Douglas Partners
Geotechnics • Environment • Groundwater

REPORT
on
REMEDIAL ACTION PLAN

UTS BLACKFRIARS CAMPUS
CHIPPENDALE

Prepared for
HUTCHINSON BUILDERS PTY LTD

Project 45996.02
March 2008

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Glossary of Terms

AC	Asbestos cement
ANZECC	Australian and New Zealand Environmental & Conservation Council
AST	Above ground storage tank
B(a)P	Benzo(a)Pyrene (a Polycyclic Aromatic Hydrocarbon compound)
bgl	below ground level
BTEX	Benzene, Toluene, Ethyl Benzene, Xylene
C_6–C_9	Light hydrocarbon chain groups
C_{10}–C_{14}	Medium hydrocarbon chain groups
C_{15}–C_{28}	Heavy hydrocarbon chain groups
C_{29}–C_{36}	Heavy hydrocarbon chain
DEC	Department of Environment and Conservation (NSW)
DP	Douglas Partners Pty Ltd
EPA	Environmental Protection Authority
ha	Hectares
mg/kg	Milligrams per kilogram
mg/L	Milligrams per litre
NATA	National Association of Testing Authorities
NSW	New South Wales
ND(nd)	Not detected above the PQL
OCP	Organochlorine Pesticides
OPP	Organophosphate Pesticides
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
PID	Photoionisation detector
ppm	Parts per million
PQL	Practical Quantitation Limit
%RPD	Relative percentage difference
TRH	Total Recoverable Hydrocarbons
TOPIC	Total Photoionisable Compounds
µg/L	Microgram per litre (or parts per billion)
UCL	Upper confidence limit of data set
UST	Underground storage tank
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

This Remediation Action Plan (RAP) outlines the methods and procedures that will be used to remediate the UTS Blackfriars Campus, located at Chippendale, to a condition suitable for the proposed land use, being student accommodation, with childcare (part) and education facilities. The existing heritage buildings will be retained and refurbished, whilst several new buildings will also be constructed.

The subject site covers an irregularly shaped area of approximately 6,600 square metres, and is occupied by several heritage buildings (offices and residential), a childcare centre, timber hall, car parking and landscaping. Environmental assessment reports prepared by Coffey for the subject site in 1993/1994 identified past site uses including distillery, industrial (nature unknown) and school.

A review of the analytical results of the previous investigations conducted at the site by both Douglas Partners Pty Ltd (DP) in 2009 and Coffey International (Coffey) between 1993 and 1998 indicated that the majority of contaminants were at concentrations within the adopted site assessment criteria but that certain heavy metals, TPH and PAH contaminants were, present at a number of locations at concentrations which would be deemed as hotspots. The detected contaminants are generally considered to be associated with the presence of ash and slag, which is sporadically distributed in the filling material located on the site.

No groundwater contamination issues have been identified.

The objective of the remedial works to be undertaken is to provide a practical strategy which mitigates the potential for environmental and human health impacts posed by the presence of contaminated soil. The objective has been deemed to be achieved when a Validation Report has been completed which shows that the site has been capped in accordance with the requirements of the RAP.

The preferred remedial option is the isolation of the contaminated soil by covering with a properly designed physical barrier system**.** This involves the installation of an engineered physical barrier system to limit the exposure of site users and/or off-site receptors to

contaminants which attains an optimal balance of risk reduction, environmental integrity, cost and long term manageability.

Physical barrier designs have been developed for the various areas of the proposed development including building slabs, paving, landscaping, retained trees and new tree plantings. No specific barrier system is intended for the existing heritage buildings which are being retained.

All physical barrier types will be underlain with a marker layer (geogrid, geotextile or similar) laid on the final surface of the contaminated fill material. Given the nature of the proposed development (ie. including a child care centre and student accommodation) the general minimum constructional requirements for a suitable physical barrier system is considered to be a permanent, engineered total thickness of 500 mm overlying the marker layer. The concrete slab (of lesser thickness) is considered an adequate barrier at proposed building locations.

The remediation of the site will be monitored by an experienced, qualified environmental consultant to ensure that the site has been remediated to the standard set out in, and in compliance with, the RAP. At the completion of the project the consultant will prepare a Validation Report. The report shall state that the works were carried out in accordance with the RAP and has been made suitable for its industrial use. It will contain a documentary record of the works.

The final validation report will also include an Environmental Management Plan (EMP) which will be used as an instrument to manage the integrity of the physical barrier system and protect workers who may become exposed to the contaminated materials in the future.

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REMEDIAL ACTION PLAN
UTS BLACKFRIARS CAMPUS, CHIPPENDALE

1. INTRODUCTION

1.1 General

Douglas Partners Pty Ltd (DP) has been commissioned by Mr Mario Hadjia of Hutchinson Builders Pty Ltd to prepare a Remedial Action Plan (RAP) for the above site. The objective of the RAP is to outline the methods and procedures necessary to remediate the subject site to a level suitable for the proposed land use, being student accommodation, with childcare (part) and education facilities.

The subject site forms part of the University of Technology Sydney (UTS) and is known as the "UTS Blackfriars Campus". The proposed development of the site includes a relocated childcare centre, student accommodation, student common facilities, and paved and grassed landscaping features. The existing heritage buildings will be retained and refurbished, whilst several new buildings will also be constructed. Further details are provided in Section 3.2 of this RAP.

This RAP details the methods and procedures by which the remediation and site validation will be achieved. It is intended that, following implementation of the RAP, the site can be considered:-

- appropriately remediated to a condition which would prevent unacceptable risks to human health and/or the environment; and
- suitable for the intended land-use.

It should be noted that this RAP does not form a detailed specification for the proposed site remediation works, but rather represents a planning document which outlines the means by which site remediation can render the site suitable for the intended land-use.

