Lands Advisory Services Pty Ltd

Detailed Site Investigation – Contamination Assessment

Proposed Caravan Park

Lot 2 DP 1015609 (288) Mungo Brush Road Hawks Nest

Report No. RGS50057.1-AD

8 March 2024

REGIONAL GEOTECHNICAL SOLUTIONS

REGIONAL GEOTECHNICAL SOLUTIONS

Manning-Great Lakes
Port Macquarie
Coffs Harbour

RGS50057.1-AD

8 March 2024

Lands Advisory Services Pty Ltd
PO Box 2317
DANGAR NSW 2309

Attention: Brett Phillips

Dear Brett,

RE: Proposed Caravan Park – Lot 2 DP 1015609 (288) Mungo Brush Road Hawks Nest
Detailed Site Investigation – Contamination Assessment

As requested, Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken a Detailed Site Investigation contamination assessment for the proposed caravan park development that is located at Lot 2 DP 1015609 (288) Mungo Brush Road Hawks Nest.

The assessment concluded that the site is suitable in its current state for the proposed development from a contamination perspective based on the findings of the report contained herein and the radiological assessment report prepared by Easterly Point Environmental Pty Ltd (Ref. 2402L01-RGS01)

The work presented herein was reviewed by Dr David Tully CEnvP SC. A copy of Dr Tully's letter pertaining to the review is appended to the report.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

For and on behalf of **Regional Geotechnical Solutions Pty Ltd**

Prepared by

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Associate Environmental Engineer

Reviewed by

Adam Holzhauser

Principal Geotechnical Engineer

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1 INTRODUCTION

1.1 Background

Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken a Detailed Site Investigation (DSI) contamination assessment for the proposed caravan park development at Lot 2 DP 1015609 (288) Mungo Brush Road Hawks Nest.

It is understood that the development will involve multiple caravan sites, internal roads, and biofiltration and primary and secondary infiltration areas. It is understood that the natural topography is to be utilised for the infiltration and detention systems and minor earthworks of less than 1m are expected to be required to achieve finished levels. The proposed development area is illustrated below.

Diagram 1: *Proposed caravan park layout.*

The site is identified as Lot 2 DP 1015609 and occupies approximately 15 hectares. The subject portion of the site which is to be developed is located over the western portion of the site and occupies approximately 10.5 hectares. The layout of the subject area is illustrated above and in the attached figures.

RGS has previously undertaken a Preliminary Site Investigation (PSI) Contamination Assessment, the results of which are presented in report RGS50057.1-C, dated 21 March 2023.

The RGS report identified the following Areas of Environmental Concern (AEC) which are the subject of a Request for Further Information (RFI) from Midcoast Council:

- AEC1 – Soils in the vicinity of brick shed;
- AEC2 – Soils in the vicinity of low brick wall and collapsed elevated tank;
- AEC3 – Fill placed for the access track; and
- AEC4 – Possible sand mining spoil.

Based on the conclusions and recommendations of the report outlined above, Midcoast Council have submitted a Request for Further Information (RFI) with regard to contamination issues which states the following:

> *Following on from the submitted Preliminary Site Investigation (Regional Geotechnical Solutions, 21 March 2023), a Detailed Site Investigation is to be submitted to demonstrate that the land is suitable for its proposed land use.*
>
> *The Detailed Site Investigation Report must be prepared in accordance with the NSW EPA (2020) Guidelines for Consultants Reporting on Contaminated Sites.*
>
> *As the Preliminary Site Investigation identified instances of potential impacts of sand mining and radiation impacts, the Detailed Site Investigation must in addition reference:*
>
> - *Northern Rivers Contaminated Land Program (NRCLP) (2021) Radiation from Heavy Mineral Sands Residues (HMSRs); and*
> - *Queensland Health (2020) Land contaminated by radioactive material – A guide to assessment, management and remediation.*
>
> *As per the recommendation of the Preliminary Site Investigation (Regional Geotechnical Solutions, 21 March 2023, Report No. RGS50057.1-AC), a Detailed Site Investigation into sand mining activities (including potential dumping of sand mining soil) on the site is to be undertaken and submitted to Council.*
>
> *The DSI is to include a clear statement advising if the land is suitable in its contaminated state (or will be made suitable after remediation) for the proposed use.*
>
> *In addition, to the above a Safework Dangerous Goods Search (which was not included in the PSI) is to be undertaken and results provided in the DSI.*

In addition to the above, the RGS Preliminary Contamination Assessment recommended that further testing may be required around the collapsed Above-ground Fuel Storage Tankl (AST) in the south-western part of the site identified as AEC2 following its removal to assess to assess the potential extent of hydrocarbon impacted soil (if any). The AST had been removed prior to field investigations for the DSI were undertaken. It Is understood that the collapsed AST had a 2,000L capacity and used for storing diesel fuel.

The location of AEC2 is shown on Figure 3.

A DSI is required to delineate the nature and extent of contamination present within AEC2 as outlined above and evaluate the site's suitability for future use as a caravan park. In addition, the assessment is aimed at addressing the items listed on Council's RFI.

The work was commissioned by Brett Phillips of Mungo Developments Pty Ltd and was undertaken in accordance with proposal number RGS50057.1-AC, dated 22 January 2024.

It is understood that an assessment dedicated to evaluating the risk of potential radiation levels exceeding residential land use guideline criteria associated with possible historical sand mining activities and spoil is being undertaken by others.

1.2 Objectives

The objectives of the DSI were to:

- Characterise the nature and extent of soil contamination present on the site (if any);
- Assess the suitability of the site for future use as a caravan park from a site contamination perspective (noting a radiation assessment is being undertaken by others); and
- Provide recommendations for on-site management, the need and options for remediation and any further investigation and testing that is required.

1.3 Scope of Works

In accordance with the relevant sections of the *National Environment Protection (Assessment of Site Contamination) Measure 1999 (Amended 2013*), the assessment involved the following process:

- Review of the previous RGS PSI report;
- A SafeWork NSW Hazardous Chemical on Premises Search;
- Site walkover to assess surface conditions and, in conjunction with the information above, identify any Areas of Environmental Concern and associated Chemicals of Concern on the site;
- Undertake sampling in accordance with applicable industry guidelines. The NSW EPA (2022) *Sampling Design Guidelines* indicate that a minimum of eight sampling points is required for characterisation by systematic sampling of the contamination status of the area where the collapsed AST was located prior to its removal;
- Collection of 8 surface and near-surface soil samples for contamination testing;
- Analysis of soil samples for a suite of potential contaminants associated with hydrocarbon storage; and
- Evaluate the results against industry accepted criteria for residential land use for the proposed caravan park.

1.4 Site Identification

General site information is provided below in Table 1. The site location is shown on Figure 1.

Table 1: Summary of Site Details

Site location:	288 Mungo Brush Road, Hawks Nest
Approximate site area:	15 Hectares (total site) 10.5 Hectares (proposed development portion)
Title Identification Details:	Lot 2 DP 1015609
Current Ownership:	Mungo Developments Pty Ltd
Current Landuse:	Vacant
Proposed Landuse:	Caravan Park
Adjoining Site Uses:	• Densely vegetated vacant lots to the north and east; • Rural residential lot to the south; • Mungo Brush Road to the west; • Wanderrabah Beach further to the east; • Myall River further to the west
Government Area:	Mid-Coast Council

2 SITE DESCRIPTION

2.1 Topography and Drainage

The site is situated within a near coastal area of Hawks Nest located between Wanderrabah Beach and Myall River.

The site is near flat with some gentle undulations. Vegetation comprises dense native tree cover and regrowth. Drainage is by overland flow to the east.

2.2 Geology

The NSW Seamless Geology Map indicates that the site is underlain by the coastal deposits that comprise fine to coarse grained quartz-lithic-carbonate sand (marine-deposited), shells, and gravel.

A summary of the conditions encountered during the PSI is provided below:

Fill: SAND, fine to medium grained, with some gravel, fine to medium grained (BH4 only);

Topsoil: SAND, fine to medium grained with rootlets, to depths of up to 0.2m; overlying

Aeolian Soils: SAND, fine to medium grained, with some areas of fine to coarse grained sand, medium dense to at least the termination of the boreholes at 7.5m.

The NSW Government "Minview" website indicates the site and the area to the north over an area of approximately 15.4km^2 are located within areas of mineral mining lease and title applications. Naturally Occurring Radioactive Minerals (NORM) including Ilmenite, Leucoxene, Monazite, Rutile, Zircon are listed minerals present. NORM can present a potential health risk, notably following processing of extracted mineral sands when, for example, these materials can concentrate in the base of the stockpiles and around the processing equipment.

2.3 Hydrogeology

A groundwater bore search on the NSW Water Information website, http://waterinfo.nsw.gov.au/gw/ indicates there are several groundwater wells including monitoring wells and private bores in the area:

- GW202680 is located near the north-western corner of the site, the drill records indicate the well was extended to a depth of 10m, the water level or bearing zones were not recorded.
- GW202681 is located approximately 360m east of the northeast corner of the site, the drill records indicate the well was extended to a depth of 5m, the water level or bearing zones were not recorded.
- GW047373 is located approximately 330m south of the southeast corner of the site, the drill records indicate the well was extended to a depth of 32m. Water bearing zones of 6.7m to 12.8m and 21.3m to 30.4m were recorded.

The bore locations are shown on Diagram 2 below.

Groundwater was encountered at a depth of 6.5m in BH3.2 (undertaken in the same location of BH3). Experience in the area indicates a maximum ground water level of 2.5m below ground surface.

Diagram 2: *Licensed groundwater bores located near the site. The approximate site boundary*

2.4 Site Observations

Field work was undertaken on 21 February 2024. Observations from a contamination perspective at the AEC2 location made during the site visit are summarised below:

- The AEC2 location is in the south-western part of the and is densely vegetated with tall native trees and smaller shrubs and ferns;
- Some remnant rusted metal flakes were present on the ground surface where the AST was located; and
- No other visual or olfactory evidence of gross hydrocarbon contamination was observed.

Selected photographs are shown below:

	
Collapsed AST in-situ prior to its removal. It was located in the south-western part of the site. It had a 2,000L capacity and was used for the storage of diesel fuel.	*Looking north showing the area where the AST was located prior to its removal. Some remnant rusted metal flakes from the AST were present on the ground surface.*

The location of where the AST was located is shown on Figure 3.

2.5 SafeWork NSW Hazardous Chemical on Premises Search

A search of the SafeWork NSW Hazardous Chemicals Stored on Premises database did not locate any records pertaining to the site. The letter from SafeWork NSW outlining as such is presented in Appendix A.

2.6 Additional Anecdotal Evidence

Discussions with the current owner who has over 40 years of knowledge of the Hawks Nest/Tea Gardens area indicated that sand mining works were not undertaken at the site.

3 FIELD AND LABORATORY INVESTIGATIONS

3.1 Sampling Plan

The NSW EPA (2022) *Sampling Design Guidelines*: *Contaminated Land Guidelines* recommend that a minimum of eight sampling points is required for characterisation of the contamination status of the collapsed AST area (<0.05ha) if a systematic sampling strategy was adopted.

Based on the above, 8 surface and near-surface soil samples were collected within the vicinity of where the collapsed was located prior to its removal. The soil samples were designated S101 to S108.

The sampling locations are shown on Figure 4.

3.2 Field Work

Field work for the assessment was undertaken on 21 February 2024 and included:

- Site walkover to assess visible surface conditions and identify evidence of contamination in the vicinity of where the collapsed AST was located prior to its removal; and
- Collection of 8 soil samples from surface and near-surface.

The locations of the sampling points are shown on Figure 4. They were obtained on site and located by measurement relative to existing site features.

Soil samples were taken from natural soil using disposable gloves and hand tools which were decontaminated between sampling points using Decon90 detergent and deionised water. The samples were collected in acid-rinsed 250mL glass jars and placed in an ice-chilled cooler box.

3.3 Laboratory Analysis

Samples were transported under chain-of-custody conditions to ALS Laboratory Group, a NATA accredited specialist chemical testing laboratory, to be analysed for the following suite of common contaminants associated with hydrocarbon storage in metallic vessels;

- Polycyclic Aromatic Hydrocarbons (PAH);
- Total Recoverable Hydrocarbons (TRH);
- Benzene, Toluene, Ethyl-benzene, Xylenes (BTEX);
- Heavy metals (arsenic, cadmium, chromium, cobalt, copper, lead, mercury, and zinc);

The results are presented in Appendix B.

3.4 Data Quality Objectives

The Data Quality Objectives (DQOs) are presented in Table 2.

Table 2 – Data Quality Objectives

DQO	Details of Process
State the Problem	A DSI is required to assess the suitability of the site for the proposed future land use as a caravan park from a contamination perspective and to address items outlined on an RFI from Council.
Identify the Decision	The principal study questions re: • What is the nature and extent of soil contamination in the identified AECs (if any)?; and • Is the land suitable for the proposed caravan park development from a contamination viewpoint?

DQO	Details of Process
Identify Inputs to the Decision	The primary inputs are: • Review of previous geo-environmental and geotechnical reports; • Site walkover assessment of subject AEC's; • Chemical analysis of selected soil samples; and • Results summary.
Define the Boundary of the Assessment	• The spatial boundaries are limited to the AEC's and property boundaries of the subject site as shown on Figures 1, 2 and 3; and • The investigation and screening levels for a Residential A land use scenario, adopting a conservative approach.
Develop a Decision Rule	The decision rules for the investigation are: • If concentrations of contaminants in soil exceed the adopted investigation and screening levels for a Residential A land use scenario, then further assessment may be required; Decision criteria for QA/QC measures are defined in Section 5. A decision on the acceptance of analytical data will be made on the basis of the data quality indicators (DQIs) in the context of precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters as follows: • **Precision**: NATA registered laboratories were used following NATA endorsed methods. An appropriate number of intra-laboratory samples were collected and analysed (following ASC NEPM guidance), the results of which are considered to be satisfactory; • **Accuracy**: The laboratory limit or reporting (LOR) was appropriate for the screening criteria utilised. NATA registered laboratories were used following industry standard test methods including appropriate method blanks, laboratory control samples, laboratory spikes and duplicates the results of which are considered to be satisfactory; • **Representativeness** – The samples were received by the laboratories in good condition. The data obtained is considered to be representative of the soils and groundwater present on site; • **Completeness** – Experienced field staff were utilised to undertake the sampling and keep appropriate documentation. Samples were in proper custody between the field and reaching the laboratory. The laboratories performed the tests requested. The data obtained from the field investigations is considered to be relevant and usable; and • **Comparability** – Sample holding times were met and samples were properly and adequately preserved. Field sampling and handling procedures were followed. The data collected is considered to be comparable.
Specify Acceptable Limits on Decision Errors	• Acceptable limits for QA/QC measures are defined in Section 5; • Acceptable investigation and screening levels are those for a Residential A land use scenario; and

DQO	Details of Process
	• Specific limits are in accordance with the appropriate NSW EPA guidelines including indicators of data quality and standard procedures for field sampling and handling.
Optimise the Design for Obtaining Data	Based on the above steps of the DQO process. The design for obtaining the required data (i.e proposed field and laboratory investigations) is presented in Section 3.1.

4 GUIDELINES AND ASSESSMENT CRITERIA

Assessment as outlined in NSW EPA *Guidelines for Consultants Reporting on Contaminated Land (2020)*.

To evaluate results, and for guidance on assessment requirements, the assessment adopted the guidelines provided in the *National Environment Protection (Assessment of Site Contamination) Measure as amended in 2013 (NEPM 2013)*. The NEPM document provides a range of guidelines for assessment of contaminants for various land use scenarios.

The proposed future land use is for a caravan park. As such, comparison with the NEPM guideline Health Investigation and Screening Levels for Residential A land use is considered appropriate for this site, adopting a conservative approach. In accordance with the NEPM guideline the following criteria were adopted for this assessment:

- Health Investigation Levels (HILs) for Residential 'A' land use (HIL-A) were used to assess the potential human health impact of heavy metals and polycyclic aromatic hydrocarbons (PAHs);
- Health Screening Levels (HSLs) for coarse textured (sand) or fine textured (silt and clay) soils on a Residential 'A' site were adopted as appropriate for the soils encountered to assess the potential human health impact of petroleum hydrocarbons and benzene, toluene, ethylbenzene and xylene (BTEX) compounds;
- Ecological Investigation Levels (EILs) for urban residential and public open space land use were used for evaluation of the potential ecological / environmental impact of heavy metals and naphthalene;
- Ecological Screening Levels (ESLs) for coarse textured (sand) soils or fine textured (silt and clay) soils on a Residential 'A' land use site were adopted as appropriate for the soils encountered, to assess the potential ecological / environmental impact of petroleum hydrocarbons, BTEX compounds and benzo(a)pyrene.

In accordance with NEPM 2013, exceedance of the respective criteria does not necessarily deem that remediation or clean-up is required but is a trigger for further assessment of the extent of contamination and associated risks. The adopted criteria are presented in the results summary table in Appendix B.

5 QUALITY ASSURANCE / QUALITY CONTROL

Samples were obtained using industry accepted protocols for sample treatment, preservation, and equipment decontamination. Sampling equipment was decontaminated between sample locations and a clean pair of nitrile gloves used for the collection of each sample into laboratory supplied glass sampling jars.

Samples were placed on ice on-site and maintained on ice during transport to the testing laboratories. One duplicate sample was collected and submitted to the laboratory for analysis for quality control purposes including Duplicate (D1) – Replicate of primary sample S102 (0.2 – 0.4m).

The Relative Percent Differences (RPDs) were calculated for the duplicate samples and are presented in the results summary table in Appendix B. The duplicate RPDs were within the control limit of 40% and indicated generally good correlation between the primary and duplicate samples.

