

Registration No.: 040337
BC Permit No:

GPS Location: Zone: 52 GDA94 ☑ Other: ☐ Specify: Easting: 701816 Northing: 8626125

From	To	Particulars of Strata
0	1.2	Gravelly soil/laterite, Red/Brown, Dry.
1.2	6	Siltstone, Red/Brown, Dry
6	12	Siltstone, Red/Brown, moist.

Name of Drilling Company: PROACTIVE DRILLING
Name of Driller: MARIUS WEATHERALD
Name of supervising driller

Date Commenced: 3/8/2017
Date Completed: 3/8/2017

Depth Drilled: 12 (m)
Completion Depth: 12 (m)

METHOD OF DRILLING

Other ☐ Auger ☐ Rev. Circ. ☐ Rotary Air ☑ Rotary Mud ☐

Specify:

HOLE DIAMETER

From (m)	To (m)	Dia. (mm)
0	12	115

DRILLING FLUID Type:

PARTICULARS OF CASING

From	To	Dia (ID)	Type
0	1	50mm	PVC

PARTICULARS OF PERFORATIONS OR SCREEN STRINGS

From	To	Dia (ID)	Aperture	Type
1	12	50mm	0.4mm	PVC

Casing Suspended: Yes ☐ No ☑
Method: N/A
Height of Casing above GL: (m)

Top of Packer Set at: N/A (m)
Length of Packer: (m)
Method of Packer Connection: N/A

CEMENTING/GRAVEL PACKING

From	To	Type
0	0.3	Cement
0.3	0.6	Bentonite
0.6	12	Gravel.

WATER BEARING BEDS

Depth (m) From	Depth (m) To	Yield (L/s)	SWL (m)	Duration (hr)	Quality	EC	pH	Bottle No.

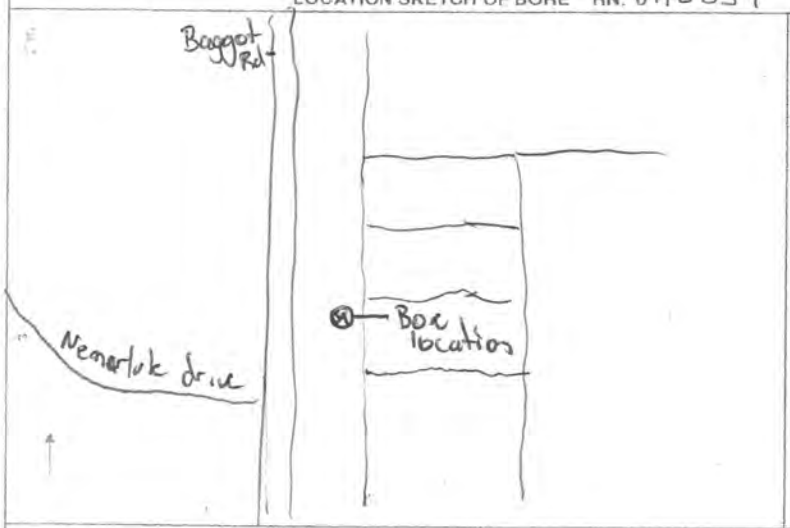
STRATA / WATER SAMPLES
Have been ☐ Will be ☐
Left at:

Completion Yield: (L/s) Method: Duration: (hr)
Completion SWL from GL: (m) Depth of Lift: (m)

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

MW147

LOCATION SKETCH OF BORE RN: 040337



LOCATION DESCRIPTION OF BORE

120 0 km

NW ☐	North ☐	NE ☑
West ☐		East ☐
SW ☐	South ☐	SE ☐

OF Intersection of Baggot Rd & Nemarluk dr.

FINAL CONSTRUCTION STATUS

Capped	Casing Pulled	Left for Obs.	Abandoned	Equipped	Backfilled	Other
☑	☐	☐	☐	☐	☐	☐

ADDITIONAL INFORMATION ABOUT THE BORE: *(Include any information which may assist for future reference)*

MONITORING ONLY

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.

MARWS WEATHERALD DL1010 — Name and licence number of driller: — Signature and licence number of licensed driller: — Date: 12 9 2017

FOR OFFICIAL USE ONLY

How Located:

GPS	TST	Survey	Hand Plotted	Other
☑	☐	☐	☐	☐

DESCRIPTION OF PROPERTY

Rural	Mineral	Pastoral	Reserve	VCL	Other
☐	☐	☐	☑	☐	☐

RECEIVED DATE 31/10/17 BY M.CHIN

ENTERED 8/11/17

Lease No:
Portion No:
Lot No:
Section No: 5730
Hundred of: BAGOT
Town of:

Class of Bore:	Town	Domestic	Investigation	Agriculture	Mineral	Pastoral	Other
	☐	☐	☑	☐	☐	☐	☐

Use of Bore:	Production	Investigation	Irrigation	Observation	Monitoring	Roads	None
	☐	☐	☐	☐	☑	☐	☐

Grid Reference: AMG ☑ Clark ☐ Zone: 52 Scale:
Easting: 701816
Northing: 8626125
Latitude:
Longitude:
Map Name:
Index Map Number: 80 10619
Date Registered:
Bore Plotted on the map? Yes ☐ No ☐
Dept Officer:
Signature:
Remarks:

S/B 0815

MW182

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

STATEMENT OF BORE

As per Water Regulations (2009)

Name of Owner: Contracted by Coffey
Location/Address: ~~15~~ 31 Nemeluck drive. Rodwilla
Intended Use: MONITORING ONLY

Registration No.: 040450
BC Permit No:

GPS Location: Zone: 52 GDA94: ☑ Other: ☐ Specify:
Easting: 701507 Northing: 8626152

From	To	Particulars of Strata
0	1.2	Gravelly soil/laterite, red/Brown dry
1.2	5	Siltstone, red/Brown, dry.
5	12	Siltstone, red/Brown, moist

Name of Drilling Company: PROACTIVE DRILLING
Name of Driller: MARIUS WEATHERALD
Name of supervising driller:
Date Commenced: 12/8/2017
Date Completed: "
Depth Drilled: 12 (m)
Completion Depth: 12 (m)

METHOD OF DRILLING

Other	Auger	Rev. Circ.	Rotary Air	Rotary Mud
☐	☐	☐	☑	☐

Specify:

HOLE DIAMETER

From (m)	To (m)	Dia. (mm)
0	12	115

DRILLING FLUID
Type: —

PARTICULARS OF CASING

From	To	Dia (ID)	Type
0	1	50mm	PVC

PARTICULARS OF PERFORATIONS OR SCREEN STRINGS

From	To	Dia (ID)	Aperture	Type
1	12	50mm	0.4mm	PVC

Casing Suspended: Yes ☐ No ☑
Method: N/A
Height of Casing above GL: (m)
(m)

Top of Packer Set at: N/A (m)
Length of Packer: (m)
Method of Packer Connection: N/A

CEMENTING/GRAVEL PACKING

From	To	Type
0	0.3	Cement
0.3	0.6	Bentonite
0.6	12	gravel

WATER BEARING BEDS

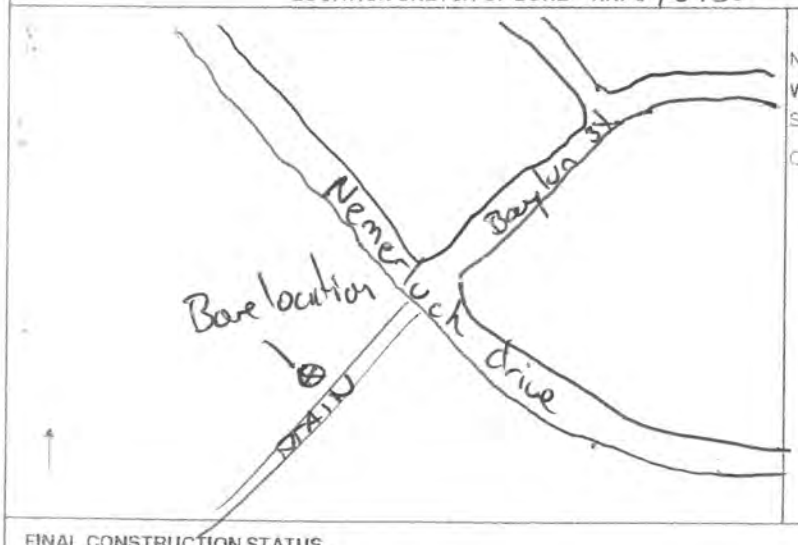
Depth (m) From	Depth (m) To	Yield (L/s)	SWL (m)	Duration (hr)	Quality	EC	pH	Bottle No.

STRATA / WATER SAMPLES
Have been ☐ Will be ☐
Left at:

Completion Yield: (L/s) Method: Duration: (hr)
Completion SWL from GL: (m) Depth of Lift: (m)

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

LOCATION SKETCH OF BORE RN: 040450



LOCATION DESCRIPTION OF BORE

100 m/km

NW ☐ North ☐ NE ☐
West ☐ East ☐
SW ☑ South ☐ SE ☐

OF: Intersection of Baylun st & Nemeluck dri

FINAL CONSTRUCTION STATUS

Capped	Casing Pulled	Left for Obs.	Abandoned	Equipped	Backfilled	Other
☑	☐	☐	☐	☐	☐	☐

ADDITIONAL INFORMATION ABOUT THE BORE: *(Include any information which may assist for future reference)*

MONITORING ONLY

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.

MARWS WEATHERALD DL1010 — Date: 20 9 2017

Name and licence number of driller: Signature and licence number of licensed driller:

FOR OFFICIAL USE ONLY

How Located: GPS ☑ TST ☐ Survey ☐ Hand Plotted ☐ Other ☐

DESCRIPTION OF PROPERTY

Rural ☐ Mineral ☐ Pastoral ☐ Reserve ☐ VCL ☑ Other ☐

RECEIVED DATE 30/10/17 BY M. CHIN

ENTER 14/11/17

Lease No: Lot No: 5632

Portion No: Section No: Hundred of:

Town of: DARWIN

Class of Bore: Town ☐ Domestic ☐ Investigation ☑ Agriculture ☐ Mineral ☐ Pastoral ☐ Other ☐

Use of Bore: Production ☐ Investigation ☐ Irrigation ☐ Observation ☐ Monitoring ☑ Roads ☐ None ☐

Grid Reference: AMG ☑ Clark ☐ Zone: 52 Scale:

Easting: 701507

Northing: 8626152 Latitude: Longitude: Map Name:

Index Map Number: 80/10652

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

Dept Officer: Signature:

Remarks: S/B 0815

MW183

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

STATEMENT OF BORE

As per Water Regulations (2009)

Name of Owner: Contracted by Coffey
Location/Address: 31 Neverluch drive Ludmilla
Intended Use: MONITORING ONLY

Registration No.: 040451
BC Permit No:

GPS Location: Zone: 52 GDA94: ☑ Other: ☐ Specify:
Easting: 701405 Northing: 8626299.

From	To	Particulars of Strata
0	1	Gravelly soil/laterite, red/Brown
1	5	siltstone, red/Brown, dry dry
5	12	Siltstone, red/Brown, moist

Name of Drilling Company: PROACTIVE DRILLING
Name of Driller: MARIUS WEATHERALD
Name of supervising driller:

Date Commenced: 12/8/2017
Date Completed: "

Depth Drilled: 12 (m)
Completion Depth: 12 (m)

METHOD OF DRILLING

Other	Auger	Rev. Circ.	Rotary Air	Rotary Mud
☐	☐	☐	☑	☐

Specify:

HOLE DIAMETER			DRILLING FLUID
From (m)	To (m)	Dia. (mm)	Type
0	12	115	—

PARTICULARS OF CASING

From	To	Dia (ID)	Type
0	1	50mm	PVC

PARTICULARS OF PERFORATIONS OR SCREEN STRINGS

From	To	Dia (ID)	Aperture	Type
1	12	50mm	0.4mm	PVC

Casing Suspended: Yes ☐ No ☑
Method: N/A
Height of Casing above GL: (m)

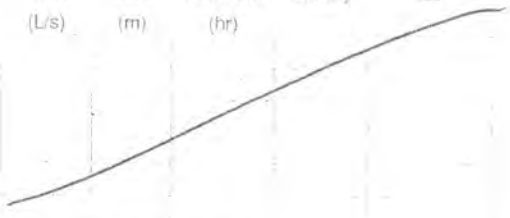
Top of Packer Set at: N/A (m)
Length of Packer: (m)
Method of Packer Connection: N/A

CEMENTING/GRAVEL PACKING

From	To	Type
0	0.3	Cement
0.3	0.6	Bentonite
0.6	12	gravel

WATER BEARING BEDS

Depth (m) From	Depth (m) To	Yield (L/s)	SWL (m)	Duration (hr)	Quality	EC	pH	Bottle No.

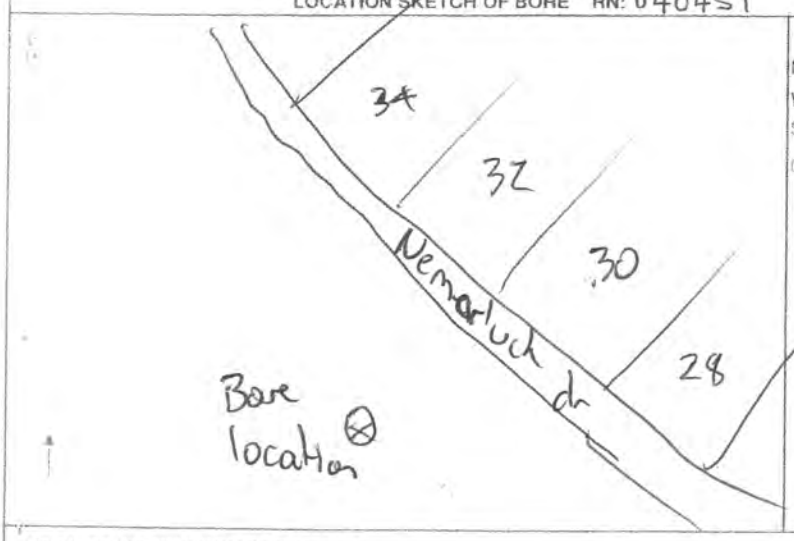


STRATA / WATER SAMPLES
Have been ☐ Will be ☐
Left at:

Completion Yield: (L/s) Method: Duration: (hr)
Completion SWL from GL: (m) Depth of Lift: (m)

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

LOCATION SKETCH OF BORE RN: 040451



LOCATION DESCRIPTION OF BORE

20 m/km

NW ☐ North ☐ NE ☐
West ☐ East ☐
SW ☑ South ☐ SE ☐

OF Nemarluk dr

FINAL CONSTRUCTION STATUS

Capped	Casing Pulled	Left for Obs.	Abandoned	Equipped	Backfilled	Other
☑	☐	☐	☐	☐	☐	☐

ADDITIONAL INFORMATION ABOUT THE BORE: *(Include any information which may assist for future reference)*

MONITORING ONLY

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.

MARWS WEATHERALD DL1010 — Date: 20 / 9 / 2017

Name and licence number of driller: Signature and licence number of licensed driller:

FOR OFFICIAL USE ONLY

How Located: GPS ☑ TST ☐ Survey ☐ Hand Plotted ☐ Other ☐

DESCRIPTION OF PROPERTY:

Rural ☐ Mineral ☐ Pastoral ☐ Reserve ☐ VCL ☑ Other ☐

RECEIVED DATE 30/10/17 BY M.CHIN

ENTER 14/11/17

Lease No: Lot No: 5632 Hundred of:

Portion No: Section No: Town of: DARWIN

Class of Bore	Town	Domestic	Investigation	Agriculture	Mineral	Pastoral	Other
	☐	☐	☑	☐	☐	☐	☐

Use of Bore	Production	Investigation	Irrigation	Observation	Monitoring	Roads	None
	☐	☐	☐	☐	☑	☐	☐

Grid Reference: AMG ☑ Clark ☐ Zone: 52 Scale:

Easting: 701405

Northing: 8626299 Latitude: Longitude: Map Name: Index Map Number: 80/10653

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

Dept Officer: Signature

Remarks: S/B 0815

MW201

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

STATEMENT OF BORE

As per Water Regulations (2009)

Name of Owner: Contracted by Coffey
Location/Address: RAAF Base, Darwin, Winnellie.
Intended Use: MONITORING ONLY

Registration No.: 040468
BC Permit No:

GPS Location: Zone: 52 GDA94 ☑ Other: ☐ Specify: Easting: 701806 Northing: 8625805

From	To	Particulars of Strata
0	1.5	Gravelly soil/laterite, red/brown, dry
1.5	6	siltstone, red/Brown, dry
6	10	siltstone, red/Brown, moist,

Name of Drilling Company: PROACTIVE DRILLING
Name of Driller: MARIUS WEATHERALD
Name of supervising driller: Pierre Striano

Date Commenced: 18/8/2017
Date Completed: "

Depth Drilled: 10 (m)
Completion Depth: 10 (m)

METHOD OF DRILLING

Other	Auger	Rev. Circ.	Rotary Air	Rotary Mud
☐	☑	☐	☐	☐

Specify:

HOLE DIAMETER

From (m)	To (m)	Dia. (mm)
0	10	150

DRILLING FLUID Type:

PARTICULARS OF CASING

From	To	Dia (ID)	Type
0	1	50mm	PVC

PARTICULARS OF PERFORATIONS OR SCREEN STRINGS

From	To	Dia (ID)	Aperture	Type
1	10	50mm	0.4mm	PVC

Casing Suspended: Yes ☐ N/A No ☑
Method:
Height of Casing above GL: (m)
(m)

Top of Packer Set at: N/A (m)
Length of Packer: (m)
Method of Packer Connection: N/A

CEMENTING/GRAVEL PACKING

From	To	Type
0	0.3	Cement
0.3	0.6	Bentonite
0.6	10	gravel

WATER BEARING BEDS

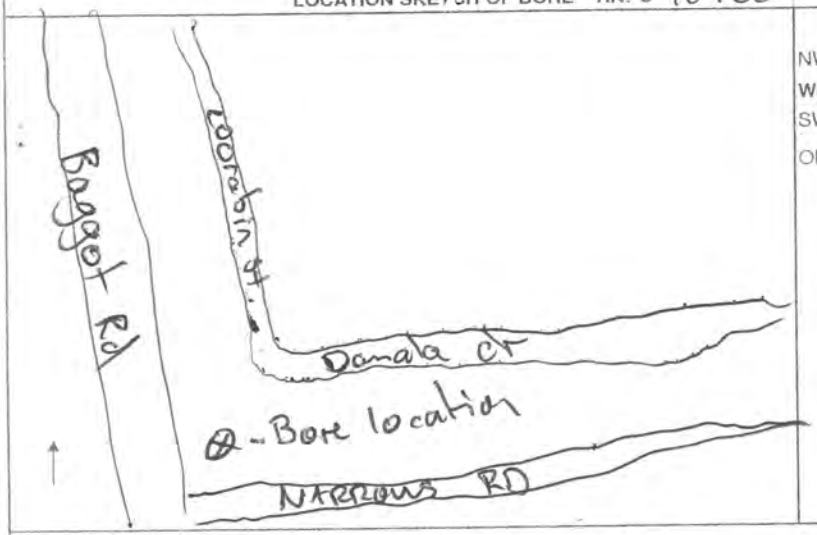
Depth (m) From	Depth (m) To	Yield (L/s)	SWL (m)	Duration (hr)	Quality	EC	pH	Bottle No.

STRATA / WATER SAMPLES
Have been ☐ Will be ☐
Left at:

Completion Yield: (L/s) Method: Duration: (hr)
Completion SWL from GL: (m) Depth of Lift: (m)

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

LOCATION SKETCH OF BORE RN: 0 40468



LOCATION DESCRIPTION OF BORE

40 0 m/km

NW ☐	North ☐	NE ☐
West ☐		East ☐
SW ☑	South ☐	SE ☐

OF: Intersection of Coorabin st & Danala ct.

FINAL CONSTRUCTION STATUS

Capped	Casing Pulled	Left for Obs.	Abandoned	Equipped	Backfilled	Other
☑	☐	☐	☐	☐	☐	☐

ADDITIONAL INFORMATION ABOUT THE BORE: *(Include any information which may assist for future reference)*

MONITORING ONLY

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.

MARCUS WEATHERALD DL1010 — 28 / 9 / 2017

Name and licence number of driller: Signature and licence number of licensed driller: Date:

FOR OFFICIAL USE ONLY

How Located:	GPS	TST	Survey	Hand Plotted	Other
	☑	☐	☐	☐	☐

DESCRIPTION OF PROPERTY:

Rural	Mineral	Pastoral	Reserve	VCL	Other
☐	☐	☐	☑	☐	☐

RECEIVED DATE 15/11/17 BY M.CHIN

ENTER 15/11/17

Lease No: Lot No: Hundred of: BAGOT

Portion No: Section No: 5730 Town of:

Class of Bore:	Town	Domestic	Investigation	Agriculture	Mineral	Pastoral	Other
	☐	☐	☑	☐	☐	☐	☐

Use of Bore:	Production	Investigation	Irrigation	Observation	Monitoring	Roads	None
	☐	☐	☐	☐	☑	☐	☐

Grid Reference: AMG ☑ Clark ☐ Zone: 52 Scale:

Easting: 701806 Lattitude: Map Name:

Northing: 8625805 Longitude: Index Map Number: 80/10666

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

Dept Officer: Signature:

Remarks: S/B 0815

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

APPENDIX C: LONG TERM ENVIRONMENTAL MANAGEMENT PLAN (LTEMP)

Richardson Park Asbestos Containment Cell

Long Term Environmental Management Plan

Department of Infrastructure, Planning and Logistics

www.ecoz.com.au

DOCUMENT CONTROL RECORD

Job	EZ21066
Document ID	204959
Author(s)	Corinne Hutchinson and Britanny Crescentino

DOCUMENT HISTORY

Rev	Reviewed by	Approved by	Issued to	Date
1	Emma Lewis	Emma Lewis	Mark Stukey (Accredited Environmental Auditor NSW and VIC) (initial review)	29 November 2021
2	Emma Lewis	Britanny Crescentino	Mark Stukey (Accredited Environmental Auditor NSW and VIC)	13 January 2022

Recipients are responsible for eliminating all superseded documents in their possession.

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Internet: www.ecoz.com.au

TABLE OF CONTENTS

Appendices

Tables

Figures

ACRONYMS

BPEM	Best Practice Environmental Management
CSM	Conceptual Site Model
DIPL	Department of Infrastructure, Planning and Logistics
DSI	Detailed site inspection
EcOz	EcOz Environmental Consultants
EMP	Environmental Management Plan
ESCP	Erosion and sediment control plan
LTEMP	Long Term Environment Management Plan
NT	Northern Territory
NT EPA	Northern Territory Environmental Protection Authority
NSW	New South Wales
PACM	Potentially Asbestos Containing Material
PAN	Pollution Abatement Notice
RAP	Remediation Action Plan
SAQP	Sampling and analysis quality plan
SWMS	Safe work method statement
WMPC Act	*Waste Management and Pollution Control Act* (Northern Territory)

1 INTRODUCTION

This Long-Term Environmental Management Plan (LTEMP) has been prepared for the Department of Infrastructure, Planning and Logistics (DIPL) by EcOz Environmental Consultants (EcOz), for the long-term management of the Richardson Park asbestos containing soils Containment Cell (Containment Cell).

To address the need for ongoing monitoring and management of the Containment Cell, a LTEMP is required and must be consistent with the Victorian Environmental Protection Authority (EPA) *Landfill Best Practice Environmental Management (BPEM)*, Section 8.2 Aftercare management. Additional information requirements for future maintenance and redevelopment works within the Richardson Park boundaries are mentioned but are not extensive in detail.

1.1 Background

DIPL has been tasked with the redevelopment of the Richardson Park sport complex, located at 40 Richardson Drive, Ludmilla, Darwin, to facilitate its ongoing use as a playing field and community open space. Richardson Park was unused from 2015 until its redevelopment in 2021. The redevelopment plans consist of demolishing and removing old infrastructure, improving the playing field, and constructing new buildings and an extension of Richardson Drive, for the site to be used as a general community space and sporting ground.

Richardson Park is located adjacent to Ludmilla Creek, which is a known contaminated site for PFAS, as such, prior to commencing works, several studies were undertaken on Richardson Park and Ludmilla Creek to investigate the contamination of the land. Those studies identified PFAS and Potential Asbestos Containing Material (PACM) as contaminants of concern. During demolition works, asbestos containing soil was identified in the southern end of the site, which triggered further sampling and investigation.

In response to the discovery of the asbestos containing soils, the Northern Territory Environmental Protection Authority (NT EPA) issued Pollution Abatement Notice (PAN) 2021/3, with a series of requirements to address asbestos management.

A Remediation Action Plan (RAP) was developed to manage the remediation of asbestos containing soils to a level suitable for the proposed land use, which included a comparison of remediation/management options. A containment cell design was developed and endorsed by an auditor accredited under the New South Wales (NSW) and Victorian Site Auditor Schemes and constructed to contain the asbestos containing soils during the Richardson Park redevelopment works.

1.2 Purpose

The LTEMP is a requirement of Attachment B of the PAN and addresses the *Contaminant Cell Closure Requirements*, of which, requirements 16, 17 and 18 refer to the LTEMP. Under the PAN the LTEMP must receive formal endorsement by an environmental auditor accredited under the NSW or Victorian environmental auditor schemes. This LTEMP has been developed to consider all regulatory requirements and guidelines to ensure its formal endorsement, provided at Appendix A.

This LTEMP has been developed in accordance with the NT EPAs *Guideline for the preparation of an Environmental Management Plan* (Version 1.0, May 2015), and outlines the site description, relevant legislation and guidelines, responsible parties, the conceptual site model, the environmental risk assessment, the environmental management strategies, corrective actions, record and reporting requirements and the review process.

1.3 Scope

This LTEMP is for the duration of the Containment Cell at Richardson Park and the ongoing management as a general community space and sporting ground.

1.4 Objective

This LTEMP provides:

- A summary of residual contamination within the Containment Cell
- Details of the Containment Cell infrastructure and design
- Details of an ongoing monitoring and maintenance regime of the Containment Cell capping layer
- A framework for ongoing management of the site during potential future disturbance of the Containment Cell, to avoid, reduce and mitigate the potential environmental impacts from such works.

2 SITE DESCRIPTION

2.1 Location and surrounding land use

The site is located at 40 Richardson Drive, Ludmilla, Lot 8434 Town of Darwin. The site consists of a playing field, viewing areas, car park and a number of structures and buildings (now demolished and removed) (potentially former canteen, and toilet blocks) associated with the sporting field. The site has not been used as a sports stadium since 2015. The total area of the site is estimated to be 5.97 hectares.