1.2 Previous Reports

The RAP has been developed based on the results of the following investigations conducted by DP and Coffey Partners International (Coffey):-

- Coffey *"UTS Blackfriars Site – Investigations"*, 2nd September, 1993;
- Coffey "*Environmental Site Assessment UTS Blackfriars Development Chippendale"*, September 1994;
- Coffey *"Health and Safety Plan* (draft)", August 1998;
- Coffey *"Environmental Management Plan* (draft)", August 1998;
- Coffey *"Site Management Plan"*, August 1998; and
- DP "*Phase 2 Contamination Assessment, UTS Blackfriars Campus, Chippendale*" March 2009 (ref: 45996.01).

The analytical results of the contamination assessments conducted at the site by Coffey and DP indicated that the concentrations of contaminants were generally below the adopted site assessment criteria (SAC) although in various locations, sporadically distributed, concentrations of certain heavy metals (primarily lead), PAH and TPH were at levels which are either designated as hotspots or indicate a potentially random spread of similar contaminants.

The detected contaminants are considered to be associated with the fill materials placed over the site, and the presence of ash and slag materials within. As stated above, the spread of contaminants was considered sporadic.

2. METHODS AND OBJECTIVES OF THE RAP

The objective of the RAP is to provide a mechanism by which the site can be remediated in an acceptable manner, with minimal environmental impact, and to a condition suitable for the proposed land-use. The main objective of this RAP is therefore to provide a strategy for site remediation which:-

- Minimises impacts from the site on the environment and on public health and safety during site demolition, remediation and construction;
- Maximises the protection of workers involved with site demolition, remediation and construction;
- Renders the site safe for the proposed (student accommodation, childcare and educational) land-use and minimises potential exposure pathways to contaminants present in filling materials (soil) and minimises the potential for any related impacts on groundwater quality; and
- Minimises impacts on the local environment during and following site remediation.

Additional objectives of the RAP are as follows:

- Set remediation goals to verify that the site has been rendered suitable for the proposed use and will pose no unacceptable risk to human health or the environment;
- Document the remedial options that may be implemented to reduce risks to acceptable levels for the proposed site use, with recommendations on the adopted option;
- Provide an Environmental Management Plan (EMP) which details the environmental safeguards required to complete the remediation and construction in an environmentally acceptable manner;
- Identify the legislative requirements of the relevant regulatory authorities for the remedial works; and
- Comply with the relevant planning instruments and local government policies.

The general scope of work designed to achieve the RAP objectives stated above is described below:

- Provide an adequate description of the site, its history and available background information;
- Provide a summary of the results of the previous site investigations and assess the contamination status of the site;
- Develop site assessment / acceptance criteria for the relevant environmental media, on the basis of the identified chemicals of concern and the proposed landuses;
- Identify potential remedial options available for the site and nominate the preferred remedial strategy;
- Develop contingency plans for the various situations that may arise during the remediation programme;
- Highlight the requirement for the works to be undertaken in accordance with the Environmental Management Plan and Health and Safety Plan prepared for the remedial works.

It is proposed that the remediation method will involve the placement of a suitable physical barrier layer over the site, comprising pavement materials and also clean fill and/or geo-membranes in areas where non-paved landscaping is proposed.

3. SITE INFORMATION

3.1 Site Description

The subject site forms an irregular, almost rectangular-shaped land parcel located at the north-eastern corner of Blackfriars and Buckland Streets, Chippendale, as shown on Drawing 1, Appendix A. The site is approximately 6,600 square metres in area and is comprised of the following land parcels:

Lot 1 in DP122324
Lot 1 in DP724081
Lot 1 in DP832799
Lots 10 -16 Sec 3 in DP466
Lots 18 - 20 Sec 3 in DP466
Lots 22 – 25 Sec 3 in DP466
Lots 1 – 14 Sec 4 in DP466
Lot 221 in DP133367
Lots 9 – 12 Sec 5 in DP466

The local government authority is the City of Sydney Council.

The site is the Blackfriars Campus of the UTS. Specific features of the site include:

- A two storey heritage listed building (Building B2), located on the western boundary, and occupied by the Australian Learning and Teaching Council;
- A two storey heritage listed building (Building B5), located on the eastern boundary, and used by the Faculty of Arts & Social Studies, International studies and China Research Centre. The campus security office is also located in this building;
- A timber clad demountable building (Building B1) located in the south-western corner and occupied by the offices of the CAMRA Project and Cultural Asset Mapping in Regional Australia;
- A two storey brick residence, labelled as “The Residence”, located in the south-eastern corner;
- A single storey timber hall, located in the north-eastern corner of the site;
- A single storey clad building, located in the north-western corner, used as the Blackfriars Children’s Centre. The building and surrounding children’s play areas are fenced off from the remainder of the site;
- Open, bitumen covered car parking facilities and landscaping (paved areas, lawns and gardens) between the buildings;
- Numerous small to large canopy trees are present within the site, particularly in the north-western corner and close to the western and southern site boundaries.

No hazardous materials survey was conducted, and therefore the nature and extent of asbestos containing materials in the existing buildings is not known.

The site is bordered by a high brick wall (in some locations forming the wall of adjoining buildings) along the northern and eastern boundaries. Part of the wall close to the north-eastern corner is propped with steel members fixed into a concrete footing. The fencing along the southern and eastern boundaries comprises steel encased in sandstone columns and footings.

Reference may be made to Plan No 72875.DGN, prepared by Rygate & Company Pty Limited, in Appendix A for the existing site layout.

At the time of conducting the fieldwork for the DP assessment there was no visible evidence of potential underground or above ground petroleum storage systems.

Furthermore, there were no surface indicators of potential soil contamination such as staining, vegetation deterioration or die-back. The lawns were lush and foliage prominent.

The following land uses were noted in the area around the site at the time of the DP investigation:

To the north: Blackfriars Broadway Inn (a 3 storey building), a carwash and University of Notre Dame (Sydney Campus) buildings.