In addition to the field quality control procedures, the laboratory conducted internal quality control testing including surrogates, blanks, and laboratory duplicate samples. The results are presented with the laboratory test results in Appendix C.

All laboratory quality control data is within acceptable limits for the tests carried out. Therefore, on the basis of the results of the field and laboratory quality control procedures and testing, the data is considered to reasonably represent the concentrations of contaminants in the soils at the sample locations at the time of sampling and the results can be adopted for this assessment.

6 RESULTS

6.1 Subsurface Conditions

The soil types recorded in surface samples collected from the vicinity of AEC 2 are summarised below in Table 3.

Table 3: Summary of Subsurface Conditions at AEC 2

Sample ID	Description
S101 – S108	Aeolian SAND, fine to medium grained. Sampled near elevated tank and brick wall.

6.2 Laboratory Results

An appraisal of the laboratory test results presented in Appendix C is provided below with reference to the adopted soil investigation and screening levels discussed in Section 4.

- Concentrations of heavy metals were either below the laboratory limit of reporting or below the adopted health investigation criteria for a Residential A site in each of the samples analysed; and
- Concentrations of TRH, PAH, and BTEX were below the laboratory limit of reporting (and therefore the adopted screening criteria) in each of the samples analysed.

6.3 Conceptual Site Model

Based on the site observations and knowledge obtained about site activities as outlined above, an updated conceptual site model (CSM) has been developed.

6.4 Potential Sources of Contamination

Potential Areas of Environmental Concern (AECs) and Chemicals of Concern (COCs) identified from the PSI are outlined in Table 4 with the likelihood of contamination updated on the basis of the findings of the DSI.

Table 4: Potential AECs and COCs

AEC	Mode of Potential Contamination	Key Potential COCs	Likelihood of Contamination
AEC1: Soils in the vicinity of brick shed	Potentially hazardous building materials	Lead and asbestos	Low
AEC2: Soils in vicinity of collapsed AST	Potential spillage or leaks of hydrocarbons from collapsed AST (since removed)	Heavy Metals, TRH, BTEX, PAH,	Low to Moderate
AEC3: Fill placed for the access track	Importation of potentially contaminated fill	Heavy Metals, TPH, BTEX, PAH, PCB, OC/OPP and asbestos	Low
AEC4*: Possible sand mining spoil	Potentially contaminated sand mining spoil dumped on site	Radiation associated with heavy mineral sand mining works	Low
Heavy Metals - Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel and Zinc *BTEX - Benzene, Toluene, Ethylbenzene and Xylene* *TRH - Total Recoverable Hydrocarbons* *PAH – Polycyclic Aromatic Hydrocarbons*			

**Dedicated radiological assessment of AEC4 to be undertaken by others and presented in a separate report.*

The approximate location of AEC2 is shown on Figure 3.

Based on the site observations and knowledge obtained about site activities as outlined above, an updated conceptual site model (CSM) has been developed.

6.5 Potential Exposure Pathways and Receptors

Based on the site observations and knowledge obtained about site activities as outlined above, potential exposure pathways and receptors identified for the assessment are summarised in Table 5.

Table 5: Potential Exposure Pathways and Receptors

Chemicals of Concern	Key Pathways	Key Receptors
Heavy metals, asbestos and radiation	Generation of dust during earthworks which is inhaled	Onsite - Construction and site workers Offsite - Adjacent sites
Heavy metals, TRH, BTEX, PAH, asbestos and radiation	Skin contact / ingestion, plant uptake, inhalation	Onsite - Construction and site workers, future site users, vegetation in landscaped/garden areas
Heavy Metals, TRH, BTEX, PAH, radiation	Surface runoff, leaching of soils, migration of groundwater plume	Offsite - Surface water and groundwater ecosystems and users, and underground services maintenance / construction workers
Heavy Metals - Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel and Zinc *BTEX - Benzene, Toluene, Ethylbenzene and Xylene* *TRH - Total Recoverable Hydrocarbons* *PAH – Polycyclic Aromatic Hydrocarbons*		

6.6 Discussion

A DSI was required to assess the site's suitability for future development of a caravan park from a contamination perspective and to address items associated with land contamination listed on an RFI from Council.

The site history study indicates that the minor developments including the construction of one shed within the development area and one shed outside the development area, a gravel access track, and a low brick wall and collapsed AST. The majority of the site has remained undeveloped and densely vegetated.

It is understood that the AST had a capacity of 2,000L and was used to store diesel fuel; it has since been removed from the site.

Sand mining activities occurred to the east and west of the site, however, the works did not encroach on the site itself. Anecdotal evidence also supports the suggestion that such activities did not occur on the site.

A SafeWork NSW database search indicated that there are no records of licences to store hazardous chemicals at the site.

Identified AEC's included soils in the vicinity of the structures, imported fill for the gravel access track, the collapsed AST and possible sand mining spoil and activities. Based on the conclusions and recommendations of the RGS PSI, the DSI was required to further assess soils in the vicinity of the

collapsed AST which had since been removed (AEC2) and radiation risks associated with potential sand mining spoil and activities (AEC4).

No visual or olfactory evidence of gross hydrocarbon contamination (such as oil staining or hydrocarbon odours) were observed.

The results of laboratory analysis of surface and near-surface soil samples collected from AEC2 revealed concentrations of the chemicals of concern were below the adopted screening criteria for residential land use in each of the samples.

A separate dedicated report regarding an assessment of the radiological risks associated with potential sand mining spoil and activities (AEC4) is to be undertaken by others.

6.7 Conclusions and Recommendations

Based on the above and the findings of the DSI presented herein, the soils tested within the vicinity of the former collapsed AST meet the requirements for a Residential A site as detailed in the NEPM 2013 guidelines. On this basis and in combination with the conclusions of the RGS PSI, the site is considered suitable for the proposed caravan park development from a contamination perspective provided the radiological assessment prepared by others concludes that the site is suitable for residential land use with respect to radiation risk.

Should potential evidence of site contamination be identified during development activities, such as soil staining, buried materials, odours or possible Asbestos Containing Materials (ACM), then a site contamination specialist should be contacted for advice without delay.

Material exported off site should be assessed in accordance with EPA guidelines for Excavated Natural Material (ENM) and Virgin Excavated Natural Material (VENM). As a preliminary guide based on the site contamination testing undertaken, the aeolian profile is likely to be classified as Virgin Excavated Natural Material. The gravel fill along the access track would likely be classified as Excavated Natural Material, however further testing would be required to classify this.

7 PRELIMINARY WASTE CLASSIFICATION

Table 2 of the '*Waste Classification Guidelines (2014)*' nominates a suite of analytes to be tested (Column 1) and also provides the maximum concentration (CT1) allowable within the soil for classification without the need for additional toxicity characteristics leaching procedure (TCLP) testing for both general solid waste (Column 2) and restricted solid waste (Column 3) for each analyte. Should the CT1 values be exceeded, the guidelines provide a Specific Contaminant Concentration (SCC) value to allow further evaluation of contaminant concentrations in conjunction with TCLP testing.

An evaluation of the laboratory test results for sampled soils against the waste classification guidelines outlined above are presented in the summary table in Appendix B.

Waste classification results indicate that the soils present on-site would classify as General Solid Waste and could be disposed of to a landfill licensed to accept to General Solid Waste.

8 LIMITATIONS

This report comprises the results of an investigation carried out for a specific purpose and client as defined in the document. The report should not be used by other parties or for purposes or projects other than those assumed and stated within the report, as it may not contain adequate or appropriate information for applications other than those assumed or advised at the time of its preparation. The contents of the report are for the sole use of the client and no responsibility or liability will be accepted to any third party. The report should not be reproduced either in part or in full, without the express permission of Regional Geotechnical Solutions Pty Ltd.

Contaminated site investigations are based on data collection, judgment, experience, and opinion. By nature, these investigations are less exact than other engineering disciplines. The findings presented in this report and used as the basis for the recommendations presented herein were obtained using normal, industry accepted practises and standards. To our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points.

Recommendations regarding ground conditions referred to in this report are estimates based on the information available at the time of its writing. Estimates are influenced and limited by the fieldwork method and testing carried out in the site investigation, and other relevant information as has been made available. In cases where information has been provided to Regional Geotechnical Solutions for the purposes of preparing this report it has been assumed that the information is accurate and appropriate for such use. No responsibility is accepted by Regional Geotechnical Solutions for inaccuracies within any data supplied by others.

If site conditions encountered during construction vary significantly from those discussed in this report, Regional Geotechnical Solutions Pty Ltd should be contacted for further advice.

This report alone should not be used by contractors as the basis for preparation of tender documents or project estimates. Contractors using this report as a basis for preparation of tender documents should avail themselves of all relevant background information regarding the site before deciding on selection of construction materials and equipment.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

For and on behalf of **Regional Geotechnical Solutions Pty Ltd**

Prepared by

Andrew Hills

Associate Environmental Engineer

Reviewed by

Adam Holzhauser

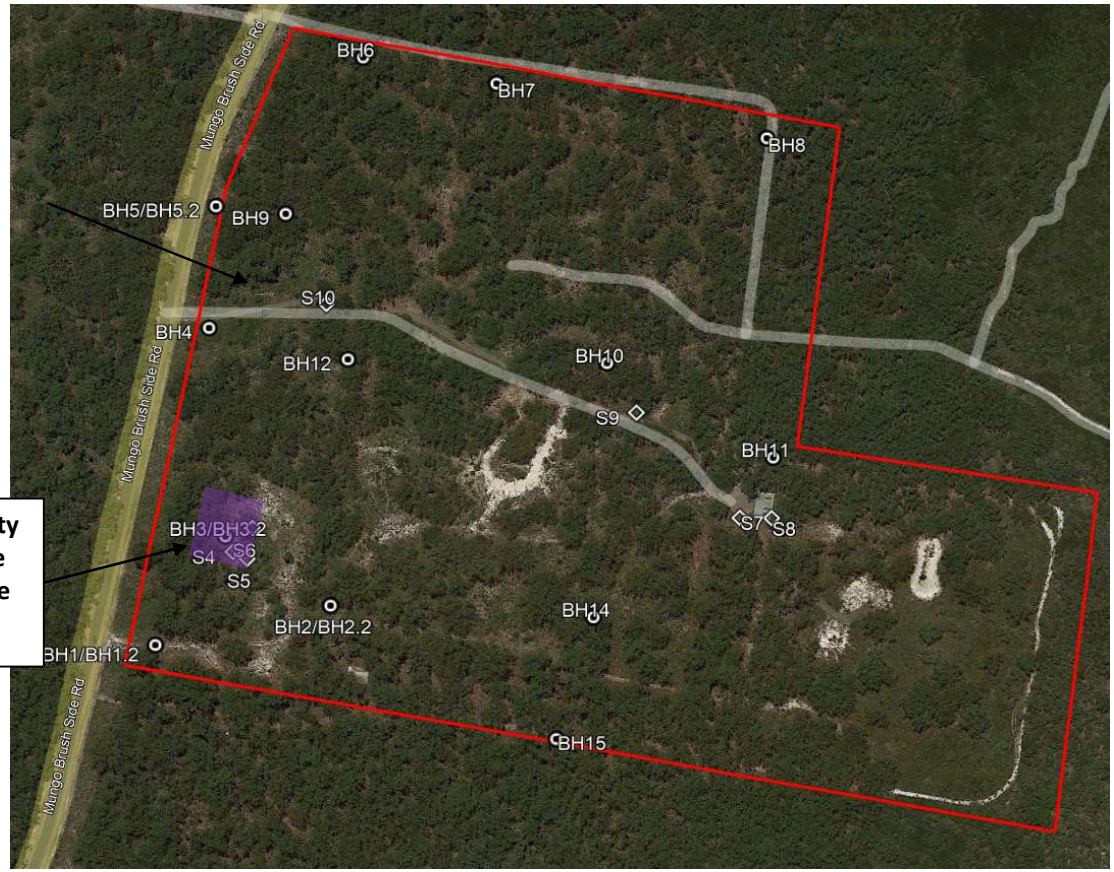
Principal Associate Engineer

Figures

REGIONAL GEOTECHNICAL SOLUTIONS	**Client:**	Lands Advisory Services Pty Ltd	Job No.	RGS50057.1
	Project:	Proposed Caravan Park	Drawn By:	LD
			Scale:	NTS
		Lot 2 DP 1015609 (288) Mungo Brush Road, Hawks Nest	Date:	21-Mar-23
	Title:	Site Location Plan	Drawing No.	**Figure 1**

REGIONAL GEOTECHNICAL SOLUTIONS

Client:	Lands Advisory Services Pty Ltd	Job No.	RGS50057.1
Project:	Proposed Caravan Park Lot 2 DP 1015609 (288) Mungo Brush Road, Hawks Nest	Drawn By:	LD
		Scale:	NTS
		Date:	21-Mar-23
Title:	Site Layout Plan	Drawing No.	**Figure 2**



REGIONAL GEOTECHNICAL SOLUTIONS

Client:	Lands Advisory Services Pty Ltd	Job No.	RGS50057.1
Project:	Proposed Caravan Park Lot 2 DP 1015609 (288) Mungo Brush Road, Hawks Nest	Drawn By:	AH
		Scale:	NTS
		Date:	7-Mar-24
Title:	Areas of Environmental Concern	Drawing No.	**Figure 3**

REGIONAL GEOTECHNICAL SOLUTIONS	**Client:**	Lands Advisory Services Pty Ltd	Job No. RGS50057.1
	Project:	Proposed Caravan Park Lot 2 DP 1015609 (288) Mungo Brush Road, Hawks Nest	Drawn By: AH Scale: NTS Date: 7-Mar-24
	Title:	Sample Location Plan	Drawing No. **Figure 3**

Appendix A

SafeWork NSW Hazardous Chemicals Search Documentation

Dear Andrew

Re: Site Search for Schedule 11 Hazardous Chemicals on premises Application – Result not found

I refer to your application for a Site Search for Schedule 11 Hazardous Chemicals on premises, received by SafeWork NSW on 31 January 2024 for the following site: 288 Mungo Brush Road, Hawks Next NSW.

A search of the records held by SafeWork NSW has not located any records pertaining to the above-mentioned premises.

If you have any further information or if you have any questions, please use one of the following options, quoting the SafeWork NSW enquiry reference number: 00941355

- Email: licensing@safework.nsw.gov.au
- Phone: 13 10 50

Kind regards

Kim Brearley
Licensing Representative
SafeWork NSW | Better Regulation Division
Department of Customer Service
p- 13 10 50
e- licensing@safework.nsw.gov.au | www.customerservice.nsw.gov.au
Level 3, 32 Mann Street, Gosford, NSW 2250

NSW GOVERNMENT | Customer Service

Appendix B

Laboratory Test Result Sheets

REGIONAL GEOTECHNICAL SOLUTIONS

Client: Lands Advisory Services Pty Ltd
Job No. RGS50057.1-AD
Project: Proposed Caravan Park
Location: Lot 2 DP 1015609 (288) Mungo Brush Road Hawks Nest

Location	DEPTH (m)	MATERIAL	TOTAL RECOVERABLE HYDROCARBONS					PAH		BTEX (sum)	HEAVY METALS							
			C6-C10	C10-C16	C16-C34	C34-C40	TOTAL 10-40	Total	b-a-p		As	Cd	Cr#	Cu	Pb	Ni	Zn	Hg
S101	0.0 - 0.2	Aeolian Soil	<10	<50	<100	<100	<50	<0.5	<0.5	<0.2	<5	<1	16	6	<5	<2	31	<0.1
S102	0.2 - 0.4	Aeolian Soil	<10	<50	<100	<100	<50	<0.5	<0.5	<0.2	<5	<1	<2	<5	<5	<2	<5	<0.1
S103	0.0 - 0.2	Aeolian Soil	<10	<50	<100	<100	<50	<0.5	<0.5	<0.2	<5	<1	<2	<5	<5	<2	<5	<0.1
S104	0.0 - 0.2	Aeolian Soil	<10	<50	<100	<100	<50	<0.5	<0.5	<0.2	<5	<1	<2	<5	<5	<2	<5	<0.1
S105	0.0 - 0.2	Aeolian Soil	<10	<50	<100	<100	<50	<0.5	<0.5	<0.2	<5	<1	<2	<5	<5	<2	<5	<0.1
S106	0.2 - 0.4	Aeolian Soil	<10	<50	<100	<100	<50	<0.5	<0.5	<0.2	<5	<1	<2	<5	<5	<2	<5	<0.1
S107	0.0 - 0.2	Aeolian Soil	<10	<50	<100	<100	<50	<0.5	<0.5	<0.2	<5	<1	<2	<5	<5	<2	<5	<0.1
S108	0.0 - 0.2	Aeolian Soil	<10	<50	<100	<100	<50	<0.5	<0.5	<0.2	<5	<1	<2	<5	<5	<2	<5	<0.1
D1 (duplicate of S102)	0.2 - 0.4	Aeolian Soil	<10	<50	<100	<100	<50	<0.5	<0.5	<0.2	<5	<1	<2	<5	<5	<2	<5	<0.1
RINSATE1		Water	<10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
										<1								
D1 RPD (%)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health Based Soil investigation Level (HIL)*:								300	3	NL	100	20	100#	6000	300	400	7400	40
Health Screening Level (HSL)**:			F1=45(0-<1m) F1=70 (1-<2m) F1=110 (2-<4m)	F2=110 (0-<1m) F2=240 (1-<2m) F2=440 (2-<4m)														
Ecological Investigation Level (EIL)***:											100				1100			
Ecological Screening Level (ESL)****:			180	120	300	2800				50	**Coarse grained soil in mg/kg**							
			180	120	1300	5600				65	**Fine grained soil in mg/kg**							
Management Limits			700	1000	2500	10000					**Coarse grained soil in mg/kg**							
			800	1000	3500	10000					**Fine grained soil in mg/kg**							

NOTES:

