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Attention: Ms Louise Browne

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Dear Sirs

Advice on Remediation Options
Parramatta Public School & Arthur Phillip High School, Macquarie Street, Parramatta

1. Introduction

This letter has been produced by Douglas Partners Pty Ltd (DP) for Grimshaw Architects LLP and provides information on the potential remediation options for asbestos and chemical contaminants identified at Parramatta Public School and Arthur Phillip High School, Macquarie Street, Parramatta. The purpose of this letter is to assist in determining the preferred remediation strategy for the site. Whilst this letter discusses options from a technical perspective, the proposed future development/ use of the site will be an important factor in determining the most appropriate strategy. This may result in different strategies being applied to different portions of the site consistent with the expected future development/ use of the site, and proposed earthworks extent and fill balance.

This advice is provided on the basis of the following reports:

- Alliance Geotechnical Report; *Detailed Site Investigation, Arthur Phillip High School and Parramatta Public School*, (Report Number: 1915-ER-1-1, dated 11 August 2015);
- DP *Report on Detailed Site Investigation (Contamination) Parramatta Public School, 174 Macquarie Street, Parramatta* (Report 85374.02.R.001.Rev0, dated 18 August 2016); and
- DP *Report on Detailed Site Investigation (Contamination) Arthur Phillip High School South Site, Macquarie Street, Parramatta* (Report 85374.02.R.002.Rev0, dated 18 August 2016).

2. Remediation Guidance and Identified Contamination Treatability

The NSW Department of Environment and Conservation (DEC) *Contaminated Sites: Guidelines for the NSW Site Auditor Scheme 2nd edition* (2006) provides the following policy on site remediation:

> *This means that soil remediation and management is implemented in the following preferred order:*
>
> 1. *on-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level*

2. *off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site*
3. *removal of contaminated soil to an approved site or facility, followed where necessary by replacement with clean fill*
4. *consolidation and isolation of the soil on-site by containment within a properly designed barrier.*

If remediation is likely to cause a greater adverse effect than leaving the site undisturbed, remediation should not proceed.

The contaminants identified at the site above the investigation levels comprise asbestos, and the chemical contaminants: lead, benzo(a)pyrene and benzo(a)pyrene TEQ[1]. The extent, and therefore expected quantities, of soils identified to date to be impacted by the chemical contaminants are relatively limited.

In general, these contaminants are not readily destroyed or broken down into less toxic daughter products by treatment. Removal or consolidation and isolation are therefore the most practical of the above remediation strategies.

3. Remediation Options - Asbestos

Asbestos, in the form of both friable asbestos and bonded asbestos, a type of asbestos-containing material (ACM), has been identified at the Parramatta Public School and Arthur Phillip High School – North sub-sites.

The following options for remediation are generally available for asbestos:

- Excavation and off-site disposal of all asbestos impacted filling;
- Excavation and off-site disposal of asbestos hotspots only, as determined by the proposed detailed asbestos investigation, and covering of remaining asbestos impacted filling below at least 100 mm of clean soil;
- On-site containment of all asbestos impacted filling, which would require a legally enforceable long term management plan; and
- Sort/ remove asbestos from filling with lower percentages of bonded asbestos (and no friable asbestos), and keeping filling which can be “cleared” of asbestos on site and disposing of other materials off-site.

A combination of the above could be applied to different portions of the site.

The above options are discussed further in the below sections.

[1] A weighted sum of carcinogenic polycyclic aromatic hydrocarbons

3.1 Option 1: Removal of All Asbestos Impacted Soils

This option comprises removal of all asbestos impacted filling from the site.

The main advantage of this option is the complete removal of filling with asbestos impacts, removing future risks and liability associated with asbestos, and negating the need for consideration / management of asbestos for future works.

The main disadvantage of this option is the cost, as it is generally the most expensive option. This option also involved the disturbance of all of the filling, increasing the risk of exposure to the asbestos during remediation compared to on-site containment in its current location. This option is also the least sustainable based on the likely volume of waste that will be disposed of to landfill.