To the east: The University of Notre Dame (including a number of 3 to 4 storey buildings positioned apparently on the site boundary), Blackfriars Place and a 4 storey residential (possibly student accommodation) building

To the south: Blackfriars Street, commercial and residential properties beyond (typically 3 storeys in height)

To the west: Buckland Street and residential properties beyond (typically 3 storeys in height; probable student accommodation).

3.2 Proposed Development

From the information provided, it is understood that the proposed development of the site is to comprise the following:

- Demolition of the existing, non-heritage buildings (including the child care centre);
- Refurbishment of several existing heritage buildings, including the relocation of the child care centre to the south-eastern corner of the site;
- Construction of a three-storey townhouse style student accommodation building;
- Construction of a four-storey student accommodation apartment building; and
- Formation of car parking, courtyards, and children's play area (part of the proposed child care centre).

No bulk excavations (e.g. for basement construction) are proposed. Minor areas of landscaping and paving, including areas designated for tree planting, have been included in the layout and minor excavations associated with these requirements and with the installation of services will be required during redevelopment.

Reference may be made to the concept plan of the proposed development, prepared by Nettleton Tribe (Drawing No 3532_DA004-P7), and Landscape Concept Plan, prepared by Context (Drawing No LSK 08573-002), both in Appendix B, for details of the proposed development and landscaping layout.

3.3 Site History

In developing a picture of the history of the site, DP reviewed information presented in previous Coffey reports, and reviewed information provided by WorkCover NSW and the Department of Water and Energy. This section presents a summary of the findings.

An archaeological assessment was conducted by Casey and Lowe Associates in August 1993 was included as part of the Coffey 1994 report. The assessment revealed the following:

- Blackfriars School was established on the site in 1883;
- Prior to the school, the site was occupied by an industrial estate which was the largest in nineteenth century Sydney;
- In 1825, the Brisbane Distillery was built over a large area, which included the subject site. A brewery was added to the site at a later date;
- Blackwattle creek, which drained to the nearby Blackwattle swamp, was dammed to create a reservoir beside the distillery. The path of Blackwattle creek is now occupied by a sewer line;
- In 1852, the distillery was taken over by Colonial Sugar Refining Company (formerly Australasian Sugar Company). During the refinery's occupation, complaints were made about the pollution of the dam and Blackwattle swamp creek. The waste was later diverted into the Abercrombie Street sewer;
- In 1878, the refinery was moved, the buildings were removed and the land was later subdivided;
- The Department of Education bought the subject site in 1883 for the development of a school, and school buildings were completed in 1884;
- The original swamp creek survived into the 1890s;
- The school was recently closed and the site taken over by the UTS.

A NSW DWE groundwater bore search was conducted on the 10 February 2009. Seven bores were found within a 1 km radius of the site. All the bores were for monitoring purposes. The water bearing zones for two of the bores (109649 and 109648) were indicated as 3.2 - 6.2 m and 5.2 - 6.2 m respectively. Drillers logs were also available for bores 109649 and 109648. Filling was encountered at depths between the surface and 4.8 m, silty sand between 4.8 m and 5.9 m, silty clay between 2.9 m and 4.9 m, silty sand between 4.9 m and 5.8 m and sandstone between 5.8 m and 7.20 m.

A search for dangerous goods licences registered with NSW WorkCover was conducted in February 2009, and did not locate any records pertaining to the site.

3.4 Topography, Geology and Hydrogeology

The general topography of the site and environs appears to slope gently downwards to the north, towards Sydney Harbour. Based on the local topography, the inferred groundwater and stormwater flow would also be towards Sydney Harbour (north).

The Soil Landscape Map of Sydney (Soil Landscape Series Sheet 9130, Scale 1:100,000, 2002), prepared by the Soil Conservation Service of NSW, indicates that the site is located within a Disturbed Terrain; land that may be extensively disturbed by human activity including complete disturbance, removal or burial of soil, or landfill including soil, rock, building, and waste materials. The investigations by Coffey and DP indicated fill depths of between 1.6 m and 4.1 m below ground level.

Reference to the Sydney 1:100 000 Geological Series Sheet indicates that the site is underlain by stream alluvium and estuarine deposits (silty to peaty quartz sand, silt and clay) as well as man made filling. The natural deposits are considered to be mainly alluvium beneath the site.

Sandstone bedrock was encountered during the Coffey and DP investigations at depths ranging from 3.8 m and 8.3 m below ground level.

Free groundwater was not encountered during drilling for the DP investigation (2009). Groundwater was observed in four wells installed at the site at depths of between 2.08 m and 3.0 m below ground level. These finding confirm the Coffey findings of groundwater at about 3.0 m below ground level, reported in 1993. The results show little or no changes in groundwater levels beneath the site over a period of 15 years (note that some fluctuations may have occurred over that time).

Based on the measured groundwater levels and regional topography, the inferred direction of groundwater flow is towards the north. The groundwater is likely to feed into Blackwattle Bay, which is located approximately 1.3 km north of the subject site.

A review of digital data supplied by NSW Department of Environment and Climate Change (DECC) based on 1:25,000 ASS Risk Mapping, 1994-1998 indicated that the site is located within an area of no known occurrences of acid sulphate soils.

4. RESULTS OF PREVIOUS INVESTIGATIONS

4.2 Coffey Reports

The client provided the following reports prepared by Coffey to DP for review.

- *UTS Blackfriars Site – Investigations*, 2nd September, 1993;
- *Environmental Site Assessment UTS Blackfriars Development Chippendale*, September 1994;
- *Health and Safety Plan* (draft), August 1998;
- *Environmental Management Plan* (draft), August 1998; and
- *Site Management Plan*, August 1998.

4.2.1 UTS Blackfriars Site – Investigations, 2nd September, 1993

This report details the findings of a geotechnical and environmental investigation of a portion of the Blackfriars Infant School. The investigation was undertaken on the north-western corner of the current subject site (the location of the current childcare centre) in order to plan for the, then proposed childcare centre. The scope of work included the drilling of 4 boreholes to bedrock and the collection of environmental and geotechnical soil samples.

