Limited Detailed Site Investigation

Stage 2 - Sandstone Ridge
Townson Road, Colebee

Prepared for
Luxeland Development Pty Ltd

Project 86061.03
September 2017
**Document History**

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<tr>
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<td>Celine Li / John Russell</td>
<td>Paul Gorman</td>
<td>6 September 2017</td>
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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<td>6 September 2017</td>
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Limited Detailed Site Investigation
Stage 2 - Sandstone Ridge
Townson Road, Colebee

1. Introduction

This report by Douglas Partners Pty Ltd (DP) presents the results of a limited detailed site investigation (LDSI) undertaken for the proposed Stage 2 – Sandstone Ridge residential subdivision located at Townson Road, Colebee (hereon in referred to as the ‘site’). The investigation was commissioned by Luxeland Development Pty Ltd on 25 July 2017 and was undertaken in accordance with DP’s proposal SYD170830 (Rev1) dated 19 July 2017.

The site covers a portion of bushland with an approximate area of 15 hectares. It is understood that a residential subdivision including 230 residential allotments, new pavements and associated infrastructure are proposed to be constructed at the site.

The objective of this LDSI is to assess whether:

- The site is considered suitable, from a site contamination standpoint, for the proposed land use (i.e. residential); or
- Remediation is required in order to render the site suitable, from a site contamination standpoint, for the proposed land use (i.e. residential).

A site locality map and plan are shown on Drawing 1, Appendix A.

In the preparation of this LDSI, reference has been made to the following guidelines endorsed by the NSW EPA:

- National Environment Protection Council (NEPC) National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended in 2013), (NEPC, 2013);
- NSW EPA, Sampling Design Guidelines (EPA, 1995); and

The current investigation was undertaken concurrently with the following investigations by DP which are reported under separate cover:

- A salinity investigation (DP project ref: 86061.04);
- A LDSI on the adjacent Stage 1 – Sandstone Ridge site (DP project ref: 86061.00);
- A salinity investigation on the adjacent Stage 1 – Sandstone Ridge site (DP project ref: 86061.01); and
- A geotechnical investigation on the adjacent Stage 1 – Sandstone Ridge site (DP project ref: 86061.02).
2. **Scope of Work**

The scope of work comprised the following:

- Undertake a review of previous investigations including the information in those reports about the site history;
- Conduct an inspection of the site and observe situations that indicate a potential for contamination and identify environmental receptors, such as:
  - Disturbed or discoloured soil;
  - Disturbed or affected vegetation;
  - Presence of stored chemicals;
  - Proximity to surface waters and groundwater; and
  - Note the presence of visible possible asbestos containing material (ACM).
- Review of site information, including:
  - Published maps of acid sulfate soil (ASS) potential;
  - Geological and topographical maps/drawings; and
  - Relevant information provided by the client (e.g. previous reports, survey plans, design plans, etc.);
- Development of a conceptual site model;
- Obtain and review dial before you dig (DBYD) plans;
- Excavation / drilling of 29 test pits / boreholes to a depth of 0.5 m into natural soils up to a maximum depth of 2.0 m below ground level (bgl) or prior refusal. Collect soil samples at regular intervals from the surface to the base of the test pit / borehole and target each soil strata and potential areas of contamination;
- Collection of 12 targeted surface soil samples at identified areas of environmental concern (site features, for example stockpiles of fly-tipped rubbish);
- Survey of test pit and borehole locations using differential GPS;
- Screening of all samples collected with a PID to assess the likely presence or absence of volatile organic compounds (VOC);
- Analysis of 33 selected soil samples (i.e. approximately two per hectare), including 10% QC replicate samples, for a combination of the following common contaminants at a NATA accredited laboratory:
  - Eight priority metals (arsenic, cadmium, chromium, copper lead, mercury, nickel, zinc);
  - Total recoverable hydrocarbons (TRH);
  - Monocyclic aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylenes (BTEX));
  - Polycyclic aromatic hydrocarbons (PAH);
  - Organochlorine pesticides (OCP), organophosphorus pesticides (OPP) and polychlorinated biphenyls (PCB);
  - Total phenols;
Limited Detailed Site Investigation, Stage 2 - Sandstone Ridge
Townson Road, Colebee

3. Site Identification, Description and Surrounding Land Uses

The site is located on the corner of Townson Road and Victory Road, Colebee. It is understood to be part of Lots 5 to 9 DP 27536 which is currently 15.2 hectares in size. The site is an approximate rectangular shaped area, with maximum north-south to east-west dimensions of approximately 338 m and 446 m respectively.

For the purposes of describing the site features, the site can be divided into two areas described below on the basis of the site inspection by DP during the fieldwork:

- North-east and east Property (Lot 9) – occupied by a single storey residence with a car parking area and a dam. Several trucks were parked in the carpark area. The dam is up to 3 m high, with building rubble observed on the surface of the clay walls. There appeared to have been significant ‘fly-tipping’ of rubbish that had occurred on the western side of this property, generally within 20 m of Victory Road (e.g. stockpiles of rubbish adjacent to TP59, Drawing 1, Appendix A). Consequently a number of fill mounds / fly-tipped rubbish stockpiles are present.

- Western side – currently bushland and farmland that appears to have been used for grazing with numerous medium to large trees with a grass covering and thick shrubs at some locations. It includes a few small timber and metal framed sheds. Some open areas appear to have previously been used as farmland.