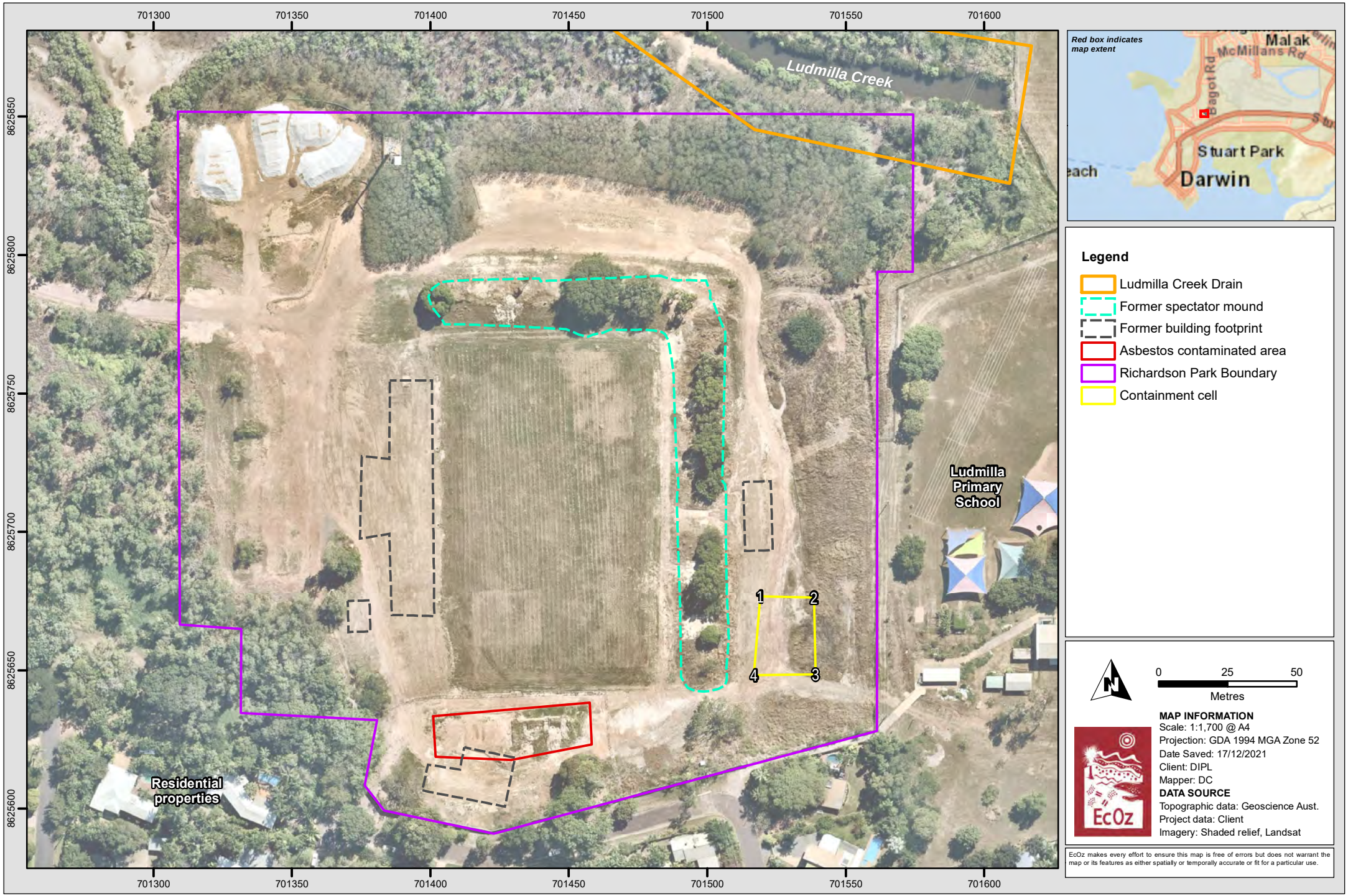
The current surrounding land use around the site is described below.

- North – Ludmilla Creek Drain and mangrove wetland
- South – Residential properties
- South-East – Puma petrol station (located approximately 250 m from the site)
- East – Ludmilla Primary School and Bagot Road further east
- West – Combination of residential and vacant vegetated land, and Darwin Racecourse and Ludmilla Wastewater Treatment Plant further west

Darwin International Airport (DIA) and the RAAF Base are located approximately 1.5 km to the north-east of the site at an estimated elevation of 30 m AHD and drain into Ludmilla Creek located north of the site.

2.2 Site layout

The Richardson Park site location and layout, including the location of the Containment Cell is presented in Figure 2-1.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ21066 - Richardson Park ERA Amendment (Asbestos) - DIPL\01 Project Files\RIchardson Park location and Site Layout Map.mxd

Figure 2-1. Site location and layout

2.3 Environmental setting

This section provides a summary of the environmental setting at Richardson Park.

2.3.1 Climate

The site is situated in Darwin which has a tropical monsoonal climate, with a distinct Dry season (approximately April to October) and Wet season (November to March). Typically, for this region, humidity, maximum and minimum temperatures are highest in the Wet season, and annual evaporation far exceeds annual rainfall.

The Darwin International Airport station (Station no. 014015) is the closest Bureau of Meteorology (BoM) weather station to the site, located approximately 2 km away. The annual rainfall data of the station is 1723.1 mm (BoM 2021). The variation in temperature and rainfall across the seasons is shown in Figure 2-2.

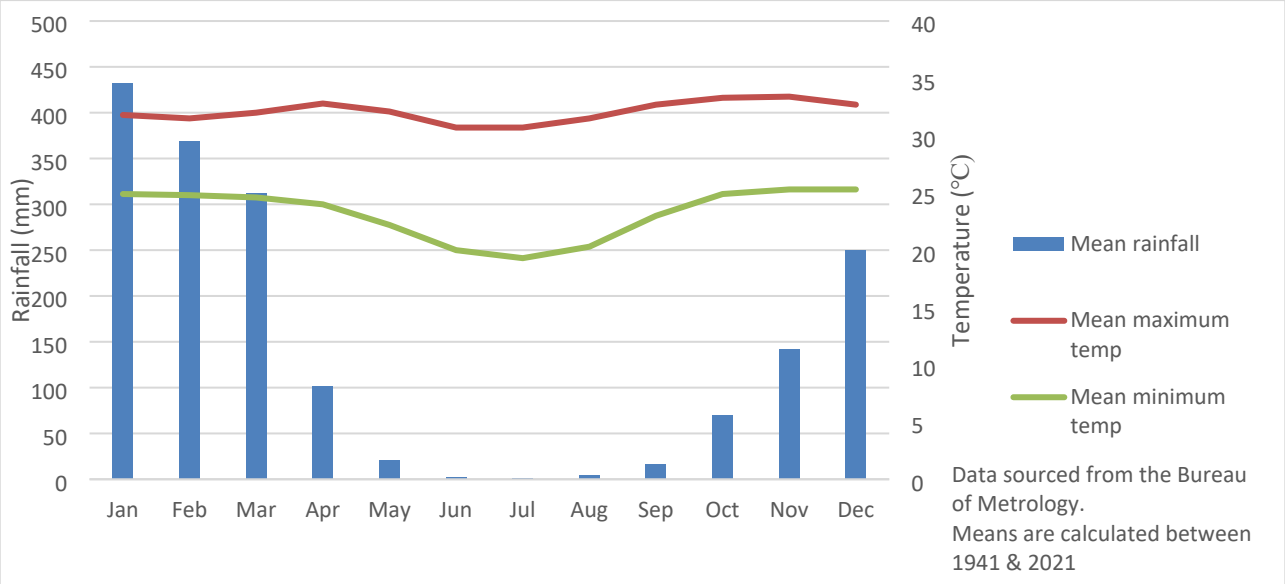


Figure 2-2. Graph of mean temperature and rainfall at Darwin Airport (Station no. 014015)

2.3.2 Topography

The site is located within the mid-lower part of the Ludmilla Creek catchment. The elevation of Richardson Park is approximately 5 m Australian Height Datum (AHD) and gently slopes to the north and north-west towards Ludmilla Creek and the adjacent estuarine fringes and mangrove wetlands.

2.3.3 Geology

The surface geology of the site is part of the Darwin Formation, consisting mainly of kandosolic redoxic hydrosols soils including claystone with minor silts and sands; and the mangrove wetland area to the north consists of intertidal hydrosols including sediments and clays (Bureau of Meteorology – Australian Groundwater Explorer). Intertidal hydrosols largely consist of mangrove debris that are regularly inundated by saline tidal waters (Isbell 2016). The playing surface of Richardson Park is clay loam topsoil.

2.3.4 Hydrology

The site is located within the Ludmilla Creek catchment. Surface water runoff from the site flows toward the north/north-west, towards Ludmilla Creek, located approximately 1 km to the north-west of the site. The adjacent area of Ludmilla Creek is tidally influenced, and during high tides waters can reach the north and north-western boundary of Richardson Park.

Given the general topography of the area, surface run off is likely to drain into the mangrove wetland area, which connects with Ludmilla Creek Drain and Ludmilla Creek.

Flooding

The majority of the northern portion of the site is also located within the storm surge zone for a 100-year average reoccurrence interval (ARI), while the majority of the site is located within the secondary storm surge zone for a 1000 year ARI. The Containment Cell is in the eastern portion of the site which is located outside of the 100 year storm surge zone.

2.3.5 Hydrogeology

A search of nearby groundwater bores on the Bureau of Meteorology National Groundwater Information System website revealed a total of 11 bores within a 500 m radius of the site. The majority of the bores were drilled in the 1980's for the purpose of stock and domestic use and have since been backfilled and are no longer in use. The bores were drilled into tertiary and quaternary sediments (Money Shoal Sedimentary) to varying depths mainly ranging from 3 to 12 m below ground level (bgl). According to the NT Government's Natural Resource Maps (NR Maps) website, the aquifer of 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.

Out of the 11 bores, 8 bores are located on the site. Drill depths ranged from 3 – 5.5 m bgl with groundwater levels ranging from 0.2 – 1.1 m bgl. The water yield in these bores were poor, with the maximum yield of 1 L/second. The heavy marine clays of the Ludmilla Creek area are known to have low permeability rates. None of the bores on site are in use today.

Given the site's close proximity to the tidal influenced body of water to the north, groundwater at the site is expected to be shallow and influenced by tidal movements. Inferred groundwater flow is expected to follow the natural topography of the land to the north, north-west towards the mangrove wetland.

2.3.6 Significant vegetation

There is no known significant vegetation types located within the site, fringes of mangrove communities associated with Ludmilla Creek are located north of the site.

2.3.7 Sensitive surrounding environments

The site is upstream of the tidally influenced Ludmilla Creek estuary outlet and drainage line which drains into Darwin Harbour. The creek flows through floodplains and mangrove communities.

2.3.8 Significant cultural/social sites

Aboriginal Sacred Sites

An Aboriginal Areas Protection Authority (AAPA) Certificate for Richardson Park was obtained in April 2020. There are no registered Aboriginal Sacred Sites at the site. Aboriginal custodians requested that the impacts to mangrove areas be limited insofar as possible and wish to see the carved sandstone memorial for grounds keeper at 'Shadow hill' to be retained.

Heritage listed infrastructure

An application to nominate Richardson Park to the NT Heritage Register, was lodged in July 2019, by residents of Ludmilla and surrounding Darwin suburbs. On May 7, 2020, a Statement on the Richardson Park Heritage Decision was released by the NT Government and declared that the decision had been made **not** to declare Richardson Park as a heritage place in accordance with section 32 of the *Heritage Act 2011*. The decision stated:

Richardson Park is a significant community site that has long provided recreation opportunities for the community and we will continue to work towards providing a better space for all to enjoy. The facilities are in a state of disrepair and require significant upgrades to meet current standards to rejuvenate and activate the space.

2.3.9 Site contamination assessment history

Richardson Park and the neighbouring Ludmilla Creek have been subject to ongoing contamination assessment since 2018 to determine the potential contaminants of concern present within area, and to develop management strategies to allow redevelopment works to commence. The key potential contaminates of concern investigated are PFAS, asbestos, TRH, BTEXN, PAHs, OC/OP pesticides and heavy metals (As, Cd, Cr, Cu, Pb, Ni, Zn and Hg).

2018 investigations

In August 2018 a detailed Richardson Park Sampling and Analysis Quality Plan (SAQP) was developed to outline the required sampling to facilitate the planning of the proposed Richardson Park improvements (EcOz 2018). This SAQP included PFAS investigations, as well as general potential contaminants of concern (i.e., heavy metals, PAHs, TRH, BTEXN and asbestos). Results of the SAQP implementation were presented in an Overall Detailed Site Investigation (DSI) 2019 (EcOz 2019). The potential contaminants of concern detected (i.e., heavy metals, PAHs, TRH, BTEXN and asbestos) within Richardson Park were found to meet guideline criteria, with the exception of some trace cations and metals that exceeded the Australian Standard Guideline for soils for landscaping use. Although no asbestos was identified in soil samples, the DSI did note that potential asbestos containing material (PACM) was identified within site buildings and infrastructure, including in cement sheeting in buildings along the southern boundary of the site (former canteen). Buried PACM pipework was also flagged as potentially occurring, and the status of PACM within the former grandstand building was unknown as the area was not accessible during the DSI sampling.

PFAS concentrations

PFAS concentrations were compared against the *2019 Draft PFAS National Environmental Management Plan (NEMP) version 2.0.* A total of 60 sites were sampled and all PFAS soil concentrations were below guideline values for the NEMP human health screening values for Public Open Space, and the interim ecological (direct exposure) criteria for public open space.

PFAS leachate analysis

PFAS leachate analysis under two pH scenarios, pH 5 to replicate naturally acidic rainfall conditions and pH 7 as a comparison of neutral water, were undertaken. The samples were compared against the *NEMP interim marine 95% species protection levels* and the *ASLP landfill acceptance criteria for unlined landfill* (i.e. representative conditions for reuse on site), and *ASLP landfill acceptance criteria for clay/single composite lined cell* (i.e. representing the appropriate criteria for acceptance of PFAS materials to the Shoal Bay Waste Management Facility. Three leachate samples recorded values exceeding the PFOS interim marine 95% species protection level of 0.13 µg/L when using pH 5 leachate water. This indicates that during rainfall conditions PFOS has the potential to leach from soils at concentrations hazardous to aquatic species at a small number of sampling locations. There were no exceedances of PFOS guideline values under pH 7 leachate conditions for either 95% species protection or landfill acceptance criteria.

Four leachate samples recorded values exceeding the PFOS+PFHxS ASLP landfill acceptance criteria for unlined landfill of 0.07 µg/L when using pH 5 leachate water. This indicates that during rainfall conditions PFOS+PFHxS has the potential to leach from soils at concentrations that would not be acceptable for reuse within redevelopment works for a small number of sampling locations. However, PFOS+PFHxS concentrations were below the guideline criteria for ASLP landfill acceptance criteria for clay/single composite lined cell (at both pH 5 and pH 7), which indicates that soils are of a quality deemed acceptable for disposal at SBWMF. There were no exceedances of PFOS+PFHxS guideline values under pH 7 leachate conditions for either 95% species protection or landfill acceptance criteria.

There were no exceedances of PFOA guideline values under pH 5 or pH 7 leachate conditions.

2020 investigations

Concrete rubble located along the northern boundary of the site was identified as potentially containing PACM material. Sampling undertaken of the stockpiled concrete and surficial soil identified no asbestos within the rubble or underlying the soil, and the concrete was deemed suitable for reuse on site (SLR 2020). A single fragment of asbestos debris was observed outside the stockpile footprint and was removed during sampling; no further fragments or debris were identified.

2021 investigations

In May 2021, asbestos was uncovered during demolition works of a retaining wall in the southern area of the site. Fourteen test pits were excavated across the southern area and samples were collected at depths of 0.1 m, 0.5 m and 1 m below surface. Asbestos was detected in concentrations above the assessment criteria for use as an open space in three of the test pits, and bonded asbestos containing material, fibrous asbestos and asbestos fines were detected.

Based on the detection of asbestos, options for disposal or on-site management were investigated. It was proposed to encapsulate the asbestos on-site in a below ground, Containment Cell, with 1 m of soil covering the cell, as per the WA DOH guidelines and detailed in the designs provided at section 2.4. Validation sampling for the entire site was undertaken in conjunction with the remediation works associated with the Containment Cell. Table 2-1 summarises of the results from the validation report. Details of the data gap analysis, sampling methodology, assessment criteria, discussion of validation sampling results and endorsement by the environmental auditor is provided at Appendix B and Appendix A.

Table 2-1. Summary of validation report results (Source: OCTIEF 2021)

Parameters	Location	Result
Asbestos	Contaminated area	No detection of asbestos remaining.
	Across Richardson Park	Asbestos was detected above guideline values at 4 test pit locations. 3 of the 4 test pits were excavated and disposed of into the Containment Cell. Validation sampling was conducted post excavation and asbestos concentrations were below assessment criteria. The final test pit was left in situ as the contamination was detected at 0.5m and no excavation of this area is expected to occur.
PFAS	Contaminated area	No detection of PFAS concentration exceeding the assessment criteria.
	Across Richardson Park	
PFAS leachate analysis (pH 5 & 7)	Contaminated area	No detection of PFAS leachable concentrations above the limit of reporting.
Heavy metals (As, Cd, Cr, Cu, Pb, Ni, Zn and Hg)	Across Richardson Park	No heavy metals detected at concentrations exceeding the assessment criteria.
PAH, TRH, BTEX or OC/OP pesticide compounds	Across Richardson Park	No detection of concentrations above the limit of reporting.

2.4 Containment Cell design

The design of the Containment Cell by Byrne Consultants has been reviewed and assessed by an accredited environmental auditor as being appropriate for the purpose of asbestos contaminated materials containment. The design of the Containment Cell included a contingency for potential expansion if during the validation sampling additional unexpected finds of contaminated asbestos soils were detected. The Containment Cell design is provided at Appendix C and the design endorsement letter is provided at Appendix D. Table 2-2 provides a summary of the key information about the Containment Cell location, construction and filling.

Table 2-2. Containment Cell key information

Description	Key information
Containment Cell coordinates	<table><tr><th>Corner</th><th>ID[1]</th><th>Latitude</th><th>Longitude</th></tr><tr><td>NW</td><td>1</td><td>12° 25' 32.330" S</td><td>130° 51' 13.882" E</td></tr><tr><td>NE</td><td>2</td><td>12° 25' 32.341" S</td><td>130° 51' 14.528" E</td></tr><tr><td>SE</td><td>3</td><td>12° 25' 33.244" S</td><td>130° 51' 14.551" E</td></tr><tr><td>SW</td><td>4</td><td>12° 25' 33.257" S</td><td>130° 51' 13.814" E</td></tr></table>
Containment Cell dimensions	28.5 m (L) x 22.3 m (W) x 2.6m (D)
Description of basal and sidewall type/construction (materials)	The walls are on a 45-degree (1 in 1) angle, and no geotextile liner was installed due to the inert nature of the asbestos and results of other potential contaminates of concern (PFAS).
Description of capping layer (types and thicknesses)	The Containment Cell has been capped using the following layering structure: • A layer of geofabric covering the entirety of the asbestos contaminated soil, allowing for minimum 600mm overlap of geofabric sheets. • Approximately 300mm depth layer of clean fill • An identification barrier layer of geofabric (hi-visibility colour) as an early warning indicator barrier layer. • 600mm of clean fill was compacted and rolled The finished height of the Containment Cell capping was 100mm below ground level in order to allow an additional 100mm of topsoil to be applied as part of the landscaping being undertaken in Stage 2 of the redevelopment works to be undertaken at Richardson Park. As asbestos is an inert waste, the Containment Cell capping is not designed to limit water seepage and is only intended to act as a physical barrier. The capping is to be monitored according to a site-specific Erosion and Sediment Control Plan (ESCP) prior to the final revegetation process (refer to Appendix E).
Filling period of Containment Cell	27th August 2021 to 09th September 2021
Completion of Containment Cell capping	14th September 2021
Summary of contaminated materials placed within the Containment Cell	1,214 tonnes of excavated soil contaminated with inert asbestos, detected by targeted soil sampling.

[1] Refers to Figure 2-1

3 LEGISLATION AND GUIDELINES

This LTEMP has been prepared with consideration of the relevant legislative requirements and guidelines listed below:

- NT EPA Pollution Abatement Notice 2021/3, issued pursuant to section 77 of the *Waste Management and Pollution Control (WMPC) Act 1998.*
- NT EPA, *Guideline for the Preparation of an Environmental Management Plan*, Version 1.0, May 2015, which satisfies the requirements of the *WMPC Act* and the *Environmental Protection Act*.
- EPA Victoria, *Best Practice Environmental Management - Siting, Design, Operation and Rehabilitation of Landfills*, Publication 788.3, August, 2015.
- The DIPL *Standard Specification for Environmental Management,* Version 2.0, July 2019.
- International Erosion Control Association (IECA) *Australasia Best Practice Erosion and Sediment Control*, November 2008.
- Specific for management of asbestos:
    - Western Australian Department of Health (DoH) Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia, August 2021.
    - National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 1999, Schedule B1 andB2, NEPC (2013).
    - Safe Work Australia Code of Practice – How to Manage and Control Asbestos in the Workplace, October 2018.
    - NT Worksafe How to Safely Remove Asbestos Code of Practice, October 2020.

3.1 Pollution Abatement Notice

Requirements 16, 17 and 18 of the PAN refer directly to the LTEMP and are detailed below.

Requirement 16 of the PAN specifies that the LTEMP must be consistent with the Victorian Environmental Protection Authority (EPA) Landfill Best Practice Environmental Management (BPEM), Section 8.2 Aftercare management. The components of the Landfill BPEM relevant to this LTEMP are described in Section 3.2 below.

Requirement 17 of the PAN specifies that the LTEMP must be formally endorsed by an environmental auditor accredited under the NSW or Victorian environmental auditor schemes. This endorsement is provided in Appendix A.

Requirement 18 of the PAN details the minimum content that must be include in the LTEMP. This includes:

- An inspection regime of the cap to monitor for cracks or erosion (see Section 6.3);
- A maintenance regime of the cap to remediate and restore depressions or seal cracks (as necessary) (see Section 6.5);
- Restrictions on vegetation types to be grown in the area (see Section 6.6); and
- Parties responsible for any ongoing monitoring and maintenance of the cell (see Section 6.3).

3.2 Guideline for the Preparation of an Environmental Management Plan

This LTEMP has been developed in accordance with the NT EPA *Guideline for the Preparation of an Environmental Management Plan*, which provides a framework for the minimum information requirements for environmental management in the Northern Territory.

3.3 Victorian EPA Landfill BPEM

PAN 2021/3 requires that this LTEMP must be consistent with the Victorian EPA's Landfill Best Practice Environmental Management (BPEM), Section 8.2 Aftercare management. Aftercare management is required until the waste within a landfill has sufficiently stabilised such that it no longer presents a risk to the environment.

The Landfill BPEM states that *"putrescible landfills require a more extensive aftercare management plan than a solid inert landfill"*. In particular, putrescible landfills require the design and use of leachate collection and treatment systems, and any landfill gas-extraction systems associated with a landfill. Effectively contained and capped asbestos is considered a solid inert landfill, therefore no leachate collection and treatment systems or gas-extraction systems form part of the Asbestos Containment Cell design and are not required in this LTEMP.

The areas of the Landfill BPEM that are relevant to the Containment Cell and this LTEMP include:

- Maintenance of landfill cap, in particular to:
  - Prevent/control erosion
  - Restore depressions, and seal and monitor cracks in the cap caused by settlement
  - Restore/maintain vegetation.
- Environmental monitoring of:
  - Groundwater
  - Surface water
  - Settlement.

3.3.1 Inspections and monitoring

The Landfill BPEM states that *"during the aftercare period, the frequency of monitoring and inspection may be decreased, frequency being based on the stability of the landfill cap and the consistency of environmental monitoring results*", and "*as most settlement occurs within the first few years after closure, the inspection program needs to be more frequent during this period*".
"If monitoring is conducted regularly, and the trend clearly demonstrates that leachate is clean and minimal landfill gas is being generated, then the auditor can be assured that the site no longer poses a risk to the environment and may recommend reducing maintenance requirements. Where this monitoring is patchy and trends are inconclusive, then this degree of assurance is not provided and EPA will not remove the maintenance requirements".

This LTEMP presents the inspection regime for the Containment Cell, including both a short term and long-term frequency (see Section 6.3).

3.3.2 Auditing

The Landfill BPEM states *"in determining whether maintenance is still required, an environmental audit by an auditor is required.*

This LTEMP details the auditing schedule and requirements for the Containment Cell integrity.

3.4 DIPL Standard Specification for Environmental Management

This LTEMP has been developed in accordance with the DIPL *Standard Specification for Environmental Management*, which specifies the minimum environmental management requirements for Northern Territory Government projects.

3.5 Best Practice Erosion and Sediment Control

A site-specific erosion and sediment control (ESCP) plan has been developed for the Richardson Park site and included as part of this LTEMP.

3.6 Management of Asbestos

In the absence of Northern Territory guidelines for Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia has been used to provide guidance for the management of Asbestos in this LTEMP. Standards from other codes of practice and NEPM have been used to develop the Health, Safety and Environment (HSE) requirements for managing asbestos for maintenance works.

4 CONCEPTUAL SITE MODEL

A final Conceptual Site Model (CSM) is required following validation sampling of the constructed Asbestos Containment Cell, and to inform the risk assessment for the long-term management of the Asbestos Containment Cell (Table 4-1).

Asbestos fibres are not soluble in water and therefore do not migrate through leaching. They do not produce an odour or vapor and therefore cannot migrate through volatilisation. Serpentine chrysotile fibres do have the ability to leach in acid, however the acidity of rainfall and groundwaters available to infiltrate the Asbestos Containment Cell are not low enough to be considered an acid substance. Asbestos fibres are therefore considered an inert waste preventing their movement to water, soil or air as a vapour once buried.

The below CSM considers the properties of asbestos and the Containment Cell design parameters.

Table 4-1. Conceptual Site Model

Source	Pathway	Exposure route	Receptor
Asbestos within the Containment Cell	Disturbance/failure of the Containment Cell via: • Capping failure (cracking, slumping, erosion) • Maintenance failure (vegetation growth) • Inspection regime failure • Unplanned or future excavations.	Movement of asbestos from solid waste into the air phase via windborne distribution.	Inhalation of asbestos fibres by: • Onsite workers • Users of the Richardson Park facilities • Nearby general public.

5 ENVIRONMENTAL RISK ASSESSMENT

The following risk assessment has been adopted from the DIPL Environmental Risk Analysis framework, which includes risk consequence and likelihood rankings (Table 5-1 and Table 5-2), risk rating categories (Table 5-3) and the risk rating matrix (Table 5-4).

The risk assessment for the long-term management of the Containment Cell is presented in Table 5-5.

Table 5-1. Risk consequence levels

Risk		Consequence
1	Negligible	No measurable impact, or Limited / minimal damage to areas of low significance.
2	Minor	Minor impacts on flora / fauna and habitat but no negative impacts to ecosystem function, or Minor impacts with no permanent or lasting detrimental effects to the environment or cultural or social values.
3	Moderate	Policy or contractual breach, or Significant localised impacts without long term detrimental environmental or social impacts, or Short term or repairable adverse effects to ecosystem function or endangered / beneficial species, habitat or cultural & heritage values.
4	Major	Legislative, regulatory or policy breach, or Significant widespread environmental effects with long term detrimental environmental or social impacts, or Localised eradication or significant impact to ecosystem function, endangered / beneficial species, habitat or cultural and heritage values.
5	Severe	Major legislative, regulatory or policy breach, or Significant extensive environmental effects with long term detrimental environmental or social impacts, or Widespread, permanent and persistent damage to ecosystem function or area of significance including cultural heritage values, or Eradication of endangered/ beneficial species or habitat.

Table 5-2. Level of likelihood

Likelihood		Likelihood description
1	Rare	May occur in exceptional circumstances
2	Unlikely	Could occur at some time
3	Possible	Might occur at some time
4	Likely	Will probably occur in some circumstances
5	Almost certain	Expected to occur in most circumstances

Table 5-3. Risk rating categories

Risk category	General description
Low	Potential impacts either require no specific management measures or can be directly managed through design measures, general mitigation measures and safety controls.
Medium	Management responsibility required. Potential impacts can be mitigated through the application of relatively standard environmental management measures.
High	Management attention needed. Detailed assessment and planning are necessary to develop appropriate measures to mitigate and manage the potential impacts associated with the risk.
Extreme	Immediate action required. Detailed assessment and planning are necessary to develop appropriate measures to mitigate and manage the potential impacts associated with the risk.