Denotes concentration exceeds health based guideline for Residential B land use

Denotes concentration exceeds ecological guideline for Residential B land use

Denotes concentration exceeds management Limits for Residential or Recreational land use

Denotes concentration exceeds health and ecological based guideline for Residential B land use

NL No Limit available

LOR Limit of Reporting

* Health Based Investigation Levels for Reseidential B (NEPM 2013)
**Health Screening Level (F1 & F2) for Residential B land use and coarse grained soil (sand) (NEPM 2013)
** Ecological Investigation Level - for Residential B land use
*** Ecological Screening Level for Residential B land use and fine grained soil
#Chromium VI
Speciation testing confirmed only Chromium III present

REGIONAL GEOTECHNICAL SOLUTIONS

Summary Table - Comparison of Contamination Analysis Results With Waste Classification Threshold Limits (Results in mg/kg)

Client: Lands Advisory Services Pty Ltd
Job No. RGS50057.1-AD
Project: Proposed Caravan Park
Location: Lot 2 DP 1015609 (288) Mungo Brush Road Hawks Nest

SAMPLE	*Material*	*DEPTH*	*TOTAL PETROLEUM HYDROCARBONS*					*PAH*	*HEAVY METALS*									
		(m)	*C6-C9*	*C10-C14*	*C15-C28*	*C29-C36*	*TOTAL*		*Arsenic*	*TCLP*	*Cadmium*	*TCLP*	*Nickel*	*TCLP*	*Lead*	*TCLP*	*Mercury*	*TCLP*
S101	Aeolian Soil	0.0 - 0.2	<10	<50	<100	<100	<50	<0.5	<5		<1		<2		<5		<0.1	
S102	Aeolian Soil	0.2 - 0.4	<10	<50	<100	<100	<50	<0.5	<5		<1		<2		<5		<0.1	
S103	Aeolian Soil	0.0 - 0.2	<10	<50	<100	<100	<50	<0.5	<5		<1		<2		<5		<0.1	
S104	Aeolian Soil	0.0 - 0.2	<10	<50	<100	<100	<50	<0.5	<5		<1		<2		<5		<0.1	
S105	Aeolian Soil	0.0 - 0.2	<10	<50	<100	<100	<50	<0.5	<5		<1		<2		<5		<0.1	
S106	Aeolian Soil	0.2 - 0.4	<10	<50	<100	<100	<50	<0.5	<5		<1		<2		<5		<0.1	
S107	Aeolian Soil	0.0 - 0.2	<10	<50	<100	<100	<50	<0.5	<5		<1		<2		<5		<0.1	
S108	Aeolian Soil	0.0 - 0.2	<10	<50	<100	<100	<50	<0.5	<5		<1		<2		<5		<0.1	
THRESHOLD LIMITS																		
GENERAL SOLID WASTE		*CT1*							*100*		*20*		*40*		*100*		*4*	
		SCC1	*650*				*10000*	*200*	*500*		*100*		*1050*		*1500*		*50*	
		TCLP1							*5*		*1*		*2*		*5*		*0.2*	
RESTRICTED SOLID WASTE		*CT2*							*400*		*80*		*160*		*400*		*16*	
		SCC2	*2600*				*40000*	*800*	*2000*		*400*		*4200*		*6000*		*200*	
		TCLP2							*20*		*4*		*8*		*20*		*0.8*	

NOTES

CT	Contaminant Threshold (without TCLP)
SCC	Specific Contaminant Concentrations (used with TCLP)
TCLP	Toxicity Characteristics Leaching Procedure (used with SCC)
Shaded	Exceeds General Solid Waste Threshold = Restricted Solid Waste
BOLD and Shaded	Exceeds Restricted Solid Waste Threshold = Hazardous Waste

CRITERIA:

Waste Classification - Classifying Waste, Part 1 (*NSW EPA 2014*)

CERTIFICATE OF ANALYSIS

Work Order	: **ES2406136**	Page	: 1 of 10
Amendment	: **1**		
Client	: **REGIONAL GEOTECHNICAL SOLUTION**	Laboratory	: Environmental Division Sydney
Contact	: LOUIS DAVIDSON	Contact	: Customer Services ES
Address	: 1/12 Jindalee Road Port Macquarie NSW 2444	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 6553 5641	Telephone	: +61-2-8784 8555
Project	: RGS50057.1 PROPOSED CARAVAN PARK	Date Samples Received	: 26-Feb-2024 09:45
Order number	: ----	Date Analysis Commenced	: 27-Feb-2024
C-O-C number	: ----	Issue Date	: 11-Mar-2024 17:35
Sampler	: ANDREW HILLS		
Site	: 288 Mungo Brush Road Hawks Nest		
Quote number	: EN/222		
No. of samples received	: 10		
No. of samples analysed	: 10		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Sanjeshni Jyoti	Senior Chemist Volatiles	Sydney Organics, Smithfield, NSW

General Comments

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

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

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

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

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

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

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

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.
- Amendment (08/03/2024):This report has been amended to add additional analysis for sample 008, S108_0.0-0.2

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	S101_0.0-0.2	S102_0.2-0.4	S103_0.0-0.2	S104_0.0-0.2	S105_0.0-0.2
			Sampling date / time	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00
Compound	CAS Number	LOR	Unit	ES2406136-001	ES2406136-002	ES2406136-003	ES2406136-004	ES2406136-005
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**4.3**	**2.8**	**3.6**	**2.1**	**4.0**
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**16**	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg	**6**	<5	<5	<5	<5
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Nickel	7440-02-0	2	mg/kg	<2	<2	<2	<2	<2
Zinc	7440-66-6	5	mg/kg	**31**	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S101_0.0-0.2	S102_0.2-0.4	S103_0.0-0.2	S104_0.0-0.2	S105_0.0-0.2
				Sampling date / time	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00
Compound	CAS Number	LOR	Unit		ES2406136-001	ES2406136-002	ES2406136-003	ES2406136-004	ES2406136-005
					Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg		**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg		**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S101_0.0-0.2	S102_0.2-0.4	S103_0.0-0.2	S104_0.0-0.2	S105_0.0-0.2
				Sampling date / time	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00
Compound	CAS Number	LOR	Unit		ES2406136-001	ES2406136-002	ES2406136-003	ES2406136-004	ES2406136-005
					Result	Result	Result	Result	Result
EP080: BTEXN - Continued									
^ **Total Xylenes**	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.5	%		**104**	**96.9**	**94.2**	**91.8**	**95.8**
2-Chlorophenol-D4	93951-73-6	0.5	%		**85.1**	**85.7**	**97.0**	**84.4**	**83.5**
2.4.6-Tribromophenol	118-79-6	0.5	%		**65.8**	**62.1**	**59.4**	**53.4**	**65.7**
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%		**105**	**88.1**	**92.8**	**92.6**	**102**
Anthracene-d10	1719-06-8	0.5	%		**83.6**	**88.6**	**89.4**	**91.4**	**85.6**
4-Terphenyl-d14	1718-51-0	0.5	%		**94.1**	**86.7**	**89.8**	**100**	**101**
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		**97.8**	**97.1**	**88.8**	**103**	**89.8**
Toluene-D8	2037-26-5	0.2	%		**102**	**99.8**	**90.3**	**108**	**95.4**
4-Bromofluorobenzene	460-00-4	0.2	%		**91.9**	**88.1**	**83.4**	**98.2**	**89.5**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	S106_0.2-0.4	S107_0.0-0.2	S108_0.0-0.2	D1_0.2-0.4	----
			Sampling date / time	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00	----
Compound	CAS Number	LOR	Unit	ES2406136-006	ES2406136-007	ES2406136-008	ES2406136-009	--------
				Result	Result	Result	Result	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	3.3	3.1	2.6	1.6	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	----
Chromium	7440-47-3	2	mg/kg	<2	<2	<2	<2	----
Copper	7440-50-8	5	mg/kg	<5	<5	<5	<5	----
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	----
Nickel	7440-02-0	2	mg/kg	<2	<2	<2	<2	----
Zinc	7440-66-6	5	mg/kg	<5	<5	<5	<5	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S106_0.2-0.4	S107_0.0-0.2	S108_0.0-0.2	D1_0.2-0.4	----
				Sampling date / time	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00	----
Compound	CAS Number	LOR	Unit		ES2406136-006	ES2406136-007	ES2406136-008	ES2406136-009	--------
					Result	Result	Result	Result	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	----
^ **Benzo(a)pyrene TEQ (half LOR)**	----	0.5	mg/kg		**0.6**	**0.6**	**0.6**	**0.6**	----
^ **Benzo(a)pyrene TEQ (LOR)**	----	0.5	mg/kg		**1.2**	**1.2**	**1.2**	**1.2**	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	----
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	----
C15 - C28 Fraction	----	100	mg/kg		<100	<100	<100	<100	----
C29 - C36 Fraction	----	100	mg/kg		<100	<100	<100	<100	----
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg		<50	<50	<50	<50	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	----
>C10 - C16 Fraction	----	50	mg/kg		<50	<50	<50	<50	----
>C16 - C34 Fraction	----	100	mg/kg		<100	<100	<100	<100	----
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	<100	<100	----
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg		<50	<50	<50	<50	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg		<50	<50	<50	<50	----
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	----
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	----
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	----
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	----
^ **Sum of BTEX**	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	S106_0.2-0.4	S107_0.0-0.2	S108_0.0-0.2	D1_0.2-0.4	----
				Sampling date / time	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00	21-Feb-2024 00:00	----
Compound	CAS Number	LOR	Unit		ES2406136-006	ES2406136-007	ES2406136-008	ES2406136-009	--------
					Result	Result	Result	Result	----
EP080: BTEXN - Continued									
^ **Total Xylenes**	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	----
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.5	%		**94.2**	**102**	**80.2**	**102**	----
2-Chlorophenol-D4	93951-73-6	0.5	%		**88.0**	**84.8**	**85.6**	**86.6**	----
2.4.6-Tribromophenol	118-79-6	0.5	%		**55.2**	**58.6**	**45.1**	**65.2**	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%		**91.1**	**93.4**	**87.7**	**101**	----
Anthracene-d10	1719-06-8	0.5	%		**90.4**	**90.7**	**89.0**	**83.3**	----
4-Terphenyl-d14	1718-51-0	0.5	%		**95.9**	**89.4**	**110**	**102**	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		**96.4**	**92.1**	**102**	**91.9**	----
Toluene-D8	2037-26-5	0.2	%		**97.0**	**94.0**	**95.7**	**96.0**	----
4-Bromofluorobenzene	460-00-4	0.2	%		**88.1**	**88.9**	**101**	**88.2**	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	RINSATE1	----	----	----	----
			Sampling date / time	21-Feb-2024 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2406136-010	--------	--------	--------	--------
				Result	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	<20	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	----	----	----	----
Toluene	108-88-3	2	µg/L	<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	----	----	----	----
^ **Total Xylenes**	----	2	µg/L	<2	----	----	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**98.8**	----	----	----	----
Toluene-D8	2037-26-5	2	%	**101**	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**118**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: SOIL		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	63	123
2-Chlorophenol-D4	93951-73-6	66	122
2.4.6-Tribromophenol	118-79-6	40	138
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	70	122
Anthracene-d10	1719-06-8	66	128
4-Terphenyl-d14	1718-51-0	65	129
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	63	125
Toluene-D8	2037-26-5	67	124
4-Bromofluorobenzene	460-00-4	66	131

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	72	143
Toluene-D8	2037-26-5	75	131
4-Bromofluorobenzene	460-00-4	73	137

Appendix C

Letter from Dr David Tully CEnvP SC

Contaminated Land Solutions

8 March 2024

Ref: CLS0254.L02

Regional Geotechnical Solutions Pty Ltd
2 Murray Dwyer Circuit
Mayfield West
NSW 2304

For the attention of Andrew Hills

Dear Louis,

RE: Report Review: Detailed Site Investigation – Contamination Assessment Proposed Caravan Park Lot 2 DP1015609 (288) Mungo Bush Road, Hawks Nest

I, Dr David Tully of Contaminated Land Solutions Pty Ltd, am a Certified Environmental Practitioner Site Contamination Specialist (General Certified Environmental Practitioner certification no. 1138 and Site Contamination Specialist certification no. SC40084).

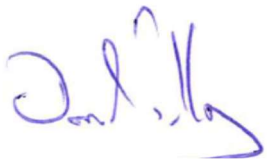
I confirm I have reviewed the Regional Geotechnical Solutions report entitled "*Detailed Site Investigation – Contamination Assessment - Proposed Caravan Park Lot 2 DP1015609 (288) Mungo Bush Road, Hawks Nest*" (Ref: RGS50057.1-AD), dated 8 March 2024 and a copy of which I have retained.

I can confirm that on the basis of the information contained within the report, I support the conclusions and recommendations provided therein.

Should the client, regulator or local authority have any queries regarding the report review, I can be contacted by e-mail via david.tully@contaminatedlandsolutions.com.au. Specific queries regarding the content of the report should be addressed to Andrew Hills at Regional Geotechnical Solutions.

For and on behalf of

Contaminated Land Solutions Pty Ltd



Dr David Tully CEnvP SC
Director
Contaminated Land Solutions Pty Ltd

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Easterly Point Environmental

www.easterlypoint.com

Mr. Andrew Hills
Associate
Regional Geotechnical Solutions
44 Bent Street
Wingham, New South Wales 2429

Ref. 24025L01-RGS01 11 March 2024

Dear Andrew,

Preliminary Radiological Investigation
Proposed Caravan Park, Lot 2 DP 1015609
288 Mungo Brush Road, Hawks Nest, NSW

Easterly Point was commissioned by Regional Geotechnical Solutions (RGS) to undertake a surface gamma radiation survey at the above site, and to provide an assessment of the potential for radioactive heavy mineral sands to be present at the site. The scope of work was detailed in Easterly Point's proposal of 11 December 2023, which was accepted by RGS on 25 January 2024.

This letter-report and attachments should be read in full, and in conjunction with the *Limitations to contaminated land information*, which are included in Appendix 1.

1.0 Objectives

The objective of this preliminary radiation investigation (PRI) was to provide a preliminary characterisation of the radiological condition at the site, along with recommendations as to further work. This PRI does not seek to address other aspects of contaminated land and/or the broader environment, and is limited to the assessment of site history and environmental information related to the potential for heavy mineral sands and the associated radiological impacts.

Queensland Health (2020) describes that the purpose of a PRI is to determine the presence of radiological contamination and to assess the need for further investigation or management. And that preliminary investigations should include:

- *a brief description of the site history, and current and past uses of the site;*
- *a description of the current condition of the site, identifying areas of actual or potential contamination;*
- *a description of the current and past potentially contaminating activities;*
- *one or more of the following types of radiation monitoring (as appropriate to the site and the suspected contaminant):*
  - *external radiation dose rate survey,*
  - *surface contamination survey,*
  - *soil or water sample analysis;*

- *an assessment of natural background radiation levels if required; and*
- *an assessment of the need for further investigation, with a description of what investigative work is necessary.*

For suspected radioactive contaminants, Queensland Health (2020) describes that "the accepted way of obtaining preliminary information is usually via a gamma dose rate survey across the site". This method is appropriate for radionuclides with a significant gamma activity component, which is the case for heavy mineral sands sites and the associated heavy mineral sands residues (HMSRs)[1].

The aim of a preliminary radiation surveys is to gain a representative view of the radiation dose rates around the site, and to delineate areas that exceed the relevant screening reference levels; which is usually a principal determinant of whether further investigation or action need to be taken. Queensland Health (2020) notes that "A screening survey may not yield conclusive results, but combined with the site history may indicate whether a more detailed investigation is required".

Accordingly, the objective of this PRI was to determine whether a significant potential for HMSRs exists at the site, and whether a more detailed investigation is required.

2.0 Scope of work and sampling strategy

The scope of work for this PRI consisted of:

- review of available site history information, including local archives, published information, and web-based resources, to inform the desktop study and to guide field work;
- conducting a preliminary surface gamma radiation survey at the site;
- analysing the resulting data, including tabulation, statistical analysis, mapping, and comparison to known data and site history; and
- reporting of findings as a standalone report, suitable for inclusion as an appendix to RGS contaminated land detailed site investigation (DSI) report.

The sampling strategy was to collect broad scale spatially correlated gamma dose rates, with targeted spot readings in areas of potential interest, while looking for discernible signs of sand mining, mineral sands, or mining and processing artefacts.

If areas of interest or specific potential mineral sands were identified, targeted soil/fill samples were proposed for subsequent laboratory analysis. Laboratory analysis could include low resolution gamma spectrometry (LRGS) and/or high resolution gamma spectrometry (HRGS) to measure activity concentrations, and total alpha activity and total beta activity to determine conditions in water or leachate. Based on the field results, no physical samples were collected for analysis.

3.0 Background

RGS (2023) undertook a preliminary site investigation (PSI) contamination assessment for a proposed caravan park development at the site, in which an area was identified with a potential for radioactive heavy mineral sands residues (HMSRs) to have been applied to land. Whereas no specific site history information was found which indicated specific mining activities, including disposal of spoil, the former Mineral Deposits Limited (MDL) dry processing plant is located 1.8 km to the north of the site, and some mining is thought to have occurred in the immediate vicinity. Accordingly, a potential exists that some radiological hazard is present at the site.

RGS (2023) recommended that:

[1] See attached *Radiation references and glossary* for details of radiological terms and units.

> *an environmental consultant experienced with assessments of radiation risks associated with former sand mines be engaged to undertaken a detailed site investigation to assess potential radiation at the site. Whilst the risk of radiation to human health is considered to be low, it would be prudent for such an assessment be undertaken based on the evidence encountered by the site history study.*

As part of their PSI, RGS identified possible sand mining and the radiation associated with sand mining works as a potential environmental concern. Sites associated with heavy mineral sands include former sand mining sites and processing plants, or land where HMSRs have been stockpiled, used as fill or bedding sands, pumped as tailings slurries, or used in trenching or top-dressing, or applied to land for any purpose; noting that they are most commonly associated with low lying land in close proximity to former dry processing plants and associated transport routes.