The logs indicated fill materials to depths of between 2.3 m and 3.9 m, and sandstone bedrock at depths of between 5.4 m and 8.3 m below ground level (bgl). The fill was

described as a mixture of sand, sandstone rubble, sandy clay, coal waste, bricks and glass fragments. Groundwater was encountered at about 3 m below ground level (bgl).

Two soil samples form each borehole (eight in total between depths of 0.6 m and 2.2 m bgl) were analysed for Total Petroleum Hydrocarbons (TPH), Polycyclic Aromatic Hydrocarbons (PAH), and a suite of heavy metals (copper, lead, zinc, cadmium, chromium, arsenic, selenium and mercury). The regulatory guidelines and thresholds which were adopted were those recommended in the 1992 Australian and New Zealand Conservation Council (ANZECC) *Guidelines for the Assessment and Management of Contaminated Sites*. [Note: Other relevant, "landuse specific" guidelines, including the NEPM Guidelines on the Investigation Levels of Soil and Groundwater, have been issued since then.]

The laboratory results indicated that the level of copper exceeded the guideline in two locations, zinc in three locations, mercury in two locations and PAH in three locations. The exceedances were detected in the fill material between 1.1 m and 2.0 m bgl, although, the report stated that the contamination appeared to be restricted to the top 3.9 m fill material. *The report exceedances remain exceedances when compared to current guidelines (refer to Section 5.2).*

No evidence of hydrocarbons or solvents was observed during the drilling or in the retrieved groundwater samples.

4.2.2 Environmental Site Assessment UTS Blackfriars Development Chippendale, September 1994

This assessment was required for redevelopment of the site into university buildings, a university residence and a childcare centre. The site condition at the time of the assessment was described as under redevelopment including the construction of underground services, pavements, buildings and landscaping. The report stated that the recommendations set out in the earlier report (Section 4.2.1 of this report) were superseded by the recommendations in this report.

The fieldwork involved the excavation of 11 test pits to a maximum depth of 3.1 m bgl. Eight soil samples were analysed for heavy metals, PAH, TPH, phenols, conductivity and pH.

The contaminant concentrations were compared to the ANZECC (1992) guidelines, Canadian Council of Ministers of the Environment (1991) *Interim Canadian Environmental Quality Criteria for Contaminated Sites* and the Dutch Ministry of Housing, Spatial Planning and Environment (1994) *Environmental Quality Objectives in the Netherlands*.

The laboratory results indicated that the level of copper and mercury exceeded the guidelines in five locations, lead and zinc in four locations, TPH (C_{15} - C_{28}) in one location and PAH in two locations. It was noted that higher heavy metal levels were detected in this investigation than in the earlier Coffey report. Toxicity characteristic leaching procedure (TCLP) tests were also conducted on selected samples and found the contaminants in the soil are not mobile. *The majority of the report exceedances remain exceedances when compared to current guidelines (refer to Section 5.2).*

The report concluded that given the current state of the site and that contaminated fill probably exists beneath historical buildings, it seems there would be little benefit in remediating the on site contaminated soils. The following was recommended for the long term:

- Operations and maintenance manual contain warnings of underlying contaminated soils;
- Warning layer in turfed and garden beds;
- Trap doors and other entrances into building under spaces should be locked and clearly signposted;
- Where garden beds may be disturbed in the future, fences should be constructed to prevent access by site users;
- In the area of the childcare centre, a cover comprising 150 mm turfed topsoil overlying 150 mm compacted roadbase overlying a plastic warning layer and the 20 mm bitumen already covering the site. It is also recommended an additional plastic warning layer be placed between the topsoil and the child care centre building footprint ;[*Note: meaning not clear, do they mean a second plastic warning layer be placed between the topsoil and compacted roadbase (or underlying material) over the footprint of the child care centre building?]*
- Soils beneath the university residence should be treated in the same way as the childcare centre, or by applying a sand or concrete or brick paving;

- Soil imported to the site should be assessed for contamination prior to placement; and
- Long term maintenance plan should be implemented to maintain the barrier system.

Note that the abovementioned capping method is generally considered inadequate by today's standards.

Overall, the report concluded that the risk of leachate migration into groundwater originating from the site is relatively low, however, groundwater assessment was recommended to determine if further management is required. Coffey recommended sampling from three locations (up-gradient, down-gradient and to provide flow direction information).

4.2.3 Health and Safety Plan (draft), August 1998

This document provided a general framework for protection against the capped soil contamination. It outlined the responsibilities of the on-site workers, the controls (work and decontamination zones), the site hazards to be aware of, the safe work practices and the reporting of any breaches of the plan.

4.2.4 Environmental Management Plan (draft), August 1998

The purpose of this plan was to ensure that all contaminated material left on site is covered and that any disposed off-site is carried out appropriately. It outlined a number of rules that need to be followed.

4.2.5 Site Management Plan, August 1998

This plan was produced to manage the soil contamination through:

- Placement of protective barriers;
- Maintenance of protective barriers;
- Application of controls on site excavation works; and
- Application of controls on works underneath buildings where there are no soil covers.

At the time this report was prepared, the status of the site was as follows.

- Protective covers had been placed over the site except areas covered by buildings or pavement. In the area of the childcare centre, the cover comprised 150 mm turf topsoil overlying 50 mm concrete overlying an orange plastic warning layer. In other unpaved areas, the cover comprised 150 mm topsoil overlying an orange plastic warning layer.
- Timber barriers had been placed around the large trees.

Note that investigation by DP in 2009 did not uncover evidence of the plastic warning layer in any of the bores. However, the hand augered bores in the child care centre did encounter refusal on hard layers, probably roadbase. Furthermore, the timber barriers around the large trees were not evident.