Table 5-4. Risk rating matrix

			Consequence rating				
			1	2	3	4	5
			Negligible	Minor	Moderate	Major	Severe
Likelihood rating	1	Rare	Low (1)	Low (2)	Low (3)	Low (4)	Low (5)
	2	Unlikely	Low (2)	Low (4)	Medium (6)	Medium (8)	Medium (10)
	3	Possible	Low (3)	Medium (6)	Medium (9)	High (12)	High (15)
	4	Likely	Low (4)	Medium (8)	High (12)	High (16)	Extreme (20)
	5	Almost Certain	Low (5)	Medium (10)	High (15)	Extreme (20)	Extreme (25)

Table 5-5. Risk assessment

Activity	Risk	Likelihood	Consequence	Inherent Risk	Mitigation measures	Likelihood	Consequence	Residual Risk
Failure of the capping layer through cracking, slumping or erosion over time.	Air/windborne distribution of asbestos fibres and their inhalation by human receptors	3	4	High (12)	• Validation of the Containment Cell construction as per the designs (see OCTIEF/Trakondy Validation Reports Appendix C and auditor endorsement Appendix D) • Implementation of the inspection regime (see Section 6.3) • Implementation of the maintenance regime (see Section 6.5) • Site-specific Erosion and Sediment Control Plan (see Appendix E).	2	2	Low (4)
Capping integrity maintenance works resulting in uncontrolled release of contaminants		3	4	High (12)	• This LTEMP incorporates maintenance works of the Containment Cell, including an asbestos monitoring component if there is a potential for interaction with asbestos fibres. • All works to be overseen by a licenced asbestos assessor and carried out by a Class A licenced asbestos removalist under the *Work Health and Safety (National Uniform Legislation) Act 2011*	2	1	Low (2)
Ineffective vegetation management resulting in failure of the capping		4	4	High (16)	• Landscaping and maintenance tender contracts scope include formal and documented training session to be familiar with the LTEMP and location of the Containment Cell • Landscaping designs consider location of the Containment Cell • Implementation of the inspection regime (see Section 6.3) • Implementation of the maintenance regime (see Section 6.5)	2	1	Low (2)
Future excavation works resulting in uncontrolled release of contaminants from Containment Cell		4	4	High (16)	• Physical warning layers (2) installed above capping material during construction. • PAN recording exact boundary coordinates of Containment Cell on contaminated lands register for any future development works • All works to be overseen by a licenced asbestos assessor and carried out by a Class A licenced asbestos removalist under the *Work Health and Safety (National Uniform Legislation) Act 2011*	2	1	Low (2)

Activity	Risk	Likelihood	Consequence	Inherent Risk	Mitigation measures	Likelihood	Consequence	Residual Risk
Disturbance of capping	Air/windborne distribution of asbestos fibres and their inhalation by human receptors	3	4	High (12)	• Landscaping, maintenance, and redevelopment works tender contracts scope include formal and documented training session to be familiar with the LTEMP and location of the Containment Cell. • Physical warning layers (2) installed above capping material during construction. • PAN recording exact boundary coordinates of Containment Cell on contaminated lands register for any future development works • All works to be overseen by a licenced asbestos assessor and carried out by a Class A licenced asbestos removalist under the *Work Health and Safety (National Uniform Legislation) Act 2011*	1	2	Low (2)
Reinstatement of the capping after unexpected disturbance		3	3	Medium (9)	• Reinstatement capping to be undertaken to the original survey levels and in accordance with Byrne Consultants detailed designs endorsed by environmental auditor (refer to Appendix C). If necessary, updated survey levels to be obtained and updated to ensure minimum thicknesses met. • Implementation of future maintenance works • All works to be overseen by a licenced asbestos assessor and carried out by a Class A licenced asbestos removalist under the *Work Health and Safety (National Uniform Legislation) Act 2011*	1	2	Low (2)
Unexpected finds of asbestos contaminated soils requiring waste disposal	Air/windborne distribution of asbestos fibres and their inhalation by human receptors Additional contaminated soil to dispose of into Contamination Cell	4	4	High (16)	• Implementation of unexpected finds protocol (see Section 6.7) • All works to be overseen by a licenced asbestos assessor and carried out by a Class A licenced asbestos removalist under the *Work Health and Safety (National Uniform Legislation) Act 2011*	1	2	Low (2)

6 ENVIRONMENTAL MANAGEMENT STRATEGIES

6.1 Project roles, responsibilities and contacts

The responsible party for overseeing and implementing this LTEMP is Crown Land Estate for the duration of time that they hold ownership of the land (Lot 5646, Town of Darwin). If ownership changes this LTEMP will be amended accordingly. Crown Land Estate will engage a maintenance contractor to be responsible for all maintenance and monitoring management tasks. The contractor will be selected through a tender process to manage maintenance under a period contract.

Table 6-1. Roles, responsibilities and contact details

Organisation	Responsibilities	Contact details
Crown Land Estate (including NTG Tender Department)	• Overseeing and implementation of LTEMP • Engagement of Environmental Consultant (if required) and Maintenance Contractor	Address: Level 5 Energy House 18-20 Cavenagh Street Darwin NT 0800 Phone: 08 8999 6886 Email: CrownLand.Estate@nt.gov.au
Maintenance Contractor (based on tender contract)	• Training, awareness, and competency as part of site induction for all employees (refer to section 0). • Containment Cell capping routine inspection (refer to section 6.3) • Containment Cell maintenance (refer to section 6.3) • Vegetation management • Inspection, maintenance, and audit reporting to Crown Land Estate (annual requirement). • Implementation of unexpected find procedure (refer to section 6.7) • Control of future maintenance/or redevelopment works • Containment cell cap reinstatement works (asbestos training is essential). • Incident reporting/notification to Crown Land Estate (refer to section 8)	Address: TBC Phone: TBC Email: TBC
Environmental Consultant (based on tender contract)	• Review and update of LTEMP in accordance with section 9. • Any other sampling requirements that occur in the event of unexpected find of contamination (refer to section 6.7).	Address: TBC Phone: TBC Email: TBC
NT EPA	• Issuing and approval of PAN.	Address: Level 1, Arnhemica House, 16 Parap Road, Parap, NT, 0820 Pollution hotline: 1800 064 567 General phone: 08 8924 4218 Email: ntepa@nt.gov.au

6.2 Training, awareness and competency

All personnel undertaking inspection, monitoring and maintenance tasks will require a formal and documented training session and site induction to be made familiar with this LTEMP, Richardson Park, maintenance requirements and any other relevant documentation. Records of this training is to be held by Contract Manager. A template site induction register is provided at Appendix F.

The Containment Cell will be detailed on the tender scoping documentation and is delineated by two physical warning layers above the capped material to ensure that personnel conducting maintenance activities or excavation works into the future, as well as the general public are aware of its presence. The instrumentation of the PAN for the area will detail the boundary of the Containment Cell.

6.3 Containment Cell cap management

The inspection and maintenance responsibilities will be held by a maintenance contractor selected through a tender process for a period contract duration.

All personnel responsible for administering the inspection and maintenance contract will be familiar with this LTEMP and its requirement. Crown Land Estate, DIPL (as the NTG Department responsible for Infrastructure, Planning and Logistics) and the tendered maintenance contractor will be required to review this LTEMP and hold a copy. The LTEMP will be provided in the tender process as a key information document for scoping of maintenance, inspection and monitoring activities.

Inspection and maintenance of the Asbestos Containment Cell capping will aim to:

- Prevent erosion and control any erosion that does occur within the capping.
- Restore depressions, and seal cracks in the capping caused by settlement.
- Restore and maintain vegetation growth on the capping.

6.4 Inspections

The inspection regime frequency is proposed to be three inspections per annum – one prior, one during and one post the wet season, for two years (the anticipated settlement period).

Following the settlement period, if inspection results are consistent, the frequency of the inspection regime can be reduced to one annual inspection post wet season.

The inspection regime total duration is scheduled for 5 years.

During each scheduled inspection, the following key items are to be reviewed and documented (photographed and recorded) as part of the inspection:

- Settlement/subsidence of the cap
- Occurrence of erosion on the cap with the potential to lead to exposure of the waste or subsurface protection and hi-vis indicator layers
- Drainage issues on and around the cap area with the potential to lead to erosion
- Vegetation health and coverage of the cap
- Weed infestations or germination of prohibited vegetation types on or in the vicinity of the capping layer
- Other issues not identified above that are deemed to be of concern to the integrity of the cap.

Records of inspection are to be provided to Crown Land Estate annually.

Table 6-2. Inspection performance criteria

Parameter	Location	Monitoring parameter	Frequency	Performance criteria/objective	Documentation
Cap Integrity	Figure 2-1	Visual inspection of cap condition and in the vicinity of cap.	Routine (1 prior, 1 during and 1 after the wet season for 2 years) (1 post wet season for 3 following years)	No visible cracks/significant damage to capping layer. No visible drainage issues on or in the vicinity of the cap i.e., ponding, forged drainage paths	Inspection checklist/report Photographs Maintenance report if corrective actions identified
Vegetation condition on cap		Visual inspection of vegetation coverage, condition, and type on cap.		Coverage: Vegetation established over 70% of the cap[2]. Type: Shallow rooted grasses species. No weeds present on cap or in vicinity of cap.	

6.5 Maintenance

Routine maintenance works are likely to comprise the following:

- Repair/reinstatement of any erosion, cracks or depressions forming in the cap
- Repair/reinstatement or installation of additional drainage structures to ensure appropriate water shed off the cell area
- Reseeding or replanting of vegetation where required or removal of any species prohibited from growing over the capped area
- Removal or eradication of weeds on or surrounding the capped area
- Mowing/slashing on or surrounding the capped area

With the exception of mowing/slashing, routine maintenance is expected to be undertaken on an annual basis (at minimum), however additional maintenance works may be triggered following the outcome of scheduled inspections. The maintenance contract will incorporate an appropriate mowing/slashing regime reflective of the seasonal conditions.

Where temporary erosion and sediment controls are required following completion of construction, these controls are to remain in place until appropriate vegetative cover has stabilised the capping layer. Where erosion and sediment controls are installed, these controls are to be maintained as appropriate following rain events to ensure their effectiveness.

Records maintenance activities and outcomes are to be provided to Crown Land Estate annually.

[2] Source: IECA (2008)

6.5.1 HSE requirements

If the Containment Cell capping is disturbed or during routine inspections maintenance works a SWMS will be developed to include the scope of works. An asbestos exclusion zone will be set up to contain the scope of works. The works are to be undertaken in accordance with relevant HSE requirements for working with asbestos such as:

- NT Work Health and Safety (National Uniform Legislation) Act 2011;
- NT Work Health and Safety (National Uniform Legislation) Regulations 2011;
- NT Worksafe How to Safely Remove Asbestos – Code of Practice;
- NT Worksafe How to Manage and Control Asbestos in the Workplace – Code of Practice;
- National Environmental Protection (Assessment of Site Contamination) Measure 1999, as amended 2013;
- Notification of asbestos removal to NT Worksafe and NTWorksafe acknowledgement of the notification;

It is assumed that majority of the works will be conducted using heavy vehicle machinery (i.e., excavator, roller, truck) which have been smoke tested and air conditioning/ventilation systems set to recirculate and or fitted with a HEPA filtering system. Each heavy vehicle machine will have a PPE kit containing a positive pressure air respirator (PAPR) P3, asbestos coveralls, that operators are to wear in an emergency. All activities conducted on foot within the asbestos exclusion area will be required to be undertaken wearing full PPE. This includes a minimum P3 PAPR respirator, tyvek coveralls, gloves and lace-less boots (or wearing boot covers or taped laces).

All personnel are to be asbestos awareness trained including in the use of PPE. All vehicles are to be serviced and have sufficient kilometres/hours to undertake all works within the exclusion zone prior to requiring their next scheduled service.

All works are to be undertaken under the supervision of an appropriately licenced asbestos removal contractor (Class A).

6.5.2 Temporary stockpiling

If temporary stockpiling of contaminated material from the Containment Cell onsite is required, the soils must be covered with a minimum of 200µm thick plastic and the plastic secured. For the containment to be effective it must be suitable to withstand environmental conditions such as heavy rain and strong wind.

6.5.3 Dust suppression/monitoring

During the movement of contaminated material from the Containment Cell dust suppression techniques, such as water and wetting agents, are to be used.

Airborne fibre monitoring is to be undertaken during the movement and placement of any asbestos contaminated material from the Containment Cell. Air monitors, equipped with membrane filters, will be strategically placed around the Containment Cell each day prior to the movement of soil. Fibre air monitoring will be undertaken to verify the effectiveness of the control measures applied and to ensure that concentrations of airborne asbestos does not exceed the control standard (0.01 fibres/ml of air). Airborne fibre monitoring samples will be analysed, and results reported each day in accordance with Section 6.2 of the WA DoH 2009 Guidelines, and corrective control or monitoring actions taken as necessary.

6.5.4 Decontamination of equipment

At completion of works all heavy vehicle machinery is to be decontaminated by a licenced asbestos removalist. All machinery will be washed and where necessary scrape any soil or other contaminates from the vehicles. All air filters to be removed and replaced with new filters prior to commencement of future works. The used filters and cleaning equipment will be disposed of as asbestos contaminated waste within the site asbestos waste receptacle.

6.6 Vegetation management

The Asbestos Containment Cell capping will be covered with 100mm of topsoil and revegetated with shallow rooted grasses species and used as a public open space. No deep-rooted vegetation will be planted on top of the Containment Cell, and any trees proposed within 2.5m of any infrastructure (including the cell) a Nylex rootbarrier or equivalent will be installed at 450mm depth.

An ESCP has been developed and provided at Appendix E, and will be reviewed if any major landscaping changes are planned for the area. This LTEMP will be updated as per the review procedure in section 9.

6.7 Alternative Richardson Park works

Future maintenance or redevelopment works programmed for Richardson Park (unrelated to the Containment Cell) may result in the discovery of additional contaminated material. Prior to any future works, the Maintenance Contractor and all subcontractors employed should prepare their own Environmental Management Plan (EMP) and associated Safe Work Method Statements (SWMS) referencing this LTEMP, environmental management strategies listed above and a site-specific risk assessment for all works. The EMP and SWMS will be reviewed by a delegate of Crown Lands Estate prior to commencement of works.

In the event during maintenance or redevelopment works, that potential contaminated material is detected at Richardson Park the unexpected finds procedure is to be implemented (refer to section 6.7).

6.7.1 Unexpected finds procedure

For other activities in Richardson Park not related to this LTEMP, there is a potential for unexpected finds of contaminated material through undetected hotspots. If any proposed excavation works are to occur, an unexpected find procedure is to be included in the EMP developed for any future works. The procedure is to include the following:

- All soil material should be assessed for potential contamination for the following:
  - Staining or discolouration;
  - Odours;
  - Waste materials such as ash or slag;
  - Construction or demolition wastes (brick, concrete, tile, timber, steel, carpet, asbestos sheeting etc).
- In the event that any potential contamination is unexpectedly found the following procedure will be implemented:
  - Stop work in the area where potential contaminated material is identified
  - In accordance with the DIPL *Standard Specification for Environmental Management (v2.0)*, the Contract Manager (or DIPL superintendent) will be notified, and a plan will be implemented to remove the material.
  - Specialists will be engaged as necessary to advise and/or oversee the removal of the unexpected find.

- The removal of the material will be conducted in accordance with relevant legislation (depending on what material is identified e.g. licenced asbestos removal contractor).
- An inspection of the point source of contamination area to be conducted.
- Validation sampling procedure to be prepared and will be undertaken once contaminated material has been removed, to ensure all the contamination has been removed.
- This LTEMP will be updated based on the results of the validation sampling; include details of sampling locations, sampling and validation results, expected extent of contamination, and management strategy (i.e., removal)
- If the material is identified as a listed waste, the waste (other than asbestos) will be removed and transported by a licenced waste contractor and disposed of at a licenced waste facility specific to the contaminated material.
- If the material is identified as asbestos, disposal of the contaminated material in the expansion area in the detailed design of the Containment Cell to be investigated as management option. This LTEMP will be reviewed and updated an accordance with section 9.

In the event that asbestos is found, an Asbestos Management Plan will be developed as part of the EMP and implemented by a suitability qualified person for the duration of the remediation works (i.e., Asbestos assessor or Environmental Consultant with experience in contaminated lands). The plan will be developed in accordance with the DIPL Standard Specification for Environmental Management (v2.0). Removal, transportation, disposal and remediation will be in accordance with the *Work Health and Safety (National Uniform Legislation) Regulations 2011*, the *Public and Environmental Health Act, the Waste Management and Pollution Control Act* and *Regulations 1998*, and relevant guidelines/industry standards.

7 CORRECTIVE ACTIONS

The environmental management strategies stipulated in Section 6 provide the overarching performance indicators for the management of the Containment Cell against which management methods can be assessed. If it is identified that the environmental management strategies are not being met, or unexpected issues arise, the following process must be followed to implement corrective actions and adapt management methods:

- Identification of issue
- Determination of appropriate action/rectification
- Assign a responsible organisation/person
- Assign a timeframe for rectification/close out of issue

Action timeframes shall give due consideration to the environmental risk associated with the issue, including but not limited to the weather forecast (i.e. maintenance actions in the wet season may be assigned a higher priority than in the dry season). The contact details to assign corrective actions to are provided in Table 6-1.

All corrective works regarding the integrity and maintenance works of the Containment Cell will be overseen by a licenced asbestos assessor and carried out by a Class A licenced asbestos removalist under the *Work Health and Safety (National Uniform Legislation) Act 2011*

8 RECORDS AND REPORTING

To achieve compliance against this LTEMP records of all training, inspection and maintenance, incident and non-conformances and auditing reporting are required. Records of all inspections and maintenance actions (routine and corrective) are to be recorded in a register with appropriate evidence (i.e. photographs) as required. Registers are required to be up to date and provided to the Contract Manager on an annual basis, or else upon request.

Table 8-1 summarises responsibility, frequency, process and required content for recording and reporting compliance.

Table 8-1. Summary of recording and reporting requirements

Responsibility	Report	Frequency	Process	Required content
Maintenance contractor	Personnel site induction records	Update as required	• Prior to commencement of works all personnel to undertake site induction • Report to Crown Land Estate (annual submission)	Record of all personnel site inductions on induction register (refer to Appendix F).
	Inspection and maintenance reports	Routine (1 prior, 1 during and 1 after the wet season for 2 years) (1 post wet season for 3 following years)	• Register to be updated to include details of each inspection and maintenance actions. • Report to Crown Land Estate (annual submission)	Record of inspection and maintenance actions in accordance with inspection checklist (refer to Appendix G).
	Incident and non-conformance reporting	As required	• Conduct investigation as per contractor internal procedure • Report to Crown Land Estate • Notification to NT EPA (if required).	Record all incidents and non-conformance reporting on internal reporting register.
	Unexpected finds of contaminated material	As required	• Implement unexpected finds procedure. • Report to Crown Land Estate • Develop corrective actions • Notification to NT EPA if Containment Cell is altered.	Report all information known to Crown Lands and NT EPA (if required).
	LTEMP compliance audit reporting	Annual	• Conduct audit • Report to Crown Land Estate	Audit checklist (refer to Appendix H)

9 REVIEW

A review of this LTEMP will occur every 5 years for general updates to ensure references to legislation/codes of practice, guidelines and standards are up to date. This is to be undertaken by an Environmental Consultant, engaged by Crown Land Estate.

Additional reviews are required in the event of:

- Change of ownership of the land (Lot 5646, Town of Darwin)
- Changed to responsible party (including contact details)
- Changes to LTEMP management strategies are identified
- Changes to the use of Richardson Park
- A revised ESCP has been issued for any major landscaping changes at Richardson Park
- Unexpected finds protocol is enacted, and Containment Cell design is changed to dispose of additional contaminated soil

10 REFERENCES

Bureau of Meteorology (2021) Climate Data Online – Darwin Airport Station 014015. [online] Available at: http://www.bom.gov.au/climate/data/ [Accessed 17 December 2021]

EcOz Environmental Consultants (2018) Richardson Park Sampling and Analysis Quality Plan, prepared for Department of Infrastructure, Planning and Logistics [unpublished].

EcOz Environmental Consultants (2019) Richardson Park Improvements – Detailed Site Investigation, prepared for Department of Infrastructure, Planning and Logistics [unpublished].

International Erosion Control Association (IECA) (2008) Best Practice Erosion and Sediment Control. [online] Available at: https://www.austieca.com.au/publications/best-practice-erosion-and-sediment-control-bpesc-document/.

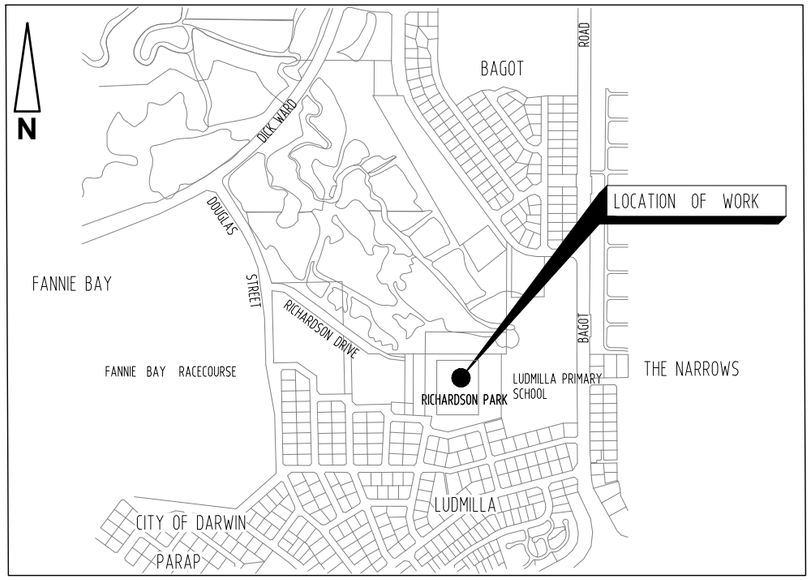
Isbell, R. (2016). The Australian Soil Classification, Second Edition. The National Committee of Soil and Terrain. CSIRO Publishing.

Octief Pty Ltd (2021) Remediation and Validation Report, prepared for EcOz Environmental Consultants [unpublished].

APPENDIX A LTEMP AUDITOR ENDORSEMENT LETTER

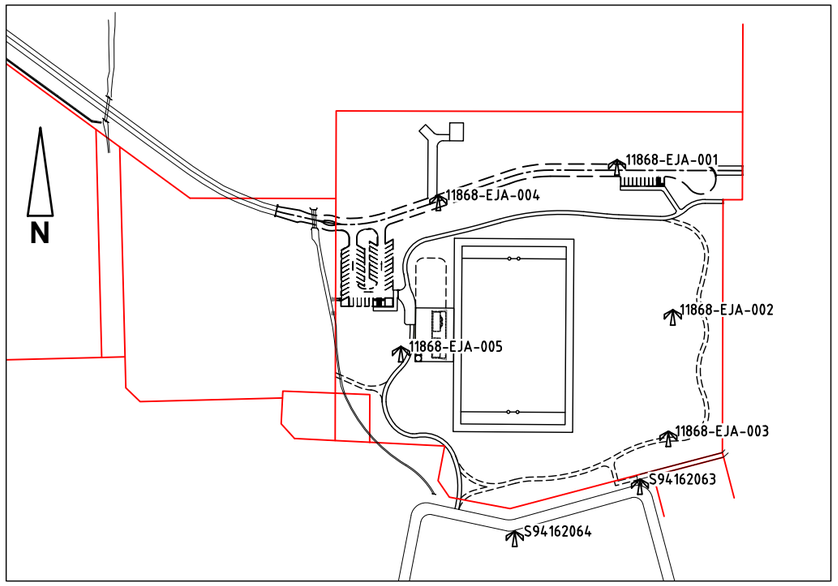
APPENDIX B VALIDATION REPORTS (OCTIEF AND TRAKONDY)

APPENDIX C BYRNE CONSULTANTS CONTAINMENT CELL DETAILED DESIGNS (ENDORSED)



LOCALITY PLAN

NOT TO SCALE



SITE PLAN

NOT TO SCALE

NOTES

GENERAL

1. ALL LEVELS GIVEN ARE TO AUSTRALIAN HEIGHT DATUM.
2. ALL DIMENSIONS ARE IN METRES UNLESS SHOWN OTHERWISE.
3. CHECK THE LOCATION OF ALL UNDERGROUND SERVICES PRIOR TO COMMENCEMENT OF WORK. CHECK LEVELS OF SERVICES IN CRITICAL AREAS. IT IS NOT GUARANTEED THAT ALL SERVICES HAVE BEEN SHOWN ON THE DRAWINGS, OR THAT CLASHES BETWEEN THE DESIGN AND EXISTING SERVICES ARE NOT PRESENT. IF CLASHES OCCUR THE CONTRACTOR / DEVELOPER SHALL CONTACT THE SUPERINTENDENT.
5. OBTAIN PERMIT(S) FROM THE RELEVANT AUTHORITY AS AND WHEN REQUIRED.
6. REINSTATE ALL SURFACES UPON COMPLETION OF THE WORKS AS DIRECTED BY AND TO THE SATISFACTION OF THE SUPERINTENDENT

DEPARTMENT OF INFRASTRUCTURE, PLANNING & LOGISTICS

7. GIVE A MINIMUM 48 HOURS NOTICE TO THE DEPARTMENT OF INFRASTRUCTURE, PLANNING AND LOGISTICS OF INTENDED COMMENCEMENT DATE AND PROGRAMME OF WORKS. ALL NOTIFICATIONS SHALL BE IN WRITING. FOR ROADWORKS CONTACT THE SUPERINTENDENT.
8. "AS CONSTRUCTED DRAWINGS" FOR ALL WORKS SIGNED BY THE CONTRACTOR SHALL BE LODGED WITH THE DEPARTMENT OF INFRASTRUCTURE, PLANNING AND LOGISTICS BY THE CONTRACTOR PRIOR TO HANDOVER.
9. ALL WORKS TO BE CARRIED OUT TO THE DEPARTMENT OF INFRASTRUCTURE, PLANNING AND LOGISTICS REQUIREMENTS AND SHALL COMPLY WITH DIPL STANDARD SPECIFICATION FOR ROADWORKS (DIPL, 2020)

ROADS & DRAINAGE

1. GRADE FINISHED SURFACE EVENLY BETWEEN LEVELS SUPPLIED. ENSURE ALL WORKS ARE FREE DRAINING.
2. ALL BATTERS SHALL BE COMPACTED TO ACHIEVE THE DENSITY REQUIRED AND A TIGHT FINISH.
3. ALL OPEN DRAINS SHALL BE CLEAN AND FREE DRAINING UPON COMPLETION.

SETOUT

1. TO ASSIST THE PLAN SETOUT FOR THIS PROJECT A 2D DIGITAL COPY OF THESE ENGINEERING DRAWINGS WILL BE MADE AVAILABLE FOR USE BY THE PROJECT SURVEYOR. ALL DRAWING NOTATION TAKES PRECEDENCE OVER ALL DIGITAL INFORMATION PROVIDED.
2. ALL SETOUT AND LEVELLING MUST COMPLY WITH WHAT IS SPECIFIED ON THE DRAWINGS AND THE LEVEL TOLERANCES NOTED IN THE SPECIFICATION.

EROSION AND SEDIMENT CONTROL

1. THE CONTRACTOR SHALL LIAISE WITH DIPL AND IS RESPONSIBLE FOR IMPLEMENTATION AND MAINTENANCE OF ALL EROSION AND SEDIMENT CONTROL MEASURES.
2. ADDITIONAL EROSION CONTROLS MAY BE REQUIRED DURING CONSTRUCTION AS DETERMINED BY THE DEPARTMENT OF ENVIRONMENT, PARKS AND WATER SECURITY OR SUPERINTENDENT.