Heavy mineral sands mining commenced in the early 1930s in northern NSW, and continued through to the early 2000s. The primary minerals were zircon and rutile, with ilmenite and monazite also being economical at various times. Mining was conducted either from floating barges or as land based, with post mining processing including concentrating by wet processing based on gravity separation, and subsequent dry processing based on electromagnetic, electrostatic, and further gravity separation. Wet processing occurred at the mine site, either on floating dredges or on land adjacent to the mining, with the more complex dry processing occurring at larger, generally off-site, dry separation plants.

The silica sand was returned to the dredge pond or used to backfill the mining voids, although at times, depending on the location of the dry mill, waste tailings and/or off-spec material was returned to the pond or void. When ilmenite and monazite were un-economical, stockpiles of these minerals were generated, usually in proximity to the dry mill.

The primary hazard associated with HMSRs results from external gamma radiation, and therefore assessments typically target the exposure to gamma radiation from the HMSRs in soils and fill materials. This hazard exists as the minerals, particularly monazite and zircon, are high in the naturally occurring radioactive materials (NORMs) uranium and thorium.

4.0 Regulatory requirements

Section 4.6, *Contamination and remediation to be considered in determining development application*, of *State Environmental Planning Policy (Resilience and Hazards)* 2021, specifies that in determining development approvals, consent authorities must consider whether the land is contaminated, and if so, whether the land will be suitable, with or without remediation, for the purpose of the proposed development. Where a change in land use is proposed, the consent authority must consider the findings of a PSI. If warranted by the findings of the PSI, a consent authority may require a DSI to be conducted.

In conducting the required investigations, Section 4.14, *Guidelines and notices: all remediation work*, of the SEPP requires that all remediation work, including associated investigations, must be carried out in accordance with, amongst others, the made and approved guidelines specified in Section 105 of the *Contaminated Land Management (CLM) Act* 1997.

The primary technical guidance for contaminated land site investigations is the National Environment Protection Council (NEPC) (2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999,* including *Amendment Measure 2013 (No. 1)* (ASC NEPM), which describes that specialised forms of assessment are required for sites affected by, amongst others, radioactive substances.

In situations where these occur, the ASC NEPM recommends that guidance for assessment requirements is sought from the relevant jurisdictional environmental or health authority. And

that while the general principles of site assessment are applicable, compliance with specialised safety protocols and assessment guidance is essential to ensure the protection of human health and the environment.

Although commonly referenced, the NSW Department of Health, Radiation Branch's 1984 Radiation Safety Information Series No. 12, is not an endorsed guidance since the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) radiation protection series commenced in 2001. The germane guidance recognised by the Environment Protection Authority (EPA) in regard to radiation protection is therefore the relevant ARPANSA guidance, including 2008, 2017, and 2020.

Whereas these provide some general comments in regard to site investigations, guidance specifically relevant to contaminated land investigations and radiation from HMSRs is found in Northern Rivers Contaminated Land Program (NRCLP) (2021) and Queensland Health (2020). NRCLP (2021) describes under *Site Assessment of Heavy Mineral Sands Residues*, that:

> *Council may require an assessment of sites potentially affected by heavy mineral sands to demonstrate suitability for the proposed development or land use.*
>
> *Queensland Health (2020) and ARPANSA guidance (2008, 2017 and 2020) provide specific details for the assessment of HMSR sites. The reporting of site assessments must be in accordance with NSW EPA statutory guidelines (e.g. EPA 2020, EPA 1995, and ASC NEPM 2013; or subsequent updates).*

NRCLP (2021) and Queensland Health (2020) have been predominantly relied on in the conducting of this PRI.

5.0 Historic review

Locations associated with heavy mineral sands in the Port Stephens area are shown in Figure 5.1 and summarised in Table 5.1 (overleaf), with the information being sourced from Morley (1981).

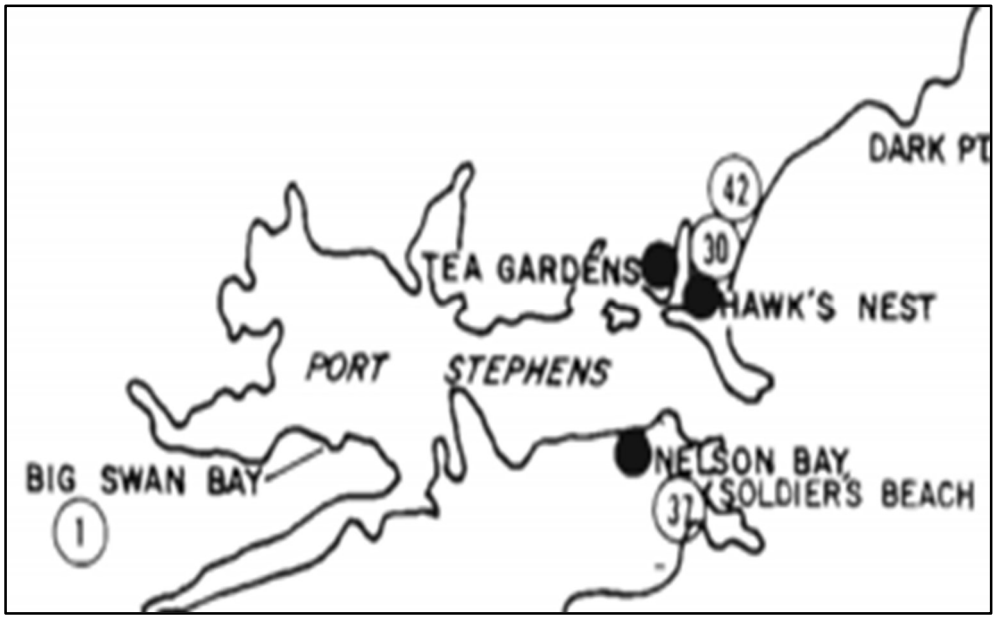


Figure 5.1: Port Stephens locations of sites associated with heavy mineral sands
Source: Morley, 1981

Table 5.1: Port Stephens historic information on heavy mineral sands (Morley 1981)

Location	Details [1]
1	Associated Minerals Pty Ltd acquired a number of existing mineral sands operations throughout the 1950s and 1960s, and mining operations were carried out on most of the areas acquired, with major mining operations at South Stradbroke Island, North Entrance, and Big Swan Bay near Newcastle. Their dry treatment plants were described as being located at North Stradbroke Island and Southport in Queensland, and Hexham in NSW; i.e. not Hawks Nest.
30	Mineral Deposits Limited (MDL) was a major producer, including at Hawks Nest, NSW. In 1981, along the northern coast of NSW the company operated eight mines with a total throughput of over 22 million tonnes of sand, and an annual production from its dry mills at Crescent Head and Hawks Nest of some 75,000 tonnes of rutile, zircon, and monazite concentrates.
37	Northen Rivers Rutile Pty was a private company which acquired leases in the Woodburn – Jerusalem Creek area, and also had interests in prospective areas in the Port Stephens district.
42	R.Z. Mines (Newcastle) (RZM) had dry concentration plants at Tomago and Harrington, with extensive mining operations at Tomago, Hawks Nest, and Harrington (Mitchell Island).

Table notes:
1. The most familiar company names are used for reference, noting that various acquisitions over the years means that often multiple companies, subsidiaries, and associated companies are described.

The first successful mining application in the Great Lakes area was granted to MDL in 1965, for an area north of Hawks Nest in the present Myall Lakes National Park (Great Lakes Council, 2007). Mining intensified and extended northwards during the 1970s as MDL and R.Z. Mines (Newcastle) (RZM) began mining the high coastal dunes lying east of Myall Lakes.

Based on concerns over environmental impacts, despite strong local support for the mining and the associated economic benefits, a small area on the eastern side of Myall Lakes was declared as the Myall Lakes National Park in 1972. The Park was progressively enlarged during the 1970s, and in June 1977, it was decided that no further mining would be allowed in the Park, and that all existing mining was to be completed by 1983, with revegetation to be completed by 1987 (Great Lakes Council, 2007). Sandmining was also carried out by RZM and MDL northward in the Elizabeth Beach and Boomerang Beach (Pacific Palms) area, and along Nine Mile Beach north of Tuncurry during the 1970s.

An ASX Third Quarter Activities Report of April 2002, described the MDL operations as:

> *The operation involves the production of rutile, zircon and ilmenite concentrate at the wholly-owned Fullerton and Viney Creek mine sites, both of which are active, and processing at the Hawks Nest dry mill. The Fullerton site, some 70 kilometres south of the mill, consists of a dredge and wet concentrator. Viney Creek is approximately 12 kilometres west of Hawks Nest and comprises a floating concentrator and two dredges. The final products of rutile and zircon are trucked to Newcastle for storage and bulk shipment, in most cases to overseas customers. Ilmenite continues to be sold in small quantities to local buyers at the mill site.*

Bartolo Safety Management Service (BSMS) (2007) describes that part of the MDL processing site was sand mined in early 1960s, and that the MDL Hawks Nest dry processing plant was established in 1966. The plant was designed to process heavy mineral concentrate from sand mining operations within the area, and produced rutile, zircon, ilmenite, and monazite. The

monazite plant was reportedly decommissioned in 1998, and removed in 1999 – 2000. Following cessation of mining operations in 2003, mineral processing operations ceased at the Hawks Nest plant, and a program of care and maintenance commenced, during which time MDL commenced the decommissioning process.

BSMS (2007) describes that little of the actual history in terms of waste deposition is known, although there were a number of remediation projects to deal with stockpiles of active material, including:

- on-site trial burial of monazite tailings in 2000;
- blending of garnet tailings with clean sand to produce non-radioactive material and buried on-site in 2002; and
- blending of active zircon magnetics stockpile with clean silica sand, and burial at the Viney Creek mining site.

A review of the available aerial photographs from the Historical, Aerial and Satellite Imagery website[2], [3] was conducted, with a 1971 and a 1993 photograph being available (see Appendix 2). The MDL plant was discernible in both, with what appears to be an old dredge path running to the west of Mungro Brush Road, from the beach at Dark Point to the MDL plant.

In the 1971 aerial photograph, a track appears to run from the plant to the northern boundary of the site, and perhaps the lower vegetation behind the dunes is a relic of former mining, although this is not sufficiently clear to form an opinion. There are no indications discernible at the site of other activities, or of HMSRs, and it appears to be undeveloped.

In the 1993 aerial photograph, there is some removal of vegetation and areas of exposed assumed beach sand. An assumed dredge path exists to the west of Mungo Brush Road, which passes behind the site. No indications of HMSRs can be seen at the site, although it appears some development has commenced.

A 2012 aerial photograph was also reviewed from the SIX Map site[4]. The site is covered by mature vegetation, with some areas of exposed white sand discernible. There is a building in the eastern portion on the northern boundary, with some structures visible to the south-west, and a shed further to the south-west, near the southern boundary. There are no discernible signs of heavy mineral sands. Some buildings abut the south-eastern boundary,

6.0 Environmental media and exposure pathways

The nature of heavy mineral sand grains means they are not readily soluble, such that contamination of surface water and groundwater is not normally a major concern in the assessment of land contamination in relation to heavy mineral sands. Other potential pathways include ingestion of minerals and indirect pathways such as in food or water, although for mineral sands, because of their insoluble nature, these pathways are not generally considered to be realistic.

Whereas inhalation of dust containing long-lived alpha-emitting radionuclides is a potential exposure pathway, the heavy nature of the minerals, and the relevant concentrations, means that dust is not a realistic exposure pathway where the dry processing of heavy mineral sands does not occur. Another potential exposure pathway is inhalation of the short-lived decay products of radon gas. However, this requires poorly ventilated areas to allow build up, and is not generally a characteristic of these minerals as the radioactive gas radon is mostly retained within the mineral sand grains.

---

[2] https://www.spatial.nsw.gov.au/products_and_services/aerial_and_historical_imagery

[3] The specific dates of the aerial photographs are not clear from the website, with multiple dates provided, and a "best guess" of the date selected.

[4] https://maps.six.nsw.gov.au

For HMSRs, as external dose rate is the radiation quantity that largely determines the annual dose for human exposure, it is exposure to external gamma radiation from the concentrates and the like that is generally targeted, with the media of concern being soils and fill materials. Nevertheless, where warranted, this approach needs to be confirmed on a site-specific basis, to confirm that surface waters, groundwaters, and air are not specific media of concern. This should include the development of a site-specific, robust conceptual site model (CSM).

The currently understood potential radiological CSM is shown in Figure 6.1, noting that following the investigation, a more accurate revised CSM can be confirmed.

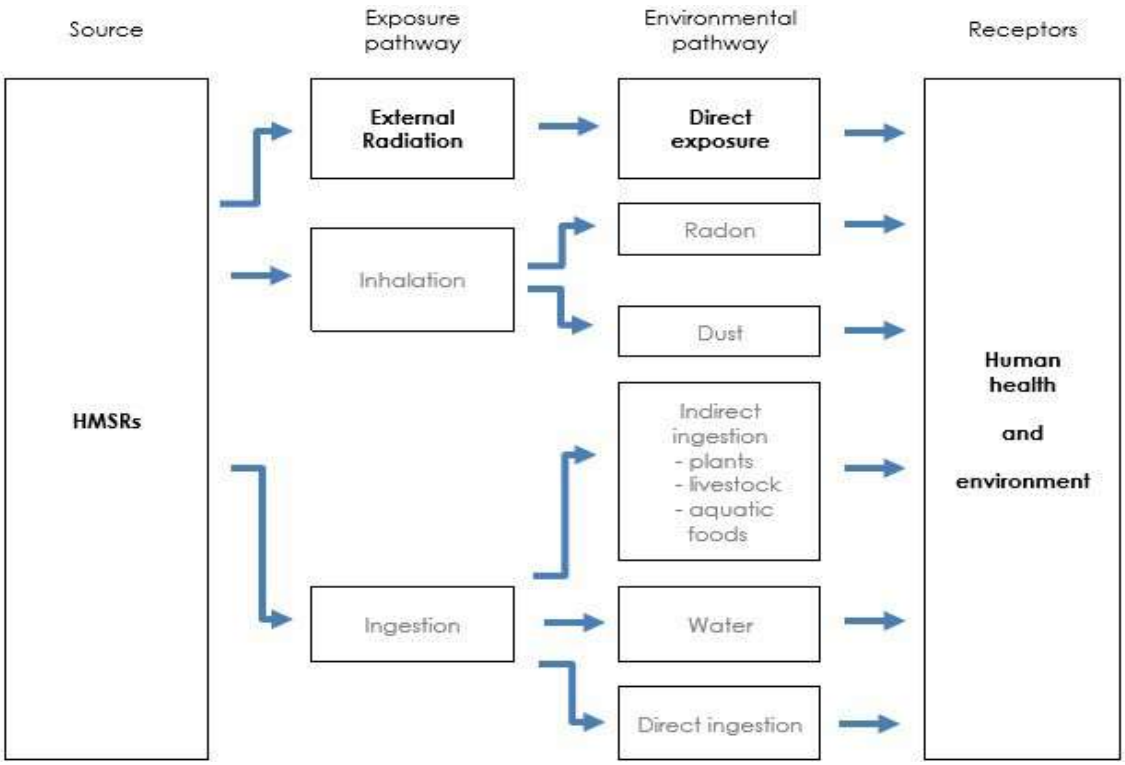


Figure 6.1: Conceptual site model (CSM) of exposures from HMSRs

7.0 Dose criteria

Queensland Health (2020) describes the default external background radiation dose rate as 80 nGy/h (terrestrial and cosmic), noting that natural background radiation varies depending on latitude, elevation, and geology.

ARPANSA (2017) describes that reference levels are used for optimisation of protection in existing exposure situations. Queensland Health (2020) has set a screening reference level for external gamma dose rates of 150 nGy/h, which includes both terrestrial and cosmic background, for preliminary screening. The application of which is described as:

> *If the value of the radiation quantity measured is less than the screening reference level, there is no requirement for further investigation unless there is evidence to suggest otherwise.*
>
> *If the value of the radiation quantity measured is greater than the screening reference level, a comparison should be made with the local natural background value to assess the need for a further investigation.*

External dose rate is the radiation quantity that largely determines the annual dose for human exposure (Queensland Health 2020), and the screening reference level of 150 nGy/h is the level above which further investigation is justified. Whereas further investigation may be as simple as ascertaining that the ambient natural radiation level in the vicinity is consistent with the measured external dose rate, if this is not the case, more detailed investigation and/or management may be required.

A dose constraint of 0.3 mSv per annum for planned exposure situations, that is situations based on current regulated practices, is specified by Queensland Health (2020). They describe that this is the dose that approved disposal of radionuclides to the environment should not exceed. This value is consistent with typical variations in natural background radiation levels in Australia, which ARPANSA (2008) describes as of the order of 0.1 – 0.3 mSv/y.

Schedule 5, *Dose limits for exposure to ionising radiation*, of the *Protection from Harmful Radiation Regulation* 2013, specifies a dose limit to members of the public as effective dose of 1 mSv per year, noting that any dose resulting from medical diagnosis or treatment, or attributable to normal naturally occurring background levels of radiation, should not be taken into account. The dose limit is the basis for determining land use dose criteria, along with the exposure duration based on the ASC NEPM (2013, B7) exposure scenarios.

At the most conservative exposure duration of 8,766 hours per year, using the mid-point conversion coefficient of 0.8 Sv Gy^{-1}, and including background radiation (terrestrial and cosmic), the residential land use criterion proposed is 300 nGy/h (1 mSv/y). This can be thought of as the HIL-A/HIL-B value in the context of the ASC NEPM (2013, B1).