The terrain is undulating and generally falls to the west and north-west (RL 26.5 m to RL 47.5 m AHD) at slopes of up to 5° with occasional areas of slopes of up to 10°. The areas of the steepest slopes are on the eastern side of the site where site levels appear to have been built up for the formation of Victory Road and falls towards creek lines that appear to flow westward towards Bells Creek.

The site is bounded by the following:

- North – by Townson Road bushland and farmland (Stage 2).
- East - Victory Road with residential subdivisions further to the east.
- South – bushland, farmland and the paintball facility (Stage 1).
- West – bushland, farmland including ‘Bells Creek’ which traverses an approximate north-south alignment and is a tributary of Eastern Creek to the north, with surrounding bushland cover.
4. Site Geology and Soils

Reference to the Penrith 1:100 000 Geological Series Sheet indicates that the site is underlain by the following:

- St Marys Formation – fluvial sediments of Triassic age comprising laterized sand and clay with ferricrete bands, includes silcrete sandstone and shale boulders.
- Bringelly Shale – Triassic age comprising laterised sand and clay with ferricrete bands, includes silcrete sandstone and shale boulders.

Approximately 50 m to 100 m to the west an area surrounding Bells Creek is mapped as underlain by Quaternary sediments comprising sands, silts and gravels. Figure 2 below shows an excerpt of the geological map of the site.
5. **Proposed Development**

It is understood that a residential subdivision including 230 residential allotments, new pavements and associated infrastructure are proposed to be constructed at the site.

6. **Review of Previous Contamination Investigations**

The following previous reports which encompass Stages 1 and 2 – Sandstone Ridge in addition to adjacent land, that are relevant to the current investigation, have also been briefly reviewed by DP:

- Sinclair Knight Merz Pty Ltd (SKM), *Report to Blacktown City Council on Preliminary Contamination Investigation for Colebee Release Area, Marsden Park, NSW* (SKM, 2003); and
In order to identify possible changes in land use or potential areas of concern, SKM (2003) included a review of aerial photography from 1947 until 2002. SKM (2012) included a review of the historical aerial photographs for various years between the early 1990’s to 2012. Aerial photography from the 2009 to present day was also reviewed by DP in order to augment the previous SKM reviews.

Our review of SKM (2003; 2012) and associated aerial photography from 2009 to present day indicates that the site has remained largely similar to its current state (i.e. predominantly bushland surrounded by rural residential properties), since circa 1947.

In summary the review of site history information provided in SKM (2003; 2012) found that the site (i.e. Stage 2 – Sandstone Ridge) appears to have been predominantly occupied by bushland and that the area is unlikely to contain widespread or gross contamination. However, the reports noted that some adjacent properties may pose some environmental risk (e.g. the paintball facility, which comprises Stage 1 – Sandstone Ridge).

NSW Planning and Environment (2016) Blacktown City Council Finalisation Report – Planning Proposal has also been reviewed by DP. The report includes a summary of DLA Environmental Pty Ltd (2013) Preliminary Environmental Site Assessment – Townson Road, Marsden Park, dated September 2013. Specifically, DLA Environmental Pty Ltd (2013) “found asbestos fragments on the surface of the northern batter of the dam at Lot 9 DP 27536. 68 Townson Road. Recommendation was made for a Clearance Certificate. An Asbestos Clearance Certificate was submitted to Council. The Certificate states that asbestos containing materials have been successfully removed from the surface of the dam bank in the north east of the Townson Road Precinct. The area does not pose a risk to health or the environment.” DP has not reviewed the actual DLA Environmental Pty Ltd report(s) and only has access to the summary provided in NSW Planning and Environment (2016).

The dam referred to in Lot 9 DP 27536 is presumably the dam located to the south of the house in the north-east corner of the site as shown on Figure 1 and Drawing 1, Appendix A.

7. Conceptual Site Model

A conceptual site model is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The conceptual site model provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present or the future i.e. it enables an assessment of the potential source – pathway – receptor linkages (complete pathways).

Potential Sources

Based on the available information, the following potential sources of contamination and associated contaminants of potential concern (CoPC) have been identified.

- S1 – Filling from unknown origin that may have been used to raise site levels:
  - CoPC include metals, TRH, BTEX, PAH, OCP, OPP, PCB, phenols and asbestos.
- S2 – Historical commercial and industrial uses adjacent to the site including a junkyard located to the north-west and the paintball facility to the south-west:
  - CoPC include metals, TRH, BTEX, PAH, PCB, and asbestos.
• S3 – Fly tipping of waste materials (typically fill mounds / fly-tipped rubbish stockpiles):
  o CoPC include metals, TRH, BTEX, PAH and asbestos.

Potential Receptors
Human health receptors:
• R1 – Construction and maintenance workers;
• R2 – End users (residential/recreational); and
• R3 – Adjacent users (residents).

Environmental receptors:
• R4 – Water bodies (Eastern Creek/ Bells Creek);
• R5 – Ecology; and
• R6 – Groundwater.

Potential Pathways
• P1 – Ingestion and dermal contact;
• P2 – Inhalation of dust and/or vapours;
• P3 – Surface water run-off;
• P4 – Leaching of contaminants and vertical migration into groundwater; and
• P5 – Lateral migration of groundwater providing base flow to water bodies.