3.2 Option 2: Removal of Asbestos Hotspots Only

This option comprises removal of the identified 'hotspots' of asbestos, whilst retaining other asbestos impacted filling on the site. The proposed detailed asbestos investigation will identify 'hotspots' relative to the guidelines, which would include all soil impacted by detectable friable asbestos and soil impacted by asbestos above the health screening level. This option is only likely to be feasible if the friable asbestos contamination is found to be limited in extent.

Given the potential for asbestos to be present in surface soils if the current filling is retained at the surface, a hard cover (e.g. asphalt) or a clean imported surface soil layer of at least 100 mm would need to be placed over the retained asbestos impacted soil. The depth of the clean imported surface soil layer should take into account the sensitive proposed use, expected potential for erosion/ wearing of the surface, and risk perceived by the school community, and as such a thicker layer may be more appropriate for this site.

This option is likely to be cheaper than Option 1, and may not require a legally enforceable environmental management plan (EMP) like Option 3.

However, there would be a risk of asbestos hotspots, including friable asbestos, being present in between sample locations from the asbestos investigation, and these, unidentified hotspots would remain on site and could be encountered at a future date. The presence of ACM in the remaining filling would impact future subsurface works, including requiring an asbestos licenced contractor, and disposing of soils as Special Waste (Asbestos). The potential presence of unrecorded asbestos hotspots would remain, and could require further work/ management in the future. To allow future works to be managed, the presence of ACM would need to be noted on the site asbestos register, and a protocol would need to be in place that triggered asbestos management requirements for any proposed subsurface works in the impacted area. Depending on the quantity / nature of the asbestos encountered during future subsurface works, remediation and / or a legally enforceable EMP may be required in the future.

3.3 Option 3: On-Site Containment

This option comprises retaining all asbestos impacted filling on-site, including the hotspots, capping the impacted filling, and having a legally enforceable environmental management plan (EMP). A capping layer would normally comprise of pavement or 0.5 m of compacted clean soil.

The advantage of this option is that disposal costs could potentially be avoided. If the material could be capped in its current location without being excavated and reworked, another advantage would be a lower risk of exposure to asbestos during remediation. Some materials may still need to be disposed off-site to achieve final design levels following construction of the capping layer, although this is likely to be limited given the currently proposed filling levels at APHS-North.

The disadvantages are the need for ongoing management of the capped asbestos, the notification of the EMP on title, and the need to import soil to cap the asbestos impacted filling.

3.4 Option 4: Emu Picking and Selective Off-Site Disposal

This option comprises removal by “emu picking” of ACM from the filling with low frequency ACM. This process requires the filling to be excavated and spread out in thin layers for hand removal of ACM, with all identified ACM disposed off-site.

This option is not considered to be suitable for the subject material due to the presence of friable asbestos.

4. Asbestos – Other Considerations

In addition to the remediation options discussed above the implications of the recorded asbestos with respect to waste classification and Work Health and Safety (WHS) requirements also need to be considered.

Soil with asbestos contamination is classifiable as Special Waste (Asbestos) regardless of the concentration of asbestos, and requires disposal to landfill. Classification according to the chemical contaminants also applies (e.g. it may also be classifiable as General Solid Waste). This should be considered in determining a budget for off-site disposal of filling.

With respect to WHS, an appropriately licenced Asbestos Contractor is required to undertake all work on asbestos impacted soils. This includes soils with low frequency sporadic ACM. For friable asbestos, a Class A licenced contractor would be required to undertake the works. The Class A or a Class B licenced contractor could undertake bonded asbestos removal works. Other requirements for work in soils with asbestos apply, and are likely to include air monitoring.

5. Further Investigation and Remediation Options – Chemical Contaminants

The following chemical contaminants have been identified above the investigation levels at the site:

- Lead above the health investigation level;
- Benzo(a)pyrene TEQ above the health investigation level; and
- Benzo(a)pyrene above the ecological screening level.