LEGEND

EXISTING

- PROPERTY BOUNDARY
- SURVEY CONTROL STATION
- SURFACE CONTOUR (6.0)
- FENCE
- ROAD CROWN
- ROAD SIGN
- STORMWATER DRAIN UNDERGROUND (D)
- STORMWATER TABLE DRAIN / SWALE (>)
- STORMWATER PIT
- ELECTRICAL LINE ABOVE GROUND (E)
- ELECTRICAL LINE UNDERGROUND (E)
- ELECTRICAL PIT / PILLAR
- ELECTRICAL POLE (PP)
- ELECTRICAL STREETLIGHT (LP)
- SEWER MAIN UNDERGROUND (S)
- SEWER ACCESS CHAMBER
- WATER MAIN VALVE (SV)
- WATER MAIN UNDERGROUND (W)
- TELECOM UNDERGROUND (T)
- TELECOM UNDERGROUND - DBYD (dT)

LEGEND

PROPOSED

- PROPERTY BOUNDARY
- FINISHED SURFACE CONTOUR (6.0)
- FENCE
- FINSHED SURFACE LEVEL (14.560)
- ROAD CROWN
- KERB ONLY
- GAP KERB
- ROAD SIGN
- STORMWATER LINE UNDERGROUND (D)
- STORMWATER CONCRETE INVERT (>)
- ELECTRICAL LINE UNDERGROUND (E)
- POWER POLE (PP)
- STREETLIGHT (LP)
- SEWER MAIN AND LOT SERVICE (S)
- SEWER ACCESS CHAMBER
- WATER MAIN HYDRANT (H)
- WATER MAIN VALVE (SV)
- WATER MAIN AND LOT SERVICE (W)

ABBREVIATIONS

AC	ACCESS CHAMBER	NIC	NOT IN CONTRACT
A/G	ABOVE GROUND	NTS	NOT TO SCALE
BM	BENCH MARK	NSL	NATURAL SURFACE LEVEL
CICL	CAST IRON CEMENT LINED	O/H	OVERHEAD
CIEL	CAST IRON EPOXY LINED	OL	OBVERT LEVEL
CT	CURVE TO TANGENT	ORG	OVERFLOW RELIEF GULLY
Cu	COPPER PIPEWORK	OUD	OPEN UNLINED DRAIN
DE	WATERMAIN DEAD END	PP	POWER POLE
DICL	DUCTILE IRON CEMENT LINED	PVC	uPVC PIPEWORK
DIEL	DUCTILE IRON EPOXY LINED	RCBC	REINFORCED CONCRETE BOX CULVERT
DP	DOWN PIPE	RCP	REINFORCED CONCRETE PIPE
D/S	DOWNSTREAM	RL	REDUCED LEVEL
EW	ENDWALL	RRJ	RUBBER RING JOINT
FFL	FINISHED FLOOR LEVEL	SEP	SIDE ENTRY PIT
FH	FIRE HYDRANT	SL	SURFACE LEVEL
FSL	FINISHED SURFACE LEVEL	SO	SOCKET
HD	HEAVY DUTY	SP	SPIGOT
HW	HEADWALL	SS	STAINLESS STEEL
GIP	GRATED INLET PIT	STN	SURVEY STATION
IL	INVERT LEVEL	SV	SLUICE VALVE
INCL	INCLUSIVE	TC	TANGENT TO CURVE
INT	INTERSECTION	TMS	TERMINAL MAINTENANCE SHAFT
IP	INTERSECTION POINT	TP	TANGENT POINT
LBP	LETTER BOX PIT	TPIT	TELSTRA PIT
LD	LIGHT DUTY	UCM	U/G CABLE MARKER
LP	LIGHT POLE	U/G	UNDER GROUND
MH	MANHOLE	UNO	UNLESS NOTED OTHERWISE
MMDD	MAXIMUM MODIFIED DRY DENSITY	U/S	UPSTREAM
		WMP	WATER MARKER POST

SURVEY CONTROL

STN	EASTING	NORTHING	RL	DESCRIPTION
S94162063	701506.933	8625611.668	7.606	CRM
S94162064	701425.287	8625577.688	8.336	CRM
11868-EJA-001	701491.993	8625819.836	5.176	SPIKE
11868-EJA-002	701528.407	8625721.997	4.727	SPIKE
11868-EJA-003	701525.533	8625642.846	6.493	SPIKE
11868-EJA-004	701375.439	8625796.779	4.090	SPIKE
11868-EJA-005	701351.025	8625698.084	5.254	SPIKE

SCHEDULE OF DRAWINGS

DRAWING NO.	CONSTRUCTION DRAWINGS
	CIVIL
B21-7850	ACM CONTAINMENT CELL - LOCALITY PLAN, SCHEDULE OF DRAWINGS, NOTES, LEGEND AND ABBREVIATIONS
B21-7851	ACM CONTAINMENT CELL - SETOUT PLAN
B21-7852	ACM CONTAINMENT CELL - SECTIONS
	ELECTRICAL
B21-8553	ELECTRICAL SERVICES - LV RECTIFICATION WORKS (OPTUS POWER SUPPLY)

2

WARNING

BEWARE OF UNDERGROUND SERVICES

The locations of underground services are approximate only and their exact position should be proven on site

No guarantee is given that all existing services are shown

No.	DESCRIPTION	DATE	INIT.	DEPT/COMPANY
2	LV RECTIFICATION WORKS	11/08/21	PM	BYRNE
1	FOR CONSTRUCTION	05/08/21	PM	BYRNE
0	CONTRACT DRAWING	13/07/21	PM	BYRNE

AMENDMENTS Plot Date: 11/08/2021

byrne CONSULTANTS
ABN 78 124 388 192
P.O.Box 43420 Casuarina NT 0811
Ph. 08 89472476 Fax: 08 89475098

Byrne Consultants Project No. NT20008

DRAWN PM DATE:	CHECKED SB DATE:
DESIGNED GM DATE:	CHECKED GB DATE:
DESIGN PROJECT LEADER DATE:	NTG PROJECT MANAGER DATE:

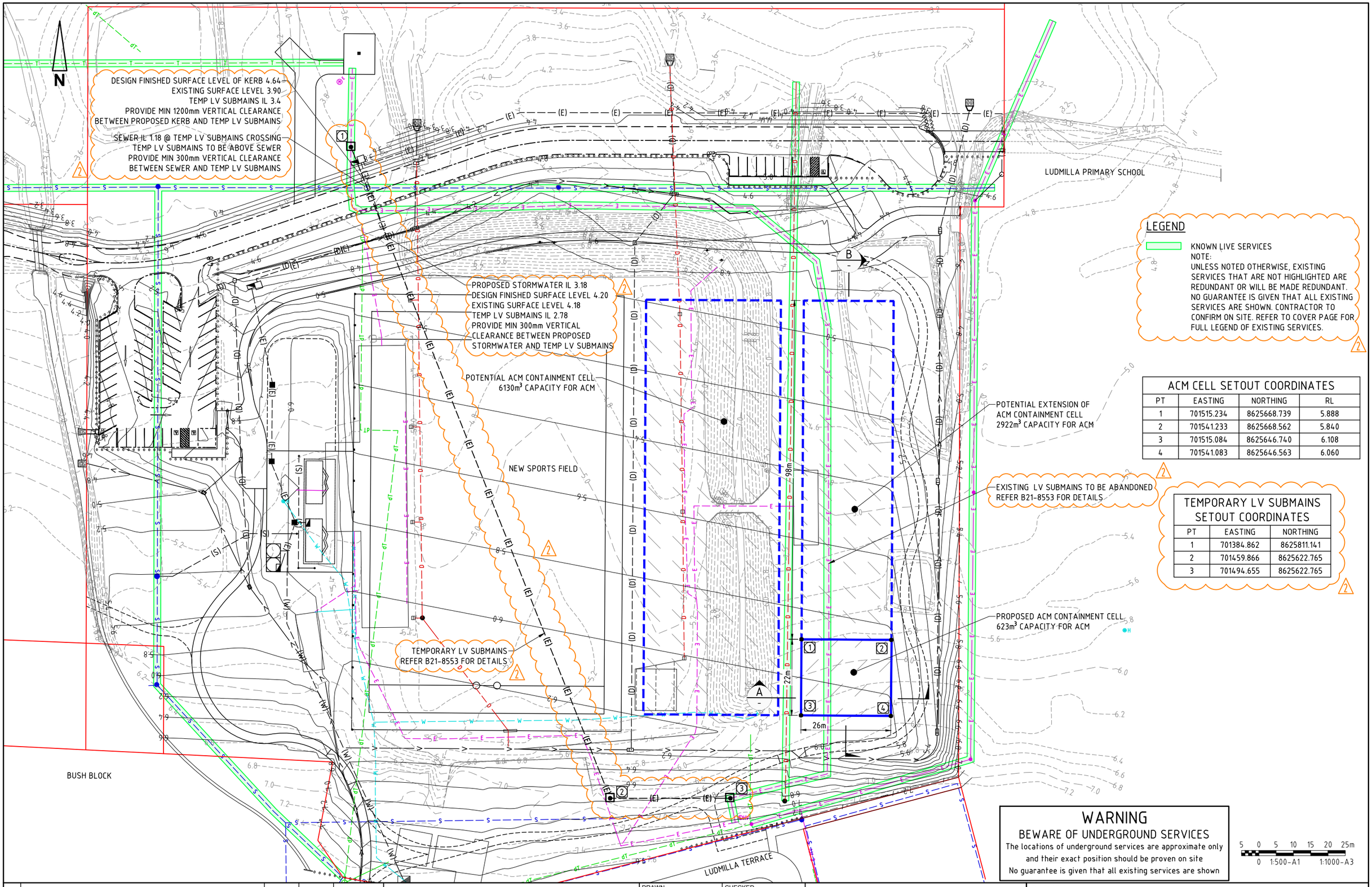
Northern Territory Government

DARWIN
LUDMILLA
RICHARDSON PARK RE-DEVELOPMENT

ACM CONTAINMENT CELL - LOCALITY PLAN, SCHEDULE OF DRAWINGS, NOTES, LEGEND AND ABBREVIATIONS

NTG PROJECT No.	NTG ASSET No.	SHEET No.	NTG DRAWING No.	AMENDMENT	SHEET SIZE
LPD08940	-	1 OF 3	B21-7850	2	A1

Ver. Dec' 2019



LEGEND

KNOWN LIVE SERVICES

NOTE:
UNLESS NOTED OTHERWISE, EXISTING SERVICES THAT ARE NOT HIGHLIGHTED ARE REDUNDANT OR WILL BE MADE REDUNDANT. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN. CONTRACTOR TO CONFIRM ON SITE. REFER TO COVER PAGE FOR FULL LEGEND OF EXISTING SERVICES.

1

ACM CELL SETOUT COORDINATES

PT	EASTING	NORTHING	RL
1	701515.234	8625668.739	5.888
2	701541.233	8625668.562	5.840
3	701515.084	8625646.740	6.108
4	701541.083	8625646.563	6.060

1

TEMPORARY LV SUBMAINS SETOUT COORDINATES

PT	EASTING	NORTHING
1	701384.862	8625811.141
2	701459.866	8625622.765
3	701494.655	8625622.765

1

WARNING

BEWARE OF UNDERGROUND SERVICES

The locations of underground services are approximate only and their exact position should be proven on site
No guarantee is given that all existing services are shown

5 0 5 10 15 20 25m
0 1:500-A1 1:1000-A3

No.	DESCRIPTION	DATE	INIT.	DEPT/COMPANY
2	LV RECTIFICATION WORKS	11/08/21	PM	BYRNE
1	FOR CONSTRUCTION	05/08/21	PM	BYRNE
0	CONTRACT DRAWING	13/07/21	PM	BYRNE

AMENDMENTS Plot Date: 11/08/2021

byrne CONSULTANTS
ABN 78 124 388 192
P.O.Box 43420 Casuarina NT 0811
Ph. 08 89472476 Fax: 08 89475098
Byrne Consultants Project No. NT20008

DRAWN: PM DATE:	CHECKED: SB DATE:
DESIGNED: GM DATE:	CHECKED: GB DATE:
DESIGN PROJECT LEADER DATE:	NTG PROJECT MANAGER DATE:

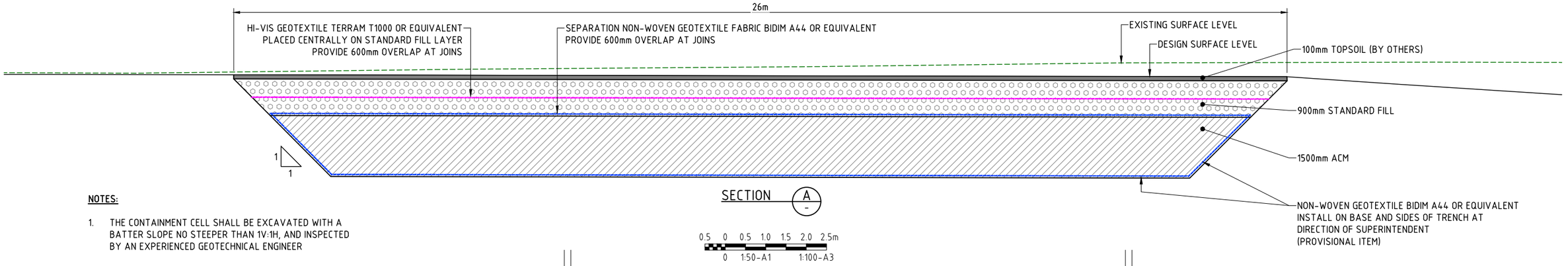
Northern Territory Government

DARWIN
LUDMILLA
RICHARDSON PARK RE-DEVELOPMENT

ACM CONTAINMENT CELL SETOUT PLAN

NTG PROJECT No.	NTG ASSET No.	SHEET No.	NTG DRAWING No.	AMENDMENT	SHEET SIZE
LPD08940	-	2 OF 3	B21-7851	2	A1

Ver. Dec' 2019



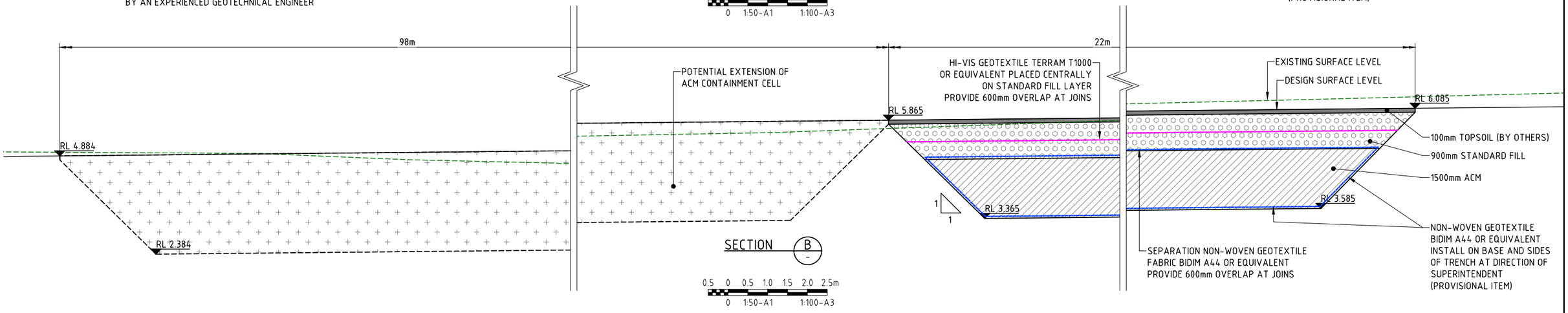
SECTION A

0.5 0 0.5 1.0 1.5 2.0 2.5m

0 1:50-A1 1:100-A3

NOTES:

1. THE CONTAINMENT CELL SHALL BE EXCAVATED WITH A BATTER SLOPE NO STEEPER THAN 1V:1H, AND INSPECTED BY AN EXPERIENCED GEOTECHNICAL ENGINEER



SECTION B

0.5 0 0.5 1.0 1.5 2.0 2.5m

0 1:50-A1 1:100-A3

ACM CONTAINMENT CELL MATERIALS SPECIFICATIONS

LAYER	THICKNESS (mm)	MATERIAL REQUIREMENTS			COMPACTION	NOTES
		GRADING	PLASTICITY	MIN CBR[1]		
STANDARD FILL	900	MAX SIZE = 100mm	PI = 2 TO 15%	20	TOP 300mm > 95%MMDD MIDDLE 300mm> 95% MMDD BOTTOM 300mm > 92% MMDD	1. STANDARD FILL (DIPL, 2020) 2. EACH 300mm COMPACTION ZONE TO BE CONSTRUCTED IN TWO 150mm THICK SUB-LAYERS. 3. EARTHWORKS SUPERVISION AS A LEVEL 1 OPERATION AS PER AS3798-2007
ACM	1500	-	-	-	COMPACT IN LAYERS, MAXIMUM 500mm THICK TO ACHIEVE A STABLE MASS.	1. ACM TO BE WETTED DURING COMPACTION TO MINIMISE DUST. 2. ALL ORGANIC MATERIAL, VEGETATION AND PUTRESCIBLE MATERIALS TO BE REMOVED PRIOR TO ACM PLACEMENT. 3. EACH LAYER TO BE TESTED WITH DYNAMIC CONE PENETROMETER TO ACHIEVE 4 BLOWS (OR GREATER) PER 100mm, WITH TESTS SPACED ON 20m GRID.

1. CBR AT 95% MMDD WITH 4.5kg SURCHARGE AND 4 DAY SOAK

	CONSTRUCTION COMPONENT	CONFORMANCE TESTING		WITNESS AND HOLD POINTS	
ITEM	DESCRIPTION	INSPECTION / TEST METHOD	FREQUENCY	WITNESS POINT	HOLD POINT
1	EXCAVATION OF CELL				
1.1	BASE AND SIDE FINISH (INCL BATTER SLOPE)	GEOTECH INSPECTION	AS REQUIRED	YES	YES
2	PLACEMENT AND LINING OF GEOTEXTILE FABRIC				
2.1	MAKE AND AND SPECIFICATION OF SEPARATION GEOTEXTILE FABRIC				YES
2.2	PLACEMENT OF GEOTEXTILE FABRIC - ACM LOWER LAYER			YES	YES
3	PLACEMENT OF ACM INTO CELL				
3.1	REMOVAL OF ORGANIC MATERIAL, VEGETATION AND PUTRESCIBLE MATERIAL			YES	YES
3.2	COMPACTION OF ACM	GEOTECH TEST	AS REQUIRED		YES
3.3	PLACEMENT OF GEOTEXTILE FABRIC - ACM TOP LAYER			YES	YES
4	PLACEMENT OF STANDARD FILL (CAPPING LAYER)				
4.1	SOURCE AND QUALITY OF STANDARD FILL LAYER	NATA TEST CERTIFICATE	AS REQUIRED		YES
4.2	COMPACTION OF STANDARD FILL	NATA TEST CERTIFICATE	AS REQUIRED		YES
4.3	PLACEMENT OF HI-VIS GEOTEXTILE FABRIC			YES	YES

WARNING

BEWARE OF UNDERGROUND SERVICES

The locations of underground services are approximate only and their exact position should be proven on site

No guarantee is given that all existing services are shown

No.	DESCRIPTION	DATE	INIT.	DEPT/COMPANY
2	LV RECTIFICATION WORKS	11/08/21	PM	BYRNE
1	FOR CONSTRUCTION	05/08/21	PM	BYRNE
0	CONTRACT DRAWING	13/07/21	PM	BYRNE

AMENDMENTS

Plot Date: 11/08/2021

byrne CONSULTANTS
ABN 78 124 388 192
P.O.Box 43420 Casuarina NT 0811
Ph. 08 89472476 Fax: 08 89475098

Byrne Consultants Project No. NT20008

DRAWN	CHECKED
PM	SB
DATE:	DATE:
DESIGNED	CHECKED
GM	GB
DATE:	DATE:
DESIGN PROJECT LEADER	NTG PROJECT MANAGER
DATE:	DATE:

Northern Territory Government

DARWIN
LUDMILLA
RICHARDSON PARK RE-DEVELOPMENT

ACM CONTAINMENT CELL - SECTIONS, MATERIALS SPECIFICATIONS, CONSTRUCTION COMPONENT NOTES

NTG PROJECT No.	NTG ASSET No.	SHEET No.	NTG DRAWING No.	AMENDMENT	SHEET SIZE
LPD08940	-	3 OF 3	B21-7852	2	A1

Ver. Dec' 2019

APPENDIX D ASBESTOS CONTAINMENT CELL DESIGN ENDORSEMENT LETTER

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

14 August 2021

Northern Territory Government
Department of Infrastructure, Planning and Logistics (DIPL)
GPO Box 1680
Darwin NT 0810

Attention: **Rohan Langworthy**
Program Manager | Land Development

Dear Rohan

Environmental Auditor Letter of Endorsement – Pollution Abatement Notice No. 2021/1 Richardson Park, 40 Richardson Drive, Ludmilla, NT (Lot 8434, Town of Darwin)

As part of the Environmental Audit of Richardson Park, this correspondence has been provided to confirm the Auditors review and endorsement of the following documents.

- Asbestos Solutions NT (2021). *Safe Work Method Statement (SWMS) to move non friable asbestos*. SWMS #001, Version 1, 3 August 2021.
- Byrne Consultants (2021a). *ACM Containment Cell – Locality Plan, Schedule of Drawings, Notes, Legend and Abbreviations*. Drawing No. B21-7850. Revision 2, 11 August 2021.
- Byrne Consultants (2021b). *Richardson Park Re-Development Options Analysis of Asbestos Containment Cells*. Revision A, 28 June 2021.
- EcOz Pty Ltd (EcOz) (2021a). *Environmental Risk Assessment Report, Richardson Park Redevelopment Project*. Revision 2, 12 January 2021. Report to DIPL.
- EcOz (2021b). *Sampling and Analysis Quality Plan, Richardson Park – Asbestos and PFAS*. Revision 2, 6 August 2021. Report to DIPL.
- NTEX (2021a). *Project Control Plan, Richardson Park Asbestos Containment*. Project T20-2110. Version 1.5, 4 August 2021. Report to DIPL.
- NTEX (2021b). *Environmental Management Plan, Richardson Park – Encapsulation of Asbestos Containing Materials On Site*. Project T20-2110. Version 2.1, 6 August 2021. Report to DIPL.
- NTEX (2021c). *Safe Work Method Statement (SWMS), Asbestos Containment*. 29 July 2021.
- Octief Pty Ltd (Octief) (2021a). *Asbestos impacted soil – testpit investigation, Richardson Park, Darwin, Northern Territory*. Version 1, 13 May 2021. Report to EcOz Pty Ltd.

- Octief (2021b). *Remediation Action Plan, Richardson Park, Ludmilla, Darwin*. Version 1, 6 July 2021. Report to EcOz Pty Ltd.

- Trakondy (2021a). *Construction Asbestos Management Plan, Richardson Park Asbestos Containment Cell, Richardson Drive, Ludmilla, Northern Territory 0820*. Revision 0.3, 11 August 2021. Report to NTEX.

- Trakondy (2021b). *Safe Work Method Statement (SWMS), Richardson Park – Asbestos in Soils Relocation to Onsite Containment Cell*. 16 August 2021. Report to NTEX.

Based on my review of the above-listed documents, and with reference to the requirements of the Pollution Abatement Notice (PAN) No. 2021/1 issued by the Northern Territory Environment Protection Authority (NT EPA) as a draft on 20 July 2021, I can conclude that:

- I have reviewed the current version of the remedial action plan (RAP, Octief 2021b) and am happy to endorse it as an appropriate plan to manage asbestos impacted soils identified at the premises, as per PAN Requirement 2.

- I consider the proposed construction of the containment cell to be consistent with the intent of the EPA Victoria (August 2015) Best Practice Environmental Management (BPEM) Publication 788.3 *Siting, design, operation and rehabilitation of landfills*, as per PAN Requirement 8.

    - BPEM compliance is detailed further in Tables 1-3 of Appendix A.

- I have therefore assessed the design of the containment cell (Byrne, 2021a) as being appropriate for the purpose and provide my endorsement, as per PAN Requirements 9 and 12.

It is considered that the above-listed documents, and this Environmental Auditor assessment and endorsement, provide compliance with Requirements 2, 8, 9 and 12 of the PAN.

Compliance with Requirements 5 (validation), 13 (EMP), and 17 (LTEMP) will be provided at various milestones in the project, with the next milestone being once the construction of the containment cell is complete (Requirement 13).

Please do not hesitate to contact the undersigned on (07) 3852 6666 with any queries.

For and on behalf of
Environmental Earth Sciences QLD

Mark Stuckey
Environmental Auditor
Accredited in NSW under the *Contaminated Land Management Act 1997*, and
Accredited in Victoria under the *Environment Protection Act 1970* Section 53 S(1)

721048 Lt1

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

APPENDIX A: REVIEW OF DESIGN DOCUMENTS AGAINST VICTORIAN LANDFILL BPEM

Table 1: Screening review – BPEM objectives

BPEM Objective	Aspect	Applicable	Partial	Not applicable	Comments
Best-practice siting considerations	Screening for potential landfill sites		✓		Containment cell siting considerations (Byrne, 2021b) Containment cell design aspects (Byrne, 2021a) Environmental assessment – refer to Octief (2021a and 2021b), EcOz (2021a and 2021b), and Byrne (2021b)
Best-practice design	Environmental assessment		✓		
	Site layout		✓		
	Liner and leachate collection system		✓		
	Construction quality assurance	✓			
	Water management	✓			
	Groundwater management	✓			
	Landfill gas			✓	Asbestos contaminated soils would generally have a low gas generation potential and is unlikely to decompose compared to municipal solid (in particular putrescible wastes) wastes where gas management is a key consideration.
	Odour, dust and air toxics	✓			Addressed separately by relevant EMP documentation and WHS provisions for construction management and handling of asbestos materials (Asbestos Solutions NT 2021 and NTEX 2021a, 2021b and 2021c).
	Bioreactor landfills			✓	Bioreactor landfills introduce moisture to the waste mass with the intention of increasing the rate of decomposition. Asbestos contaminated soils would generally have a low potential for decomposition and therefore this aspect is not applicable to the containment cell scenario.

BPEM Objective	Aspect	Applicable	Partial	Not applicable	Comments
	Noise	✓			The proposed containment cell construction, filling and closure will be completed as part of the CAMP (Trakondy, 2021a) and SWMS (Asbestos Solutions NT 2021, NTEX 2021c and Trakondy 2021b).
	Traffic considerations	✓			The proposed containment cell construction, filling and closure will be completed within the bounds of the site. A such, no special considerations for traffic management are considered to be required over and over the usual construction site traffic management provisions.
	Site security and fencing	✓			The proposed containment cell construction, filling and closure will be completed within the bounds of the site. Site security and fencing is addressed separately in the EMP and SWMS.
Best-practice operation	Environmental management	✓			Addressed separately in the Project Control Plan (PCP), EMP and SWMS.
	Financial assurance			✓	
	Waste minimisation			✓	
	Waste acceptance			✓	
	Waste pre-treatment			✓	
	Waste placement			✓	
	Waste cover			✓	
	Litter control			✓	
	Fires			✓	
	Contingency planning			✓	
	Management of chemicals and fuels			✓	

BPEM Objective	Aspect	Applicable	Partial	Not applicable	Comments
	Disease vector control			✓	
	Noxious weed control			✓	
	Performance monitoring and reporting		✓		
Best-practice rehabilitation and aftercare	Rehabilitation	✓			To be managed by LTEMP.
	Aftercare management			✓	To be addressed in separate provisions of the NT EPA Notice 2021/1

Notes:

- Applicable: All aspects are applicable to the assessment.
- Partial: one or more of the aspects are not applicable to the assessment.
- Not applicable: No aspects are applicable to the assessment, with discussion and justification provided in the 'comments' column.