Summary of Potentially Complete Pathways
A ‘source–pathway–receptor’ approach has been used to assess the potential risks of harm being caused to human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways (complete pathways). The possible pathways between the above sources (S1 to S3) and receptors (R1 to R6) are provided in Table 1 below.
Table 1: Summary of Potentially Complete Pathways

<table>
<thead>
<tr>
<th>Source</th>
<th>Transport Pathway</th>
<th>Receptor</th>
<th>Risk Management Action Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1: Filling</td>
<td>P1: Ingestion and dermal contact</td>
<td>R1: Construction and maintenance workers R2: End users (residential/recreational)</td>
<td>An intrusive investigation is recommended to assess possible contamination including chemical testing of the soils. If the site soils are contaminated at unacceptable levels, mitigation / remediation measures will need to be implemented to manage the risk to the identified receptors.</td>
</tr>
<tr>
<td></td>
<td>P2: Inhalation of dust and/or vapours</td>
<td>R1: Construction and maintenance workers R2: End users (residential/recreational) R3: Adjacent users (residents)</td>
<td></td>
</tr>
<tr>
<td>S2: Adjacent industrial land use (junkyard and paintball facility)</td>
<td>P3 – Surface water run-off P4 – Leaching of contaminants and vertical migration into groundwater P5: Lateral migration of groundwater providing base flow to water bodies</td>
<td>R4: Water bodies (Eastern Creek/Bells Creek) R5: Ecology R6: Groundwater</td>
<td></td>
</tr>
<tr>
<td>S3: Fly tipping of waste materials</td>
<td>Metals, TRH, BTEX, PAH, PCB, asbestos</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Metals, TRH, BTEX, PAH, PCB, asbestos</td>
<td></td>
<td></td>
</tr>
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</table>

8. Fieldwork

8.1 Data Quality Objectives

This LDSI has been devised broadly in accordance with the seven step data quality objective (DQO) process as specified in Schedule B2 of NEPC (2013). The DQO process is outlined as follows:

- Stating the Problem;
- Identifying the Decision;
- Identifying Inputs to the Decision;
- Defining the Boundary of the Assessment;
- Developing a Decision Rule;
- Specifying Acceptable Limits on Decision Errors; and
- Optimising the Design for Obtaining Data.

The DQOs have been addressed within the report as shown in Table 2, below.
Table 2: Data Quality Objectives

<table>
<thead>
<tr>
<th>Data Quality Objective</th>
<th>Report Section where Addressed</th>
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<tr>
<td>State the Problem</td>
<td>S1 Introduction</td>
</tr>
<tr>
<td>Identify the Decision</td>
<td>S1 Introduction (objective)</td>
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<td></td>
<td>S12 Discussion of Results</td>
</tr>
<tr>
<td>Identify Inputs to the Decision</td>
<td>S1 Introduction</td>
</tr>
<tr>
<td></td>
<td>S6 Review of Previous Contamination Investigations (site history information)</td>
</tr>
<tr>
<td></td>
<td>S2 Scope of Work</td>
</tr>
<tr>
<td></td>
<td>S9 Site Assessment Criteria</td>
</tr>
<tr>
<td></td>
<td>S10 Fieldwork Results</td>
</tr>
<tr>
<td></td>
<td>S11 Results of Laboratory Analysis</td>
</tr>
<tr>
<td>Define the Boundary of the Assessment</td>
<td>S3 Site Identification and Surrounding Land Uses</td>
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<td></td>
<td>Site Drawings - Appendix A</td>
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<tr>
<td>Develop a Decision Rule</td>
<td>S9 Site Assessment Criteria</td>
</tr>
<tr>
<td>Specify Acceptable Limits on Decision Errors</td>
<td>S10 Fieldwork Results</td>
</tr>
<tr>
<td></td>
<td>S9 Site Assessment Criteria</td>
</tr>
<tr>
<td></td>
<td>QA/QC Procedures and Results, Appendix B</td>
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<tr>
<td>Optimise the Design for Obtaining Data</td>
<td>S2 Scope of Works</td>
</tr>
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<td></td>
<td>S8.2 Soil Sampling Rationale</td>
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<tr>
<td></td>
<td>QA/QC Procedures and Results, Appendix B</td>
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</table>

8.2 Soil Sampling Rationale

A full DSI typically includes a soil sampling density which meets the minimum recommended number of sampling points for site characterisation based on the detection of circular hot spots using a systemic grid sampling pattern in Table A of NSW EPA (1995) Sampling Design Guidelines, which, for a site of 15 ha is 165 sampling points. Given the nature of this site and the generally low to moderate risk profile for site contamination (based on the review of site history information), a sampling density which meets Table A of NSW EPA (1995), is not considered to be necessary.

The adopted programme of limited sampling comprised an overall sampling density of at least two test locations per hectare. This included a mix of test pits / boreholes and some targeted near surface soil samples at identified areas of environmental concern (i.e. a representative proportion of the fill mounds / fly-tipped rubbish stockpiles).

Based on the available site history information, there appears to be a low potential for adjacent off-site contaminant point-sources. Therefore DP considers that the likelihood of groundwater contamination at the site is low and that a groundwater assessment is not required.
8.3 Fieldwork Methods

The fieldwork was undertaken between 3 and 8 August 2017 and involved the following:

- A walkover inspection by an experienced environmental engineer.
- The excavation of 20 test pits (Pits 44 to 52, 53 to 56, 58 to 60, 62 to 64 and 66 to 68), using either a 3.5 tonne or 5 tonne excavator to depths of 0.5 m to 2.5 m which was either the limit of investigation or practical refusal.
- The drilling of nine boreholes (Bores 53, 57, 61, 65 and 69 to 73) using a ute-mounted auger drilling rig to depths of 0.5 m to 2.5 m.
- The collection of near surface soil samples form targeted locations (refer to Section 0 for details).
- Sampling of soils to assist in logging and to provide specimens for laboratory testing.