Subsequent recommendations were as follows:

- For excavation and work underneath buildings, a workplace health and safety plan must be developed;
- Trapdoors and other entrances need to be locked and signposted;
- The Operation and maintenance manual must state that works on site need to be carried out in accordance with this plan;
- EPA approval must be granted for off site removal of any soil underneath the warning layer;
- Site works must be conducted in a way that protects the environment.

The plan also stated that a biannual inspection should be undertaken to check the status of the soil and a report (including a review of excavation, disposal and safety records) should be provided to UTS.

4.2.6 DP Report

DP was commissioned by Hutchinson Builders in 2009 to complete a Phase 2 Contamination Assessment on the UTS Blackfriars Campus. At the time, the site was the subject of the current proposed development including relocation of the childcare centre, student accommodation, student common facilities, and paved and grassed landscaping features. The existing heritage buildings were to be retained and refurbished, whilst several

new buildings would also be constructed. *The assessment was a precursor to the development of this RAP.*

At the time of the investigation (February / March 2009), the subject features and uses were the same as those outlined in Section 3.1 of this report.

The objectives of the phase 2 contamination assessment were to:-

- assess soil and groundwater conditions for contamination resulting from historical use of and activities undertaken at the property with regard to the proposed development;
- provide an opinion on the site's suitability for the proposed redevelopment; and
- provide a Preliminary *in situ* Waste Classification and Acid Sulphate Soil (ASS) assessment.

The Phase 2 Contamination Assessment involved the following general scope of works:

- Review of the Coffey reports (referenced earlier in this section);
- Review of additional site history information, WorkCover NSW records, and regional groundwater information;
- Soil sampling at a total of sixteen (16) locations spaced across the accessible areas of the site. This number complies with the NSW DECC sampling design guidelines. Note that the termination of hand augered bores was governed by augering difficulties;
- Screening of recovered soil samples for volatile vapours using a calibrated, field portable photo-ionisation detector (PID);
- Installation of four (4) groundwater monitoring wells;
- Conducting laboratory analysis on selected soil samples at a NATA accredited analytical laboratory for a combination of the following potential contaminants:
  - Heavy Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn);
  - Total Petroleum Hydrocarbons (TPH);
  - Monocyclic Aromatic Hydrocarbons (Benzene, Toluene, Ethylbenzene and Xylene – BTEX);
  - Polycyclic Aromatic Hydrocarbons (PAH);

- Organochlorine Pesticides (OCP) / Polychlorinated Biphenyls (PCB);
- Phenols;
- Cyanide;
- Asbestos;
- Volatile Organic Compounds (VOC);
- SPOCAS test (for acid sulphate soil assessment);
- TCLP (leaching) for waste classification purposes.

- Conducting laboratory analysis on four groundwater samples for Heavy Metals, TPH, BTEX, PAH, Phenols, PCB, OCP, VOC and hardness.

Given the proposed land uses (ie. student accommodation, childcare, and student facilities) the laboratory test results were assessed against the health based criteria for residential development with accessible soils (childcare centre), and the health based criteria for residential development with minimal soil access (remainder of site). In additional, provisional phytotoxicity-based investigation levels for sandy loams were applicable in the area of the proposed landscape. With regard to petroleum hydrocarbons, the NSW EPA *Contaminated Sites: Guidelines for Assessing Service Station Sites* (1994) threshold concentrations for sensitive land were adopted as the site assessment criteria (SAC).

The fieldwork for the assessment revealed the presence of fill materials to depths ranging from about 2.0 m in the western portion to about 4.1 m in the eastern portion, overlying soft to firm clay (alluvium) then sandstone bedrock. The bedrock was encountered at depths ranging from 3.8 m to 5.2 m depth. Groundwater was encountered in a number of bores ranging in depths between 2.3 m and 3.8 m below existing ground level.

The results of the soil analysis indicate that the majority of organic and inorganic contaminant concentrations in all sampled and tested soils were within the adopted SAC. The exceptions were as follows:

- Concentrations of benzo(a)pyrene (ranging from 2.2 mg/kg to 36 mg/kg), exceeding the SAC, were detected in 13 out of 48 soil samples analysed;

- Concentrations of Total PAH (ranging from 31 mg/kg to 430 mg/kg), exceeding the SAC, were detected in 10 of the 48 soil samples analysed;
- Concentrations of TPH (C10-C36) of 1,360 mg/kg and 2,120 mg/kg, exceeding the SAC of 1,000 mg/kg, at Bore 1 and Bore 11;
- Sample 9/0.2-0.5 collected from the surfical filling had lead concentrations of 1,500 mg/kg, which exceeded the SAC (1,200 mg/kg); and
- Exceedances of PPILs for copper, lead, mercury, nickel and zinc were detected in several samples collected from the surficial filling.

No groundwater contamination issues were identified.

The results were found to be similar to those reported by Coffey.

Based on the results of the assessment, it was considered that the site can be rendered suitable for the proposed redevelopment, subject to the preparation and implementation of a remedial action plan (RAP). An Environmental Management Plan (EMP) would also be required for the long term management of on-site contaminated soils.

The filling encountered in the test bores was given a preliminary General Solid Waste (non-putrescible) classification in accordance with the DECC *Waste Classification Guidelines*, April 2008, provided that the material is not cross-contaminated with other material. However, further *ex situ* waste classification of the filling was recommended upon excavation and stockpiling. It was also noted that building rubble was encountered in the test bores, thus, there was considered to be a potential for asbestos to be present in the filling materials.

Preliminary test results also indicated a low potential for the presence of Acid Sulphate Soils (ASS) which is in agreement with the risk map classification indicating that no known ASS occurrences were previously recorded in the area. However, due to a slightly elevated S_{POS} value and hence the potential for the presence of ASS recorded in a sample of grey clay filling, it was recommended that further ASS analysis should be conducted during the additional *ex situ* waste classification assessment of excavated material.