8.0 Measuring external radiation

External radiation surveys are conducted using an appropriate dose rate meter, held approximately 1 m above the ground. In addition to the radiation source, dose rate meters also measure some radiation intrinsic to the meter, terrestrial background radiation, and cosmic background radiation; with the amount of cosmic radiation measured in part dependent on the type of meter used.

Queensland Health (2020) describes that radiation monitoring equipment should:
- have a suitable energy response to detect the suspected contaminants;
- have a minimum detectable level lower than that of natural background radiation; and
- be able to distinguish the presence of the radioactive contaminant from the naturally occurring background radioactive material.

Uncharged radiation including gamma, X-ray, and neutrons interact with other atoms via direct collision, and as a result travel some distances into a material before losing any energy. Consequently, intervening material provides "shielding" from gamma radiation, with denser materials providing greater shielding, as these increase the chance of collisions. However, due to the probabilistic nature of the interactions between gamma radiation and matter, not all of the radiation's energy will be lost in the shielding material; in fact, a portion of the incident radiation will pass through the shield unaltered, such that even with shielding in place, a radiation dose can be detected beyond the shielding.

In a practical sense, this means that with typical soil densities and moisture content, approximately 90% of the measured exposure rate originates from the top 0.2 m of material over an 8 m radii at 1 m above the ground. Gamma radiation emitting materials at greater depths are therefore shielded by overlying materials. The degree of shielding is related to both the activity and quantity of the source material, and the thickness and density of the shielding material. This means that regardless of surface readings, surface surveys cannot categorically rule out radioactive materials at depth.

Dose rate meters assume that a semi-infinite plain is being measured (open geometry), with confounding readings occurring where "multiple planes" exist (enclosed geometry). These geometry effects occur where readings are taken close to walls or batters, or within test pits or trenches, as multiple sources increase the recorded dose rate.

9.0 Sampling and analysis methods

The surface gamma radiation survey was conducted by Marc Salmon[5] of Easterly Point, by walking at a slow pace along transects across the site. The survey was conducted using a calibrated Radiation Solutions RS-220G 2" NaI(Tl) gamma spectrometer (Serial No. 6366), with locations recorded using a Reach RS2 GPS connected to the RS-220; noting that locations are approximate and do not exactly correlate with the mapped positions.

The accuracy of the survey and of the positional recording rely on the quality of the available satellite coverage, which can be reduced by vegetation and structures. In this case, thick vegetation and the rural location meant a low quality of satellite coverage, and at the time of the survey, orientation within the site was difficult. Nevertheless, sufficient coverage of the site was achieved to allow an opinion as to the potential for HMSRs.

The survey was conducted approximately 1 m above the ground, with dose rate readings recorded every ~ 5 seconds. The recorded dose rates were corrected by the calibration factor of the dose rate meter (0.91) and for background cosmic radiation, such that background radiation as both cosmic and terrestrial is included in the reported dose rates. The dose rate meter used meets the requirements and specifications detailed in Queensland Health (2020) for radiation monitoring equipment, including appropriate calibration, with the calibration certificate shown in Appendix 3.

10.0 Investigation results

The site inspection and field monitoring were conducted on the 21 February 2024, in concert with field work by Andrew Hills of RGS. The site was heavily vegetated with mature trees in the most part, with some tracks and areas of low grasses, along with areas of bare exposed sand. Along the tracks, some areas of basalt roadbase gravel were obvious, although this did not appear to be extensive. While there were a number of old buildings/structures, there were no indications of former mining, processing, or associated artefacts or relics. There were no traces of heavy mineral sands discernible in any areas of the site, noting that the characteristics generally include gunmetal grey to black heavy sands, with a distinct glassy – metallic lustre (sparkle). Site photographs are shown in Appendix 4.

The surface gamma radiation survey results are summarised in Figure 10.1 (overleaf) as a histogram of dose rates, and the dose rates are spatially plotted in Figure 3 (figures section). The recorded dose rates were all below the screening refence level of 150 nGy/h, and were generally below background of 80 nGy/h. The maximum reading was 97 nGy/h, the median was 44.6 nGy/h, and the 3rd quartile of the data set was 51.3 nGy/h; noting that where HMSRs exist, readings are generally in the 100s and 1,000s nGy/h. Where elevated readings were recorded, i.e. > 80 nGy/h, gravel roadbase was noted on the ground surface, and no elevated readings indicative of HMSRs were detected related to the site.

---

[5] Marc Salmon is a current member of prescribed organisations under Schedule 14, *Prescribed organisations*, of the Queensland *Environmental Protection (EP) Regulation* 2019 (the Environment Institute of Australia and New Zealand (EIANZ) and the Australasian Radiation Protection Society (ARPS)), pursuant to Section 564 of the Queensland *Environment Protection (EP) Act* 1994. He has qualifications and experience relevant to the regulatory function as required under Section 564.

Marc is a Certified Environmental Practitioner (CEnvP) Site Contamination Specialist (SCS), a NSW EPA accredited site auditor, and a Queensland DES approved contaminated land auditor. He has specialist training and experience in radiation protection and in the assessment and management of contaminated land.

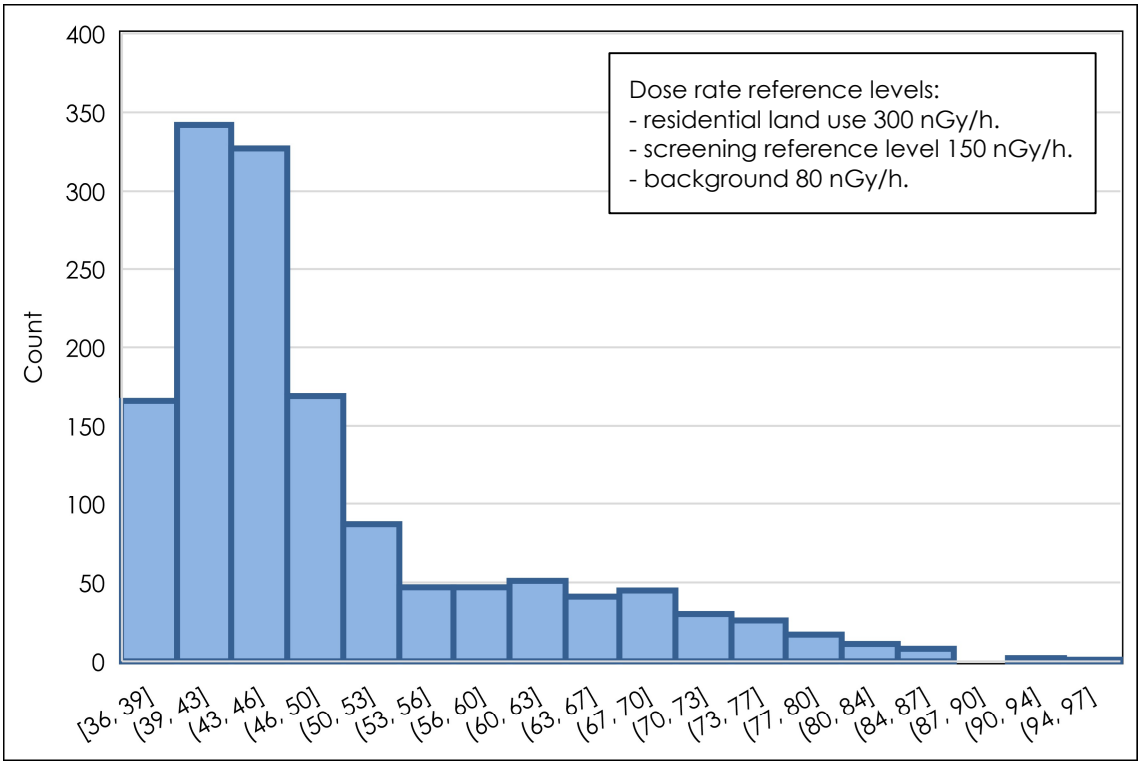


Figure 10.1: Histogram of surface gamma radiation survey (nGy/h), February 2024

11.0 Discussion and conclusion

The PRI conclusions are based on the information described in this letter-report and attachments, and the conclusions should be read in conjunction with the complete report and attachments, including Appendix 1, *Limitations to contaminated land information*.

The site history review did not uncover any historical information, including within the available aerial photographs, to suggest processing activities or waste disposal occurred at the site, and no indications of heavy mineral sands were discernible during the site inspection and surface gamma radiation survey. It is noted that from the aerial photograph review and previous site inspections at the MDL plant, substantial volumes of HMSRs were retained on that site; suggesting a lower potential for sites in the surrounding area to have been used for application to land of HMSRs.

While it is noted that the vegetation and associated leaf litter were dense, and in much of the site the soil surface was obscured, no dose rates were recorded which indicate heavy mineral sands. While the thick vegetation and site location restricted satellite coverage, thereby impeding the ability for orientation on the site at all times, sufficient coverage and data was achieved to state that there is considered to be a very low probability of significant HMSRs at the site.

Nevertheless, as for all subsurface work, a potential exists that further material or areas of potential contamination could be detected. While this is considered unlikely in regard to heavy mineral sands or radiation, an unexpected findings protocol (UFP) should be developed for any future site work, and the UFP should include the potential for the identification of heavy mineral sands.

✧ ✧ ✧ ✧

Thank you for your time in regard to this matter. Please do not hesitate to contact the undersigned on (02) 6685 6681 if you require additional information or clarification.

Yours sincerely
Easterly Point Environmental Pty Ltd

Marc Salmon
Principal Environmental Scientist

Accredited Site Auditor (NSW)
Contaminated Land Auditor (Qld)
MEIANZ, CEnvP SCS, MARPS

Attached:

Radiation references and glossary

Figures

Figure 1: Site location and site layout

Figure 2: Site layout and proposed caravan park

Figure 3: Surface gamma radiation survey (nGy/h), 21 February 2024

Appendix 1 – Limitations to contaminated land information

Appendix 2 – Aerial photographs

Appendix 3 – Calibration certificates

Appendix 4 – Site photographs

Radiation references and glossary

References – radiological

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) (2008) *Management of Naturally Occurring Radioactive Material (NORM); Radiation Protection Series No. 15*.

ARPANSA (2014) *Fundamentals: Protection Against Ionising Radiation, Radiation Protection Series F-1*.

ARPANSA (2017) *Guide for Radiation Protection in Existing Exposure Situations; Radiation Protection Series G-2*.

ARPANSA (2020) *Code for Radiation Protection in Planned Exposure Situations; Radiation Protection Series C-1 (Rev. 1)*.

Department of Environment and Climate Change NSW (DECC) (2009) *Guidance for Licensing of Mineral-sand Mining that Generates Radioactive Residues*.

National Environment Protection Council (NEPC) (2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999*, including *Amendment Measure 2013 (No. 1)*, (ASC NEPM), including:
- *Schedule A: Recommended General Process for Assessment of Site Contamination;*
- *Schedule B1: Schedule B1: Guideline on Investigation Levels for Soil and Groundwater*;
- *Schedule B2: Guideline on Site Characterisation;* and
- *Schedule B7: Guideline on Derivation of Health-Based Investigation Levels.*

New South Wales Department of Health, Radiation Branch (1984) *Radiation Safety Information Series No. 12, Clean-Up and Disposal of Radioactive Residues from Commercial Operations Involving Mineral Sands*.

Northern Rivers Contaminated Land Program (NRCLP) (2021) *Radiation from Heavy Mineral Sands Residues (HMSRs)*.

Queensland Health (2020) *Land contaminated by radioactive material – A guide to assessment, management and remediation*.

References – site related

Bartolo Safety Management Service (BSMS) (November 2007) *Radiation Remediation Plan For the MDL Pty Ltd Site, Hawks Nest, NSW*.

Great Lakes Council and NSW Heritage Office (2007) Great Lakes Council Heritage Study.

Morley I. W. (1981) *Black Sands; A History of Mineral Sand Mining in Eastern Australia*.

Regional Geotechnical Solutions (RGS) (March 2023) *Preliminary Site Investigation, Proposed Caravan Park, Lot 2 DP 1015609 (288) Mungo Brush Road, Hawks Nest*, (Ref. RGS50057.1-AC).

Glossary

ALARA	
Alpha (α)	Alpha particles are emitted from the nucleus of a radioisotope and are made up of two protons and two neutrons, with a positive charge of two (+2). They are highly ionising but only weakly penetrating.
Beta (β)	Beta particles are energetic electrons emitted by the nucleus of the radioisotope and they have a negative charge of one (-1). Beta particles are less ionising than alphas but more penetrating.
Becquerel (Bq)	SI unit of radioactivity, which is defined as the activity of a quantity of radioactive material in which one nucleus decays per second. *Radiation activity* as the number of particles/photons emitted per second by a radioactive source.
Dose rate units	1 sievert (Sv) = 1,000 millsieverts (mSv), 1 mSv = 1,000 microsieverts (µSv) and 1 µSv = 1,000 nanosieverts (nSv); 1 gray (Gy) = 1,000 milligrays (mGy), 1 mGy = 1,000 micrograys (µGy) and 1 µGy = 1,000 nanograys (nGy).
Gamma (γ)	Gamma rays are a type of ionising electromagnetic radiation, produced by changes within the nucleus. Gamma rays are weakly ionising but highly penetrating.
Gray (Gy)	Radiation exposure as an absorbed dose. It is equivalent to the energy in joules deposited in a kilogram of a substance by the radiation.
HMSRs	Heavy mineral sand residues are waste or reject materials of heavy mineral sands, primary the minerals rutile, ilmenite, zircon, and/or monazite. Found at sites associated with heavy mineral sands, including former sand mining sites and processing plants, or land where these materials have been stockpiled, used as fill or bedding sands, pumped as tailings slurries, or used in trenching or top-dressing, or applied to land for any purpose.
Potassium (K)	Isotope potassium 40 or K-40.
NORMs	Naturally occurring radioactive materials, which include K-40, Th-232, and U-238.
Sievert (Sv)	*Radiation exposure* as an *equivalent dose*. It is the absorbed dose weighted for harmful effects of different radiation types. Determined by multiplying the absorbed dose (Gy) by a radiation weighting factor (WR), as some types of radiation are inherently more dangerous to biological tissue. *Radiation exposure* as an *effective dose*. It is the equivalent does weighted for which parts of the body are exposed. Determined by multiplying the equivalent does to an organ by the tissue weighting factor (WT), as some organs are more sensitive to radiation then others. The total effective dose is the sum of the effective dose to all exposed organs.
Thorium (Th)	Isotope thorium 232 or Th-232.
Uranium (U)	Isotope uranium 238 or U-238.