The ground surface levels and easting and northing were determined by dGPS methods, accurate to 0.1 – 0.15 m. The pit and borehole locations are shown on Drawings 1 and 2, Appendix A.

8.4 Soil Sampling Procedures

Environmental sampling was performed according to standard operating procedures outlined in the DP Field Procedures Manual. All sampling data was recorded on test pit / borehole logs included in Appendix C and samples selected for laboratory analysis were recorded on DP chain-of-custody (COC) sheets. The general soil sampling procedure comprised:

- Use of disposable sampling equipment including disposal nitrile gloves;
- Transfer of samples into laboratory-prepared glass jars and capping immediately with Teflon lined lids.
- Labelling of sampling containers with individual and unique identification, including project number sample location and sample depth;
- Screening of replicate soil samples collected in sealed plastic bags for total photoionisable compounds using a calibrated PID; and
- Placement of sample containers and bags into a cooled, insulated and sealed container for transport to the laboratory.

Envirolab Services Pty Ltd (Envirolab), accredited by NATA, was employed to conduct sample analysis. The laboratory is required to carry out in-house QC procedures.

8.5 Analytical Rationale

The analytical scheme for soil samples was designed to obtain an indication of the potential presence and possible distribution of identified CoPC being metals, TRH, BTEX, PAH, OCP, OPP, PCB, phenols, and asbestos. The rationale for the sample selection and the analyte selection were based on the conceptual site model. The results of the analytical testing were compared with the adopted site assessment criteria (SAC) discussed below.

9. Site Assessment Criteria
The proposed use for the site after development is residential. The relevant SAC have been selected accordingly.

The analytical results from the laboratory testing have been assessed (as a Tier 1 assessment) against the investigation and screening levels in Schedule B1 of NEPC (2013). This guideline has been endorsed by the NSW EPA under the Contaminated Land Management Act 1997. The Schedule provides investigation and screening levels for commonly encountered contaminants which are applicable to generic land uses and include consideration of, where relevant, the soil type and the depth of contamination.

### 9.1 Health Investigation and Screening Levels

The HILs and HSLs are scientifically-based, generic assessment criteria designed to be used in the first stage (Tier 1) of an assessment of potential risks to human health from chronic exposure to contaminants. HILs are applicable to assessing health risks arising from direct contact to a range of contaminants. HSLs are used to assess selected petroleum compounds and fractions to assess the risk to human health via inhalation and direct contact with affected soils and groundwater.

HSLs have been developed for a range of petroleum hydrocarbons as either petrol or diesel mixtures, and for different land uses, media, pathways, soil types and depths to contamination.

The investigation and screening levels are not intended to be used as clean up levels. They establish concentrations above which further appropriate investigation (e.g. Tier 2) should be undertaken. They are intentionally conservative and are based on a reasonable worst-case scenario for four generic land uses.

Potential exposure pathways considered were:

- Soil vapour intrusion (for hydrocarbon contamination); and
- Direct contact.

Soil types considered were:

- Sand (conservative), given the general variability of soil types at the site.

Depth to contamination considered was:

- 0 to <1 m for soil HSLs have been adopted as an initial conservative screen; and
- HILs apply generally to the top 3 m of soil for residential land use.

Relevant land use criteria considered were:

- **HIL-A** – Residential with garden/accessible soils; and

For petroleum hydrocarbons, the exposure scenario for a maintenance worker performing intrusive ground works has also been considered and these criteria are extracted from the CRC CARE Technical Reports on which the NEPC (2013) HSLs are based. The adopted soil HILs and HSLs are shown on the following table.
### Table 3: Health Investigation and Screening Levels (HILs/HSLs) in mg/kg

<table>
<thead>
<tr>
<th>Contaminants</th>
<th>Direct Contact</th>
<th>Vapour Intrusion</th>
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<tbody>
<tr>
<td></td>
<td>Resident /Site user HIL/HSL-A</td>
<td>Intrusive Worker</td>
</tr>
<tr>
<td><strong>Heavy Metals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Cadmium</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Chromium (VI)</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Copper</td>
<td>6000</td>
<td>-</td>
</tr>
<tr>
<td>Lead</td>
<td>300</td>
<td>-</td>
</tr>
<tr>
<td>Mercury (inorganic)</td>
<td>40</td>
<td>-</td>
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<tr>
<td>Nickel</td>
<td>400</td>
<td>-</td>
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<tr>
<td>Zinc</td>
<td>7400</td>
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<tr>
<td><strong>PAH</strong></td>
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<tr>
<td>Benzo(a)pyrene TEQ</td>
<td>3</td>
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<tr>
<td>Total PAH</td>
<td>300</td>
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<tr>
<td>Naphthalene</td>
<td>1400</td>
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<td><strong>TRH</strong></td>
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<td>C6 – C10 (less BTEX) [F1]</td>
<td>4,400</td>
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<td>&gt;C10-C16 (less Naphthalene) [F2]</td>
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<td>&gt;C16-C34</td>
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<td>HCB</td>
<td>10</td>
<td>-</td>
</tr>
</tbody>
</table>
## 9.2 Ecological Investigation and Screening Levels

Ecological Investigation Levels (EILs) have been developed and discussed in NEPC (2013) for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physiochemical properties and land use scenarios and generally apply to the top 2 m of soil, which essentially corresponds to the root zone and habitation zone of many species. The EIL is determined for a contaminant using the following formula:

\[
EIL = ABC + ACL, \quad \text{where}
\]

\[
\begin{align*}
ABC &= \text{Ambient Background Concentration} \\
ACL &= \text{Added Contaminant Limit}
\end{align*}
\]

The ABC of a contaminant is the soil concentration in a specific locality that is the sum of naturally occurring background levels and the contaminants levels that have been introduced from diffuse or non-point sources (e.g. motor vehicle emissions). The ABC is determined through direct measurement at an appropriate reference site (preferred) or through the use of methods defined by Olszowy et al. (1995) or Hamon et al. (2004) (NEPC, 2013).