Table 2: BPEM required outcome review

Aspect	Required outcomes	Impact (NA, low, moderate, high)	Discussion	Recommendation
Best-practice siting considerations				
Screening for potential landfill sites	Ensure that the landfill is sited to protect groundwater, surface waters, and flora and fauna.	LOW	The purpose is to encapsulate soils that contain asbestos only and the cell is not intended to receive any soils with soluble contaminants that could dissolve in groundwater or surface water. Further, capping will be in place to protect flora and fauna; no uptake of contaminants into the capping vegetation (grass) is expected.	None

Aspect	Required outcomes	Impact (NA, low, moderate, high)	Discussion	Recommendation
	All new landfills must deposit waste at least two metres above the long-term undisturbed depth to groundwater, unless the operator satisfies EPA Victoria that sufficient additional design and management practices will be implemented, and EPA determines that regional circumstances exist that warrant the new landfill.	LOW	This requirement is in place to prevent leachate entering groundwater and also to ensure the liner is not structurally compromised by rising groundwater levels. In this case, there is no leachate developed, hence there is no potential environmental impact to the groundwater. The base of the containment cell is not planned to be sealed, allowing groundwater to fluctuate within the cell without putting stress on any basal liner.	None
Best practice design				
Environmental assessment	Investigate water management requirements.	LOW	The purpose is to encapsulate soils that contain asbestos only and the cell is not intended to receive any soils with soluble contaminants that could dissolve in surface water or groundwater. During operation surface water management will be required to ensure runoff is limited to the dedicated asbestos work area(s), as to prevent the spread of contamination on the site. This will be achieved with interim control measures, such as mulch bunds. Surface water runoff within the cell will need to be treated as contaminated with asbestos and will need to be captured, treated and discharged accordingly. The cell may be formed partially beneath the water-table. During operation, groundwater will need to be considered contaminated with asbestos and will need to be captured, treated and discharged accordingly. There will be no leachate, as the contained soils do not have a soluble contaminant that could dissolve in water, either during operation or after closure. After closure all runoff will be treated as clean water.	Impacted surface and groundwater during operation is to be managed as per the EMP (NTEX, 2021b)
Liner and leachate	Design and construction of the best liner and leachate collection system practicable to prevent contamination of groundwater.	LOW	The intent of the proposed containment cell is to provide a physical barrier only. Leachate will not be generated, hence the liner is not intended to prevent water ingress or enable the capture of leachate. The geofabric liner is designed so	None

Aspect	Required outcomes	Impact (NA, low, moderate, high)	Discussion	Recommendation
collection system			that the material in the cell will maintain moisture potential in equilibrium with the surrounding/ underlying geological media under fluctuating water-table conditions.	
	Design and construct the landfill liner such that the appropriate maximum seepage rate shown in Table 6.1 is not exceeded.	LOW	Leachate will not be generated hence seepage rates do not apply. Seepage rates are expected to be similar to those in the surrounding lithology, in particular as hydraulic gradients will not be altered and material porosity and hydraulic conductivity are also expected to be similar.	None
	Implementation of the best practicable measures to meet all groundwater quality objectives contained in SEPP (Waters of Victoria) below the landfill liner.	LOW	Leachate will not be generated hence there will be no impact to groundwater.	None
	Geotechnically stable sub-base and liner.	LOW	The sub-base will be formed in excavated rock and the embankments formed from compacted fill. The embankment slopes have been designed as appropriate to the inferred geotechnical conditions of the fill material.	Excavation and embankment construction to be undertaken as Byrne (2021a)
Construction quality assurance (CQA)	Development and implementation of a Construction Quality Assurance (CQA) plan to ensure that the liner and leachate collection system meets the requirements of the specifications and drawings.	Moderate	No liner or leachate system is proposed. Provision for a liner is provided in Byrne (2021a).	None
	Development and implementation of a CQA plan to ensure that the stability of sub-base and liner are achieved.	Moderate	The Contractor has a construction quality assurance plan in line with AS/NZS ISO 9001:2000 – Quality Management Systems. This sets out the Hold Point and Witness Point requirements for the civil earthworks / geotechnical and structural components of the containment cell.	Trakondy (2021a) is to be kept up to date, and hold points and witness points verified as appropriate
	The installation of geotextiles must meet the requirements of Section 4 of Appendix F of the BPEM.	Moderate	The geotextiles in this design are for the purposes of identification of contaminated soils, rather than the typical function of protecting geomembranes or filtering drainage layers. The transport, handling and storage of the geotextile are to be as per the specifications in the construction	

Aspect	Required outcomes	Impact (NA, low, moderate, high)	Discussion	Recommendation
			quality assurance plan, which are considered appropriate for the usage of geotextile.	
	The CQA plan for geotextiles must address the issues raised in section 5 of Appendix F and should follow the suggestions unless an alternative provides an equivalent or better outcome.	Moderate	The geotextiles in this design are for the purposes of identification of contaminated soils, rather than the typical function of protecting geomembranes or filtering drainage layers. The quality, strength and performance specified in the design are considered appropriate to the usage of the geotextile, and will be monitored and tested as per the construction quality assurance plan.	Trakondy (2021a) is to be kept up to date, and hold points and witness points verified as appropriate
Water management	Segregation of stormwater, leachate and groundwater.	Moderate	During operation, stormwater diversions are to be constructed to divert clean water away from the cell. All stormwater runoff within the cell will be treated as contaminated with asbestos and will be captured, treated and discharged accordingly. The cell may be formed partially beneath the water-table. During operation, groundwater will be considered contaminated with asbestos and will be captured, treated and discharged accordingly. There will be no leachate, as the contained soils do not have a soluble contaminant that could dissolve in surface or groundwater, either during operation or after closure.	Impacted surface and groundwater during operation (i.e. construction) is to be managed as per NTEX (2021b), and post-closure by the LTEMP.
	Assurance that waste discharges to surface waterways are minimised and do not cause water quality objectives to be breached.	Moderate	All stormwater runoff within the cell will be treated as contaminated with asbestos and will be captured, treated and discharged accordingly. The cell may be formed partially beneath the water-table. During operation, the groundwater will be considered contaminated with asbestos and will be captured, treated and discharged accordingly.	

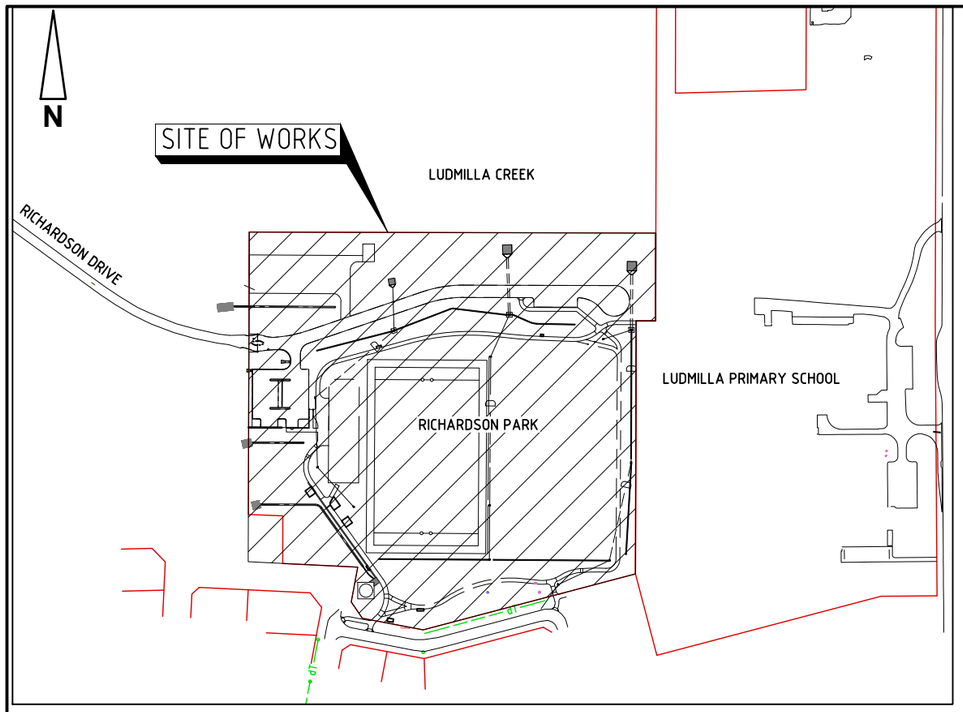
Aspect	Required outcomes	Impact (NA, low, moderate, high)	Discussion	Recommendation
Groundwater management	Implement a groundwater monitoring program in accordance with Landfill licensing guidelines (EPA publication 1323).	LOW	No leachate is being generated, hence there will be no impact to the groundwater and therefore no requirement for monitoring bores.	None
	Ensure that the landfill liner cannot be damaged through groundwater pressure.	LOW	The intent of the proposed containment cell is to provide a physical barrier only. Leachate will not be generated, hence the liner is not intended to prevent water ingress or enable the capture of leachate. The geofabric liner is designed so that the material in the cell will maintain moisture potential in equilibrium with the surrounding/underlying geological media under fluctuating water-table conditions.	None
	Minimise risk to groundwater by siting landfill in accordance with BPEM section 6.2 (site layout) and utilising a liner and leachate collection system in accordance with section 6.3 (liner and leachate collection system).	LOW		
Best-practice rehabilitation and aftercare				
Rehabilitation	That the seepage through the landfill cap is no more than 75% of the anticipated seepage rate through a basal liner that meets best-practice requirements.	LOW	The containment cell capping is not designed to limit water seepage and is intended to act as a physical barrier only.	None
	Design and construction of the best cap practicable to prevent pollution of groundwater and degradation of air quality.	Moderate	The capping solution includes 2 x geofabric components (including 1 high visibility fabric), compacted clean fill and topsoil layers (see Byrne, 2021a). The containment cell capping is not designed to limit water seepage and is intended to act as a physical barrier only.	None
	Design and construction of the most robust cap to ensure that the system will continue to protect the environment in the event of several components of the system failing.	Moderate	The capping solution includes 2 x geofabric components (including 1 high visibility fabric), compacted clean fill and topsoil layers (see Byrne, 2021a).	Aftercare requirements for the cell are to be developed as per the LTEMP and PAN No. 2021/1.

Table 3: Summary of impact and recommended management

Aspect	Required outcomes	Impact	Discussion	Recommendations
Construction quality assurance	Development and implementation of a Construction Quality Assurance (CQA) plan to ensure that the liner and leachate collection system meets the requirements of the specifications and drawings.	Moderate	No liner or leachate system is proposed.	**Project quality assurance plan is to be kept up to date, and hold points and witness points verified by Construction Superintendent as appropriate.**
	Development and implementation of a CQA plan to ensure that the stability of sub-base and liner are achieved.	Moderate	The Contractor has a construction quality assurance plan in line with AS/NZS ISO 9001:2000 – Quality Management Systems. This sets out the Hold Point and Witness Point requirements for the civil earthworks/ geotechnical and structural components of the containment cell.	
	The installation of geotextiles must meet the requirements of Section 4 of Appendix F of the BPEM.	Moderate	The geotextiles in this design are for the purposes of identification of contaminated soils, rather than the typical function of protecting geomembranes or filtering drainage layers. The transport, handling and storage of the geotextile are to be as per the specifications in the construction quality assurance plan, which are considered appropriate for the usage of the geotextile.	**Use of geotextiles in the encapsulation design is for identification of impacted soils. The geotextile products selected are considered appropriate for this purpose.**
	The CQA plan for geotextiles must address the issues raised in section 5 of Appendix F and should follow the suggestions unless an alternative provides an equivalent or better outcome.	Moderate	The geotextiles in this design are for the purposes of identification of contaminated soils, rather than the typical function of protecting geomembranes or filtering drainage layers. The quality, strength and performance specified in the design are considered appropriate to the usage of the geotextile, and will be monitored and tested as per the construction quality assurance plan.	
Water management	Segregation of stormwater, leachate and groundwater.	Moderate	During operation, stormwater diversions are to be constructed on the north, west and eastern bunds to divert clean water away from the cell. All stormwater runoff within the cell will be treated as contaminated	**Impacted surface and groundwater during operation (i.e. construction) is to be**

Aspect	Required outcomes	Impact	Discussion	Recommendations
			with asbestos and will be captured, treated and discharged accordingly. The cell may be formed partially beneath the groundwater table. During operation, the groundwater will be considered contaminated with asbestos and will be captured, treated and discharged accordingly. There will be no leachate, as the contained soils do not have a soluble contaminant that could dissolve in surface or groundwater, either during operation or after closure.	**managed as per NTEX (2021b), and post-closure by the LTEMP.**
	Assurance that waste discharges to surface waterways are minimised and do not cause water quality objectives to be breached.	Moderate	All stormwater runoff within the cell will be treated as contaminated with asbestos and will be captured, treated and discharged accordingly. The cell may be formed partially beneath the groundwater table. During operation, the groundwater will be considered contaminated with asbestos and will be captured, treated and discharged accordingly.	**Impacted surface and groundwater during operation (i.e. construction) is to be managed as per NTEX (2021b), and post-closure by the LTEMP.**
Rehabilitation	Design and construction of the best cap practicable to prevent pollution of groundwater and degradation of air quality.	Moderate	The capping solution includes 2 x geofabric components (including 1 high visibility fabric), compacted clean fill and topsoil layers. The containment cell capping is not designed to limit water seepage and is intended to act as a physical barrier only.	**As asbestos contamination poses no pathway of migration via leaching to groundwater, intermittent saturation of the base of the cell is not considered to be of concern.**
	Design and construction of the most robust cap to ensure that the system will continue to protect the environment in the event of several components of the system failing.	Moderate	The capping solution includes 2 x geofabric components (including 1 high visibility fabric), compacted clean fill and topsoil layers.	**Aftercare requirements for the cell are to be developed as per the LTEMP and PAN No. 2021/1.**

APPENDIX E EROSION AND SEDIMENT CONTROL PLAN



GENERAL ARRANGEMENT

NOT TO SCALE

SCHEDULE OF DRAWINGS	
DRAWING NO.	CONSTRUCTION DRAWINGS
C031	EROSION AND SEDIMENT CONTROL PLAN - COVER SHEET
C032	EROSION AND SEDIMENT CONTROL PLAN - NOTES
C033	EROSION AND SEDIMENT CONTROL PLAN - SITE ESTABLISHMENT AND EARTHWORKS
C034	EROSION AND SEDIMENT CONTROL PLAN - DRAINAGE, PAVEMENTS AND REHABILITATION
	STANDARD DRAWINGS
	IECA STANDARD DRAWINGS - DRAINAGE CONTROLS
ECM-01	EROSION CONTROL MATS
RCD-01	CHECK DAMS
DB-01	FLOW DIVERSION BANKS
	IECA STANDARD DRAWINGS - EROSION CONTROLS
GRAVEL-01	GRAVELLING
R-01	REVEGETATION - GENERAL
	IECA STANDARD DRAWINGS - SEDIMENT CONTROLS
ESC-02	GRATED STORMWATER (FIELD) INLET SEDIMENT TRAP
ESC-03	KERB INLET SEDIMENT TRAP
EXIT-04	VIBRATION GRID
MB-01	MULCH FILTER BERMS
SF-01	SEDIMENT FENCE
SF-02	SEDIMENT FENCE NOTES
RFD-03	ROCK FILTER DAM (INSTREAM)
	IECA DEWATERING
GFB-01	GRASS FILTER BEDS
FB-01	FILTER BAGS AND FILTER TUBES

WARNING

BEWARE OF UNDERGROUND SERVICES

The locations of underground services are approximate only and their exact position should be proven on site

No guarantee is given that all existing services are shown

LEGEND

EXISTING FEATURES

- PROPERTY BOUNDARY
- SURFACE CONTOUR (14.6)
- FENCE
- WATERMAIN/VALVE (W)
- COMMS LINE/PIT (T)
- OVERHEAD POWER LINES/POWER POLE
- EXISTING ROAD SIGN
- SURVEY REFERENCE MARK

PROPOSED WORKS

- DESIGN CENTRELINE
- FINISHED SURFACE CONTOUR (14.6)
- KERB ONLY
- MOUNTABLE GAP KERB
- COMMS LINE (T)
- POWERLINES/POWER POLE (PP)
- CULVERT
- ROAD SIGN
- ROAD GUIDE POST (GP)
- BATTER

GENERIC INSTALLATION SEQUENCE

THE FOLLOWING TABLE INDICATES MINIMUM EROSION AND SEDIMENT CONTROL MEASURES FOR THE WORKS. SITE CONDITIONS, SUCH AS THE PRESENCE OF DISPERSIVE SOILS, MAY WARRANT HIGHER EROSION AND SEDIMENT CONTROL STANDARDS. MARK OUT INITIAL LIMITS OF DISTURBANCE AND IDENTIFY LOCATION OF DISPERSIVE SOIL (IF ANY). IF DISPERSIVE SOIL IS ENCOUNTERED, CONTACT THE ESCP DESIGNER PRIOR TO COMMENCING WORKS.

ITEM	INSTALLED	REMOVED
ENTRY/EXIT ROCK PAD	PRIOR OR IN CONJUNCTION WITH SITE CLEARING.	ONCE SITE IS STABILISED AND ALL TEMPORARY FACILITIES HAVE BEEN REMOVED.
DIVERSION CHANNELS/BERMS	PRIOR OR IN CONJUNCTION WITH SITE CLEARING.	ONCE SITE IS STABILISED AND ALL TEMPORARY FACILITIES HAVE BEEN REMOVED.
MULCH BERMS	IMMEDIATELY FOLLOWING CLEARING OF SITE AND MULCHING OF CLEARED VEGETATION	ONCE SITE IS STABILISED AND ALL TEMPORARY FACILITIES HAVE BEEN REMOVED
SEDIMENT FENCE	PRIOR OR IN CONJUNCTION WITH SITE CLEARING.	ONCE SITE IS STABILISED AND ALL TEMPORARY FACILITIES HAVE BEEN REMOVED
ROCK CHECK DAMS	INSTALLED WITHIN OPEN DRAINS IMMEDIATELY FOLLOWING EXCAVATION.	ONCE ENTRY/EXIT ROCK PAD AND STOCKPILE AREAS HAVE BEEN DECOMMISSIONED.
ROCK FILTER DAMS	INSTALLED WITHIN OPEN DRAINS IMMEDIATELY FOLLOWING EXCAVATION.	ONCE SITE IS STABILISED AND ALL TEMPORARY FACILITIES HAVE BEEN REMOVED
SEDIMENT BASIN	PRIOR OR IN CONJUNCTION WITH SITE CLEARING	ONCE SITE IS STABILISED AND ALL TEMPORARY FACILITIES HAVE BEEN REMOVED
REVEGETATION	PROGRESSIVELY AS GROUND DISTURBANCE ACTIVITIES ARE COMPLETED.	N/A

GENERAL NOTES

1. THIS ESCP IS FOR GUIDANCE ONLY. IT IS THE CONTRACTOR'S RESPONSIBILITY TO CUSTOMISE THIS ESCP TO SITE SPECIFIC CONDITIONS AND IMPLEMENT ALL MEASURES IN ACCORDANCE WITH THE DIPL STANDARD SPECIFICATIONS FOR ENVIRONMENTAL MANAGEMENT.
2. THIS IS A 'WET SEASON' ESCP. NOTE THAT IN THE TOP END OF THE NORTHERN TERRITORY, EARTHWORKS ARE CONSIDERED HIGHER RISK DURING THE WET SEASON MONTHS (OCTOBER TO APRIL OF EACH YEAR) AND GREATER CONTROLS ARE REQUIRED DURING THIS TIME.
3. ALL WORKS MUST BE UNDERTAKEN IN ACCORDANCE WITH THE APPROVED ESCP AND ASSOCIATED DEVELOPMENT CONDITIONS.
4. EROSION AND SEDIMENT CONTROL MEASURES MUST CONFORM TO THE STANDARDS AND SPECIFICATIONS CONTAINED IN:
   A. THE APPROVED ESCP AND SUPPORTING DOCUMENTATION; AND
   B. THE LATEST VERSION OF INTERNATIONAL EROSION CONTROL ASSOCIATION (IECA) GUIDELINES, IF THE STANDARDS AND SPECIFICATIONS ARE NOT CONTAINED IN THE APPROVED ESCP.
5. CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTATION, MONITORING AND MANAGEMENT OF ALL EROSION AND SEDIMENT CONTROL MEASURES TO THE SATISFACTION OF THE SUPERINTENDENT.
6. CONTRACTOR MUST TAKE ALL REASONABLE AND PRACTICABLE MEASURES TO CONTROL STORM WATER FLOW VELOCITIES, MINIMISE SOIL EROSION AND SEDIMENT RUNOFF, AND MITIGATE ENVIRONMENTAL HARM.
7. UNEXPECTED CIRCUMSTANCES OR LARGE STORM EVENTS MAY NECESSITATE AMENDMENT OF THE ESCP. IN THE EVENT THAT SITE CONDITIONS CHANGE SIGNIFICANTLY FROM THOSE CONSIDERED WITHIN THE APPROVED ESCP, A REVISED EROSION AND SEDIMENT CONTROL PLAN (ESCP) MUST BE SUBMITTED FOR APPROVAL TO DEPWS AND ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES MUST BE IMPLEMENTED.
8. WHERE THERE IS HIGH PROBABILITY OF ENVIRONMENTAL HARM OCCURRING DUE TO SEDIMENT LEAVING THE SITE, CONTRACTOR MUST IMPLEMENT ALL REASONABLE AND PRACTICABLE MEASURES REQUIRED TO MITIGATE SUCH HARM, INCLUDING IMPLEMENTATION OF APPROPRIATE ADDITIONAL CONTROL MEASURES. WITH THE ESCP AMENDED AS SOON AS POSSIBLE, AND RE-SUBMITTED FOR APPROVAL TO DEPWS.
9. CONTRACTOR MUST MAINTAIN SUFFICIENT EROSION AND SEDIMENT CONTROL MATERIALS ON SITE FOR SHORT NOTICE REPAIRS.
10. CONTRACTOR MUST MONITOR THE WORKS AREA WEEKLY, OR DAILY DURING RAINFALL, AND ADAPT ESC PRACTICES AS REQUIRED TO MAINTAIN THE REQUIRED PERFORMANCE STANDARD.

STAGING OF WORKS	
ITEM OF WORKS	TIMING SCHEDULE
SITE MOBILISATION AND ESTABLISHMENT	DEC 2021
SITE PREPARATION AND EARTHWORKS	DEC 2021 - JAN 2022
STORMWATER AND DRAINAGE	JAN - MAR 2022
PAVEMENT	FEB - MAR 2022
REHABILITATION (PROGRESSIVE)	FEB - APR 2022

SITE	RICHARDSON PARK REDEVELOPMENT LOTS 8434 TOWN OF DARWIN	
ADDRESS	40 RICHARDSON DRIVE LUDMILLA	
DEVELOPMENT PERMIT	N/A	
AREA OF WORKS	5.97 ha	
CONSTRUCTION PERIOD	DEC 2021 - APR 2022	
CONTRACTOR CONTACTS		
• SITE MANAGER	TBC	
• PROJECT MANAGER	MARCO GERBINO	0498 000 147
• ENVIRONMENTAL OFFICER	TBC	
• ESCP DESIGNER	PAUL BRANDIS CPESC No. 00009681	0411 560 831

No.	AMENDMENT DESCRIPTION	DATE	INIT.	DEPT/COMPANY
0	CONTRACT DRAWING	15/12/21	PM	BYRNE

byrne. ABN 78 124 388 192
P.O.Box 43420 Casuarina NT 0811
Ph. 08 89472476 Fax: 08 89475098
Byrne Consultants Project No. NT21091

Drawn: PM Date: -	Checked: MC Date: -
Designed: PB Date: -	Checked: MC Date: -
Design Project Leader: SPB Date: -	NTG Project Manager: MG Date: -

Northern Territory Government

DARWIN REGION
LOT 8434, RICHARDSON DRIVE, LUDMILLA
RICHARDSON PARK RE-DEVELOPMENT

EROSION & SEDIMENT CONTROL PLAN COVER SHEET

NTG Project No.	NTG Asset No.	Sheet Reference	NTG Drawing No.	Amendment	
LPD08940	02609	31 OF 36	B21-11746	0	A1

Version: March 2021

PLOTTED ON: 17/Dec/2021 9:43 AM
USER: PAUL MANGOHIG
FILE LOCATION: C:\12dsw\data\BYRNE-TMS\NT20008 - DIPL_Q20-0001 Richardson Park Concept Design_358\04 CADD\DWG\NT21091-C031_C034.dwg

SITE MANAGEMENT

1. CONSTRUCTION ACTIVITIES MUST BE STAGED SO THAT LAND DISTURBANCE IS CONFINED TO AREAS OF MANAGEABLE SIZE AND THE EXTENT AND DURATION OF SOIL EXPOSURE IS LIMITED. EROSION AND SEDIMENT CONTROL MEASURES MUST BE PROGRESSIVELY IMPLEMENTED TO SUIT.
2. ALL OFFICE AND OPERATIONAL ACTIVITIES MUST BE LOCATED SUCH THAT ALL LIQUID EFFLUENT (E.G. WASH-DOWN WATER) IS TOTALLY CONTAINED AND TREATED WITHIN THE SITE.
3. ALL LIQUIDS AND CHEMICALS MUST BE STORED AND HANDLED ON-SITE IN ACCORDANCE WITH RELEVANT STANDARDS, INCLUDING AS1940 - THE STORAGE AND HANDLING OF FLAMMABLE AND COMBUSTIBLE LIQUIDS.
4. SITE SPOILS MUST BE LAWFULLY DISPOSED OF IN A MANNER THAT DOES NOT RESULT IN ONGOING SOIL EROSION OR ENVIRONMENTAL HARM.
5. EXCAVATION WORKS MUST BE STAGED SO THAT THE DURATION OF EXPOSED OPEN TRENCHES IS LIMITED. TRENCHING MUST ONLY BE OPENED UP WHERE IT IS INTENDED TO BE BACKFILLED IN THE SAME WORKING DAY.
6. NO LIQUID EFFLUENT IS PERMITTED TO BE DISPOSED OF ON SITE.
7. ACCESS TRACKS ARE TO BE GRADED TO A CROWN OR WITH CROSSFALL DRAINAGE.
8. ACCESS TRACKS ARE TO INCORPORATE STABILISED ENTRY/EXIT POINTS.
9. ACCESS TRACKS ARE TO BE MONITORED FOR EXCESSIVE SEDIMENT TRACKING INTO ADJACENT PUBLIC ROADS. A REVIEW OF THE CONTROLS WILL BE UNDERTAKEN AND ADDITIONAL MEASURES MAY BE EMPLOYED WHERE SEDIMENT BUILD-UP OCCURS ON PUBLIC ROADS AT VEHICLE EXIT POINTS.

CLEARING AND GRUBBING

1. MINIMISE DISTURBANCE TO ONLY THOSE AREAS REQUIRED FOR CONSTRUCTION. ALL OTHER AREAS WILL BE FLAGGED AS "NO-GO ZONE"
2. ALL CLEARING MUST BE CONDUCTED IN ACCORDANCE WITH FEDERAL, TERRITORY AND LOCAL GOVERNMENT ENVIRONMENTAL POLICIES.
3. BEFORE CLEARING COMMENCES, AREAS OF VEGETATION NOMINATED FOR PROTECTION MUST BE CLEARLY IDENTIFIED AND MARKED ON SITE (BY FLAGGING OR FENCING) AND INSPECTED BY THE SUPERINTENDENT. CLEARING OF VEGETATION MUST BE RESTRICTED TO THE NOMINATED AREAS. CONTRACTOR MUST TAKE ALL REASONABLE AND PRACTICABLE MEASURES TO MITIGATE RISK OF UNNECESSARY LAND CLEARING AND PREVENT REMOVAL OR DISTURBANCE OF ALL VEGETATION AND GROUND COVERS (ORGANIC OR INORGANIC) INTENDED TO BE RETAINED.
4. WHERE CLEARING IS REQUIRED FOR THE PURPOSE OF INSTALLING EROSION AND SEDIMENT CONTROL MEASURES, EXTENTS OF CLEARING MUST BE KEPT TO A MINIMUM.
5. DISTURBANCE OF THE NATURAL ENVIRONMENT MUST BE LIMITED TO THE MINIMUM IN KEEPING WITH THE SITE CLEARING PLANS.
6. CONTRACTOR MUST TAKE ALL PRACTICABLE AND REASONABLE MEASURES DURING CLEARING OPERATIONS TO PREVENT THE FORMATION OF FLOW PATHS THAT CAN CONCENTRATE SURFACE RUNOFF AND CREATE POTENTIAL FOR EROSION.

STOCKPILE MANAGEMENT

1. AVOID PLACEMENT OF STOCKPILES (WHERE PRACTICABLE) WITHIN 50m OF ANY DRAINS, DRAINAGE LINE OR OTHER WATERWAYS. SUITABLE TYPE 2/3 EROSION AND SEDIMENTATION CONTROLS TO BE IMPLEMENTED WHERE NOT PRACTICABLE.
2. THE FOLLOWING CONTROLS MUST BE IMPLEMENTED FOR STOCKPILES OF ERODIBLE MATERIAL:
   A. STOCKPILES MUST BE LOCATED AT LEAST 2m FROM ANY RETAINED VEGETATION AND CONCENTRATED DRAINAGE LINES.
   B. EARTH DIVERSION BUNDS MUST BE INSTALLED IMMEDIATELY UP-SLOPE OF THE STOCKPILE, WHERE THE CONTRIBUTING CATCHMENT EXCEEDS 1500m2 AND MUST BE MANAGED TO AVOID CONCENTRATING FLOW CAUSING EROSION.
   C. SEDIMENT CONTROL MEASURES MUST BE INSTALLED DOWNSTREAM OF THE STOCKPILE (E.G. MULCH BERMS OR SEDIMENT FENCES).
   D. TRENCH SPOIL AND BACKFILL MATERIAL MUST GENERALLY BE STOCKPILED A MINIMUM OF 1.0m FROM OPEN TRENCHES.
6. STOCKPILE OF MATERIALS VULNERABLE TO SEDIMENTATION TO BE COVERED IF REQUIRED.
7. STRIPPED TOPSOIL MUST BE STOCKPILED FOR REUSE. TOPSOIL STOCKPILE HEIGHTS MUST BE 1.5m MAX. ALL OTHER STOCKPILE HEIGHTS MUST BE 3.0m MAX WITH 1 IN 4 BATTERS MAX.
8. TOPSOIL STOCKPILES MUST NOT BE COMPACTED OR WHEEL ROLLED.
9. LONG-TERM STOCKPILES (10 DAYS OR MORE) MUST BE ADEQUATELY STABILISED (E.G. COVER, VEGETATION, SOIL BINDER, OR OTHER) AS DEEMED APPROPRIATE BY THE ESCP DESIGNER.
10. ALL DISTURBED AREAS OF STOCKPILES MUST BE SUITABLY STABILISED AND REHABILITATED WITH GRASS OR OTHER COVER.

