2 Site Identification

2.1 Location and Setting

Site information is summarised in Table 1.

Table 1: Site background information

Site address	George Evans Rd, Mundamia, NSW.
Lot and DP (Title Information)	Lot 3 DP 568613 & Lot 384 DP755952 .
Zoning	1(d) 'General Rural'.
Local government area (LGA)	Shoalhaven City Council.
Current land use	Rural residential / agricultural / livestock grazing.
Proposed land use	Residential.
Surrounding land uses	Predominantly rural with some rural residential allotments to the west and north, residential developments to the south east.
Geology and soil landscapes	Nowra Sandstone, a subgroup of the Megalong Conglomerate Group geology. Nowra Landscape consisting of moderately deep (50 – 100cm) brown podzolic soils on crests/upper slopes, with yellow earths or yellow podzolic soils on mid slopes, lower slopes and drainage depressions.
Topography and drainage	Elevations across the site range from 36 – 70 mAHD with a general fall to the east.
Sensitive receptors	The site drains to an unnamed creek to the east which eventually drains to the Shoalhaven River.

Site location is shown in Figure 1 and site features relevant to the investigation are shown Attachment A.

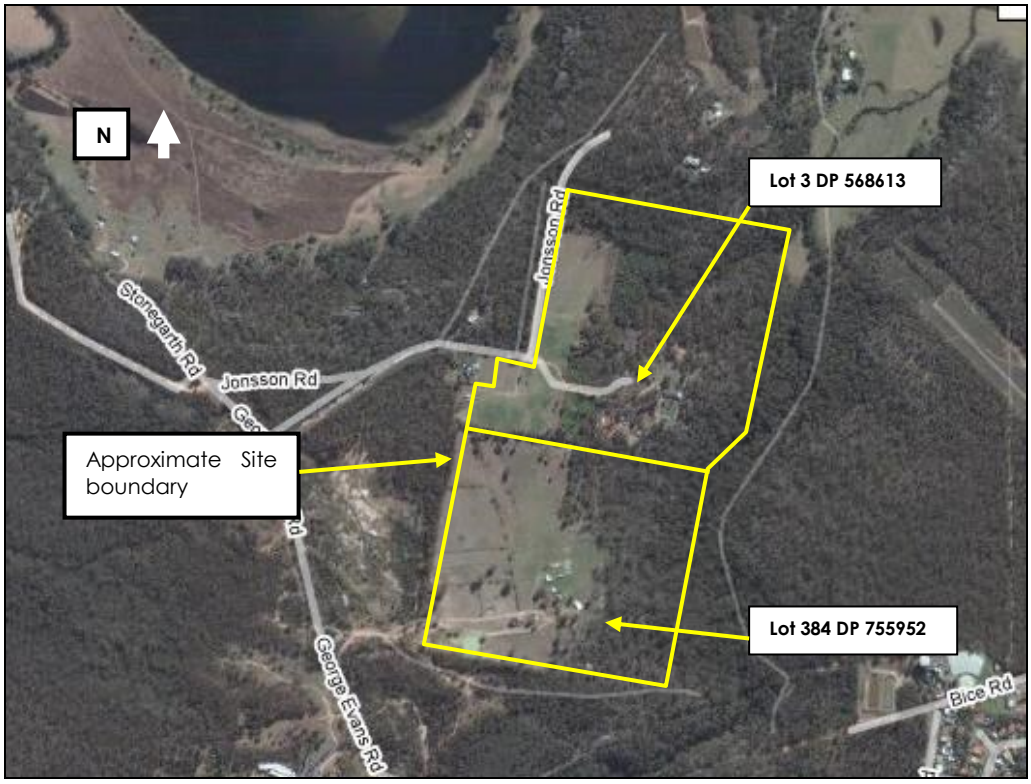

Figure 1: Subject site location (outlined in yellow) (www.googlemaps.com).

2.2 Groundwater

Site groundwater conditions have been previously described as part of a geotechnical assessment (MA, 2008b) and are described as follows:

- Groundwater was observed in 4 out of 13 boreholes (to a maximum depth of 2.8 mbgl).
- Groundwater seepage was observed in the eastern portion of Lot 384. The area of seepage had vegetation indicating the seepage is a permanent feature and not limited to periods immediately following rainfall.
- Waterlogged soils were observed in the southern portion of Lot 3 in an area up to 100m downslope of the dam located on the northern boundary of Lot 384.

The nature of encountered groundwater suggests that no shallow aquifers exist where an aquifer is a formation or geological unit able to yield economic useful quantities of water.