ACLS are based on the soil characteristics of estimated pH, CEC and clay content.

EILs (and ACLs where appropriate) have been derived for only a short list of contaminants including As, Cu, Cr (III), DDT, naphthalene, Ni, Pb and Zn. An Interactive (Excel) Calculation Spreadsheet may be used for calculating site-specific EILs, and has been provided in the ASC NEPM Toolbox.

The relevant EILs have been selected using average pH and CEC of the site soils based on six samples tested for pH and CEC as follows:
• Average pH 5.5 (range 4.6 to 6.8) based on six soil pH sample results within the upper 2.0 m of the soil profile;
• Average CEC 9.7 (range 4.6 to 20) based on six soil CEC sample results within the upper 2.0 m of the soil profile;
• Clay content 10% (conservative assumption); and
• NSW traffic and ‘high’ traffic volume.

Table 4: Ecological Investigation Levels (EILs) in mg/kg

<table>
<thead>
<tr>
<th>Analyte</th>
<th>EIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals</td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>100</td>
</tr>
<tr>
<td>Cadmium</td>
<td>NC</td>
</tr>
<tr>
<td>Chromium (III)</td>
<td>410</td>
</tr>
<tr>
<td>Copper</td>
<td>160</td>
</tr>
<tr>
<td>Lead</td>
<td>1100</td>
</tr>
<tr>
<td>Mercury (inorganic)</td>
<td>NC</td>
</tr>
<tr>
<td>Nickel</td>
<td>160</td>
</tr>
<tr>
<td>Zinc</td>
<td>390</td>
</tr>
<tr>
<td>OCP</td>
<td></td>
</tr>
<tr>
<td>DDT</td>
<td>180</td>
</tr>
<tr>
<td>PAH</td>
<td></td>
</tr>
<tr>
<td>Naphthalene</td>
<td>170</td>
</tr>
</tbody>
</table>

Notes to Table 4:
NC - No Criteria

Ecological Screening Levels (ESLs) are used to assess the risk of selected petroleum hydrocarbon compounds, BTEX and benzo(a)pyrene to terrestrial ecosystems. ESLs apply to the top 2 m of the soil profile, which essentially corresponds to the root zone and habitation zone of many species.

ESLs have been derived in NEPC (2013) for the same four petroleum fractions as the HSLs (F1 to F4) as well as BTEX and Benzo(a)pyrene. The ESLs are shown on the following table. The following site specific data and assumptions have been used to determine the ESLs:
• The ESLs will apply to the top 2 m of the soil profile;
• The ESLs for urban residential and public open space apply; and
• A “coarse” soil texture (conservative) has been adopted as an initial screen given the general variability of soil types at the site.
Table 5: Ecological Screening Levels (ESLs) in mg/kg

<table>
<thead>
<tr>
<th>Analyte</th>
<th>ESL</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRH</td>
<td></td>
<td>All ESLs are low reliability apart from those marked with * which are moderate reliability</td>
</tr>
<tr>
<td>C₆ – C₁₀ (less BTEX) [F1]</td>
<td>180*</td>
<td></td>
</tr>
<tr>
<td>&gt;C₁₀–C₁₆ (less Naphthalene) [F2]</td>
<td>120*</td>
<td></td>
</tr>
<tr>
<td>&gt;C₁₆–C₃₄ (F3)</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>&gt;C₃₄–C₄₀ (F4)</td>
<td>2800</td>
<td></td>
</tr>
<tr>
<td>BTEX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Toluene</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Ethyl Benzene</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Xylenes</td>
<td>105</td>
<td></td>
</tr>
<tr>
<td>PAH</td>
<td>B(a)P</td>
<td>0.7</td>
</tr>
</tbody>
</table>

9.3 Management Limits for Petroleum Hydrocarbons

In addition to appropriate consideration and application of the HSLs, there are additional considerations which reflect the nature and properties of petroleum hydrocarbons, including:

- Formation of observable light non-aqueous phase liquids (LNAPL);
- Fire and explosion hazards; and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services.

Management Limits to avoid or minimise these potential effects have been adopted in NEPC (2013) as interim Tier 1 guidance. Management Limits have been derived for the same four petroleum fractions as the HSLs (F1 to F4). The adopted Management Limits are shown on the following table. The following site specific data and assumptions have been used to determine the Management Limits:

- The Management Limits will apply to any depth within the soil profile;
- The Management Limits for residential, parkland and open space apply; and
- A “coarse” soil texture (conservative) has been adopted as an initial screen given the general variability of soil types at the site.