DUST CONTROL

1. ALL DUST CONTROL MEASURES MUST BE APPLIED AND MAINTAINED IN ACCORDANCE WITH APPROVED ESCP DRAWINGS.
2. CONTRACTOR MUST BE RESPONSIBLE FOR THE EFFECTIVE CONTROL OF ALL DUST AND WINDBORNE MATERIAL EMANATING FROM THE SITE THROUGHOUT THE CONSTRUCTION PERIOD.
3. CONTRACTOR MUST IMPLEMENT ALL MEASURES NECESSARY TO MINIMISE WIND EROSION AND PREVENT MATERIAL FROM THE SITE BEING BLOWN OVER OR ONTO PROPERTY OUTSIDE OF THE SITE. MEASURES MUST INCLUDE BUT NOT BE LIMITED TO:
   A. MINIMISING TRAFFIC MOVEMENTS ON DISTURBED SURFACES AND LIMITING VEHICLE SPEEDS TO 25KPH;
   B. MAINTAINING EXPOSED SURFACES IN A MOIST CONDITION THROUGH FREQUENT WATERING;
   C. PROGRAMMING WORKS TO MINIMISE THE LIFE OF SOIL STOCKPILES, OR TEMPORARILY STABILISING LONG TERM STOCKPILES.
4. DURING DRY PERIODS, UTILISE WATER TRUCK TO WATER DOWN WORKS SURFACES TO MINIMISE DUST GENERATION. DUST SUPPRESSION IS TO BE IMPLEMENTED BY SITE SUPERVISOR AS REQUIRED BY VISUAL INSPECTION.

SURFACE WATER AND DRAINAGE CONTROL

1. ALL DRAINAGE CONTROL MEASURES MUST BE APPLIED AND MAINTAINED IN ACCORDANCE WITH APPROVED ESCP DRAWINGS.
2. DURING THE CONSTRUCTION PHASE, ALL REASONABLE AND PRACTICABLE MEASURES MUST BE IMPLEMENTED TO:
   A. DIVERT CLEAN SURFACE WATERS AWAY FROM THE SITE IN A MANNER THAT MINIMISES EROSION OR CONTAMINATION OF WATER.
   B. CONTROL FLOW VELOCITIES AND PREVENT SOIL EROSION ALONG DRAINAGE PATHS, INCLUDING ENTRY/EXIT POINTS; AND ENSURE ALL WATERS ARE DISCHARGED ONTO STABLE LAND, IN A NON-EROSIVE MANNER, AND AT A LEGAL POINT OF DISCHARGE.
   C. MANAGEMENT OF DRAINAGE IS TO AVOID CONCENTRATION OF FLOW.
   D. OPEN PROFILE TRAPEZOIDAL DRAINS INSTEAD OF "V" DRAINS ARE TO BE USED.
3. CONTROL WATER MOVEMENT THROUGH THE WORKS AREA; FLOW DIVERSION BANKS AND CATCH DRAINS ARE TO BE INSTALLED AS PER DRAWINGS.

EROSION CONTROL AND SURFACE STABILISATION

1. ALL EROSION CONTROL MEASURES MUST BE APPLIED AND MAINTAINED IN ACCORDANCE WITH APPROVED ESCP DRAWINGS.
2. SYNTHETIC EROSION CONTROL TREATMENTS MUST NOT BE USED IF SUCH MATERIALS ARE LIKELY TO CAUSE ENVIRONMENTAL HARM.

DEWATERING

1. CONTRACTOR MUST MITIGATE SEDIMENT RELATED ENVIRONMENTAL HARM AND/OR IMPACT TO STORMWATER INFRASTRUCTURE RESULTING FROM DEWATERING ACTIVITIES.
2. FLOW DIVERSION BARRIERS, OR OTHER APPROPRIATE SYSTEMS, MUST BE USED TO MINIMISE THE QUANTITY OF WATER ENTERING EXCAVATIONS.
3. DEWATERING CONTROL MAY INCLUDE GEOFABRIC FILTERS AND NON-WOVEN FILTERING FENCING.
4. SEDIMENT LADEN WATER MUST NOT BE DISCHARGED OFF-SITE WITHOUT FIRST BEING TREATED SATISFACTORILY TO THE FOLLOWING REQUIREMENTS:
   - TURBIDITY: MAX 75 NTU
   - PH: 6.5 TO 8.5

REVEGETATION AND REHABILITATION

1. ALL DISTURBED AREAS AND EARTHWORKS MUST BE PROGRESSIVELY REHABILITATED WITH GRASS, OR OTHER COVER. REFER PROJECT DRAWINGS FOR LANDSCAPING DETAILS.
2. DUE TO WORKS BEING UNDERTAKEN DURING THE WET SEASON, GRASSING MUST BE APPLIED VIA HYDROMULCHING WITH PAPER PULP (OR SIMILAR APPROVED).

TRENCHING

1. TRENCHES ARE TO BE EXCAVATED, LAID AND BACKFILLED WITHIN THE SAME DAY TO REDUCE EXPOSURE.
2. EXCAVATED TRENCH MATERIAL TO BE USED TO CREATE FLOW CONTROL BERMS ON THE UPSTREAM SIDE OF THE TRENCH.

ROCK FILTER DAMS (WITH FILTER CLOTH)

1. HEIGHT OF ROCK FILTER DAM (H) TO BE 500mm IN ALL CASES.
2. WHERE RFD IS LOCATED IN DRAINAGE CHANNELS, EXTEND ROCK UP BATTERS TO FORM A 200mm SPILLWAY CHUTE (FREEBOARD FROM SHOULD/TOP OF BATTER).
3. WHERE RFD IS LOCATED IN DRAINAGE CHANNELS, IT MAY BE REQUIRED TO SHIFT THEM UPSTREAM FROM THE END OF DRAIN TO ENSURE THE DRAIN HAS SUFFICIENT DEPTH FOR INSTALLATION OF CONTROLS WITH CONTROLLED OVERFLOW SPILLWAYS. WHERE IT IS NOT PRACTICABLE TO ACHIEVE A DRAIN HEIGHT OF 700mm, RFD HEIGHT (H) SHOULD BE REDUCED AND THE 200mm SPILLWAY DEPTH SHOULD BE MAINTAINED.

SEDIMENT BASIN

1. SEDIMENT BASIN CONSTRUCTION AND OPERATIONS MUST COMPLY WITH THE IECA SEDIMENT BASIN CONSTRUCTION SPECIFICATIONS.
2. SEDIMENT BASIN CONSTRUCTION MUST BE CERTIFIED BY AN APPROPRIATELY QUALIFIED CIVIL ENGINEER OR GEOTECHNICAL ENGINEER.
3. SUCCESSFUL OPERATION OF THE SEDIMENT BASIN RELIES ON APPROPRIATE APPLICATION OF FLOCCULANT/COAGULANT, BOTH IN TERMS OF PRODUCTS AND DOSAGE RATES. OVERDOSING OF CHEMICALS WILL RESULT IN POOR PERFORMANCE. THE FOLLOWING DOSAGE MUST BE APPLIED UNLESS APPROVED BY THE ESCP DESIGNER:
   - CHEMICAL: TO BE DETERMINED
   - DOSAGE RATES: TO BE DETERMINED
4. A 'RAINFALL-ACTIVATED DOSAGE SYSTEM' HAS BEEN NOMINATED, WHICH RELIES ON ACCURATE SETUP BASED ON CONTRIBUTING CATCHMENT AREA. CONSULT THE ESCP DESIGNER TO CONFIRM THE APPROPRIATE SETUP ARRANGEMENT AND ADVISE IF THE CATCHMENT AREA HAS BEEN ALTERED.

SEDIMENT CONTROL

1. ALL SEDIMENT CONTROL MEASURES MUST BE APPLIED AND MAINTAINED IN ACCORDANCE WITH APPROVED ESCP DRAWINGS.
2. ALL REASONABLE AND PRACTICABLE MEASURES MUST BE TAKEN TO PREVENT, OR AT LEAST MINIMISE, THE RELEASE OF SEDIMENT FROM THE SITE. SEDIMENT CONTROL DEVICES MUST BE INSTALLED TO TRAP SEDIMENT AS CLOSE TO THE SOURCE AS PRACTICABLE.
3. SEDIMENT CONTROL DEVICES MUST NOT PRESENT A SAFETY HAZARD FOR SITE WORKERS AND/OR THE PUBLIC.
4. SEDIMENT FENCES ARE TO BE INSTALLED ALONG THE DOWN SLOPE SIDE OF THE EARTHWORK ACTIVITIES AS PER IECA STANDARD DRAWINGS SF-01 AND SF-02. ENSURE RETURNS ARE PROVIDED.
5. SEDIMENT CONTROLS ARE TO REMAIN IN PLACE UNTIL THE ACTIVITIES ARE FINISHED AND AREAS ARE STABILISED.
6. TRACKING OF SEDIMENTS ONTO ROADS EXTERNAL OF THE SITE IS NOT PERMITTED. ENTRY/EXIT TO SITE MUST BE RESTRICTED TO DEFINED POINTS, WITH SUPPLEMENTARY ENTRY/EXIT SEDIMENT CONTROLS INSTALLED.
7. SEDIMENT CONTROL DEVICES MUST BE DE-SILTED WHEN CAPACITY IS REDUCED BELOW 75%.
8. SEDIMENT CONTROLS MUST BE INSPECTED WEEKLY DURING CONSTRUCTION AND IMMEDIATELY AFTER EACH RAINFALL EVENT.

INSTALLATION AND MAINTENANCE

1. THE INSTALLATION AND MAINTENANCE OF ALL EROSION AND SEDIMENT CONTROLS MUST BE OVERSEEN BY A SUITABLY QUALIFIED PERSON (E.G. CERTIFIED PROFESSIONAL IN EROSION AND SEDIMENT CONTROL) TO ENSURE WORK PRACTICES ARE CONSISTENT WITH THE APPROVED ESCP.
2. THE CONTRACTOR MUST ENSURE SUITABLE CONSTRUCTION ACCESS IS AVAILABLE FOR THE INSTALLATION AND ONGOING MONITORING AND MAINTENANCE OF SEDIMENT CONTROL DEVICES.
3. DRAINAGE CONTROLS MUST BE MAINTAINED TO PREVENT BLOCKAGES AND UNCONTROLLED WATER DIVERSION/ FLOODING.
4. SEDIMENT CONTROLS, INCLUDING SEDIMENT BASINS, MUST BE MAINTAINED TO ENSURE SEDIMENT RETENTION CAPACITY DOES NOT FALL BELOW 75%. ALL MATERIALS, WHETHER LIQUID OR SOLID, REMOVED FROM SEDIMENT CONTROL DEVICES AND PLACES OF SEDIMENT DEPOSITION, MUST BE DISPOSED OF IN AN APPROVED MANNER THAT DOES NOT CAUSE FURTHER SOIL EROSION OR ENVIRONMENTAL HARM. MATERIALS MUST BE DISPOSED OF IN A LOCATION THAT PREVENTS MATERIALS RE-ENTERING THE SYSTEM. WHERE PRACTICABLE, CAPTURED SEDIMENT IS TO BE MIXED INTO EARTHWORKS OPERATIONS.
5. IF ANY EROSION AND SEDIMENT CONTROLS ARE FOUND TO BE DAMAGED OR INEFFECTIVE, RESULTING IN EROSION OR SEDIMENT LOSS, THE CONTRACTOR MUST MAKE GOOD AND CONSULT THE ESCP DESIGNER TO IDENTIFY NEEDS FOR ADDITIONAL REPAIRS, IMPROVEMENTS, SUBSTITUTES, OR ADDITIONAL CONTROL MEASURES.
6. ALL TEMPORARY EROSION AND SEDIMENT CONTROLS MUST BE MAINTAINED FULLY OPERATIONAL UNTIL PERMANENT STABILISATION OF WORKS AREAS IS COMPLETED (80% GRASS COVERAGE).
7. THE CONTRACTOR MUST MAINTAIN SUFFICIENT SPARE MATERIALS (E.G. GEOFABRIC, SEDIMENT FENCE, MULCH, ROCK) TO ENABLE ANY REQUIRED REPAIRS IN TIMELY MANNER.

MONITORING AND REPORTING

1. ALL EROSION AND SEDIMENT CONTROL MEASURES MUST BE INSPECTED:
   A. ROUTINE WEEKLY INSPECTIONS, WHEN WORKS ARE BEING UNDERTAKEN ONSITE;
   B. MONTHLY DETAILED ADUITS;
   C. DAILY, WHEN RAIN IS OCCURING, AND WITHIN 18 HOURS FOLLOWING A RAINFALL EVENT OF SUFFICIENT INTENSITY AND DURATION TO CAUSE ON-SITE RUNOFF; AND
   D. WITHIN 24 HOURS PRIOR TO EXPECTED RAINFALL.
2. ALL SEDIMENT DEPOSITED OFFSITE AS A DIRECT RESULT OF CONSTRUCTION ACTIVITIES MUST BE REMOVED AND THE AREA APPROPRIATELY CLEANED / REHABILITATED AS SOON AS PRACTICABLE.
3. ANY FAILURE IN APPLIED DRAINAGE, EROSION AND SEDIMENT CONTROLS MUST BE REPORTED TO THE SUPERINTENDENT WITHIN 24 HOURS OF THE INCIDENT OCCURRING.
4. ANY INCIDENT WHICH RESULTS IN UNAUTHORISED DISCHARGE OF SEDIMENT OR SEDIMENT LADEN WATER TO A WATERWAY, OR HAS POTENTIAL TO RESULT IN SERIOUS ENVIRONMENTAL HARM, MUST BE REPORTED TO THE NT ENVIRONMENT PROTECTION AUTHORITY (NTEPA) WITHIN 24 HOURS VIA THE POLLUTION HOTLINE ON 1800 064 567.

WARNING

BEWARE OF UNDERGROUND SERVICES

The locations of underground services are approximate only and their exact position should be proven on site

No guarantee is given that all existing services are shown

No.	AMENDMENT DESCRIPTION	DATE	INIT.	DEPT/COMPANY
0	CONTRACT DRAWING	15/12/21	PM	BYRNE

byrne. ABN 78 124 388 192
P.O.Box 43420 Casuarina NT 0811
Ph. 08 89472476 Fax: 08 89475098
Byrne Consultants Project No. NT21091

Drawn: PM Date: -	Checked: MC Date: -
Designed: PB Date: -	Checked: MC Date: -
Design Project Leader: SPB Date: -	NTG Project Manager: MG Date: -

Northern Territory Government

DARWIN REGION
LOT 8434, RICHARDSON DRIVE, LUDMILLA
RICHARDSON PARK RE-DEVELOPMENT

EROSION & SEDIMENT CONTROL PLAN NOTES SHEET

NTG Project No.	NTG Asset No.	Sheet Reference	NTG Drawing No.	Amendment	
LPD08940	02609	32 OF 36	B21-11747	0	A1

Version: March 2021

N

"NO GO ZONE"

"NO GO ZONE"

5646

20mm SINGLE SIZE AGGREGATE GRAVEL SHEETING
REFER IECA STD DRG GRAVEL-01

LV CARPARK

CONSTRUCTION EXIT WITH RUMBLE GRID
REFER IECA STD DRG EXIT-04

ENTRY AND EXIT
ALL VEHICLE

OUTLET

SEDIMENT BASIN

OUTLET

SEDIMENT BASIN

20mm SINGLE SIZE AGGREGATE GRAVEL SHEETING
REFER IECA STD DRG GRAVEL-01

OFFICE
LAYDOWN
STOCKPILES

OPEN SWALE TO SEDIMENT BASIN

3725

"NO GO ZONE"

"NO GO ZONE"

8434

BUNDS TO BE REMOVED

OPEN SWALE TO SEDIMENT BASIN

3727

5789

"NO GO ZONE"

LUDMILLA TERRACE

BROADWAY

3310

3311

3359

PORTER STREET

LUDMILLA TERRACE

WATTS STREET

3312

3340

3360

3343

3342

3341

3361

LEGEND

- PROPERTY BOUNDARY
- SURVEY CONTOURS (EXIST)
- LIMIT OF CLEARING
- SWALE DRAIN
- STORMWATER FLOW DIRECTION
- SEDIMENTATION FENCE
- MULCH BERM
- RUMBLE PAD OR RUMBLE STRIP

REFER TO DRG C02 FOR MAIN LEGEND

WARNING

BEWARE OF UNDERGROUND SERVICES

The locations of underground services are approximate only and their exact position should be proven on site

No guarantee is given that all existing services are shown

NOTES:

1. LIMIT OF CLEARING IS INDICATIVE ONLY. REFER PROJECT DRAWINGS FOR SPECIFIC LIMITS.
2. INSTALL SEDIMENT FENCES (OR MULCH BERMS) TO ALL AREAS WHERE DIRTY STORMWATER CAN FLOW OFF SITE. INSTALL IN ACCORDANCE WITH IECA STANDARD DRAWINGS AND PROVIDE RETURNS.
3. SPECIFIC STOCKPILE AREAS HAVE NOT BEEN NOMINATED. ALL STOCKPILES MUST COMPLY WITH STOCKPILE MANAGEMENT NOTES ON DWG C602.
4. MANAGEMENT OF DUST MUST COMPLY WITH NOTES ON DWG C602.
5. WHERE EARTHWORKS ARE COMPLETED AND DISTURBED SURFACES WILL NOT BE ACTIVELY WORKED FOR MORE THAN 30 DAYS IN THE DRY SEASON, OR 10 DAYS IN THE WET SEASON, EXPOSED SURFACES AND BATTERS MUST BE STABILISED USING MULCHING, EROSION CONTROL BLANKETS, SOIL BINDERS, OR GRASSING, AS DEEMED APPROPRIATE BY THE ESCP DESIGNER, AND TO THE SATISFACTION OF THE SUPERINTENDENT.

7.5 0 7.5 15 22.5 30 37.5m

0 1:750 - A1 1:1500 - A3

No.	AMENDMENT DESCRIPTION	DATE	INIT.	DEPT/COMPANY
0	CONTRACT DRAWING	15/12/21	PM	BYRNE

byrne.
ABN 78 124 388 192
P.O.Box 43420 Casuarina NT 0811
Ph. 08 89472476 Fax: 08 89475098

Byrne Consultants Project No. NT21091

Drawn	Checked
PM Date: -	MC Date: -
Designed	Checked
PB Date: -	MC Date: -
Design Project Leader	NTG Project Manager
SPB Date: -	MG Date: -

Northern Territory Government

DARWIN REGION

LOT 8434, RICHARDSON DRIVE, LUDMILLA
RICHARDSON PARK RE-DEVELOPMENT

EROSION & SEDIMENT CONTROL PLAN
SITE ESTABLISHMENT AND EARTHWORKS

NTG Project No.	NTG Asset No.	Sheet Reference	NTG Drawing No.	Amendment	
LPD08940	02609	33 OF 36	B21-11748	0	A1

Version: March 2021

PLOTTED ON: 17/Dec/2021 9:43 AM
USER: PAUL MANGOHIG
FILE LOCATION: C:\12dsw\data\BYRNE-TMS\NT20008 - DIPL_020-0001 Richardson Park Concept Design_358\04 CADD\DWG\NT21091-C031_C034.dwg

N

"NO GO ZONE"

"NO GO ZONE"

"NO GO ZONE"

"NO GO ZONE"

"NO GO ZONE"

5646

ROCK FILTER DAM
REFER IECA STD DRG RFD-03

3725

8434

GRATED INLET SEDIMENT TRAP
REFER IECA STD DRG ESC-02

ROCK FILTER DAM
REFER IECA STD DRG RFD-03

3727

5789

LUDMILLA TERRACE

ROCK CHECK DAM
REFER IECA STD DRG RCD-01

3310

3311

3312

PORTER STREET

LUDMILLA TERRACE

WATTS STREET

BROADWAY

3359

3360

3361

3362

3363

3364

3365

3366

3340

3341

3342

3343

KERB INLET SEDIMENT TRAP
REFER IECA STD DRG ESC-03

KERB INLET SEDIMENT TRAP
REFER IECA STD DRG ESC-03

LEGEND

- PROPERTY BOUNDARY
- 5.6 SURVEY CONTOURS (DESIGN)
- SURVEY CONTOURS (EXIST)
- CATCHMENT EXTENTS
- MULCH BERM
- STORMWATER FLOW DIRECTION
- GRATED INLET SEDIMENT TRAP
- TOPSOIL AND GRASS
- ROAD PAVEMENT
- CONCRETE PATHWAY
- ROCK FILTER DAM
- ROCK CHECK DAM

REFER TO DRG C02 FOR MAIN LEGEND

WARNING

BEWARE OF UNDERGROUND SERVICES

The locations of underground services are approximate only and their exact position should be proven on site

No guarantee is given that all existing services are shown

NOTES:

1. REFER C031 FOR NOTES

7.5 0 7.5 15 22.5 30 37.5m

0 1:750-A1 1:1500-A3

No.	AMENDMENT DESCRIPTION	DATE	INIT.	DEPT/COMPANY
0	CONTRACT DRAWING	15/12/21	PM	BYRNE

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Drawn	PM Date: -	Checked	MC Date: -
Designed	PB Date: -	Checked	MC Date: -
Design Project Leader	SPB Date: -	NTG Project Manager	MG Date: -

Northern Territory Government

DARWIN REGION

LOT 8434, RICHARDSON DRIVE, LUDMILLA
RICHARDSON PARK RE-DEVELOPMENT

EROSION & SEDIMENT CONTROL PLAN STORMWATER, PAVEMENTS AND REHABILITATION

NTG Project No.	NTG Asset No.	Sheet Reference	NTG Drawing No.	Amendment	
LPD08940	02609	34 OF 36	B21-11749	0	A1

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USER: PAUL MANGOHIG
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APPENDIX F TEMPLATE SITE INDUCTION REGISTER

Name:	Company:	Date site induction completed

APPENDIX G INSPECTION AND MAINTENANCE CHECKLIST

Containment Cell Inspection and Maintenance Checklist

Location:	Containment Cell	**Date and Time:**	
Inspection Completed by:	Name:		
	Position:		
	Signature:		

Inspection items	Yes	No	N/A	Comments
General management				
Have all corrective actions raised in the previous inspections been closed out on internal reporting register?	☐	☐	☐	
Cap integrity				
Are there any visible cracks/significant damage to capping layer?	☐	☐	☐	
Drainage - Is there any distinct drainage issues on the capping layer or in the vicinity? i.e. ponding, forged drainage lines, erosion or sedimentation issues within drainage lines?	☐	☐	☐	
Erosion – Is there any erosion on or in the vicinity that may impact the capping layer.	☐	☐	☐	
Vegetation condition				
Is the vegetation cover over 70% of the cap surface area?	☐	☐	☐	
Are there any new species germinating in the vicinity of the cap that need to be investigated/removed?	☐	☐	☐	
Are there any weeds that require management on the capping layer?	☐	☐	☐	

All corrective actions to be added to the internal reporting register for tracking and close out.

#	Corrective actions required (including evidence)	Responsible person	Due Date

Other comments/notes

Photographs		

APPENDIX H AUDIT CHECKLIST

Action	Responsibility	Timing	Sign off
Environmental induction and training awareness			
All site staff and contractors will be made aware of this LTEMP and the Containment Cell their environmental responsibilities.	Maintenance Contractor Site Manager	Prior to works	
Containment Cell cap inspections			
• Inspection regime undertaken in accordance with schedule in section 6.3. • Records of the inspections conducted, outcomes and corrective actions kept on a internal register for the duration of the inspection regime. • Register of inspection regime provided to Crown Lands Estate annually, through Contract Manager.	Maintenance Contractor Site Manager	During the works	
Containment Cell cap maintenance works			
• If the Containment Cell capping is disturbed or during routine inspections maintenance works a SWMS to be developed for scope of works and provided to Crown Land Estate prior to commencement of works.	Maintenance Contractor Site Manager	Prior to works	
• Records of any maintenance works to the Asbestos Containment Cell cap are recorded on an internal register, and annually provided to the Crown Land Estate. • Records of any airborne fibre monitoring undertaken during movement and placement of asbestos contamination material are recorded on an internal register, and annually provided to the Crown Land Estate. • Where required, an ESCP was prepared and implemented, and erosion and sediment control measures were maintained regularly and after rainfall events. • Where required, erosion and sediment control measures were not removed until Containment Cell cap was stabilised. • Register of maintenance outcomes provided to Crown Lands Estate annually		During the works	
• Decontamination of all heavy vehicle machinery and disposal of used filters and cleaning equipment to be undertaken within the site asbestos waste receptacle. • Records of any decontamination and contaminated waste receptacle disposal to be recorded on an internal register, and annually provided to the Crown Land Estate.		Post works	
Vegetation management			
• Prior to any landscaping works conducted under the maintenance contract, location of Asbestos Containment Cell was provided to landscaping contractor and incorporated in all designs.	Maintenance Contractor Site Manager	During the works	

Action	Responsibility	Timing	Sign off
Alternative Richardson Park works (not on Containment Cell)			
• An EMP (including the unexpected finds procedure in section 6.7.1) and SWMS to be developed for scope of works and reviewed by Crown Land Estate prior to commencement of works. • Prior to any alternative works conducted on Richardson Park location the Asbestos Containment Cell was provided to landscaping contractor and incorporated in all designs.	Maintenance Contractor Site Manager	Prior to works	
• In the event of unexpected finds, the unexpected finds procedure is implemented, and includes all works to be undertaken by personnel with asbestos training and supervised by Asbestos Assessor.	Maintenance Contractor Site Manager	During works	

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APPENDIX D: EA SAQP (ECOZ, 2021B) REVIEW

From: Mark Stuckey
To: Britanny Crescentino
Cc: Matthew Conroy; Rohan Langworthy; Kat Spruth; Anna Sheldon
Subject: RE: Richardson Park - Additional Information (Soil and Groundwater)
Date: Thursday, 29 July 2021 3:29:28 PM
Attachments: image003.png
image005.jpg
image006.png
image007.jpg
image008.jpg

Hi Brittany,

Thank you for the additional information – I am becoming increasingly comfortable that the cell will be excavated into the Cretaceous Darwin Member claystone and that permanent groundwater is likely to be below the level of the base of the cell in this unit (albeit with a potential ephemeral perched layer in the fill).

I can definitely review your sampling plan as soon as it is ready.

If PFAS risk is not changed by moving material around, then groundwater interaction should not be an issue.

Once I receive your formal plan, I will look to provide provisional approval within a day (or sooner if necessary), so that I am not slowing the process down and you can mobilise.

Regards,
Mark

Environmental Earth Sciences - Contamination Resolved

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From: Britanny Crescentino
Sent: Wednesday, 28 July 2021 2:45 PM
To: Mark Stuckey <mstuckey@eesigroup.com>
Cc: Matthew Conroy <Matthew.Conroy@octief.com.au>; Rohan Langworthy <Rohan.Langworthy@nt.gov.au>
Subject: RE: Richardson Park - Additional Information (Soil and Groundwater)

Good Afternoon Mark,

Please find below the additional information in response to your initial response and information discussed last week.

Summary of review of DSI Field sheets:

- There was no indication of groundwater interception during the DIS as only surface samples were only taken at depths of 0.1-0.2m (which is expected as these were surface samples).
- Minimal notes were undertaken during this sampling because PFAS contamination was the main concern and it was assumed that the soils were relatively consistent throughout the site as the soil taken was from the surface fill layer. General soil structure was noted and provided below.
- Sampling was undertaken 19 November 2018 and follow up 27 February 2019 to test the potential leachate of PFAS at pH 5 and pH7.

Date sampled	Site ID	Soil Structure Notes
19/11/2018	SS06	Brown topsoil with minor fine sand and plant – gravel

19/11/2018	SS09	Organic soil, dark brown
19/11/2018	SS14	Sandy topsoil
27/02/2019	SS19	Loamy sand
27/02/2019	SS28	Loamy sand
27/02/2019	SS33	Sandy Clay with fine gravel
27/02/2019	SS49	Clayey Sand
27/02/2019	SS02	Clayey Sand
27/02/2019	SS09	Loam
27/02/2019	SS16	Sand with loam
27/02/2019	SS04	Silty sand
27/02/2019	SS25	Sandy loam
27/02/2019	SS23	Sandy loam

Additional pile of concrete rubble that contains a pile of pipes on the site, it is unknown if these are PACM reference
Sampling and investigation of this concrete pile has been completed, SLR conducted surface soil sampling underneath concrete stockpile in the northern area of Richardson Park in June 2020.
Sampling included the presence/absence of asbestos (along with a number of other potential contaminates (not PFAS).
No asbestos presence was noted in the stockpile and in the soil sampling under the rubble.
A single fragment of asbestos debris was observed outside the stockpile footprint and was removed from the sampling and disposed of.
Please see SLR memo of the work undertaken and SLR recommendations attached for your information.