The following options for further investigation or remediation of the chemical contaminants could be applied to the site.

- Quantitative risk assessment (this option does not comprise remediation);
- Excavation and off-site disposal of all contaminated soil;
- On-site containment of the contaminated soil, which would require a legally enforceable long term management plan; and
- Microencapsulation and On-site containment of the contaminated soil.

The above options are discussed further in the below sections.

5.1 Option 1: Quantitative Risk Assessment

This option comprises further assessment to determine the actual risk that the identified contamination poses at the site under the proposed land use. This option is most readily applied to the health-based investigation level exceedances (i.e. the lead and benzo(a)pyrene TEQ).

The current investigation levels are based on a generic land use scenario for residential land use with accessible soil with default assumptions for this scenario. A quantitative risk assessment (QRA) would assess the risk based on the exposure scenarios and exposed populations that would actually be present under the proposed school land use.

If the QRA found that the contaminants identified to exceed the generic investigation levels did not pose a risk to future school users, then no remediation/ management would be required. If a potential risk was identified by the QRA, remediation/ management would be required in accordance with one of the following options.

The main advantage of this option is the potential to avoid the need for remediation or management.

The potential disadvantages of this option are that it may not avoid the need for remediation/ management, and as such would add investigation cost for no reduction in remediation costs; or given the expected small quantities of chemically contaminated soil identified at the site, this option may not be the cheapest even if it showed that the remediation was not required. The other disadvantage is the potential perceived risk of contamination being present above the generic investigation levels by some members of the school community regardless of the findings of the QRA.

5.2 Option 2: Removal of All Contaminated Soils

This option comprises removal of all contaminated soils from the site.

The main advantage of this option is the complete removal of filling with contaminant impacts, removing future risks and liability associated with the contamination, and negating the need for consideration / management of contamination for future works.

The main disadvantage of this option is often the cost, as it is generally the most expensive option for large volumes of soil. However given that the expected relatively small volume of chemically contaminated soil, this may not be more expensive than the costs associated with on-site containment and ongoing management (unless undertaken in conjunction with the asbestos contamination).

This option is also the least sustainable based on the volume of waste that will be disposed of to landfill.

5.3 Option 3: On-Site Containment

Health-based Investigation Level Exceedances

This option comprises retaining all chemically contaminated soils on-site, capping the impacted filling, and having a legally enforceable environmental management plan (EMP). A capping layer would normally comprise of pavement or 0.5 m of compacted clean soil.

The advantage of this option is that disposal costs could potentially be avoided, although some materials may still need to be disposed off-site to achieve final design levels following construction of the capping layer.

The disadvantages are the need for ongoing management of the capped contamination, the notification of the EMP on title, and the need to import soil to cap the impacted filling.

If the asbestos was to be also to be contained on-site, the additional cost of containing the chemically contaminated soils is likely to be minimal.

Ecological-based Investigation Level Exceedances

These investigation levels generally only apply to the upper 2 m of the profile. Placement of the soil contaminated with benzo(a)pyrene relative to the ecological based investigation levels below 2 m would be appropriate to manage this material, without the need for further management or an EMP.

5.4 Option 4: Microencapsulation and On-Site Containment

This option would be the same as Option 3, however with the addition of microencapsulation of the contaminated soil (e.g. with a cement matrix). This option is generally only warranted when on-site containment is not sufficient to manage the risk to the environment from the contamination (e.g. due to the leachability of the contaminant).

This is not considered to be warranted for the site.

6. Limitations

Douglas Partners (DP) has prepared this advice for this project at Parramatta Public School and Arthur Phillip High School, Macquarie Street, Parramatta. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Grimshaw Architects LLP 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.

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 and the modelling methods used. The advice may also be limited by budget constraints imposed by others or by site accessibility.

Yours faithfully
Douglas Partners Pty Ltd

Nerilee Edwards
Associate

Reviewed by

pp: T. Brennan

Tim Wright
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Attachment: About this Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.