Table 6: Management Limits in mg/kg

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Management Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRH</td>
<td></td>
</tr>
<tr>
<td>C₆ – C₁₀ (F1)</td>
<td>700</td>
</tr>
<tr>
<td>&gt;C₁₀–C₁₆ (F2)</td>
<td>1000</td>
</tr>
<tr>
<td>&gt;C₁₆–C₃₄ (F3)</td>
<td>2500</td>
</tr>
<tr>
<td>&gt;C₃₄–C₄₀ (F4)</td>
<td>10,000</td>
</tr>
</tbody>
</table>

Notes to Table 6:
Separate management limits for BTEX and naphthalene are not available hence these should not be subtracted from the relevant fractions to obtain F1 and F2.
9.4 Asbestos in Soil

NEPC (2013) provides the following definitions for forms of asbestos:

- Bonded asbestos containing material (ACM) comprises asbestos-containing-material which is in sound condition, although possibly broken or fragmented, and where the asbestos is bound in a matrix such as cement or resin (e.g. asbestos fencing and vinyl tiles). This term is restricted to material that cannot pass a 7 mm x 7 mm sieve. This sieve size is selected because it approximates the thickness of common asbestos cement sheeting and for fragments to be smaller than this would imply a high degree of damage and hence potential for fibre release.

- Fibrous asbestos (FA) comprises friable asbestos material and includes severely weathered cement sheet, insulation products and woven asbestos material. This type of friable asbestos is defined here as asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. This material is typically unbonded or was previously bonded and is now significantly degraded (crumbling).

- Asbestos fines (AF) includes free fibres, small fibre bundles and also small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve. Bonded ACM fragments to pass through a 7 mm x 7 mm sieve implies a substantial degree of damage which increases the potential for fibre release.

Bonded ACM is equivalent to ‘non-friable’ asbestos in Safe Work Australia (2011), which is defined therein as ‘material containing asbestos that is not friable asbestos, including material containing asbestos fibres reinforced with a bonding compound’.

From a risk to human health perspective, FA and AF are considered to be equivalent to ‘friable’ asbestos in Safe Work Australia (2011), which is defined therein as ‘material that is in a powder form or that can be crumbled, pulverised or reduced to a powder by hand pressure when dry, and contains asbestos’.

NEPC (2013) stipulates that the threshold for asbestos soil contamination under a recreational land use scenario (i.e. public open space such as parks, playgrounds, playing fields e.g. ovals, secondary schools and unpaved footpaths) is:

- 0.001% asbestos for FA and AF;
- 0.02% w/w asbestos for ACM, for the impacted (soil) volume; and
- No visible asbestos for surface soils.

A detailed asbestos assessment was not undertaken as part of these works. Therefore the presence or absence of asbestos at a limit of reporting of 0.1 g/kg has been adopted for this assessment as an initial screen.
10. **Fieldwork Results**

The subsurface conditions encountered in the boreholes are presented in the test pit and borehole logs in Appendix C together with notes defining classification methods and descriptive terms.

A summary of the typical sequence of subsurface conditions encountered in the test pits and boreholes at the site is presented below:

- **Topsoil**
  - Topsoil (clayey silt, sandy silty and silty clay with some vegetation) up to 200 mm thick. No topsoil was encountered in Pits 13, 16 or 22 overlying,

- **Filling**
  - Silty sand, and silty clay filling to depths of 0.4 m to 1.0 m in Pits 44, 51, 67; overlying,

- **Natural soils**
  - stiff to hard clay, clayey silt and silty sand with some ironstone gravel; overlying,

- **Extremely low to very low strength rock**
  - Generally extremely low strength, light grey shale or sandstone at depths of 0.9 m to 1.8 m in Pits 50, 51, 52, 62 and 63. Pits 49 and 57 included low and medium strength sandstone from depths of 0.3 m to 0.8 m.

No free groundwater was observed whilst excavating pits or drilling boreholes. Backfilling of the test pits and boreholes at the completion of excavation and drilling precluded long-term monitoring of the groundwater levels.

No asbestos cement fragments (bonded ACM) were observed during fieldwork. This includes at each individual test location or during the general site inspection. There were, however, heavily vegetated areas of the site which necessarily precluded inspection. Furthermore, a detailed inspection of the entire ground surface was beyond the current scope of work.

A total of 12 surface samples were collected from various locations across the site. The sample coordinates, associated targeted site feature (typically a representative proportion of fill mounds / fly-tipped rubbish stockpiles) and soil descriptions are shown on the following table.
Table 6: Surface Samples Summary