Groundwater test pits
Sampling of three test pit samples were undertaken by EcOz in the northern area of Richardson Park during July 2019.
I have provided a map of the location of the testpits (DP test pit location map).
The test pits ranged from 1.6 to 2.2m bgl, with ~100mm to ~300mm water observed in the test pits. I have provided a summary below.

Test pit ID	**Test pit depth (m)**	**Level groundwater observed (mm)**
TP02	1.6	~100
TP03	1.8	~150
TP04	2.2	~300

-
Groundwater is expected to flow the natural topography of the land to the north, north-west towards the mangrove wetland, and the groundwater aquifer water level decreases from the surface progressively as it gets further away from Ludmilla Creek tidal influence.

-
Historic groundwater bores reports summary:
I have provided the groundwater bore reports for Richardson Park in the attached Z-file. All these bores have been backfilled, and no groundwater will be used for maintenance of the site.
All water sourced for the remediation works and ongoing maintenance will be mains supply water.
There is a sketched map of the locations of the bores.

Bore No.	**Bore name:**	**Date drilled**	**SWL (m)**	**Identified level of soil fill (m bgl)**	**Approximate location in comparison to encapsulation cell**
RN20824	1/82	January 1982	0.6m (Stuck water at)	0- 3.50m	
RN20825	2/82		0.35m	0- 2m	
RN20820	3/82		0.65m	0- 2m	
RN21149	8/82		0.2m	0- 1m	
RN20827	4/82		0.19m	0- 3m	
RN20828	5/82		0.8m	0- 3m	
RN20829	6/82		1.10m	0- 1m (laterite and iron stone pebbles)	West of encapsulation cell expansion area
RN20830	7/82		0.65m	0- 1m (laterite and iron stone pebbles)	West of encapsulation cell

Proposed additional sampling plan:
A draft proposed additional sampling plan is being prepared. When we have a draft sampling plan for the locations and depths of the sampling, would I please be able to get you to review this to ensure that we have enough sampling sites at depths that will meet your expectations. Prior to formally submitting the plan to you for review?

If the PFAS is being moved from one are to another on site, and not necessarily increasing the environmental PFAS leachate risk will it still be an issue to have the cell interacting with groundwater.

Also what are your expected timeframes once you receive the report that we will get the go ahead to undertake the sampling?

-
Matt, did you have any further soil characterisation or groundwater interception information from Octief's sampling in the asbestos contaminated, are you could provide to Mark ?
Can you also review and clarify the description of the extent of asbestos as requested below by Mark.

Thank you,

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Environmental Consultant - Approvals
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www.ecoz.com.au

From: Mark Stuckey <mstuckey@eesigroup.com>
Sent: Tuesday, 20 July 2021 4:47 PM
To: Britanny Crescentino <Britanny.Crescentino@ecoz.com.au>
Cc: Jeff Richardson <Jeff.richardson@ecoz.com.au>; Rohan Langworthy <Rohan.Langworthy@nt.gov.au>; Julie Brasher <Julie.Brasher@nt.gov.au>; Kat Spruth <kspruth@eesigroup.com>
Subject: RE: Richardson Park Asbestos Contaminated Materials - Remediation Works

Hi Britanny,

Please find below our initial response following review of the information provided.

Summary
The main items of note are:

- Requirement for additional asbestos delineation
- Requirement for characterisation of other CoPCs (particularly at depth where bulk excavations either to remove asbestos contamination or to prepare the containment cells).
- Groundwater appears to be shallow, therefore if the asbestos impacted soil has PFAS…encapsulation in a cell that extends 2.4 m bgl (approx. 1 m below GW table) is going to require assessment to determine that this is appropriate.

Asbestos delineation (lateral and vertical)

- The description of the extent of asbestos (southern asbestos zone associated with the former canteen) ACM/asbestos fines zone is confused throughout various reports, causing concern with respect to the efficacy of the vertical delineation completed. Please review and confirm:
    - Octief Asbestos Testpit Investigation "*The asbestos containing soils sits at a 300 mm layer approximately 700 mm below the surface*"
    - Octief (June 2021) Civil Contractor Scope of Works *"….between 300 m^3 and 600 m^3 of asbestos containing soil has been confirmed in the surface soils and in a 400 mm thick layer located approximately 300 mm below the current ground surface*"
    - Octief (July 2021) RAP "*the asbestos containing soil was found in a 300 mm layer and extended to approximately 700 mm below the surface*"
- Asbestos does not appear to have been laterally delineated to the west (beyond SP1). Delineation activities have also not been completed in the vicinity of SP3 and SP14 where asbestos was identified at surface/surface drain respectively. It is also understood from the materials provided that no assessment has been completed (to date) beneath the former grandstand structure (concrete foundations) removed in 2020, therefore condition with respect to asbestos contamination (or otherwise) is not known. (It is noted that the main Grandstand building

could contain asbestos; EcoOz (2019) "*it is not known if PACM is present in the main grandstand building (located along the western boundary) as the interior of the building could not be assessed and inspected*".) This data gap should be reviewed.

- It appears minimal asbestos assessment has been completed across the remainder of the site area (including within those areas proposed as potential ACM containment cell locations). For example, the CLA notes Byrne consultants (Table 3.2) asbestos containment cell designs also acknowledges the absence of information on asbestos in various areas of the site – particularly areas associated with:
    - Potential ACM Containment Cell Option B (no sampling previously completed);
    - Potential ACM Containment Cell Option D (1 sample previously collected); and
    - Potential ACM Containment Cell Option E (no sampling previously completed).

While it is noted an unexpected finds protocol has been included in the RAP and the potential ACM Containment Cell Designs incorporate an allowance for additional containment (if required), additional assessment would be useful to confirm absence of additional buried ACM across the site, noting that much of the asbestos encountered to date, aside from so-called "surface ACM fragments" was present at a depth of 300 mm below ground surface, 100 mm below the maximum depth of the EcoOz (2019) DSI.

- EcoOz (2021) References an "*additional pile of concrete rubble that contains a pile of pipes on the site, it is unknown if these are PACM*" and that "*additional sampling is required for any PACM…*" to ensure the materials are appropriately characterised for off-site disposal or reuse on site, ass appropriate. Was this completed?

Data Gaps:

The CLA considers additional assessment will be required at the site to adequately address several data gaps (see below), associated with the delineation of asbestos contamination at the site and with other CoPCs, particularly PFAS, at depth. Such investigations could likely be completed alongside preparatory works proposed for the Richardson Park development and need not hinder the overall construction timeline.

- No assessment has been completed with respect to non-asbestos (e.g. PFAS) CoPCs across the site at depth intervals beyond 0.2 metres below ground level (m bgl) (noting the Ecosure DSI, 2019 had excellent site coverage, but sample collection was limited to the 0.1-0.2 m bgl depth interval). While a surface investigation is suitable for assessing site-sourced contamination associated with former potentially contaminating site activities with a "top-down" mode of contamination, this assessment is insufficient to assess contaminants at deeper intervals, potentially present due to the migration of contaminated groundwater and/or groundwater surface water interactions under the site, associated with off-site land uses. Nor is it sufficient therefore, to provide adequate characterisation of materials to be excavated to facilitate containment cell construction. For example (and of particular relevance to the site conceptual site model [CSM]):
    - It is understood shallow groundwater is likely to be present: Eight groundwater bores were previously located on Richardson Park [now destroyed] and were installed to maximum depths of between 3 and 5.5 m bgl with reported static water levels between 0.2 and 1.1 m bgl. Furthermore, groundwater seepage was encountered in at least 4 test pits (TP2, TP3, TP203 and TP204) between 1.4 and 2.3 mbgl during geotechnical investigations completed at the site by Douglas Partners and WANT between 2015 and 2019 (refer attachments – DP/WANTs test pit location plan unavailable). Shallow groundwater underlying the site is likely to be influenced by the tidally influenced Ludmilla Creek Drain, to the north.
    - The maximum depth of excavation proposed for the containment cell is 2.4 m bgl (comprising 1.5 m ACM containment followed by 0.9 m of clean fill capping). It is therefore logical to assume excavations of this depth are likely to encounter groundwater and saturated aquifer matrix.
- Furthermore, it does not appear that concentrations of PFAS in soil from the southern asbestos-impacted area (OCTIEF Test pits SP1 through SP6) have been assessed. Given it is proposed to excavate these materials and encapsulate below the water table, they will require adequate characterisation to confirm suitability (or otherwise) for on-site disposal, prior to placement.
- For consideration: Is there a potential, in future, that proposed recreational sporting fields will be irrigated using bore water? If so, it may be useful to assess groundwater condition for suitability for use – contingent on condition, this may require management under a site management plan (SMP).

Remediation Action Plan/Containment cell design:

In summary, the CLA considers the remediation action plan (RAP) generally details an appropriate methodology for the remediation of *asbestos* contamination such that the site may be rendered suitable for the proposed use. However, the RAP should be reviewed in light of the comments provided with respect to additional asbestos delineation requirements and the additional site characterisation required for other CoPCs at depth, particularly in those areas where bulk excavation will be required [for construction of the asbestos containment cell and/or to excavate the materials intended to be placed therein].

As indicated above, although supplementary investigation to characterise these materials will be required, it is likely such investigations can be incorporated into the preparatory works phases. However, please note the following:

- While the CLA concurs with Byrne Consultants (2021) "*in the case of ACM there is no potential for gas, odour or leachate risks as it is non putrescible*", the CLA notes that PFAS may be present in the soils to be excavated within the southern asbestos-impacted area (this should be confirmed by supplementary assessment as indicated above).

Given the preliminary asbestos containment cell designs suggest containment cells may extend to a maximum depth of 2.4 m bgl and therefore will likely be at or below the groundwater table, the current encapsulation options may not be suitable for the on-site containment of PFAS-impacted soils. Given PFAS solubility in water, even if the design phase incorporates an adequate liner and capping system such that ingress of water (rainfall/surface water/groundwater) into the containment cell is minimised, the risk of future release may be deemed too high by the regulator and/or ongoing monitoring/ management requirements may be considered too onerous. Refer to NEMP (2020).

Ultimately, further characterisation to determine PFAS status should be undertaken. Should PFAS in soils be confirmed, at minimum, the buffer distances recommended in the Victorian landfill BPEM for encapsulation cells "*Byrne Consultants, 2021, Section 2.2*" should be deemed applicable for the proposed underground cells. However, this requirement may be waived if the excavated soils can be proven inert (asbestos only) and PFAS-free.

Regards,
Mark

Environmental Earth Sciences - Contamination Resolved

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From: Britanny Crescentino
Sent: Friday, 16 July 2021 3:33 PM
To: Mark Stuckey <mstuckey@eesigroup.com>
Cc: Jeff Richardson <Jeff.richardson@ecoz.com.au>; Rohan Langworthy <Rohan.Langworthy@nt.gov.au>; Julie Brasher <Julie.Brasher@nt.gov.au>
Subject: Richardson Park Asbestos Contaminated Materials - Remediation Works

Good Afternoon Mark,

Please find attached a letter requesting your auditor services to review the information regarding the management of Richardson Park Asbestos Contaminated Materials (ACM) in an encapsulation cell to be constructed at Richardson Park.

I have also attached the following attachments to the letter:

- Octief Asbestos Testpit investigation report
- Bryne Consulting Options Analysis of Asbestos Containment Cells
- Contractor Scope of Works
- Asbestos Remediation Management Plan (Appendix B contains details of the encapsulation designs by Bryne)

Please contact myself if there is anything further you require for your assessment, or want to discuss anything further.

Thank you,

Britanny Crescentino
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www.ecoz.com.au

ENVIRONMENTAL EARTH SCIENCES
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APPENDIX E: EA ENDORSEMENT: RAP AND CONTAINMENT CELL DESIGN

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

27 August 2021

Northern Territory Government
Department of Infrastructure, Planning and Logistics (DIPL)
GPO Box 1680
Darwin NT 0810

Attention: **Rohan Langworthy**
Program Manager | Land Development

Dear Rohan

Environmental Auditor Letter of Endorsement – Pollution Abatement Notice No. 2021/3 Richardson Park, 40 Richardson Drive, Ludmilla, NT (Lot 8434, Town of Darwin)

As part of the Environmental Audit of Richardson Park, this correspondence has been provided to confirm the Auditors review and endorsement of the following documents.

- NTEX (2021). *Environmental Management Plan, Richardson Park – Encapsulation of Asbestos Containing Materials On Site*. Project T20-2110. Version 2.3, 27 August 2021. Report to DIPL. Referred to as the EMP.
- Trakondy (2021). *Construction Asbestos Management Plan, Richardson Park Asbestos Containment Cell, Richardson Drive, Ludmilla, Northern Territory 0820*. Revision 0.4, 27 August 2021. Report to NTEX. Referred to as the CAMP.

Based on my review of the above-listed documents, and with reference to the requirements of the Pollution Abatement Notice (PAN) No. 2021/3 issued by the Northern Territory Environment Protection Authority (NT EPA) on 24 August 2021, I can conclude that:

- I consider that the EMP and CAMP listed above (NTEX, 2021 and Trakondy, 2021) includes the following information, as required in the PAN (PAN Requirement 14) and therefore provide my endorsement of the EMP and CAMP (PAN Requirement 13):
    a) waste types to be accepted within the containment cell;
    b) waste prohibited from placement within the containment cell;
    c) waste placement methods;
    d) dust control and monitoring;
    e) noise control and monitoring;
    f) stormwater, surface water, groundwater management;
    g) decontamination measures;
    h) signage and fencing to be established and maintained during works;

i) measures to ensure staff and contractors are aware of PAN requirements; and

j) reporting requirements for potential contraventions of this PAN.

It is considered that the above-listed EMP and CAMP, and this Environmental Auditor assessment and endorsement, provide compliance with Requirements 13 and 14 of the PAN.

Compliance with Requirements 5 (validation) and 17 (LTEMP) will be provided at various milestones in the project.

Please do not hesitate to contact the undersigned on (07) 3852 6666 with any queries.

For and on behalf of
Environmental Earth Sciences QLD

Mark Stuckey
Environmental Auditor
Accredited in NSW under the *Contaminated Land Management Act 1997*, and
Accredited in Victoria under the *Environment Protection Act 1970* Section 53 S(1)

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APPENDIX F: EA ENDORSEMENT: EMP AND CAMP

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

14 August 2021

Northern Territory Government
Department of Infrastructure, Planning and Logistics (DIPL)
GPO Box 1680
Darwin NT 0810

Attention: **Rohan Langworthy**
Program Manager | Land Development

Dear Rohan

Environmental Auditor Letter of Endorsement – Pollution Abatement Notice No. 2021/1 Richardson Park, 40 Richardson Drive, Ludmilla, NT (Lot 8434, Town of Darwin)

As part of the Environmental Audit of Richardson Park, this correspondence has been provided to confirm the Auditors review and endorsement of the following documents.

- Asbestos Solutions NT (2021). *Safe Work Method Statement (SWMS) to move non friable asbestos*. SWMS #001, Version 1, 3 August 2021.
- Byrne Consultants (2021a). *ACM Containment Cell – Locality Plan, Schedule of Drawings, Notes, Legend and Abbreviations*. Drawing No. B21-7850. Revision 2, 11 August 2021.
- Byrne Consultants (2021b). *Richardson Park Re-Development Options Analysis of Asbestos Containment Cells*. Revision A, 28 June 2021.
- EcOz Pty Ltd (EcOz) (2021a). *Environmental Risk Assessment Report, Richardson Park Redevelopment Project*. Revision 2, 12 January 2021. Report to DIPL.
- EcOz (2021b). *Sampling and Analysis Quality Plan, Richardson Park – Asbestos and PFAS*. Revision 2, 6 August 2021. Report to DIPL.
- NTEX (2021a). *Project Control Plan, Richardson Park Asbestos Containment*. Project T20-2110. Version 1.5, 4 August 2021. Report to DIPL.
- NTEX (2021b). *Environmental Management Plan, Richardson Park – Encapsulation of Asbestos Containing Materials On Site*. Project T20-2110. Version 2.1, 6 August 2021. Report to DIPL.
- NTEX (2021c). *Safe Work Method Statement (SWMS), Asbestos Containment*. 29 July 2021.
- Octief Pty Ltd (Octief) (2021a). *Asbestos impacted soil – testpit investigation, Richardson Park, Darwin, Northern Territory*. Version 1, 13 May 2021. Report to EcOz Pty Ltd.

- Octief (2021b). *Remediation Action Plan, Richardson Park, Ludmilla, Darwin*. Version 1, 6 July 2021. Report to EcOz Pty Ltd.

- Trakondy (2021a). *Construction Asbestos Management Plan, Richardson Park Asbestos Containment Cell, Richardson Drive, Ludmilla, Northern Territory 0820*. Revision 0.3, 11 August 2021. Report to NTEX.

- Trakondy (2021b). *Safe Work Method Statement (SWMS), Richardson Park – Asbestos in Soils Relocation to Onsite Containment Cell*. 16 August 2021. Report to NTEX.

Based on my review of the above-listed documents, and with reference to the requirements of the Pollution Abatement Notice (PAN) No. 2021/1 issued by the Northern Territory Environment Protection Authority (NT EPA) as a draft on 20 July 2021, I can conclude that:

- I have reviewed the current version of the remedial action plan (RAP, Octief 2021b) and am happy to endorse it as an appropriate plan to manage asbestos impacted soils identified at the premises, as per PAN Requirement 2.

- I consider the proposed construction of the containment cell to be consistent with the intent of the EPA Victoria (August 2015) Best Practice Environmental Management (BPEM) Publication 788.3 *Siting, design, operation and rehabilitation of landfills*, as per PAN Requirement 8.

    - BPEM compliance is detailed further in Tables 1-3 of Appendix A.

- I have therefore assessed the design of the containment cell (Byrne, 2021a) as being appropriate for the purpose and provide my endorsement, as per PAN Requirements 9 and 12.

It is considered that the above-listed documents, and this Environmental Auditor assessment and endorsement, provide compliance with Requirements 2, 8, 9 and 12 of the PAN.

Compliance with Requirements 5 (validation), 13 (EMP), and 17 (LTEMP) will be provided at various milestones in the project, with the next milestone being once the construction of the containment cell is complete (Requirement 13).

Please do not hesitate to contact the undersigned on (07) 3852 6666 with any queries.

For and on behalf of
Environmental Earth Sciences QLD

Mark Stuckey
Environmental Auditor
Accredited in NSW under the *Contaminated Land Management Act 1997*, and
Accredited in Victoria under the *Environment Protection Act 1970* Section 53 S(1)

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ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

APPENDIX A: REVIEW OF DESIGN DOCUMENTS AGAINST VICTORIAN LANDFILL BPEM

Table 1: Screening review – BPEM objectives

BPEM Objective	Aspect	Applicable	Partial	Not applicable	Comments
Best-practice siting considerations	Screening for potential landfill sites		✓		Containment cell siting considerations (Byrne, 2021b) Containment cell design aspects (Byrne, 2021a) Environmental assessment – refer to Octief (2021a and 2021b), EcOz (2021a and 2021b), and Byrne (2021b)
Best-practice design	Environmental assessment		✓		
	Site layout		✓		
	Liner and leachate collection system		✓		
	Construction quality assurance	✓			
	Water management	✓			
	Groundwater management	✓			
	Landfill gas			✓	Asbestos contaminated soils would generally have a low gas generation potential and is unlikely to decompose compared to municipal solid (in particular putrescible wastes) wastes where gas management is a key consideration.
	Odour, dust and air toxics	✓			Addressed separately by relevant EMP documentation and WHS provisions for construction management and handling of asbestos materials (Asbestos Solutions NT 2021 and NTEX 2021a, 2021b and 2021c).
	Bioreactor landfills			✓	Bioreactor landfills introduce moisture to the waste mass with the intention of increasing the rate of decomposition. Asbestos contaminated soils would generally have a low potential for decomposition and therefore this aspect is not applicable to the containment cell scenario.

BPEM Objective	Aspect	Applicable	Partial	Not applicable	Comments
	Noise	✓			The proposed containment cell construction, filling and closure will be completed as part of the CAMP (Trakondy, 2021a) and SWMS (Asbestos Solutions NT 2021, NTEX 2021c and Trakondy 2021b).
	Traffic considerations	✓			The proposed containment cell construction, filling and closure will be completed within the bounds of the site. A such, no special considerations for traffic management are considered to be required over and over the usual construction site traffic management provisions.
	Site security and fencing	✓			The proposed containment cell construction, filling and closure will be completed within the bounds of the site. Site security and fencing is addressed separately in the EMP and SWMS.
Best-practice operation	Environmental management	✓			Addressed separately in the Project Control Plan (PCP), EMP and SWMS.
	Financial assurance			✓	
	Waste minimisation			✓	
	Waste acceptance			✓	
	Waste pre-treatment			✓	
	Waste placement			✓	
	Waste cover			✓	
	Litter control			✓	
	Fires			✓	
	Contingency planning			✓	
	Management of chemicals and fuels			✓	

BPEM Objective	Aspect	Applicable	Partial	Not applicable	Comments
	Disease vector control			✓	
	Noxious weed control			✓	
	Performance monitoring and reporting		✓		
Best-practice rehabilitation and aftercare	Rehabilitation	✓			To be managed by LTEMP.
	Aftercare management			✓	To be addressed in separate provisions of the NT EPA Notice 2021/1

Notes:

- Applicable: All aspects are applicable to the assessment.
- Partial: one or more of the aspects are not applicable to the assessment.
- Not applicable: No aspects are applicable to the assessment, with discussion and justification provided in the 'comments' column.

Table 2: BPEM required outcome review

Aspect	Required outcomes	Impact (NA, low, moderate, high)	Discussion	Recommendation
Best-practice siting considerations				
Screening for potential landfill sites	Ensure that the landfill is sited to protect groundwater, surface waters, and flora and fauna.	LOW	The purpose is to encapsulate soils that contain asbestos only and the cell is not intended to receive any soils with soluble contaminants that could dissolve in groundwater or surface water. Further, capping will be in place to protect flora and fauna; no uptake of contaminants into the capping vegetation (grass) is expected.	None

Aspect	Required outcomes	Impact (NA, low, moderate, high)	Discussion	Recommendation
	All new landfills must deposit waste at least two metres above the long-term undisturbed depth to groundwater, unless the operator satisfies EPA Victoria that sufficient additional design and management practices will be implemented, and EPA determines that regional circumstances exist that warrant the new landfill.	LOW	This requirement is in place to prevent leachate entering groundwater and also to ensure the liner is not structurally compromised by rising groundwater levels. In this case, there is no leachate developed, hence there is no potential environmental impact to the groundwater. The base of the containment cell is not planned to be sealed, allowing groundwater to fluctuate within the cell without putting stress on any basal liner.	None
Best practice design				
Environmental assessment	Investigate water management requirements.	LOW	The purpose is to encapsulate soils that contain asbestos only and the cell is not intended to receive any soils with soluble contaminants that could dissolve in surface water or groundwater. During operation surface water management will be required to ensure runoff is limited to the dedicated asbestos work area(s), as to prevent the spread of contamination on the site. This will be achieved with interim control measures, such as mulch bunds. Surface water runoff within the cell will need to be treated as contaminated with asbestos and will need to be captured, treated and discharged accordingly. The cell may be formed partially beneath the water-table. During operation, groundwater will need to be considered contaminated with asbestos and will need to be captured, treated and discharged accordingly. There will be no leachate, as the contained soils do not have a soluble contaminant that could dissolve in water, either during operation or after closure. After closure all runoff will be treated as clean water.	Impacted surface and groundwater during operation is to be managed as per the EMP (NTEX, 2021b)
Liner and leachate	Design and construction of the best liner and leachate collection system practicable to prevent contamination of groundwater.	LOW	The intent of the proposed containment cell is to provide a physical barrier only. Leachate will not be generated, hence the liner is not intended to prevent water ingress or enable the capture of leachate. The geofabric liner is designed so	None

Aspect	Required outcomes	Impact (NA, low, moderate, high)	Discussion	Recommendation
collection system			that the material in the cell will maintain moisture potential in equilibrium with the surrounding/ underlying geological media under fluctuating water-table conditions.	
	Design and construct the landfill liner such that the appropriate maximum seepage rate shown in Table 6.1 is not exceeded.	LOW	Leachate will not be generated hence seepage rates do not apply. Seepage rates are expected to be similar to those in the surrounding lithology, in particular as hydraulic gradients will not be altered and material porosity and hydraulic conductivity are also expected to be similar.	None
	Implementation of the best practicable measures to meet all groundwater quality objectives contained in SEPP (Waters of Victoria) below the landfill liner.	LOW	Leachate will not be generated hence there will be no impact to groundwater.	None
	Geotechnically stable sub-base and liner.	LOW	The sub-base will be formed in excavated rock and the embankments formed from compacted fill. The embankment slopes have been designed as appropriate to the inferred geotechnical conditions of the fill material.	Excavation and embankment construction to be undertaken as Byrne (2021a)
Construction quality assurance (CQA)	Development and implementation of a Construction Quality Assurance (CQA) plan to ensure that the liner and leachate collection system meets the requirements of the specifications and drawings.	Moderate	No liner or leachate system is proposed. Provision for a liner is provided in Byrne (2021a).	None
	Development and implementation of a CQA plan to ensure that the stability of sub-base and liner are achieved.	Moderate	The Contractor has a construction quality assurance plan in line with AS/NZS ISO 9001:2000 – Quality Management Systems. This sets out the Hold Point and Witness Point requirements for the civil earthworks / geotechnical and structural components of the containment cell.	Trakondy (2021a) is to be kept up to date, and hold points and witness points verified as appropriate
	The installation of geotextiles must meet the requirements of Section 4 of Appendix F of the BPEM.	Moderate	The geotextiles in this design are for the purposes of identification of contaminated soils, rather than the typical function of protecting geomembranes or filtering drainage layers. The transport, handling and storage of the geotextile are to be as per the specifications in the construction	

Aspect	Required outcomes	Impact (NA, low, moderate, high)	Discussion	Recommendation
			quality assurance plan, which are considered appropriate for the usage of geotextile.	
	The CQA plan for geotextiles must address the issues raised in section 5 of Appendix F and should follow the suggestions unless an alternative provides an equivalent or better outcome.	Moderate	The geotextiles in this design are for the purposes of identification of contaminated soils, rather than the typical function of protecting geomembranes or filtering drainage layers. The quality, strength and performance specified in the design are considered appropriate to the usage of the geotextile, and will be monitored and tested as per the construction quality assurance plan.	Trakondy (2021a) is to be kept up to date, and hold points and witness points verified as appropriate
Water management	Segregation of stormwater, leachate and groundwater.	Moderate	During operation, stormwater diversions are to be constructed to divert clean water away from the cell. All stormwater runoff within the cell will be treated as contaminated with asbestos and will be captured, treated and discharged accordingly. The cell may be formed partially beneath the water-table. During operation, groundwater will be considered contaminated with asbestos and will be captured, treated and discharged accordingly. There will be no leachate, as the contained soils do not have a soluble contaminant that could dissolve in surface or groundwater, either during operation or after closure.	Impacted surface and groundwater during operation (i.e. construction) is to be managed as per NTEX (2021b), and post-closure by the LTEMP.
	Assurance that waste discharges to surface waterways are minimised and do not cause water quality objectives to be breached.	Moderate	All stormwater runoff within the cell will be treated as contaminated with asbestos and will be captured, treated and discharged accordingly. The cell may be formed partially beneath the water-table. During operation, the groundwater will be considered contaminated with asbestos and will be captured, treated and discharged accordingly.	