5. SITE ASSESSMENT CRITERIA

5.1 Soil

On the basis that the proposed land-use includes a child care centre, student accommodation and educational facilities, the soil analytical results adopted for site characterisation and the proposed remediation strategy are as follows:

- Health-based (soil) Investigation Levels (HILs) for residential development with gardens and accessible soil, including children's day care centres (Column 1 HILs) for Urban Development Sites in NSW as specified in NSW DEC [now DECC] *Guidelines for the NSW Site Auditors Scheme, 2006 [applicable to the proposed childcare centre];*
- Health-based (soil) Investigation Levels (HILs) for residential development with minimal access to soil including high-rise apartments and flats (Column 3 HILs) [*applicable to the remainder of the site*];
- The provisional phytotoxicity investigation levels (PPILs) published in the NSW DEC *Guidelines for the NSW Site Auditors Scheme, 2006,* which have been used as a screening guide for potential adverse impacts on future plant growth [*applicable to the top soil (top 500 mm) in unsealed/unpaved landscape areas*]. Note that the published PPBIL typically apply to sandy loam soils or soils of a closely similar texture for pH 6–8;
- Threshold concentrations for sensitive sites, NSW EPA [now DECC] *Guidelines for Assessing Service Station Sites,* 1994, for assessing petroleum hydrocarbons *[applicable to the whole of the site]*.

Based on the above guidelines, the SAC are summarised in Table 1 below.

Table 1 – Site Assessment Criteria for Soils

Analyte	Health Based Site Assessment Criteria[1] (childcare centre) (mg/kg)	Health Based Site Assessment Criteria[2] (remainder of site) (mg/kg)	Phytotoxicity Based Site Assessment Criteria[3] (Imported Fill, and whole of the site[unsealed areas]) (mg/kg)
As	100	400	20
Cd	20	80	3
^{6}Cr	12%	48%	400
Cu	1000	4000	100
Hg	15	60	1
Ni	600	2400	60
Pb	300	1200	300 / 600[7]
Zn	7000	28000	200
C_6-C_9	65[4]	65[4]	65[4]
C_{10}-C_{14}	1000 [4]	1000 [4]	1000 [4]
C_{15}-C_{28}			
C_{29}-C_{36}			
Benzene	1[4]	1[4]	1[4]
Ethyl Benzene	50[4]	50[4]	50[4]
Toluene	130[4]	130[4]	130[4]
Xylene	25[4]	25[4]	25[4]
PAH (Total)	20	8	8 / 20 [8]
Benzo(a)pyrene	1	4	1 / 4 [8]
Phenols	8500	34000	8500 / 34000 [8]
PCBs	10	40	10 / 40 [8]
Asbestos	None Detected in surface soils[5]	None Detected in surface soils[5]	None Detected
Aldrin + Dieldrin	10	40	10 / 40 [8]
Chlordane	50	200	50 / 200 [8]
DDD+DDE+DDT	200	800	200 / 800 [8]
Heptachlor	10	40	10 / 40 [8]

Notes:

1. NSW EPA *Contaminated Sites Guidelines for the NSW Site Auditor Scheme* (2006) Health Investigation Levels Column 1 for residential development with gardens and accessible soil, including children's day care centres (NEHF A)
2. NSW EPA *Contaminated Sites Guidelines for the NSW Site Auditor Scheme* (2006) Health Investigation Levels Column 2 for residential development with minimal access to soils (NEHF D)
3. NSW EPA *Contaminated Sites Guidelines for the NSW Site Auditor Scheme* (2006) Provisional Phytotoxicity based investigation levels (PPBIL) to be used in conjunction with NEHFA or NEHF D for

assessing imported fill materials proposed for placement in capping layer, and soils within the plant root zones [top 500 mm of soil in unpaved/unsealed areas]

4. NSW EPA *Guidelines for Assessing Service Station Sites*, 1994. Threshold concentrations for sensitive sites, (for TPH and BTEX), for all landuses
5. NSW EPA Advice to Site Auditors, dated 31 March 2000, reference CH8028/HOF3511.
6. all Chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) will be too reactive and unstable under the normal environment.
7. NEHF A for lead is less than the PPBIL, hence within the childcare centre, 300mg/kg is the SAC
8. SAC dependant upon area of fill placement (ie. childcare centre or remainder of the site)

Soil / fill material is considered to meet the health based SAC if:

i) The 95% UCL of the average concentrations for a data set of samples of like material complies with the adopted SAC (Table 2, Columns 1 or 2) [Note that statistical analysis does not apply to the assessment of PPILs];

ii) Any individual analyte concentration in the soil is not considered to present a potential health risk. For some analytes (non-volatile), 250% of the HIL value is adopted for the absolute maximum upper limit concentration for individual samples, however, the 95% UCL of the average concentrations must comply.

iii) The standard deviation of the results must be less than 50% of the values given in Table 2, Columns 1 or 2.

5.2 Groundwater

Sydney Harbour is considered to be the ultimate receiving body for groundwater sourced from or passing beneath the site, whereas the groundwater in the immediate environ may be classified as a “fresh water” ecosystem. On this basis, the groundwater investigation levels (GILs) were selected for the protection of 95% of species for a freshwater ecosystem (a conservative approach, as opposed to marine ecosystems) in line with DECC guidance. The applicable guideline is the *Guidelines for Fresh and Marine Water Quality*’ Australia and New Zealand Environment and Conservation Council (ANZECC, 2000). The trigger values for the protection of 95% species for a fresh water ecosystem were used where available. In the absence of the 95% level of protection trigger values the moderate and low reliability trigger values and/or other recognized standing screening criteria were also referenced.

In cases where Australian criteria are not available, then the internationally recognized Dutch Intervention Values are adopted as screening reference. It is noted that these international standards are not endorsed by DECC, but are considered relevant as useful assessment screening values.

Based on the above guidelines, the adopted GIL are summarised in Table 2 below. [Note: Based on the analytical findings of the groundwater samples, no signs of unacceptable groundwater impacts or elevated concentrations of contaminants were noted. As such, groundwater contamination beneath the site is not considered to be an issue of concern and remediation of groundwater is not considered required. The GILs have, nevertheless, been established for reference purposes.