3 Extent of Remediation Required

3.1 Contamination Identified

Previous reports have identified contamination in excess of adopted project SILs. Samples are summarised in Table 2 and locations are shown in Attachment A.

Table 2: Summary of identified contamination

Sample ID	Contaminant	Value (mg/kg)	SIL (mg/kg)
2193/AreaB/A	TRH (C_{10} – C_{36})	58,053	1000

3.2 Remediation Required

The following is a summary of remediation requirements to render the site fit for intended residential land use:

1. Further investigation of areas beneath dwellings and site sheds found across the site and unable to be accessed during Stage 2 works.

2. Remediation of TRH (C_{10}-$C_{–36}$) impacted soils in the south east corner of Lot 3, DP 568613 ("Area B").

3. Remediation of asbestos containing materials (fibre sheeting) found in rubbish piles across the site.

A review of available and relevant remediation technologies suitable to address remediation requirements is outlined in Sections 4.

4 Remediation Programme

4.1 General

The following sections present a plan for remediation and management of TRH (C_{10}-C_{36}) impacted soils and potential ACM fibre sheeting identified on the site.

4.2 Remediation Goal

The goal of remediation is to remediate site soils adequately for residential use. The RAP also provides a strategy for management of excavation spoil.

4.3 Remediation Objectives

To address the remediation goal; removal of contaminated soils and asbestos is required to remove risk to future site users. It is likely that removal of site soil beneath sheds and buildings shall be required to render these areas fit for use.

4.4 Remediation Criteria

4.4.1 Soil Remediation Criteria

Remediation criteria for soil are established based on the following references:

- NEPC (1999) National Environmental Protection (Assessment of Site Contamination) Measure (NEPM).
- NSW DEC (2006) Guidelines for the NSW Auditor Scheme (Second Edition).
- NSW EPA (1994) Guidelines for Assessing Service Station Sites.

Human health based soil investigation levels (SIL) for residential land use, provided in Column A of Table 11-A in the NEPC (1999) *Guidelines on Health-Based Investigation Levels* (and reproduced in NSW DEC, 2006) have been adopted. Adopted SIL for BTEX and TRH is derived from NSW EPA (1994). Adopted criteria are summarised in Table 3.

There are currently no national or NSW OEH endorsed guidelines relating to human health of environmental investigation of material containing asbestos on sites. The NSW DEC previously provided interim advice that "no asbestos in the soil at the surface is permitted". MA has adopted an asbestos investigation level of "non-detect" for this site.

Table 3: Adopted soil remediation and typical laboratory detection levels (LOR)

Contaminant of concern	Soil remediation criteria (mg/kg)	LOR (mg/kg)
TRH (C_6-C_9)	65	25
TRH (C_{10}-C_{36})	1,000	250
TPH(C_{16}-C_{35}) Aliphatic	5,600	100
TPH(>C_{35}) Aliphatic	56,000	100
TPH(C_{16}-C_{35}) Aromatic	90	50
Benzene	1.0	0.2
Toluene	1.4	0.5
Ethyl benzene	3.1	1
Xylene (total)	14	3
Total PAH	20	1.55
Benzo(a)pyrene	1	0.05
Total Phenols	8,500	0.05
Arsenic (total)	100	4
Cadmium	20	0.5
Chromium (VI)	100	1
Copper	1,000	1
Lead	300	1
Mercury	15	0.1
Nickel	600	1
Zinc	7,000	1
Asbestos	Non detect	0.1

4.4.2 Waste Classification

The procedures for classifying waste are detailed in the NSW DECC (2009): *Waste Classification Guidelines.* Part 1: *Classifying Waste* requires that wastes be classified in a step wise manner. It is noted that under NSW DECCW (2009), the steps for waste classification must be applied in the order stated.

Part 2 of the Waste Guidelines, *Immobilisation of Waste*, apply to wastes classified as hazardous in accordance with Part 1 of the Waste Guidelines because of the high levels of contaminant(s). Currently, there is no licensed landfill which can accept hazardous waste. Soil classified as hazardous waste must be treated prior to disposal. In some cases the contaminants are able to be immobilised so that they will not be released into the landfill leachate at levels of concern.

Part 3 of the Waste Guidelines, *Waste Containing Radioactive Material* is considered not to apply to this project as risks of the wastes identified containing radioactive material is considered very low.

Part 4 of the Waste Guidelines, *Acid Sulfate Soils* applies to acid sulfate soils which are required to be disposed to landfill.