Figures

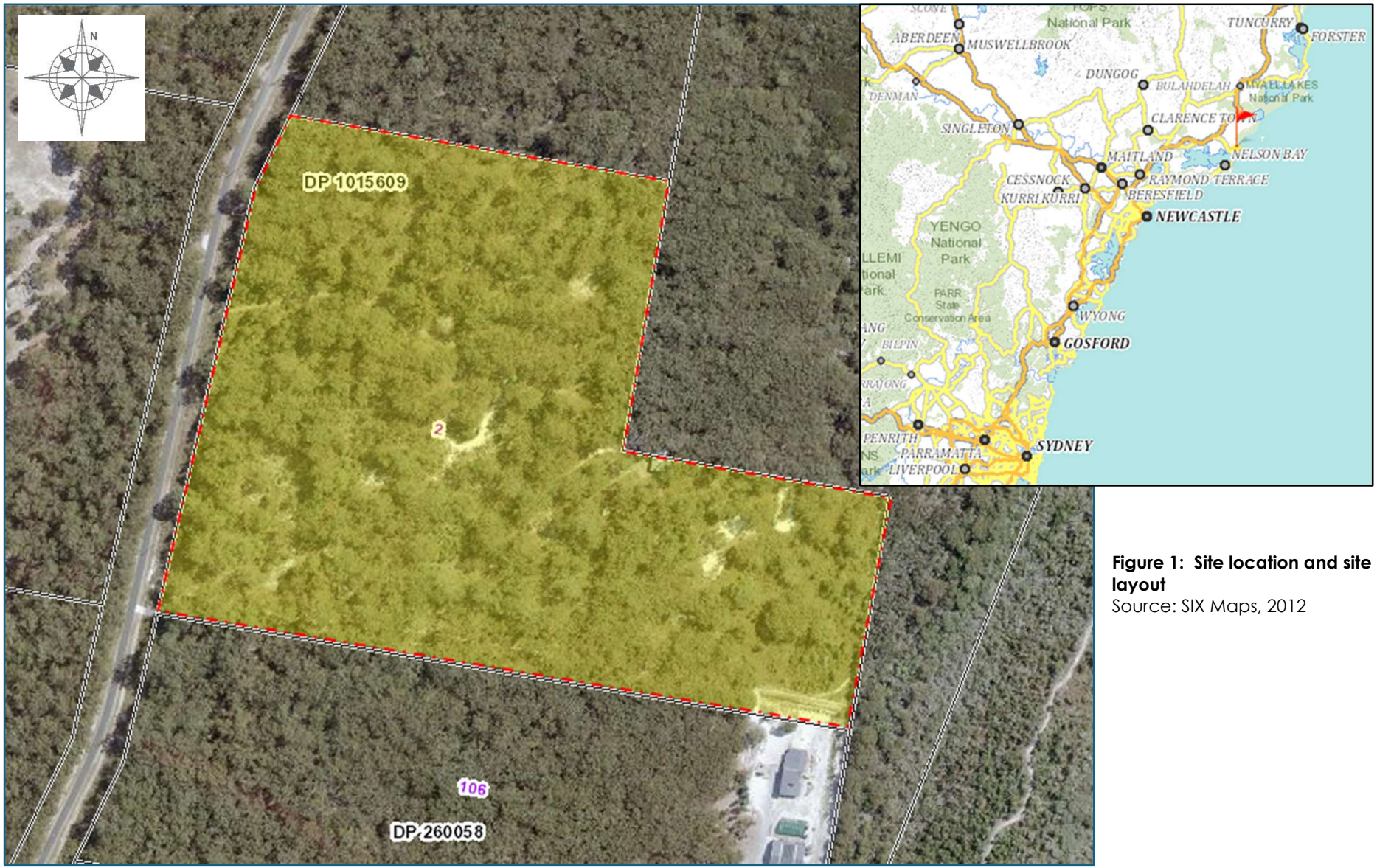


Figure 1: Site location and site layout
Source: SIX Maps, 2012

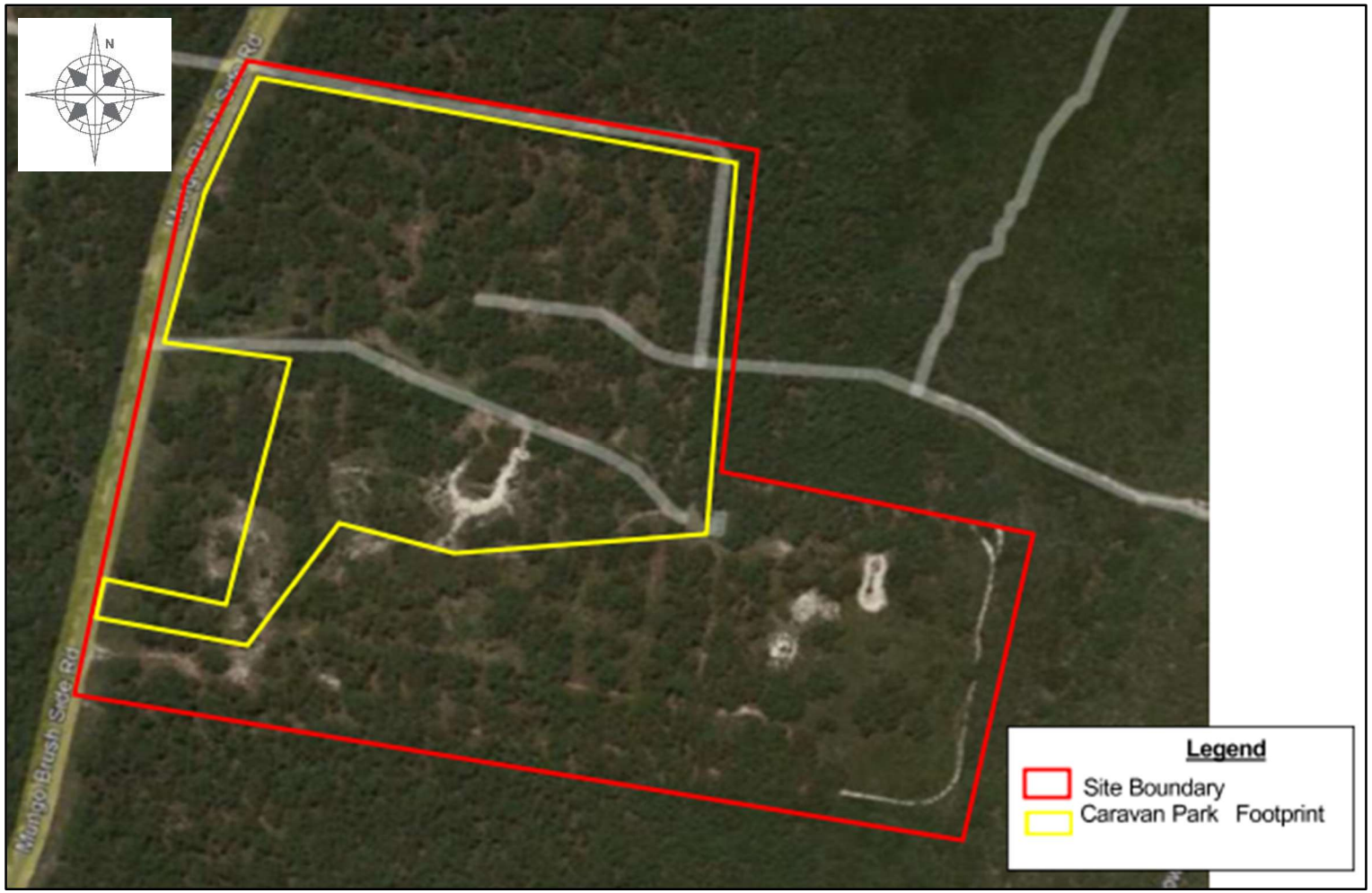
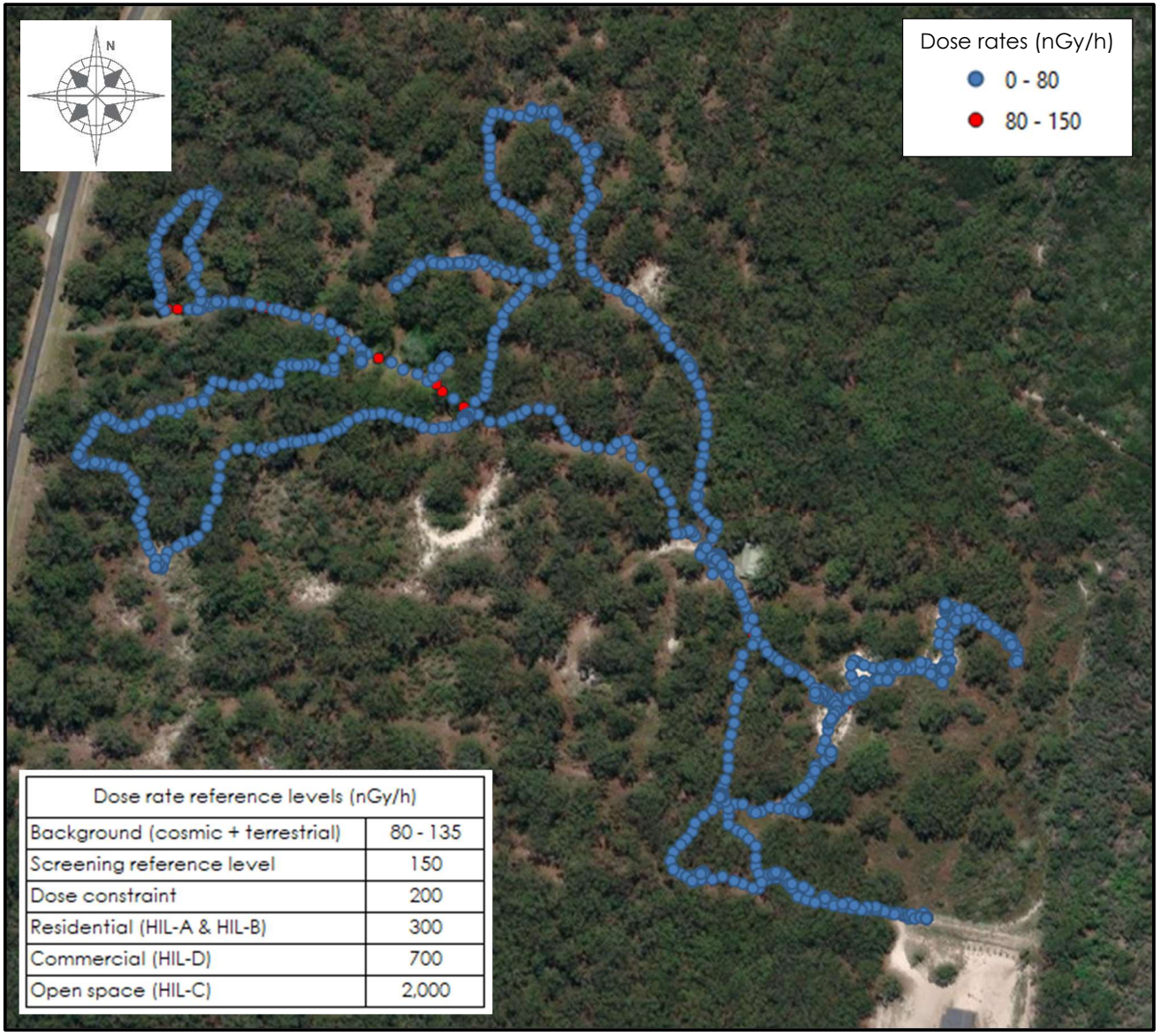


Figure 2: Site layout and proposed caravan park
Source: Regional Geotechnical Solutions, 2023



Dose rate reference levels (nGy/h)	
Background (cosmic + terrestrial)	80 - 135
Screening reference level	150
Dose constraint	200
Residential (HIL-A & HIL-B)	300
Commercial (HIL-D)	700
Open space (HIL-C)	2,000

Figure 3: Surface gamma radiation survey (nGy/h), 21 February 2024
Locations approximate. Source: Esri satellite image, 2024

Appendix 1

Limitations to contaminated land information

General limitations to contaminated land information

The findings of this reporting are based on the objectives and scope of the services provided. Easterly Point Environmental performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environmental assessment profession. No warranties or guarantees, expressed or implied, are made.

Easterly Point's review/assessment is strictly limited to identifying the environmental conditions associated with the subject property in regard to site contamination, and does not seek to provide an opinion regarding other aspects of the environment not related to site contamination, or to the suitability of the site in regard to:

- other aspects of the environment not related to site contamination; or
- hazardous building materials in buildings or structures; or
- structures, footings, infrastructure, and the like, whether above or below ground; or
- the suitability of fill materials for any use and any geotechnical considerations; or
- to the suitability of the site in regard to landuse planning or legal use of the land; or
- regulatory responsibilities or obligations (for which a legal opinion should be sought); or
- the work health and safety (WHS) legislation; or
- the suitability of any engineering design.

Reviews of such information are only in relation to the contaminated land aspects of any project or site. If specialist technical review of such documents is required, these should be obtained by from appropriate specialist.

The reporting and conclusions are based on the information obtained at the time of the assessments. Changes to the subsurface conditions may occur subsequent to the investigation described, through natural processes or through the intentional or accidental addition of contaminants, and these conditions may change with space and time.

Field monitoring, sampling and chemical analysis of environmental media and structures are based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate, based on regulatory requirements, site history, and the proposed landuse, not on sampling and analysis of all media, at all locations, for all potential contaminants.

Limited field monitoring, and environmental sampling and laboratory analyses, were undertaken as part of the investigations reviewed or conducted by Easterly Point, as described. Ground conditions, contaminants, and material types/composition can vary between sampling locations, and this should be considered when extrapolating between sampling locations. Except at each sampling location, the nature, extent and concentration of contamination is inferred only.

Furthermore, the test methods used to characterise the contamination at each sampling location are subject to limitations and provide only an approximation of the contaminant concentrations. Monitoring and chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

The absence of any identified hazardous or toxic materials at the site should not be interpreted as a warranty or guarantee that such materials do not exist at the site. Therefore, future work at the site which involves subsurface excavation or removal of structures or parts thereof, should be conducted based on appropriate management plans. These should include, *inter alia*, environmental management plans, including unexpected findings protocols, hazardous building materials management plans, and work health and safety plans.

If additional certainty is required, then additional site history information should be obtained, or additional exploration and sampling and analysis should be conducted. This decision should be made by the user of this information based on an appropriate risk management process, and the user should commission additional services if required.

Appendix 2

Aerial photographs

1971 (?) aerial photograph
Source: NSW Spatial Services, 2024

1993 (?) aerial photograph
Source: NSW Spatial Services, 2024

2012 aerial photograph
Source: NSW Six Maps, 2024

Appendix 3

Calibration certificates

Queensland Government

Forensic and Scientific Services

CERTIFICATE OF CALIBRATION

CLIENT: Easterly Point Enviromental

PO BOX 2363
Byron Bay NSW 2481

ATTN: Marc Salmon

Laboratory Reference: 2401007
Client Order Number: n/a
Quote Number: n/a
Date Received: 11/01/2024
Date Commenced: 11/01/2024
Laboratory Number/s: 23PX392

INSTRUMENT DESCRIPTION

	Instrument	Detector
Manufacturer:	Radiation Soulutions INC.	-
Model:	RS220	-
Serial Number:	6366	-
Type :	Scintillator with GM Tube	-

ENVIRONMENTAL GAMMA EXPOSURE

Method of Analysis: **QIS 21119** QHFSS in-house method - Instrument Testing/Calibration Procedure

PRE CALIBRATION CHECKS

Visual Inspection: Check performed adequately on receipt, during and after the calibration process.

Battery Check: Check performed adequately on receipt, during and after the calibration process.

High/Low Voltage: N/A

Self-diagnosis system: N/A

Desiccant condition: N/A

Mechanical zero: No adjustment was necessary.

Check Source Reading: No check source was supplied.

Background/Leakage: In the terrestrial shadow shield this survey meter reads approximately 4.1 nGy/hr, which is a combination of the instrument's response to cosmic radiation and intrinsic noise of the instrument. This value can be compared to the known cosmic radiation level stated below.

CALIBRATION CONDITIONS

Detector Reference Point: The effective measurement point was taken to be the centre of the detector volume.

Instrument Orientation: The instrument was orientated so that its detector axis was parallel to the surface plane of the calibration pads.

ATMOSPHERIC CONDITIONS

Dry Bulb Temperature:	30	°C
Relative Humidity:	60	%
Atmospheric Pressure:	1015.2	hPa (761.4 mm Hg)
Height Above Sea Level:	32.4	m
Cosmic radiation[2]:	38.8	nGy/h

The geometric mean correction factor below can be multiplied by the instrument readout to normalise the value to the RNS calibration pads.

0.91

This factor is determined from the resullts in Table 1. The correction applied assumes a linear proportional response (i.e correction is a % increase above or below expected response). The geometric mean is used as a weighted correction which favours higher dose rates owing to reduced measurement uncertainty.

Enquiries: Principal Health Physicist
Phone (+61) 7 3096 2901

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Coopers Plains QLD 4108
AUSTRALIA

PO Box 594
Archerfield QLD 4108
AUSTRALIA

Phone (+61 7) 3096 2900
Fax (+61 7) 3096 2913
Email FSS-RadiationScience@health.qld.gov.au

CALIBRATION TRACEABILITY

The expected Air Kerma Rates (AKR) 0.15m above the Calibration pads are traceable to measurements using a transfer calibration High Pressure Ion Chamber (RSS-131ER -SN- 12B0038D) calibrated with a Cs-137 (0.662 MeV) sn:1192GN, Nominal Activity- 0.037 GBq (Ref Date: 01/07/1984) sources traceable to NIST standards.

CALIBRATION RESULTS - DOSE RATE MODE - Table 1

Calibration pad 1 is made from un-spiked aerated concrete and is used to normalise results from the instrument. Such that the readings only show the instruments response from the spiked material only.

PAD (#)	Expected AKR @ 150 mm (From PAD material Only) (nGy/h)	Cosmic and PAD 1 Corrected Instrument AKR (nGy/h)	Number of measurements[a]	Variation from expected (%)	Calibration Factor
1	-	-	125	-	-
2	20 ± 9	24 ± 11	64	19.0%	0.84 ± 0.53
3	59 ± 8	63 ± 14	63	7.0%	0.93 ± 0.24
4	181 ± 9	194 ± 21	63	7.3%	0.93 ± 0.11
5	303 ± 11	325 ± 26	61	7.1%	0.93 ± 0.08

a. Each measurement noted above is a average of five 1 second readings, taken by the instrument.

COMMENTS

General: The instrument meets the requirements specified by the NHMRC codes of practice for radiation gauges, borehole logging, etc.

Over-Range Response: N/A

Energy Dependence Factors: The response of the instrument was tested for a range of NORM energies (46keV to 2.612 MeV) using U-238; Th-232 and progeny spiked aerated concrete (density=1600kg/m^3) planar sources shown to be homogenous and produce uniform radiation fields.

Accuracy: For the calibration of an instrument of this type, the accuracy is dependent of the laboratory measurements, the accuracy of the intercomparison transfer standard and the stability of the instrument being calibrated. The relative uncertainty of the corrected measurement tends to be larger at the very low air kerma levels associated with pad #2.

Uncertainties: The uncertainties stated on this document have a 95% coverage factor.