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Depth (m)</th>
<th>Easting (m)</th>
<th>Northing (m)</th>
<th>Targeted Site Feature</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>59A</td>
<td>0.0-0.1</td>
<td>300967</td>
<td>6267015</td>
<td>Adjacent to stockpile of rubbish near TP59</td>
<td>FILLING: brown silty sand with gravels and building debris, humid</td>
</tr>
<tr>
<td>59B</td>
<td>0.0-0.1</td>
<td>300976</td>
<td>6267011</td>
<td>Adjacent to stockpile of rubbish near TP59</td>
<td>FILLING: brown silty sand with gravels and building debris, humid</td>
</tr>
<tr>
<td>59C</td>
<td>0.0-0.1</td>
<td>300982</td>
<td>6267005</td>
<td>Adjacent to stockpile of rubbish near TP59</td>
<td>FILLING: brown silty sand with gravels and building debris, humid</td>
</tr>
<tr>
<td>59D</td>
<td>0.0-0.1</td>
<td>300992</td>
<td>6266977</td>
<td>Adjacent to stockpile of rubbish near TP59</td>
<td>FILLING: brown silty sand with gravels and building debris, humid</td>
</tr>
<tr>
<td>59E</td>
<td>0.0-0.1</td>
<td>300954</td>
<td>6266978</td>
<td>Adjacent to stockpile of rubbish near TP59</td>
<td>FILLING: brown silty sand with gravels and building debris, humid</td>
</tr>
<tr>
<td>60A</td>
<td>0.0-0.1</td>
<td>300928</td>
<td>6267076</td>
<td>Toe of stockpile on southern end of dam near TP60</td>
<td>FILLING: brown silty clay with gravels and sand, humid</td>
</tr>
<tr>
<td>60B</td>
<td>0.0-0.1</td>
<td>300927</td>
<td>6267073</td>
<td>Top of stockpile on southern end of dam near TP60</td>
<td>FILLING: brown silty clay with gravels and sand, humid</td>
</tr>
<tr>
<td>66A</td>
<td>0.0-0.1</td>
<td>300844</td>
<td>6267135</td>
<td>Toe of stockpile on western end of pond near TP66</td>
<td>FILLING: light brown silty sand with gravels and some clay, moist</td>
</tr>
<tr>
<td>66B</td>
<td>0.0-0.1</td>
<td>300844</td>
<td>6267144</td>
<td>Top of stockpile on western end of pond near TP66</td>
<td>FILLING: light brown silty sand with gravels and some clay, moist</td>
</tr>
<tr>
<td>67A</td>
<td>0.0-0.1</td>
<td>300917</td>
<td>6267153</td>
<td>Next to rainwater tank of property at Townson Rd/Victory Rd junction</td>
<td>TOPSOIL/FILLING: brown clayey silt with gravels, wet</td>
</tr>
<tr>
<td>67B</td>
<td>0.0-0.1</td>
<td>300894</td>
<td>6267140</td>
<td>Next to parked trucks in carpark at Townson Rd/Victory Rd junction</td>
<td>FILLING: grey asphaltic concrete, moist</td>
</tr>
<tr>
<td>67C</td>
<td>0.0-0.1</td>
<td>300892</td>
<td>6267114</td>
<td>Building rubble stockpile on SW corner of carpark at Townson Rd/Victory Rd junction</td>
<td>FILLING: brown silty sand with gravels and building debris</td>
</tr>
</tbody>
</table>

Selected site photographs depicting site features including the location of some of the targeted soil samples are included in Appendix A.
11. Results of Laboratory Analysis

11.1 Laboratory Results

The tabulated analytical results are summarised together with the SAC in Appendix D. The laboratory certificates of analysis and associated chain of custody documentation is provided in Appendix E.

11.2 Quality Assurance and Quality Control Results

The methodology, results and discussion of the field and laboratory QA/QC assessment are provided in Appendix B. Based on the results of the QA/QC assessment the data is considered to be suitable for use in assessing the contamination status of the site.

12. Discussion of Results

In summary the review of site history information provided in SKM (2003; 2012) found that the site (i.e. Stage 2 – Sandstone Ridge) appears to have been predominantly occupied by bushland and that the area is unlikely to contain widespread or gross contamination. However, the reports noted that some adjacent properties may pose some environmental risk (e.g. the paintball facility, which comprises Stage 1 – Sandstone Ridge).

Twenty-nine test pits / boreholes were excavated / drilled across the site. Twelve targeted near surface soil samples were also collected at identified areas of environmental concern (i.e. site features, for example stockpiles of fly-tipped rubbish).

Thirty-three soil samples collected from the test pits / boreholes / targeted near surface locations were submitted for testing of a combination of a range of common organic and inorganic contaminants. Recorded concentrations of metals were all below the adopted SAC. Recorded concentrations of organic contaminants (TRH, BTEX, PAH OCP, OPP, PCB and phenols) were all below the adopted SAC with the exception of:

- Targeted near surface soil sample 67B where TRH C_{16-34} at 320 mg/kg exceeded SAC (ESL Urban Residential/ Public Open Space for coarse soil) of 300 mg/kg.

The exceedance of the coarse soil ESL is only marginal. Moreover, given that sample 67B is a clayey silt soil, the ESL for fine soil may be more relevant than the conservatively adopted SAC (i.e. ESL for coarse soil). The ESL for fine soil is 1300 mg/kg and on this basis, sample 67B does not exceed the soil-texture specific ESL.

Detectable concentrations of TRH and PAH were recorded in some soil samples, however, at concentrations below the adopted SAC.

No asbestos cement fragments (bonded ACM) were observed during fieldwork. This includes at each individual test location or during the general site inspection. There were, however, heavily vegetated areas of the site which necessarily precluded inspection. Furthermore, a detailed inspection of the entire ground surface was beyond the current scope of work.
13. Conclusions and Recommendations

Contaminant concentrations in the soil samples were all within the adopted SAC. Based on the results of the soil testing and low potential for adjacent off-site contaminant point-sources, DP considers that the likelihood of groundwater contamination at the site is low and that a groundwater assessment is not required.

NSW Planning and Environment (2016) notes that asbestos fragments were found on the surface of the northern batter of the dam at Lot 9 DP 27536. An Asbestos Clearance Certificate was subsequently submitted to Council. The Certificate states that asbestos containing materials have been successfully removed from the surface of the dam bank in the north east of the Townson Road Precinct (NSW Planning and Environment, 2016). Given that historical asbestos contamination is known to have been present at the site and that fly-tipped material (rubbish) is also present, the presence of further pockets of asbestos contamination at the site cannot be ruled out.

Based on the findings of this LDSI, and in the context of the conceptual site model, it is concluded the site is suitable, from a site contamination standpoint, for the proposed land use (i.e. residential). Under the supervision of an Environmental Consultant, all fly-tipped rubbish stockpiles and any associated fill mounds should be classified in accordance with NSW EPA guidelines and disposed off-site prior to the commencement of the bulk earthworks. In addition, an unexpected finds protocol (UFP) should be in place during future civil and construction works in the event that unexpected finds (e.g. asbestos, as discussed above) are encountered during the course of the bulk earthworks. The UFP is outlined in Section 13.1, below.