Preliminary classification of identified contamination is hazardous waste as measured TRH (C_{10}-C_{36}) concentrations exceed the specific contaminant concentrations (SCC1 and SCC2) outlined in DECC (2009). TRH (C_{10}-C_{36}) contamination identified in "Area B" is likely the result of soil staining and fuel storage refuse (empty storage cans found in area). Further waste classification of all remedial excavation spoil will be undertaken to provide a definitive classification prior to offsite removal.

Waste impacted with ACM fragments is classified as Asbestos Special Waste.

5 Assessment of Remedial Options

5.1.1 Assessment of Remedial Options for Soil Remediation

Soil remedial technologies have been reviewed to determine technologies most suitable to meet the site remediation objectives. NSW DEC (2006) provides a preferred hierarchy of options for site clean-up and/or management, which was originally developed in NEPC (1999). The hierarchy is outlined as:

- On-site treatment of the contamination so that is it destroyed and the associated risk is reduced to an acceptable level.
- Off-site treatment of excavated soil, so that the contamination is destroyed or the associated risk is reduced to an acceptable level, after which the soil is returned to the site.
- Removal of contaminated material to an approved facility, followed (where necessary) by replacement with appropriate material.
- Cap and contain material onsite with an appropriately designed barrier.
- Do nothing.

Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy would be required.

Review of available soil remediation strategies and technologies is considered on the basis of:

- Effectiveness at achieving remediation objectives.
- Suitability in light of the proposed development.
- Anticipated costs.
- Ongoing environmental and public health adequacy.

A review of treatment options is presented in Table 4.

Table 4: Review of soil remediation technologies

NEPM (1999) remediation hierarchy	Advantages	Disadvantage	Comments
Capping / Containing	o Likely to be low cost approach compared to offsite disposal.	o Contaminated soils remain onsite. o EMP required for ongoing management of material.	Capping shall be an unsuitable remedial technique as unacceptable levels of TRH (C_{10}-C_{36}) contamination will remain onsite which will have potential to pose future contamination risk. Capping also places future land use restrictions on the site with the requirement of an ongoing EMP. Capping is not considered appropriate for the site.
Onsite *ex-situ* treatment and reuse	o Treated soils are made suitable reuse onsite or offsite disposal at lower COC concentrations. o Minimal costs associated with offsite disposal.	o Requires establishment of onsite remediation area. o Remediation area would significantly increase development timeframes and may add cost (pending COC concentrations and type). o Treatment method ineffective for treating all COC identified.	This technique is not considered suitable for long chain hydrocarbons such compounds as remediation is likely to be prolonged or unachievable.
Offsite disposal	o Provides the shortest timeframe for remediation. o Removes risks to human health and long term management requirements. o Removes groundwater pollution source(s). o Allow reuse for residential (access to soil) purposes.	o High cost for material transport and disposal charges. o Additional cost associated with classifying wastes prior to offsite disposal.	This treatment option is the most suitable for site development. Impacted soil shall be removed from site minimising risks to human health and long term site management responsibilities.
Do Nothing	o No works required.	o Will not remove contaminants. o TRH (C_{10}-C_{-36}) contamination combined with asbestos present unacceptable human-health risks. o Site unable to be developed for residential (access to soil) purposes.	This approach will preclude future redevelopment for residential (access to soil) purposes. Human-health risks will remain.

5.1.2 Preferred Soil Remediation Option

In consideration of soil remediation technologies presented in Table 4, excavation and offsite disposal is considered the most suitable technology. This is considered suitable for remediation of contaminated soils for potential future site use for residential purposes.

Methods outlining the process of soil remediation are detailed in Section 6.

6 Remediation and Validation Planning

6.1 Remediation Plan

6.1.1 Overview

The following sections outline works required to remediate identified contaminated soils such that the site is fit for intended use.

Unless otherwise identified, activities discussed below will be the responsibility of the contractor or its representative.

6.1.2 Remediation Sequence

The following site remediation sequence is proposed.

1. Notify Council in accordance with SEPP 55.
2. Preparation of a safety and environmental management plan for the remediation by the contractor.
3. Site establishment.
4. Sampling beneath site sheds and dwellings which shall be completed following all building demolition works.
5. Site asbestos survey following the removal of identified refuse piles across the site.
6. Remediation of TRH (C_{10}-C_{36}) contaminated soils and where identified, ACM fibre sheeting via excavation. This is to be followed by validation of resulting excavations.
7. Waste classification assessment of remedial spoil for offsite disposal.
8. Preparation of validation report.
9. Execute contingency plans if and when required.

6.2 Notification to Shoalhaven City Council

In accordance with SEPP55 - Remediation of Land (1998), the remediation works are considered to be Category 1 due to the site being in a coastal protection zone. As such, development consent is required for these works.