The adopted assessment criteria for the groundwater samples are presented in the following table.

Table 2 – Groundwater Investigation Levels

Analyte	Groundwater Investigation Level (mg/L)		Source
	Fresh Water Trigger Value (slightly to moderately disturbed ecosystems – 95% protection)	Other	
Metals			
Arsenic	0.013-0.024	-	ANZECC, 2000
Cadmium	0.0002	-	ANZECC, 2000
Chromium (III)	0.0033-0.001*	-	ANZECC, 2000
Copper	0.0014	-	ANZECC, 2000
Lead	0.0034	-	ANZECC, 2000
Zinc	0.008	-	ANZECC, 2000
Nickel	0.011	-	ANZECC, 2000
Mercury	0.00006	-	ANZECC, 2000
TPH/BTEX	-	-	
C_6 to C_9 Fraction	-	-	-
C_{10} to C_{36} Fraction	-	0.6[1]	DUTCH, 2000
Benzene	0.95	-	ANZECC, 2000
Toluene	0.18*	-	ANZECC, 2000
Ethylbenzene	0.08*	-	ANZECC, 2000
Total Xylenes	0.075-0.35*	-	ANZECC, 2000
PAH			
Benzo(a)pyrene	0.0001*	-	ANZECC, 2000
Naphthalene	0.016	-	ANZECC, 2000
Anthrancene	0.00001*	-	ANZECC, 2000
Phenanthrene	0.0006*	-	ANZECC, 2000
Fluoranthene	0.001*	-	ANZECC, 2000
OCP			
HCB	0.05*	-	ANZECC, 2000
BHC	-	-	ANZECC, 2000
Lindane	0.0002	-	ANZECC, 2000
Heptachlor	0.00009	-	ANZECC, 2000
Methoxychlor	0.000005*	-	ANZECC, 2000
Aldrin	0.000001*	-	ANZECC, 2000
Dieldrin	0.00001*	-	ANZECC, 2000
Enrin	0.00002	-	ANZECC, 2000
Endosulfan – alpha	0.0000002*	-	ANZECC, 2000
Endosulfan - beta	0.000007*	-	ANZECC, 2000
Endosulfan	0.0000002	-	ANZECC, 2000
DDE	0.00003*	-	ANZECC, 2000
DDT	0.00001	-	ANZECC, 2000
Mirex	0.00004*	-	ANZECC, 2000
Toxaphene	0.0002	-	ANZECC, 2000

	Groundwater Investigation Level (mg/L)		
Chlordane	0.00008	-	ANZECC, 2000
PCB			
Arochlor 1016	0.000001*	-	ANZECC, 2000
Arochlor 1221	0.001*	-	ANZECC, 2000
Arochlor 1232	0.0003*	-	ANZECC, 2000
Arochlor 1242	0.0006	-	ANZECC, 2000
Arochlor 1248	0.00003*	-	ANZECC, 2000
Arochlor 1254	0.00003	-	ANZECC, 2000
Arochlor 1260	0.025*	-	ANZECC, 2000
Arochlor 1262	0.050*	-	ANZECC, 2000
Arochlor 1268	0.050*	-	ANZECC, 2000
Phenols			
Phenol	0.32	-	ANZECC, 2000
Cyanide			
Cyanide	0.007	-	ANZECC, 2000

Notes:

*: insufficient data for reliable trigger value (interim working value or low reliability value used)

1: In assessing TPH (C_{10}-C_{36}) concentrations in groundwater, the Dutch Intervention Value (Dutch, 2000) was utilised as the GIL, as there are currently no high reliability Australian based guidelines other than a low reliability threshold of 7 µg/L, which is not routinely achievable by the NATA accredited laboratories.

The GIL applicable to VOC have not been listed as all groundwater tests to date have not detected any VOC.

6. SITE CHARACTERISATION

Based on the investigations undertaken by both DP (2009) and Coffey (1993 to 1998) the pertinent characteristics of the subject site are as follows:

- The site is irregular in shape, occupying an area of approximately 6,600 square metres.
- The site is currently occupied by a number of UTS buildings, some of which are heritage listed and will be retained (and refurbished) under the proposed development.
- The existing ground surface comprises predominantly building ground floors, bitumen, concrete and grass. Based on available earlier investigation reports, there is likely to be

a below-surface warning layer (plastic) beneath the topsoil and compacted roadbase in the existing child care centre, as part of the capping profile recommended by Coffey. Although a warning layer was also recommended for the remainder of the site (beneath a topsoil layer) there was no evidence encountered during the fieldwork for the DP investigation.

- The site is underlain by fill materials. The encountered depths of filling ranging from about 1.6 m to 4.1 m below existing ground level. The fill generally comprises clayey sand/sand/clay/silty sand/sandy clay material with various amounts of gravel, brick, concrete, plastic and sandstone fragments. Ash and slag inclusions were encountered in the filling at a number of sampled locations. Given the uncontrolled nature of the filling, it is likely that ash and/or slag are sporadically present in the general filling.
- The filling material is sporadically contaminated with primarily PAH, and to a lesser extent TPH and some metals. PAH concentrations at some sampled locations significantly exceed the adopted SAC. Toxicity Characteristic Leaching Procedure (TCLP) testing indicates that the PAH is not leachable. The PAH contaminant is considered to be due primarily to the presence of ash and slag in the imported fill materials. Other potential contaminants including metals, BTEX, OCP, PCB, Phenols, Cyanide, Volatile Organic Compounds (VOC) and Asbestos were not encountered in the soils at concentrations greater than laboratory detection limits or background levels.
- Based on test results, the filling has been given a preliminary classification of General Solid Waste (non-putrescible) in accordance with the DECC *Waste Classification Guidelines*, April 2008, provided that the material is not cross-contaminated with other material (further ex-situ testing is recommended). As construction debris (brick, tile, gravel, glass and concrete fragments) were noted in all of the bores, there is a potential for asbestos to be present in the filling. In this regard, it is prudent that special care should be adopted during excavation to check for the presence of asbestos in the filling. If potential asbestos containing materials are noted, then the affected filling materials should be demarcated and segregated from the general bulk of the filling for further verification testing by a qualified environmental consultant. The waste classification of the affected materials must be verified and the waste class reconfirmed before they can be disposed off-site.
- In general, the test results indicted a low potential for the presence of acid sulphate soils (ASS) in the soils analysed, which is in agreement with the risk map classification