Reference:

1: Radiation & Nuclear Science unit Technical Document RSS14-004 - NORM based Environmental Radiation Calibration Facility - Calibration Procedure (based on published paper: *Wallace, J 2016 JER, Establishing a NORM Based Radiation Calibration Facility. Also, extra information and method is described in Radiation & Nuclear Science unit Technical Document RNSTR-001 - LARGE AREA NORM CALIBRATION PADS.*

2: FAA's Civil Aerospace Medical Institute Radiobiology Research Team, CARI-6. 2004, United States of America

NEXT CALIBRATION DUE **9 January 2025**

PERFORMED BY

Matthew Wiggins
Health Physicist
Radiation & Nuclear Science
11-January-2024

REVIEWED BY

Peter Medley
Pushpendra Chauhan
Senior Health Physicist
Radiation & Nuclear Science
12/01/2024

Enquiries: Principal Health Physicist
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Fax (+61 7) 3096 2913
Email FSS-RadiationScience@health.qld.gov.au

Appendix 4

Site photographs

Plate 1: Near on-site building, typical ground surface and vegetation cover

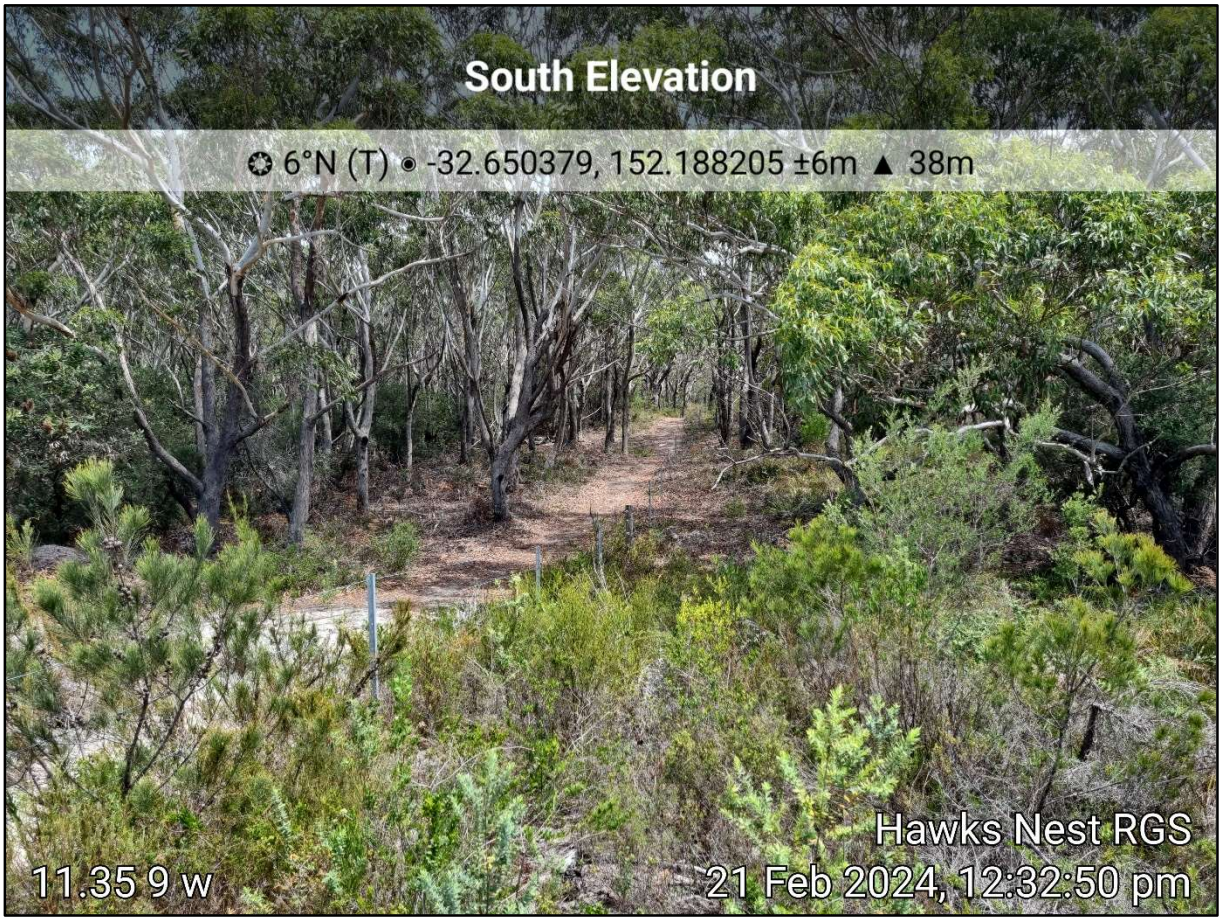


Plate 2: Looking along southern boundary, with typical vegetation shown

Plate 3: Typical exposed surface of beach sands, with no indications of HMSRs

Plate 4: Exposed surface in east of site, beach sands with no indications of HMSRs

Plate 5: Some roadbase basalt gravel, beach sands with no indications of HMSRs

Plate 6: Animal burrows, beach sands with no indications of HMSRs

REGIONAL GEOTECHNICAL SOLUTIONS

Manning-Great Lakes
Port Macquarie
Coffs Harbour

RGS50057.1-AD

10 May 2024

Lands Advisory Services Pty Ltd
PO Box 2317
DANGAR NSW 2309

Attention: Brett Phillips

Dear Brett

RE: Proposed Caravan Park – 288 Mungo Brush Road, Hawks Nest
Detailed Site Investigation Contamination Assessment – Response to RFI

1 INTRODUCTION and BACKGROUND

This letter has been prepared in response to a Request for Further Information (RFI) received from Midcoast Council (DA No. DA2023/0608) regarding the Detailed Site Investigation Contamination Assessment (DSI) undertaken by Regional Geotechnical Solutions Pty Ltd (RGS) and Preliminary Radiological Assessment undertaken by Easterly Point Environmental Pty Ltd (EPE) for the proposed caravan park at 288 Mungo Brush Road, Hawks Nest.

RGS and EPE have reviewed the work presented in the aforementioned reports, and also the previous Preliminary Site Investigation Contamination Assessment (PSI) prepared by RGS.

The reports outlined above are referenced as follows:

- **PSI Report** (Ref. RGS50057.1-AC), prepared by RGS, dated 21 March 2023;
- **DSI Report** (Ref.50057.1-AD), prepared by RGS, dated 8 March 2024; and
- **Preliminary Radiological Investigation** (Ref. 24025L01-RGS01), dated 11 March 2024.

The RGS PSI identified the following Areas of Environmental Concern (AEC) which are outlined below:

- **AEC1** – Soils in the vicinity of the brick shed;
- **AEC2** – Soils in the vicinity of the low brick wall and collapsed elevated fuel storage tank;
- **AEC3** – Fill placed for the access track; and
- **AEC4** – Possible sand mining spoil.

2 MIDCOAST COUNCIL RFI

2.1 Land Contamination – General Contaminants

Midcoast Council comment:

- ***AEC1*** *– This area was identified as a potential AEC by the PSI. However, the DSI does not address this area in further detail;*
- ***AEC3*** *– This area was identified as a potential AEC by the PSI. However the DSI, does not address this area in further detail; and*
- ***AEC's 1 and 3*** *noted in the PSI were not addressed within the DSI. Further commentary is to be provided concerning AEC1 and AEC3.*

In relation to the points raised in the RFI regarding AEC's 1 and 3 as outlined above, RGS provides the following comments:

The contaminated land assessment process is undertaken in three stages: PSI (Stage 1), DSI (Stage 2) and remediation and validation (Stage 3). A DSI is undertaken based on the conclusions and recommendations made by the PSI (if any). PSI's regularly identify AEC's that do not warrant further investigation or inclusion in a DSI, based on a low likelihood and risk of contamination impacting upon human health and/or environment.

In the case of AEC1 and AEC3 in the RGS PSI prepared for the subject site, it was concluded that further investigation was not warranted as the risk of contamination was deemed to be low. As such, further investigation of AEC1 and AEC3 was not undertaken.

Selected excerpts from the PSI report showing are presented below.

6.2.1 Potential Sources of Contamination

Potential Areas of Environmental Concern (AECs) and Chemicals of Concern (COCs) identified for the assessment are outlined in Table 5.

Table 5: Potential AECs and COCs

AEC	Mode of Potential Contamination	Key Potential COCs	Likelihood of Contamination
AEC1: Soils in the vicinity of brick shed	Potentially hazardous building materials	Lead and asbestos	Low
AEC2: Soils in vicinity of low brick wall and elevated tank	Potential contaminates previously stored in the tank. Potentially hazardous building materials	Heavy Metals, TPH, BTEX, PAH, PCB, OC/OPP and asbestos	Moderate
AEC3: Fill placed for the access track	Importation of potentially contaminated fill	Heavy Metals, TPH, BTEX, PAH, PCB, OC/OPP and asbestos	Low
AEC4: Possible sand mining spoil	Potentially contaminated sand mining spoil dumped on site	Heavy Metals, TPH, BTEX, PAH, radiation associated with sand mining works	Low
Heavy Metals - Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel and Zinc *BTEX - Benzene, Toluene, Ethylbenzene and Xylene* *TPH - Total Petroleum Hydrocarbons* *PAH – Polycyclic Aromatic Hydrocarbons* *PCB – Polychlorinated Biphenyls* *OC/OPP – Organochlorine and Organophophorus Pesticides*			

It is understood that that the brick shed was constructed by a previous owner who intended to use the shed as an office for a caravan park that was previously proposed before the project was abandoned. The steel shed was likely used for storage, however, no evidence of the sheds use could be found in the desktop study.

No visual or olfactory evidence of contamination (such as oil staining or hydrocarbon odours) were observed.

The results of laboratory analysis of surface soil samples collected from four targeted locations (AEC's outlined above), revealed concentrations of the chemicals of concern were either below the laboratory reporting limit, or below the adopted health investigation criteria for a Residential A site.

6.4 Conclusions and Recommendations

Based on the above and the findings of the PSI presented herein, the soils tested meet the requirements for a Residential A site as detailed in the NEPM 2013 guidelines and the site can be made suitable for the proposed development in its current state from a contamination perspective.

Further testing may be required around the collapsed elevated tank following its removal to assess potential extent of hydrocarbon impacted soils.

It is recommended an environmental consultant experienced with assessments of radiation risks associated with former sand mines be engaged to undertaken a detailed site investigation to assess potential radiation at the site. Whilst the risk of radiation to human health is considered to be low, it would be prudent for such an assessment be undertaken based on the evidence encountered by the site history study.

The PSI recommended that further investigation was warranted in relation to AEC2 (collapsed fuel storage tank) and AEC4 (potential radiation associated with historical sand mining activities).

Subsequently, the DSI was undertaken based upon the conclusions and recommendations presented in the PSI with further work being undertaken to address both AEC2 (undertaken by RGS) and AEC4 (undertaken by EPE).

2.2 Land Contamination – Radiation

Midcoast Council comment:

- *AEC4 – Area identified as a potential AEC by the PSI due to potential radiation impacts from historical sand mining within the surrounding areas; and*
- *Additional information is required in response to the submitted DSI and PSI (radiation assessment) as detailed in the RFI.*

In relation to the points raised regarding AEC 4 in the RFI, EPE has provided responses in a separate correspondence (Ref.24025L02-RGS02, dated 10 May 2024) which should be read in conjunction with this letter.

3 REVIEW CONCLUSIONS

Based on the review of the PSI and DSI reports with respect to AEC1 and AEC3, RGS maintains that the conclusions made by both reports, and the methodologies used to come to such conclusions, are sound and have been undertaken in accordance with the relevant guidelines and contaminated land assessment process. As such, no further work is considered necessary in regard to potential contamination risks (if any) associated with AEC1 and AEC3.

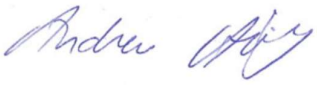
In addition, it is noted that both the PSI and DSI reports were peer reviewed by Dr David Tully (Certified Environmental Practitioner, Site Contamination Specialist, C.EnvP) in accordance with Council's requirements for reports submitted to Council which are associated with the contaminated land process.

As per the PSI and DSI recommendations, should materials be encountered during the development of the site which exhibit signs of potential contamination such as staining, odours and/or fibrous materials then an experienced environmental consultant should be engaged without delay.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

For and on behalf of **Regional Geotechnical Solutions Pty Ltd**

Prepared by



Andrew Hills

Associate Environmental Engineer

Reviewed by

Steve Morton

Principal Geotechnical Engineer

Easterly Point Environmental

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Mr. Andrew Hills
Associate
Regional Geotechnical Solutions
44 Bent Street
Wingham, New South Wales 2429

Ref. 24025L02-RGS02 10 May 2024

Dear Andrew,

Review of Midcoast Council Comments
Proposed Caravan Park, Lot 2 DP 1015609
288 Mungo Brush Road, Hawks Nest, NSW

Easterly Point conducted a site inspection and a surface gamma radiation survey at the site, which was reported in a preliminary radiation investigation (PRI) on 11 March 2024 (Ref. 24025L01-RGS01). Comments from Midcoast Council's Environmental Health Officer were received via an Internal Referral on 2 May 2024. Comments relative to the PRI included:

> *Further clarification would be required from the consultant as to the methodology of the above ground survey. Under the document* Land Contamination by Radioactive Material – A guide to assessment, management and remediation *(QLD), it is recommended that the dose rate survey is undertaken within a grid pattern of intervals of 2-5m. Departure of this methodology may be considered if the site history reflects this change.*

And,

> *Further clarification is also sought on the previous use of the property. An additional aerial photo was sourced in addition to the photos included within the PSI. The additional photo is included below and although the information on the photo is vague, it may be assumed the photo was taken in 1967 (top left hand side of photo). This photo shows an area within the development footprint that appears disturbed and should be included within the commentary of the contaminated land assessment.*

Survey methodology

The objective of the PRI was to provide a preliminary characterisation of the radiological condition at the site, along with recommendations as to further work. This PRI did not seek to address other aspects of contaminated land and/or the broader environment, and is limited to the assessment of site history and environmental information related to the potential for heavy mineral sands and the associated radiological impacts.

Queensland Health (2020)[1] describes that the purpose of a PRI is to determine the presence of radiological contamination and to assess the need for further investigation or management. And that preliminary investigations should include:

- *a brief description of the site history, and current and past uses of the site;*
- *a description of the current condition of the site, identifying areas of actual or potential contamination;*
- *a description of the current and past potentially contaminating activities;*
- *one or more of the following types of radiation monitoring (as appropriate to the site and the suspected contaminant):*
  - *external radiation dose rate survey,*
  - *surface contamination survey,*
  - *soil or water sample analysis;*
- *an assessment of natural background radiation levels if required; and*
- *an assessment of the need for further investigation, with a description of what investigative work is necessary.*

For suspected radioactive contaminants, Queensland Health (2020) describes that "the accepted way of obtaining preliminary information is usually via a gamma dose rate survey across the site". This method is appropriate for radionuclides with a significant gamma activity component, which is the case for heavy mineral sands sites and the associated heavy mineral sands residues (HMSRs).

The aim of a preliminary radiation surveys is to gain a representative view of the radiation dose rates around the site, and to delineate areas that exceed the relevant screening reference levels; which is usually a principal determinant of whether further investigation or action need to be taken. Queensland Health (2020) notes that "A screening survey may not yield conclusive results, but combined with the site history may indicate whether a more detailed investigation is required".

Accordingly, the objective of the PRI was to determine whether a significant potential for HMSRs existed at the site, and whether a more detailed investigation is required. Section 3.5, *Detailed site investigation* (Queensland Health 2020), describes that:

> *A detailed site investigation is required if the results of the preliminary investigation indicate actual or potential contamination. The strategies used to conduct the detailed investigation (where to look, what to look for, and what analyses to conduct) should be informed by the outcome of previous investigations.*

Whereas for the conducting of detailed radiological site investigation[2], a 2 m grid pattern is recommended for residential properties or other properties at which the occupancy of particular individuals is or could be high, and a 5 m grid is recommended for all other properties, that guidance is preceded by:

> *The following guide to the surface densities and borehole depths at which external radiation dose is measured should be followed <u>unless the site history and conditions, or the preliminary investigation, suggests otherwise.</u>*

[1] Queensland Health (2020) *Land contaminated by radioactive material – A guide to assessment, management and remediation*.

[2] In part, some confusion is caused by the general contaminated land terminology of "preliminary site investigation (PSI)" and "detailed site investigation (DSI)", and the use of the terms preliminary and detailed in regard to radiological site investigations. In general, where a contaminated land PSI recommends a DSI and includes radiological matters as "areas of concern", unless clear evidence exists as to HMSRs and/or a history of mining and/or disposal, then a preliminary radiation investigation should initially be conducted .

Aerial photograph interpretation

The following figures are show in Attachment 2, and illustrate the site and the surrounding area in relation to mineral sands mining and processing:

- Figure 1: Aerial photograph circa 1970, showing MDL plant in bottom left and dredge path parallel to beach;
- Figure 2: Aerial photographs circa 1970 and circa 1973, showing site and sand mining being conducted off-site to the west;
- Figure 3: Aerial photograph circa 1993, showing MDL plant and sand stockpiles, and former dredge paths; and
- Figure 4: Aerial photograph circa 1993, showing MDL plant and sand stockpiles, and former dredge paths.

Whereas an area of disturbed sand is shown in the 1973 photograph in Figure 2, comparison with the area of the active dredge and associated dredge ponds, along with the former dredge paths, and the operations at the MDL plant, including stockpiling of mineral sands, strongly suggests that this area of disturbed sand is unrelated to the mining of mineral sands or the disposal of mineral sands wastes.

This is reinforced by the site inspection results, which described that:

> *The site inspection and field monitoring were conducted on the 21 February 2024, in concert with field work by Andrew Hills of RGS. The site was heavily vegetated with mature trees in the most part, with some tracks and areas of low grasses, along with areas of bare exposed sand. Along the tracks, some areas of basalt roadbase gravel were obvious, although this did not appear to be extensive. While there were a number of old buildings/structures, there were no indications of former mining, processing, or associated artefacts or relics. There were no traces of heavy mineral sands discernible in any areas of the site, noting that the characteristics generally include gunmetal grey to black heavy sands, with a distinct glassy – metallic lustre (sparkle).*

This is further supported by the surface gamma radiation survey results, which are all less than the screening reference level of 150 nanograys per hour (nGy/h), as shown in Figure A.