Consideration should be given to fencing the site to minimise the likelihood of further fly-tipping that could occur subsequent to the issue of this report.

13.1 Unexpected Finds Protocol

If unexpected conditions with respect to contamination are encountered by the Contractor during the earthworks (such as fragments of suspected asbestos, buried structures or unexpected contaminated soil or contaminants) and construction, the following general approach will be adopted:

- Upon discovery of a unexpected find (UF), works will cease in that area, the Contractor’s Site Manager is to be notified and the affected area closed off by the use of barrier tape.
- The location of the UF should be surveyed using dGPS with sub-meter accuracy.
- The Site Manager is to contact the Principal’s Representative (PR), and the PR is to notify an appropriately qualified Environmental Consultant.
- The Environmental Consultant will inspect the area and make an assessment of the significance of the find in terms of the potential impact to human health and the environment with reference to NSW EPA endorsed guidelines including NEPC (2013).
- Provision of advice from the Environmental Consultant to the PR regarding the recommended course of action;
- The Environmental Consultant will prepare a report detailing their assessment including the extent and methods of remediation, as required.
The assessment results together with a suitable management plan shall be provided by the PR to the Consent Authority (Blacktown Council) for written approval consistent with the DA conditions prior to the removal or treatment of such contamination / hazardous materials.

The agreed management/remedial strategy shall be implemented.

In the event that the UF relates to the identification of asbestos the following protocol will also apply:

- Upon discovery of suspected asbestos (e.g. fragments of ACM), the site foreman is to be notified and the affected area closed off by the use of barrier tape and warning signs. Warning signs shall be specific to Asbestos Hazards and shall comply with the Australian Standard 1319-1994 Safety Signs for the Occupational Environment.

- The Environmental Consultant or Occupational Hygienist is to be notified to inspect the area and confirm the presence of asbestos and determine extent of remediation works to be undertaken. An assessment report detailing this information will be compiled by the Environmental Consultant or Occupational Hygienist and provided to the PR.

- The assessment results together with a suitable management plan shall be provided by the PR to the Consent Authority (Blacktown Council) for written approval prior to the removal or treatment of ACM.

- The agreed management/remedial strategy shall be implemented.

- The impacted soil will be stockpiled for:
  - Remediation (if evaluated to be feasible by the Environmental Consultant or Occupational Hygienist); or
  - Waste classification (including sampling and chemical analysis) prior to off-site disposal.

- In dry and windy conditions the stockpile will be lightly wetted and covered with plastic sheet whilst awaiting remediation / disposal.

- All work associated with asbestos in soil will be undertaken by an appropriately licenced contractor.

- Monitoring for airborne asbestos fibres is to be carried out during the soil excavation and remediation (if undertaken).

- Documentary evidence (weighbridge dockets) of correct disposal is to be provided to the contractors construction manager.

- At the completion of the excavation, a clearance inspection is to be carried out and written confirmation is to be provided by the Environmental Consultant or Occupational Hygienist that the area is safe to be accessed and worked. Validation will include soil sampling and testing.

- Details of the incident are to be recorded in the site record system.

A form to be completed by the Contractor’s Site Manager is on page 22 of this report (below) and should be completed and sent to the Environmental Consultant in the event of encountering a UF.
Unexpected Find Form

Unexpected Find No. ________________________________

Date ________________________________

Location ________________________________

Actions

<table>
<thead>
<tr>
<th>Item</th>
<th>Action Taken</th>
<th>Action Taken By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unexpected find encountered</td>
<td>Affected area closed off by barrier tape</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>Notify the Principal’s Representative</td>
<td>Site Manager</td>
</tr>
<tr>
<td></td>
<td>Notify and Environmental Consultant</td>
<td>Principal’s Representative</td>
</tr>
</tbody>
</table>

Information for the Environmental Consultant to be completed by the Contractor’s Site Manager

Description of the Unexpected Find

Does the Unexpected Find potentially involve asbestos

Yes

No
14. References


NSW Planning and Environment (2016) Blacktown City Council Finalisation Report – Planning Proposal

OEH (2011) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites

SKM (2003) Preliminary Contamination Site Investigation, Colebee Release Area & Adjoining Lands Local Environmental Study

SKM (2012) Contamination Assessment- Townson Road, Marsden Park

15. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Townson Road, Colebee in accordance with DP’s proposal dated 19 July 2017 and acceptance received from Kevin Ma dated 25 July 2017. The work was carried out under DP’s Conditions of Engagement. This report is provided for the exclusive use of Luxeland Development Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP’s field testing has been completed.

DP’s advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.
This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Asbestos has not been detected by observation or by laboratory analysis, either on the surface of the site, or in filling materials at the test locations sampled and analysed. Building demolition materials, (general rubbish) such as concrete, brick, tile, were, however, located at above-ground stockpiles of fly-tipped material / general rubbish, and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos.

Although the sampling plan adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the site that have not been sampled and analysed. This is either due to undetected variations in ground conditions or to budget constraints (as discussed above), or to vegetation preventing visual inspection and reasonable access. It is therefore considered possible that HBM, including asbestos, may be present in unobserved or untested parts of the site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

Douglas Partners Pty Ltd
Appendix A

Drawings, Site Photographs and Notes About this Report
NOTE:
1: Base drawing from Chadwick Cheng Consulting Surveyors (Dwg Ref. 31326/D3, dated 11.7.2012)
2: Test locations are approximate only and are shown with reference to existing features.