Aspect	Required outcomes	Impact (NA, low, moderate, high)	Discussion	Recommendation
Groundwater management	Implement a groundwater monitoring program in accordance with Landfill licensing guidelines (EPA publication 1323).	LOW	No leachate is being generated, hence there will be no impact to the groundwater and therefore no requirement for monitoring bores.	None
	Ensure that the landfill liner cannot be damaged through groundwater pressure.	LOW	The intent of the proposed containment cell is to provide a physical barrier only. Leachate will not be generated, hence the liner is not intended to prevent water ingress or enable the capture of leachate. The geofabric liner is designed so that the material in the cell will maintain moisture potential in equilibrium with the surrounding/underlying geological media under fluctuating water-table conditions.	None
	Minimise risk to groundwater by siting landfill in accordance with BPEM section 6.2 (site layout) and utilising a liner and leachate collection system in accordance with section 6.3 (liner and leachate collection system).	LOW		
Best-practice rehabilitation and aftercare				
Rehabilitation	That the seepage through the landfill cap is no more than 75% of the anticipated seepage rate through a basal liner that meets best-practice requirements.	LOW	The containment cell capping is not designed to limit water seepage and is intended to act as a physical barrier only.	None
	Design and construction of the best cap practicable to prevent pollution of groundwater and degradation of air quality.	Moderate	The capping solution includes 2 x geofabric components (including 1 high visibility fabric), compacted clean fill and topsoil layers (see Byrne, 2021a). The containment cell capping is not designed to limit water seepage and is intended to act as a physical barrier only.	None
	Design and construction of the most robust cap to ensure that the system will continue to protect the environment in the event of several components of the system failing.	Moderate	The capping solution includes 2 x geofabric components (including 1 high visibility fabric), compacted clean fill and topsoil layers (see Byrne, 2021a).	Aftercare requirements for the cell are to be developed as per the LTEMP and PAN No. 2021/1.

Table 3: Summary of impact and recommended management

Aspect	Required outcomes	Impact	Discussion	Recommendations
Construction quality assurance	Development and implementation of a Construction Quality Assurance (CQA) plan to ensure that the liner and leachate collection system meets the requirements of the specifications and drawings.	Moderate	No liner or leachate system is proposed.	**Project quality assurance plan is to be kept up to date, and hold points and witness points verified by Construction Superintendent as appropriate.**
	Development and implementation of a CQA plan to ensure that the stability of sub-base and liner are achieved.	Moderate	The Contractor has a construction quality assurance plan in line with AS/NZS ISO 9001:2000 – Quality Management Systems. This sets out the Hold Point and Witness Point requirements for the civil earthworks/ geotechnical and structural components of the containment cell.	
	The installation of geotextiles must meet the requirements of Section 4 of Appendix F of the BPEM.	Moderate	The geotextiles in this design are for the purposes of identification of contaminated soils, rather than the typical function of protecting geomembranes or filtering drainage layers. The transport, handling and storage of the geotextile are to be as per the specifications in the construction quality assurance plan, which are considered appropriate for the usage of the geotextile.	**Use of geotextiles in the encapsulation design is for identification of impacted soils. The geotextile products selected are considered appropriate for this purpose.**
	The CQA plan for geotextiles must address the issues raised in section 5 of Appendix F and should follow the suggestions unless an alternative provides an equivalent or better outcome.	Moderate	The geotextiles in this design are for the purposes of identification of contaminated soils, rather than the typical function of protecting geomembranes or filtering drainage layers. The quality, strength and performance specified in the design are considered appropriate to the usage of the geotextile, and will be monitored and tested as per the construction quality assurance plan.	
Water management	Segregation of stormwater, leachate and groundwater.	Moderate	During operation, stormwater diversions are to be constructed on the north, west and eastern bunds to divert clean water away from the cell. All stormwater runoff within the cell will be treated as contaminated	**Impacted surface and groundwater during operation (i.e. construction) is to be**

Aspect	Required outcomes	Impact	Discussion	Recommendations
			with asbestos and will be captured, treated and discharged accordingly. The cell may be formed partially beneath the groundwater table. During operation, the groundwater will be considered contaminated with asbestos and will be captured, treated and discharged accordingly. There will be no leachate, as the contained soils do not have a soluble contaminant that could dissolve in surface or groundwater, either during operation or after closure.	**managed as per NTEX (2021b), and post-closure by the LTEMP.**
	Assurance that waste discharges to surface waterways are minimised and do not cause water quality objectives to be breached.	Moderate	All stormwater runoff within the cell will be treated as contaminated with asbestos and will be captured, treated and discharged accordingly. The cell may be formed partially beneath the groundwater table. During operation, the groundwater will be considered contaminated with asbestos and will be captured, treated and discharged accordingly.	**Impacted surface and groundwater during operation (i.e. construction) is to be managed as per NTEX (2021b), and post-closure by the LTEMP.**
Rehabilitation	Design and construction of the best cap practicable to prevent pollution of groundwater and degradation of air quality.	Moderate	The capping solution includes 2 x geofabric components (including 1 high visibility fabric), compacted clean fill and topsoil layers. The containment cell capping is not designed to limit water seepage and is intended to act as a physical barrier only.	**As asbestos contamination poses no pathway of migration via leaching to groundwater, intermittent saturation of the base of the cell is not considered to be of concern.**
	Design and construction of the most robust cap to ensure that the system will continue to protect the environment in the event of several components of the system failing.	Moderate	The capping solution includes 2 x geofabric components (including 1 high visibility fabric), compacted clean fill and topsoil layers.	**Aftercare requirements for the cell are to be developed as per the LTEMP and PAN No. 2021/1.**

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

APPENDIX G: EA REVIEW: REMEDIATION/ VALIDATION REPORT AND LTEMP

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Comment #	Section #	Heading	Auditor Comment
1	-	General	• A number of typos/grammatical (e.g plural agreement) and formatting errors have been identified throughout. Please review prior to reissue. • The report should be prepared as a standalone document the clearly sets out the "story" of what investigation works occurred on site and why. Then, what remediation and validation works occurred on site and why. Therefore, although a number of reports are appended, the front-end of the report needs to include sufficient information (supported by relevant figures) that the reader is not required to search for the relevant information within the appendices. Specifically, the CLA considers the report would benefit from further review with respect to its structure and terminology used, particularly with respect to ensuring a logically ordered, complete and detailed narrative for both the supplementary assessment/site characterisation works and, the various phases of remediation/validation works is supplied. Specifically, as the report seeks to detail two seperate phases of activity it swould be beneficial to (as practicable) construct the report in this manner so the reader can clearly distinguish between investigation/characterisation activities and those relating to remediation and validation. For example: 1/ Supplementary Investigation Supplementary investigation across the wider site area completed in accordance with the DRAFT SAQP. These works include investigation (asbestos and PFAS, as well as limited sampling for other contaminants) across the wider site area where excavation is planned or could occur. Particularly - the grandstand area, berms and the footprint of the proposed containment cell. This phase also includes delineation sampling in the "southern asbestos area", an area identified as impacted during historic works. 2/Remediation/validation Remediation of the southern impacted area as well as hotspots identified during supplementary investigation activities, followed by validation (multiple phases) of the residual site surfaces/hotspot investigations.
2	-	Figures	Please provide a regional site location plan.
3			Please provide a site layout plan that includes all relevant site features (those that are mentioned in the text) for example; grandstand footprint, stockpiles, former site building footprints, drainage line to Ludmilla Creek, Ludmlla Creek. This is not an exhaustive list. Refer (for example) to Figures 2-1 and 2-2 of the DRAFT SAQP.
4			Please include a figure that shows relevant historic investigation locations and concentrations of contaminants reported to provide context as to why a requirement for remediation was triggered. Refer (for example) to Figure 2-1 of the DRAFT SAQP.
5			• Please include a proposed sample location figure (for the supplementary investigation works). This figure should show proposed investigation locations intended to assess the wider site area (where excavation may occur and previous assessment for CoPCs has not been completed) and, southern asbestos area delineation sampling locations. • Separate figures should be prepared for actual investigation locations showing exceedances/visual observations of contamination (if any); and remediation/validation phases of work.
6			Please include figures which show the locations of validation samples. It would be useful to show each stage of validation and associated analytical results, to provide support to the text as to why multiple phases of excavation and validation were required and how this activity progressed. Where hotspots were identified and excavated, figures should show the wall and base samples collected (and associated results) to support the assertion that successful hotspot remediation and validation was achieved.
7	-	Executive Summary	• Please review and update with reference to the comments provided on the report text below.
8	1.1	Introduction	Please review Section 1 and update accordingly in consideration of the following: "*Octief was engaged to undertake additional validation sampling* ". Please review and confirm appropriate terminology : It is the Auditors understanding that Octief was engaged to: • Undertake delineation sampling around a previously identiifed asbestos impacted area, designated the "southern asbestos area"; • Undertake additional site assessment across the balance of the site (previously uninvestigated areas) to characterise shallow soils with repect to asbestos, PFAS and other contaminants; • Undertake additional assessment within the proposed asbestos containment cell area, to characterise materials proposed to be excavated during cell construction; and • Following required remediation works, undertake validation sampling of surface scrapes/excavations to validate that impacted materials have been successfully removed to the extent practical Please reference a location and layout figure (refer comment 2)
9	1.2	Background	• Please refer to comments regarding inclusion of a site location and layout figure. • Review background section in relation to that provided in the RAP - the RAP provides a good summary of previous investigation complted at the site and would be worth incorporating here, as practicable, for consistency. • Noting tht the EcoOz SAQP is referenced (with respect to providing guidance on supplementary site characterisation and delineation sampling). It may also be worth referencing that the Octief RAP which provided guidance as to the validation activities and criteria required, post remediation.
10	1.3	Objectives	Refer to comment 8 above and amend as necessary.
11	1.4	Scope of work	Please review and amend in consideration of comment 1 above. The scope should have included a number of phases of fieldwork including site-wide characterisation, assessment of the proposed asbestos containment cell footprint and validation sampling. PFAS acronym - please correct.
12	1.5	Technical framework	Please note, WA DoH has been updated (now 2021). Please amend reference throughout.
13	2.1	Site identification	Please include the following additional site identification information at minimum (could consider tabulating): Site owner, Site address Parcel reference, Site area Current occupier Current/proposed land use Current/future zoning Local government authority Central co ordinates
14	-	NEW	Please include a site description - based on the pre-works site inspection completed. This should describe key site features, topography, vegetation and current condition at time of inspection.
15	3	Site history	This section appears to primarily provide a "historic site investigation summary" rather than a full site history. Were other searches/components of a typical site history assessment (typically certificates of title, aerial photography, search of environmental registers/information held by the regulator [in this instance NT EPA]) ever completed? If available - would be best to seperate these into subsections. If not available/not completed - rationale as to why this information was not reviewed should be provided and maybe consider re-naming the section to "previous environmental investigations". With respect to the previous site investigation info: • It would be useful to provide Figures (refer earlier comments) showing historic investigation locations which triggered the requirement for remediation and validation (as well as additional site characteristion). • You could consider tabulating this section to ensure a greater consistency in the previous investigation information supplied. The Auditor also notes not all historic investigations have been mentioned here, therefore the narrative is incomplete. For example - information on groundwater bores installed at the site and groundwater samples collected from testpits is mentioned for the first time in Section 4 and reference to a geotechnical investigation completed in June 2019 by Douglas Partners is mentioned for the first time in Section 7.4. Please review and update accordingly.
16	4	Environmental Setting	For better logical flow to the document, consider moving Section 4 above the site history section to logically flow on from the site description and surrounding land use sections. • Paragraph 1-3 are repeated elsewhere in this section. To avoid repetition please ensure the information is only presented once. Note: Information on historic investigation results should be included in the site history section. • Topography: Please include description of site-specific topography, particularly observations with respect to variable site elecations and bunding observed. (Note - if a site description section is included, this information may be better presented there) • Please provide reference to site soils. • Please include reference to any environmentally sensitive areas in the vicinity of the site.
17	5	Initial Conceptual Site Model	As the introduction to this section indicates the CSM is based on previous environmental assessment and data gap analysis, should the CSM not be presented after the data gap analysis?
18	7		The SAQP was prepared for supplementary site characterisation works (previously unassessed areas; balance of the site, particularly the grandstand area and the proposed asbestos containment cell) as well as validation works. Please review and amend as necessary. The narrative provided specifies particular site features, historic sampling locations where delineation is required and investigation areasas well as proposed number of samples to achieve the assessment and validation objectives. Figures should be supplied to make it clear to the reader what investigation has been completed that has triggered the requirement for these works and what investigation locations are proposed to achieve the delineation/supplementary investigation requirements. It may be worthwhile providing subheadings in this section to make it clear that the report is providing information on multiple phases of work . Specifically: • Supplementary investigation (characterisation of the wider site area, assessment of existing stockpiles and assessment of the proposed asbestos containment cell area); and • Post excavation, validation sampling Please provide rationale as to why groundwater sampling was considered unnecessary and was not been included as part of the supplementary site assessment works to close-out this item.
19	8.1	Summary of contamination	Consider re-naming to "Summary of contamination - preremediation) As per items 2-6 - it would be beneficial to provide a figure to show where and what concentrations of asbestos have been identified - this would be particularly useful in support of the volume estimates of impacted soil provided. Note: This is the first section that provides a volume estimate of asbestos impacted material. How was this volume calculated? If the calculation was based on historic investigation information, reference to this investigation/investigation(s) should be included. Or, if this is a reproduction of a volume estimate previously provided in a historic investigation, this should be introduced, for the first time, in the "previous environmental investigations" section.
20	8.3	Selected remedial method	It would be worth including details with respect to the containment cell here including a Figure showing its proposed location. Where on site it was proposed to be constructed - dimensions (Length, width, depth)
21	9	Sampling methodology	Please note WA DoH guidelines have been updated (now WA DOH, 2021) Decontamination: It is understood PFAS samples were collected during the works. Decon 90 can contain trace levels of PFAS. Please provide narrative as to impacts (if any) on analytical results obtained
22		NEW	Please provide a section providing a tabulated laboratory schedule confirming which samples were analysed for which analytes and documenting QA/QC (duplicate/triplicate) pairs. This table should also provide rationale for the additional investigation program. For example: Sample ID Rationale Analytical Suite TPX Delineation (Southern asbestos area, SPX) TPX Supplementary site assessment - Grandstand TPX Supplementary site assessment - proposed asbestos containment cell Please refer to Table 4.3.7 of the DRAFT SAQP for applicable rationale for consistency.
23	10.1.1	Asbestos	Please refer comment above with respect to WA DoH update.
24	11	Quality assurance/Quality control	Please refer to Item 18 above and provide comment.
25	12	Soil results	Please include a general fieldworks section which summarises the different phases of fieldwork completed. E.g Sentence 1 of Section 12.1.1 followed by.... These field events comprised: • Fieldwork 1 (date) - Advancement of x testpits...here, here and here...for this purpose • Fieldwork 2 (date)..... It is important to make clear that the works discussed in Section 12 are the supplementary site characterisation and asbestos delineation works. Not remediation works, which are discussed in later sections.
26	12.1.1	Soil description	A soil description ha not been provided in this section. Please provide a generalised lithological summary for materials encountered across the site (this could be tabulated). • Consider combining this section with 12.1.2 to describe visual and/or olfactory evidence of contamination. • Please ensure a figure is provided to indiate where asbestos was visually identified at surface in the testpits.
27	12.1.2		As above
28	12.1.1	Deviation from SAQP	• This section should be Section 12.1.3. • This section is confusing given testpit IDs are provided for the first time and the number of samples completed, where and why has not yet been introduced in the report text. Consider comment 19. • Has Oktiefs visual validation information been included in this report? Evidence is required - please provide appropriate inspection checklists/clearance certificates in an appendix. • Has the Trakondy lateral delineation sampling information been supplied, reviewed for QA/QC and confirmed suitable to be relied upon? As this report is intended as a validation report, this information is required for completeness. Information must be incorporated into the text and appropriate figures supplied. Please reference Appendix D. • The SAQP required a rinsate sample to be collected for one in every 20 samples and submitted to the same laboratory for analysis of PFAS (short suite). This was not completed and represents a deviation. Please provide commentary.
29	12.2		Please review all subheadings in this section. They do not appear in consecutive order.
30	12.2.1	Asbestos - test pits	• Does this section relate only to supplementary characterisation sampling completed across the site, rather than validation sampling? Please review this section for clarity in consideration of report comments provided so far. • Please adjust the figure or supply seperate figures to show the three-phase investigation. • Please ensure information pertaining to identification of ACM and/or AF/FA is included on appropriate figures.
31	12.2.2	Other contaminants	"*8 primary samples were collected from site during validation sampling and 9 interlaboratory duplicates* " • Were these samples actually collected during supplementary assessment works for the wider site area? • How were more interlaboratory duplicates collected, than primary samples?
32	12.3	Remediation Works	This section would probably be upgraded to a level 1 heading • The current narrative is unclear and confused. For example "*three successive sampling events" were completed but an "initial round of sampling was conducted on the 31 August, 1 September and 2 September, with the additional sampling being conducted on the 7 September* ". Please review and provide a more detailed, logical narrative explaining the phases of fieldwork, excavation and validation that were completed within the southern site area. Plese include dates for excavation activities. • Please supply supporting figures showing the progressive excavation and validation phases, including sampling locations and laboratory analytical results that triggered the requirement for additional phases of excavation/hotspot excavation. • Please refer to comments above regarding updated WA DoH asbestos guidelines.

Comment #	Section #	Heading	Auditor Comment
33	New	Validation	It would be worthwhile inserting a new level 1 heading "validation activities" or similar and moving all text from pargraph 3 of Section 12.3 into it. It is important that sufficient detail is provided with respect to the validation methodology, criteria and validation sampling/re-sampling activities and visual validation that was completed across the site to confirm suitability for use. At present, insufficient information and accompanying figures is provided to make this clear to the reader. At minimum the validation section should include: • Adopted Methodology: Description of visual validation method and sampling methodology where validation samples were collected (while a cross reference to an earlier section could be incorporated so as to describe the actual method employed e.g collection via testpitting...the validation section should include full details with respect to sampling frequencies adopted during each validation phase and why. •Validation criteria • Validation activities: This section should (similar to Section 12) provide: -A timeline of remediaton and subsequent validation activities -A description of remediation and validation activities - A tabulated laboratory schedule, preferably split by order of validation activities and accompanying rationale, for example: Sample ID Rationale Analytical Suite Phase 1: X date to X date XX Validation of excavation Area X - base XXX Validation of excavation Area X - wall XXX Validation of excavation Area X - wall XXX Re-validation of area X following additional excavation... This section should be supported by appropriate Figures. Please note - as the ability to confirm suitability for use is contingent on the remediation/validation activities completed, it is critical that this section be sufficiently detailed that it is clear exactly what activities occurred, when and in what order.
34	13.1	Asbestos	Please refer to comments above regarding requirement for clear figures and clarity regarding works completed. Please ensure where terminology such as "the north-eastern hotspot" is used, this information/labeling appears on the accompanying figure.
35	14	Conclusions and recommendations	Please review and update with consideration to comments provided above.
36	15	References	Please review for completeness and update as required.

Comment #	Section #	Heading	Auditor Comment
1		General	• A number of typos/grammatical (e.g plural agreement) have been identified throughout. Please review prior to reissue. (Note spelling: Mark Stuckey) • A number of formatting errors have eben identified (particularly with respect to Figures and figure repetition throughout the document) • Page numbers need to be updated.
2	1.1	Background	Mark is accredited under both the NSW and VIC site auditor schemes- worth updating.
3	1.2 and 1.3	Objectives/Scope of work	The current objectives and scope sections read more as the document "purpose". Consider whether this information would be better placed under a "purpose" subheading....with a new objectives/scope of works section added. Consider, for example, twhether the following would be appropriate to describe the LTEMP scope and objectives. That is, to: • Summarise residual contamination within the containment cell • Document the site containment infrastructure • Detail a program of ongoing monitoring of the condition of the capping layer;; and • Provide a framework for ongoing management of the site during potential future disturbance of the ACM containment cell
4	2.1	Location and surrounding land use	Please ensure the site location and layout figure includes all site features referenced in the text (including, but not necessarily limited to, former building footprints of relevace and the Ludmilla Creek Drain.
5	2.2	Site layout	• Incomplete sentence (looks like the Figure reference has been pushed over the page beyond a section break). Please review and correct formatting for final version. • Please ensure all figures are provided as full-page, A4 figures in the final document.
6	2.3	Containment Cell	This section is really important as it will not only be used to inform users of the LTEMP as to where exactly the containment cell is on site, but what contamination it contains and therefore provides the basis of the environmental management strategies (to be discussed later) with respect to maintenance and potential disturbance. For this reason, it is recommended that key containment cell information is tabulated for clarity and includes, at minimum: Containment cell location (Figure and corner grid references) Containment cell size (length, width, depth, surface area and capacity) Description of basal and sidewall type/construction (materials) Description of capping layer (types and thicknesses) Filling period Summary of contaminated materials placed within the cell. It is recognised some of this information is shown in the figure/provided in text. Recommended just to update to ensure all information requirements are covered off. In addition: • Please review/check formating for this section., • Figure 2-2 is the same figure supplied as Figure 2-1. Please review and amend as necessary. • Please review the following sentance for sense/reword for clarity "The Asbestos Containment Cell has been constructed to its largest capacity due to the volume of asbestos containing material found during the Richardson Park Redevelopment. " • As this document is intended to detail management requirements for the capping layer, it should be prepared as a single, standalone reference document. Can the site-specific erosion and sediment control/monitoring plan be provided as an appendix? • Figure 2-1 is repeated after this section?
7	2.4	Environmental setting	With reference to Section 5.7 of the NT EPA EMP guideline, please review this section and expand for completeness to ensure all relevant "environmental overview" inforamtion is completed. For example (as relevant): • Site proximity to sites of cultural/social significance (or confirmation there are none) • National reserves/sensitive environments (including conservation reserves) • Topography, • Soils and geology (split) • Vegetation • Climate • Groundwater and hydrogeology • Natural processes relevant to the existing environment (e.g fire and flooding – noting reference to flooding has been included). It may be worth splitting this section into subheadings to ensure these items are addressed in logical order. Suggestion/not requirement. •Figure 2-2 is repeated after this section (?)
8	3	Legislation and guidance	Please review for completeness and consider if additional regulations, codes of practice and industry standards relevant to asbestos management should be included (particularly in relation to future works (subsurface maintenance works) that could disturb the existing capping layer. For example (for consideration): •Model Work Health and Safety Act 2016 (WHS Act); •Model WHS Regulation 2016; •Safe Work Australia Code of Practice – How to Manage and Control Asbestos in the Workplace (2016); •Safe Work Australia Code of Practice – How to Safely Remove Asbestos (2016); •Guidance note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres – •NOHSC:3003(2005); •Safe Work Australia Code of Practice – How to Manage Work Health and Safety Risks; •Safe Work Australia Code of Practice – Management the Work Environment and Facilities; •National Environment Protection (Assessment of Site Contamination) Measure 1999, Schedule B1 andB2, NEPC (2013); and •Western Australian Department of Health (DoH) 2021 Guidelines for the Assessment, Remediation and •Management of Asbestos Contaminated Sites in Western Australia (endorsed by the NT EPA). NT Acts and legislation and interstate publications t. For example: •Environmental Offences and Penalties Act •Soil Conservation and Land Utilisation Act •Waste Management and Pollution Control Act •Water Act •Weeds Management Act •Environmental Offences and Penalties Regulations •Waste Management and Pollution Control (Administration) Regulations •Water Regulations •Weeds Management Regulations •International Erosion Control Association (IECA) Australasia Best Practice Erosion and Sediment Control
9	4	Responsibilities	This section appears to repeat information that is included in Section 7.1 . Consider whether these two sections could be combined in some manner for better flow to the document.
10	6	Environmental Risk Assessment	Table 6-5 Risk assessment includes some management measures that are not included elsewhere in the LTEMP (for example works to be overseen by a licenced asbestos assessor) - please review and determine if additional sections are required. Please also refer to comment x below.
11			This section does not take into account controls/management requirements for future works that may include the disturbance of the cap/necessitate cap reinstatement and/or waste disposal, or provide details with respect to an unexpected finds protocol to be followed in the event excavations are required across the remainder of the site. (It is acknowledged in Section 5, the conceptual site model, that unplanned or future excavations are a porential exposure pathway and thus the LTEMP should include sections that cover these eventualities. For example: **Control of future maintenance works (HSE):** • Prior to any future subsurface works, all subcontractors should prepare their own SWMS referencing the LTEMP/including a risk assessment which will be reviewed by (?) • All subsurface works that will (or may) disturb the cap should be undertaken in accordance with relevant HSE requirements for working with asbestos such as: • Minimum general controls should include (list PPE) with additional controls where workers will or are likely to be exposed to asbestos such as during excavation beneath the cap (for example, P2 masks/Tyvek/working under supervision of a licenced asbestos removal contractor • For subsurface works elsewhere on the site (outside the containment area) - an unexpected finds protocol should be followed. (Please include a UFP). • Decontamination requirements **Cap reinstatement** • Cap to be reinstated to original survey levels or, if necessary, updated survey levels to be obtained and updated to ensure minimum thicknesses met. • Any damages to geotextile layers to be replaced prior to reinstatement • Revegetation of any vegetation removed to stabilise cap • Record keeping **Stockpiling** • Provide controls for stockpiling of soils, should material require to be removed from containment cell. **Dust suppression/monitoring requirements** **Erosion and sediment control requirements** **Off-site waste disposal considerations**
12	7.1	Responsibilities, Training and Awareness	The document does reference parties responsible for the LTEMP (Section 4 and, to a point, Section 7.1, but this i provided in a very high level manner and because of the seperation between sections is not very clear. Consider, for clarity, whether this section can be amended to provide more direct, succinct information. For example consider splitting into two sections: **1 Project roles, responsibilities and contacts.** - Including a table c with headings such as organisation/role/responsibilities, with the responsibility heading providing a comprehensive list of all responsibilities for each organisation. Responsibilties would include (but not necessarily be limited to): • Site inductions • Training • Cap maintenance/inspections • Vegetation management • Routine (inspection) reporting • Incident reporting/notification • Auditing • LTEMP review and update **2 Training, awareness and competency** This section would detail what training and competency is required to work on site. Could include – environmental/asbestos awareness inductions, toolbox talks.
13	7.1	New	With respect to LTEMP review and update: A section should be provided detailing the prcess that will be used to review and update the LTEMP so it remains relevant and uptodate. This section should recommend review frequencies or triggers. For example - every 5 years for general updates to ensure references to legislation/codes of practice, guielines and standards is uptodate. With additional reviews should: There be a change of site owner/operator LTEMP procedure change Changes to site use/apprved site use or development This section should assign the review responsibility to someone (qualified/experienced environmentl consultant)
14	7.2-7.3	Inspections/maintenance	In accordance with the NT EMP guidance an EMP must establish environmental objectives and define appropriate performance criteria that are specific, measurable and achievable While the Auditor does not disagree with the monitoring program proposed in Sections 7.2 through 7.3 to better comply with the guidance, we need to specify measurable performance criteria. The program of inspections will then assess compliance with this criteria, and this is the trigger for corrective actions to be deployed. This doesn't need to be overly onerous given it really is cap integrity that is being assessed here. Perhaps, for example performance criteria could include (but not necessarily be limited to): **Vegetation:** Coverage: Vegetation established over x % of cap Type: only shallow rooted species are present across cap surface **Cap condition:** No visible cracks/depression/evidence of erosion observed.
15	7.2-7.3	Inspections/maintenance	For ease of use, it would be useful to provide a tabulated summary of monitoring requirements against key performance indicators/objectives and documentation requirements. For example ==>
16	7.3	Vegetation management	• Can the erosion/sediment control plan be appended to this document?
17	8	Corrective actions	Please refer to Section 5.11 and to ensure recommended, relevant information is included. At minimum, this section should be augmented to include contact details for responsible parties (in the event , for example a cap breach is identified) alongside the incident response process. Items to consider include notification requirements to relevant authorities and the recording/reporting requirements for environmental incidents/corrective actions. If responsible parties are not yet known, a "TBC" entry could be included.

Comment #	Section #	Heading	Auditor Comment
18	9	Record keeping	Consider amending section heading to: Records and reporting This section should provide a detailed list of all records and reporting requirements required to achieve compliance with the LTEMP. It would perhaps be useful to tabulate this using the headings "Responsibility, report, frequency, process (e.g. who to complete, and who (if anyone) the report needs to be sent to/notified), required content" Such a table would need to include, for example, at minium: • Attendance records for environmental inductions/toolbox talks/environmental meetings/training records (as relevant) • All audit, monitoring and inspection records for compliance with LTEMP (field checklist(s) refer to appendix and accompanying photographs) • Records of non-conformances and corrective actions taken/incident reports • Annual LTEMP compliance audit (append audit checklist as an appendix)
19	9	Record keeping	There appears to be some cross over between Sections 9 and 10. Please review and determine if the two can be combined to ensure all information on record keeping and reporting is clear and concise.
20	10	Auditing	As above. Also - would be useful to include the Audit checklist as a full-page proforma suitable for use. (This could be included as an appendix).
21		Appendices	It would be worthwhile including the following additional appendices: • Erosion/sediment control plan • Site induction register • Field inspection checklist (routine) • Audit checklist