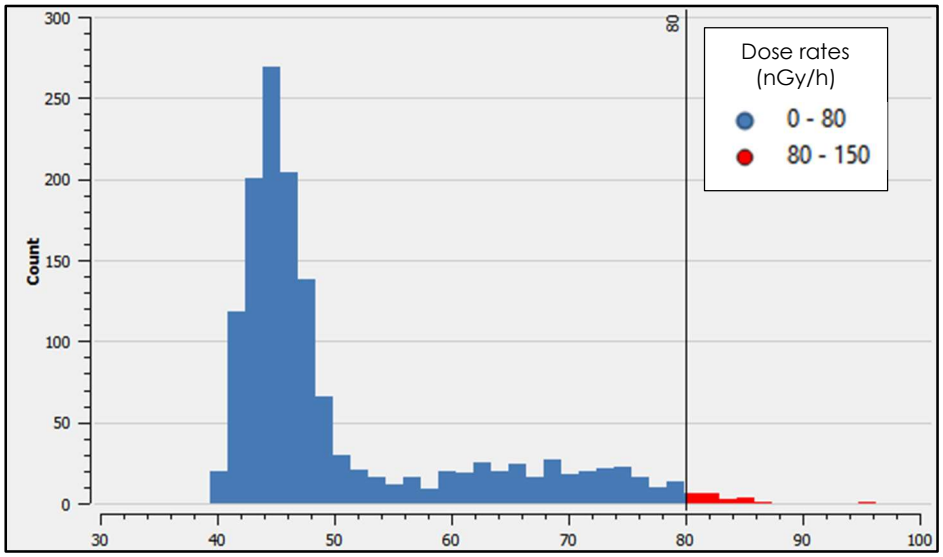

Figure A: Summary of dose rates (nGy/h)

Discussion and conclusion

The PRI concludes that:

> *The site history review did not uncover any historical information, including within the available aerial photographs, to suggest processing activities or waste disposal occurred at the site, and no indications of heavy mineral sands were discernible during the site inspection and surface gamma radiation survey. It is noted that from the aerial photograph review and previous site inspections at the MDL plant, substantial volumes of HMSRs were retained on that site; suggesting a lower potential for sites in the surrounding area to have been used for application to land of HMSRs.*
>
> *While it is noted that the vegetation and associated leaf litter were dense, and in much of the site the soil surface was obscured, no dose rates were recorded which indicate heavy mineral sands. While the thick vegetation and site location restricted satellite coverage, thereby impeding the ability for orientation on the site at all times, sufficient coverage and data was achieved to state that there is considered to be a very low probability of significant HMSRs at the site.*
>
> *Nevertheless, as for all subsurface work, a potential exists that further material or areas of potential contamination could be detected. While this is considered unlikely in regard to heavy mineral sands or radiation, an unexpected findings protocol (UFP) should be developed for any future site work, and the UFP should include the potential for the identification of heavy mineral sands.*

Easterly Point considers that the findings of the PRI are valid, and that a detailed radiation investigation is not warranted based on the current information. This position is supported by the Queensland Health (2020) guidance, as summarised in Figure B (overleaf), which shows the process for determining if a detailed radiation investigation is required. Notwithstanding these findings, as described in the PRI, a radiation and mineral sands specific UFP should be developed prior to the commencement of the site development.

✧ ✧ ✧ ✧

Thank you for your time in regard to this matter. Please do not hesitate to contact the undersigned on (02) 6685 6681 if you require additional information or clarification.

Yours sincerely
Easterly Point Environmental Pty Ltd

Marc Salmon
Principal Environmental Scientist

Accredited Site Auditor (NSW)
Contaminated Land Auditor (Qld)
MEIANZ, CEnvP SCS, MARPS

Attachment 1 – Limitations to contaminated land information

Attachment 2 – Aerial photograph figures

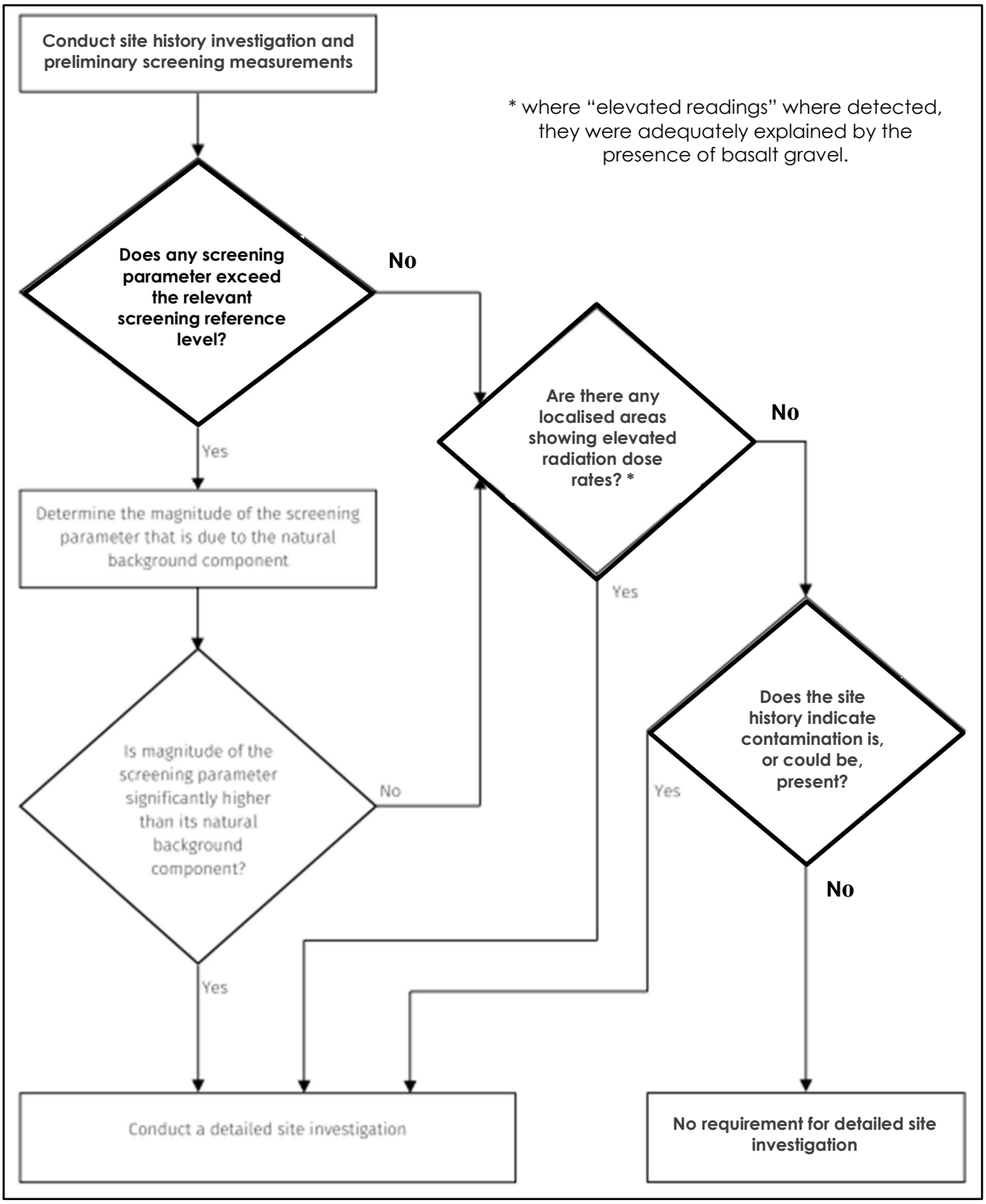

Figure B: Determining the requirement for a detailed radiation investigation
Source: Queensland Health 2020

Attachment 1

Limitations to contaminated land information

General limitations to contaminated land information

The findings of this reporting are based on the objectives and scope of the services provided. Easterly Point Environmental performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environmental assessment profession. No warranties or guarantees, expressed or implied, are made.

Easterly Point's review/assessment is strictly limited to identifying the environmental conditions associated with the subject property in regard to site contamination, and does not seek to provide an opinion regarding other aspects of the environment not related to site contamination, or to the suitability of the site in regard to:

- other aspects of the environment not related to site contamination; or
- hazardous building materials in buildings or structures; or
- structures, footings, infrastructure, and the like, whether above or below ground; or
- the suitability of fill materials for any use and any geotechnical considerations; or
- to the suitability of the site in regard to landuse planning or legal use of the land; or
- regulatory responsibilities or obligations (for which a legal opinion should be sought); or
- the work health and safety (WHS) legislation; or
- the suitability of any engineering design.

Reviews of such information are only in relation to the contaminated land aspects of any project or site. If specialist technical review of such documents is required, these should be obtained by from appropriate specialist.

The reporting and conclusions are based on the information obtained at the time of the assessments. Changes to the subsurface conditions may occur subsequent to the investigation described, through natural processes or through the intentional or accidental addition of contaminants, and these conditions may change with space and time.

Field monitoring, sampling and chemical analysis of environmental media and structures are based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate, based on regulatory requirements, site history, and the proposed landuse, not on sampling and analysis of all media, at all locations, for all potential contaminants.

Limited field monitoring, and environmental sampling and laboratory analyses, were undertaken as part of the investigations reviewed or conducted by Easterly Point, as described. Ground conditions, contaminants, and material types/composition can vary between sampling locations, and this should be considered when extrapolating between sampling locations. Except at each sampling location, the nature, extent and concentration of contamination is inferred only.

Furthermore, the test methods used to characterise the contamination at each sampling location are subject to limitations and provide only an approximation of the contaminant concentrations. Monitoring and chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

The absence of any identified hazardous or toxic materials at the site should not be interpreted as a warranty or guarantee that such materials do not exist at the site. Therefore, future work at the site which involves subsurface excavation or removal of structures or parts thereof, should be conducted based on appropriate management plans. These should include, *inter alia*, environmental management plans, including unexpected findings protocols, hazardous building materials management plans, and work health and safety plans.

If additional certainty is required, then additional site history information should be obtained, or additional exploration and sampling and analysis should be conducted. This decision should be made by the user of this information based on an appropriate risk management process, and the user should commission additional services if required.

Attachment 2

Aerial photograph figures

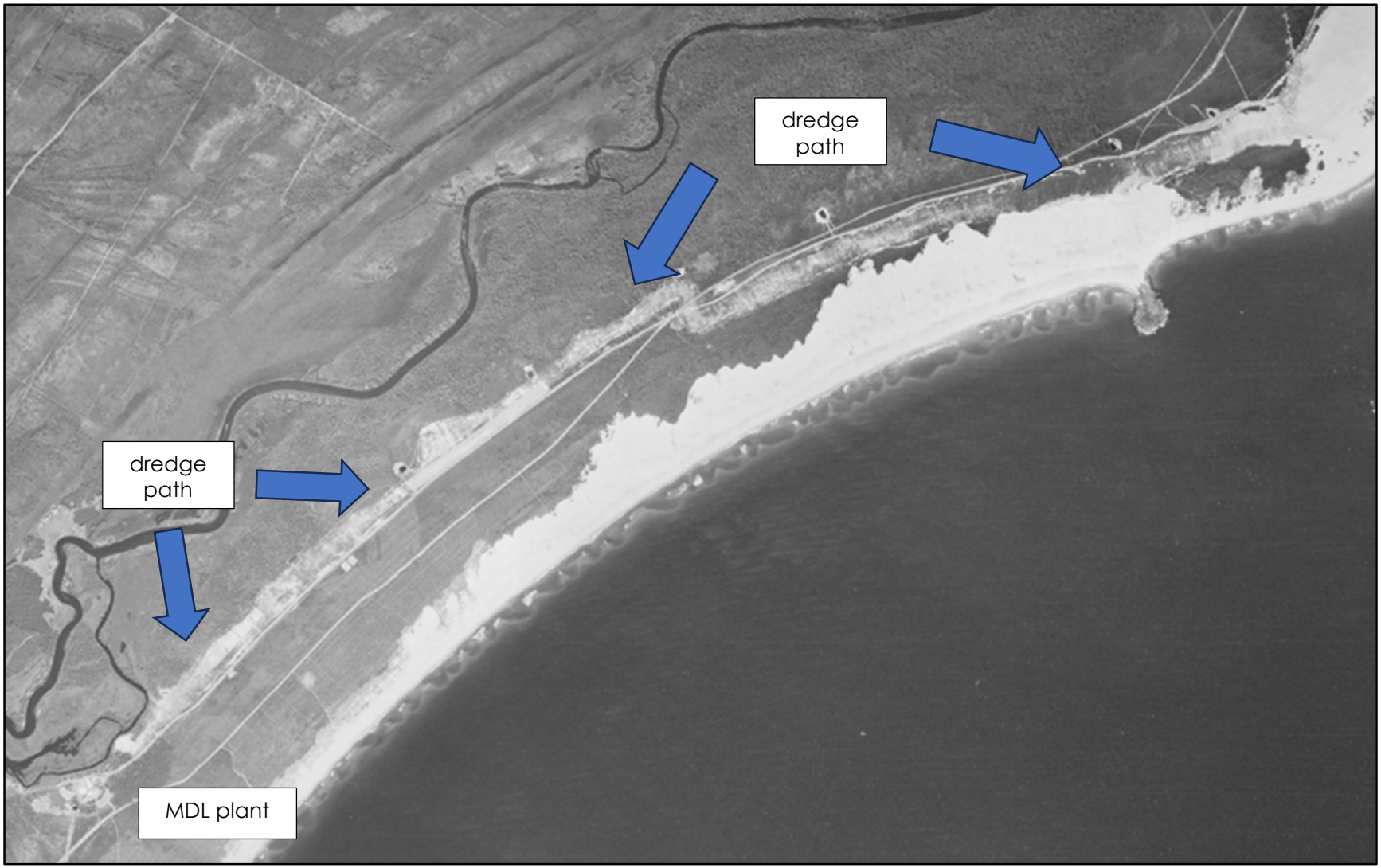

Figure 1: Aerial photograph circa 1970, showing MDL plant in bottom left and dredge path parallel to beach
Source: NSW Spatial Services, Historical, Aerial and Satellite Imagery

Figure 2: Aerial photographs circa 1970 and circa 1973, showing site and sand mining being conducted off-site to the west
Source: NSW Spatial Services, Historical, Aerial and Satellite Imagery

Figure 3: Aerial photograph circa 1993, showing MDL plant and sand stockpiles, and former dredge paths
Source: NSW Spatial Services, Historical, Aerial and Satellite Imagery

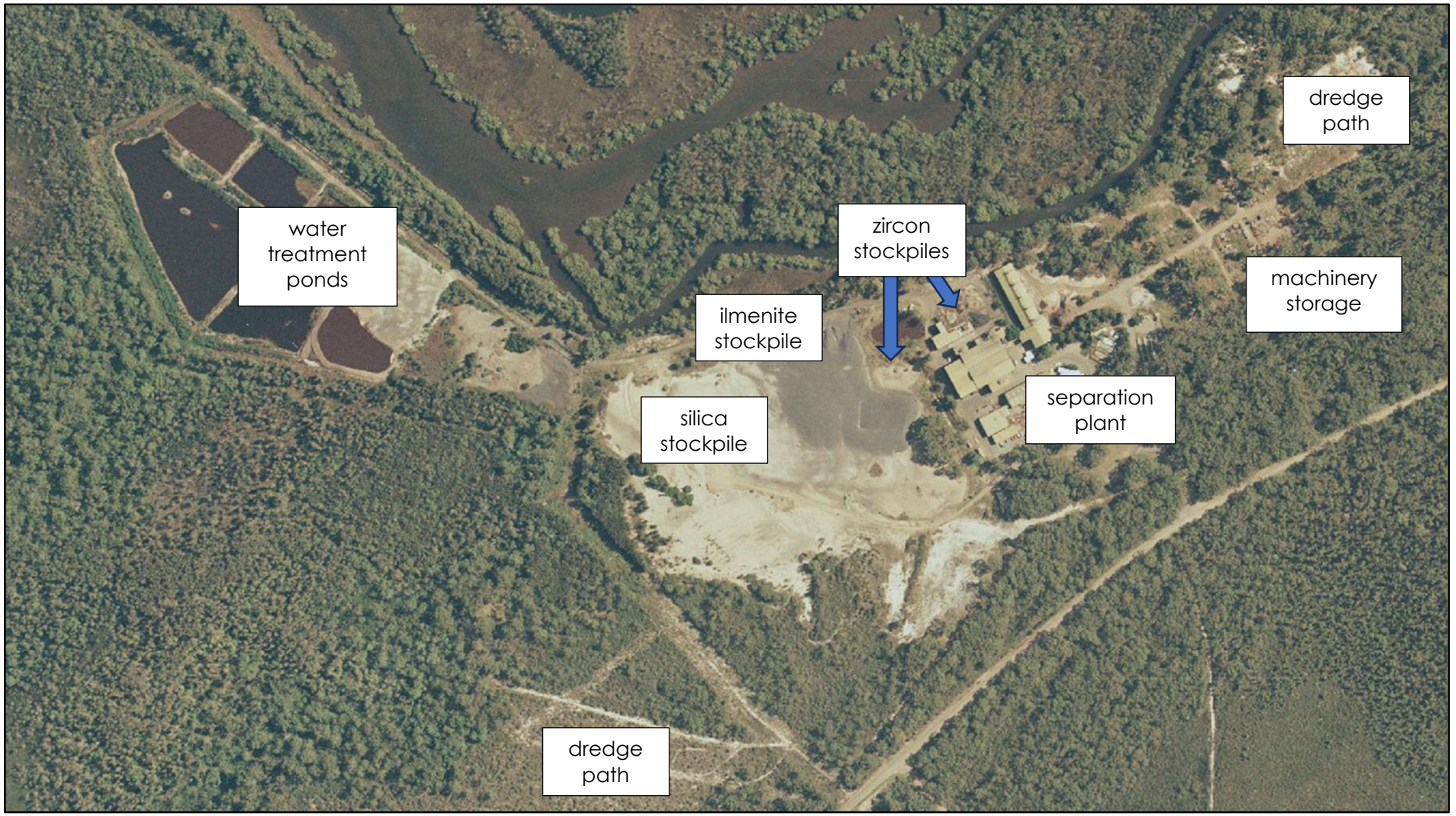

Figure 4: Aerial photograph circa 1993, showing MDL plant and sand stockpiles, and former dredge paths
Source: NSW Spatial Services, Historical, Aerial and Satellite Imagery, and
Bartolo W. C. F. (2021) The Process for the Remediation of a Heavy Mineral Sands Processing Site and the Success,
in *Radiation Protection in Australasia (2021) Vol. 38, No. 1*