indicating that no known ASS occurrences were previously recorded in the area. However, due to the slightly elevated S_{POS} value and hence the potential presence of ASS in sample 13/1.7-2.0, it is recommended that further ASS analysis should be conducted during the additional *ex situ* waste classification assessment of the stockpiled material, in order to verify the validity of the SPOCAS results. Further ex-situ testing was thus recommended.

- Testing of groundwater samples, from close to both the upgradient (southern) and down-gradient (northern) site boundaries did not uncover the presence of elevated concentrations of contaminants. As such, groundwater contamination beneath the site is not considered to be an issue of concern.

The following Table 3 presents a summary of the laboratory test data for the adopted soil analytes, reported by both DP and Coffey. The 95% upper confidence limit (UCL) of the average concentrations was calculated using *PRO UCL Version 4* (downloaded from the US EPA website).

Table 3 – Summary of Soils Test Results

Analyte	Number of Samples Tested	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Mean Concentration (mg/kg)	95%UCL of Mean Concentration (mg/kg)
As	40	1.2	9.0	4.9	5.3 (N)
Cd	40	<0.1	2.1	0.7	0.8 (N)
Cr	40	3.0	32	12	14 (N)
Cu	40	2.0	350	60	82 (N)
Hg	39	0.004	47	2.04	3.8 (LN)
Ni	24	1.0	137	12	21 (LN)
Pb	40	10	3900	289	525 (LN)
Zn	39	2.0	960	169	230 (N)
C_6-C_9	32	<10	<25	NA	NA
C_{10}-C_{36}	32	<30	2120	271	445 (AN)
Benzene	16	<0.5	<0.5	NA	NA
Ethyl Benzene	16	<0.5	<0.5	NA	NA
Toluene	16	<1.0	<1.0	NA	NA
Xylene	16	<3.0	<3.0	NA	NA
PAH (Total)	59	<0.2	556	56	85 (AN)
Benzo(a)pyrene	56	<0.05	36	4.1	5.8 (AN)
Phenols	18	<1	<5	NA	NA
PCBs	10	<0.1	<1	NA	NA
Cyanide	10	<0.5	<0.5	NA	NA
Cresol	8	<2	<2	NA	NA
VOC	3	<2.0	<2.0	NA	NA
OCP	10	NA	NA	NA	NA

Notes:
N: Normal distribution
LN: Lognormal distribution
AN: Normal distribution, adjusted for skewness
NA: Not Applicable

7. REMEDIATION OBJECTIVES AND PREFERENCE

7.1 Remediation Rationale

Generally, the main objectives of site remediation works are to ensure that the remediated site is rendered suitable for the proposed child care centre, student accommodation and educational facilities development, and that the works will pose no unacceptable risk to human health or to the environment.

7.1.1 Data Quality Objectives

The scope of remediation works has been devised broadly with reference to the seven step data quality objective process, as defined in Australian Standard *Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil: non-volatile and semi-volatile compounds* (AS 4482.1 – 2005). The DQO process is outlined as follows:

(a) State the Problem

The site will require to be rendered suitable for the proposed child care centre, student accommodation and educational facilities development.

(b) Identify the Decision

Elevated levels of contaminants (viz. lead, PAH, TPH) have been recorded in filling material across the site to be remediated. Given the low leachability of the contaminants of concern and, hence, their relative immobility, the potential for contaminant migration is not considered an issue of concern. Implementation of a permanent capping over this material will further reduce the potential environmental impacts due to these materials.

The isolation or capping of the soil contamination to create a physical barrier system is considered to be the preferred, practical remedial strategy for the project. Given the heterogeneous and uncontrolled nature of the fill, there is a strong likelihood that further residual, unidentified 'hot-spots' are present in the soil material. In this regard, a capping strategy is considered to be a more robust and encompassing strategy than a strategy that is based on the removal of 'identified hot-spots' [and hence has an elevated level of

uncertainties with respect to the impacts due to residual contamination]. The isolation and encapsulation strategy is also considered to be a more conservative approach and, under the proposed development scenario, this remedial strategy is considered to pose a lesser environmental risk than other remedial options. The strategy will also result in the minimisation of waste and in the disposal of soil to landfill. In addition to reducing the quantities of waste to be disposed to landfill, this will also reduce the associated traffic movements generated from associated waste disposal activities.

(c) Identify Inputs to the Decision

Findings of the previous DP and Coffey investigations have been used to characterise the site with regard to the likely nature and extent of the contamination over the site. The ANZECC publication, *Guidelines for the Assessment of On-site Containment of Contaminated Soil*, 1999, has been considered in the development of the capping strategy. The risks associated with the site are deemed to be satisfactorily managed by the adoption of the strategies outlined in these documents.

The key inputs to the Validation Report for the success of the strategy will include;

- capping construction details,
- survey data relating to pre-bulk earthwork levels and final levels,
- photographic record of the works,
- plans,
- Environmental Management Plan (EMP)

(d) Define the Boundary of the Assessment

The boundary of the assessment is summarised in Section 3 “Site Information” and Drawing 1.

(e) Develop a Decision Rule

The progress and completeness of the site remediation works will be verified in a Validation Report. Remediation is deemed to be complete when an appropriate permanent physical

barrier system has been constructed which satisfies the requirements of the RAP, and an EMP has been prepared and implemented.

(f) Specify Acceptable Limits on Decision Errors

Specific limits for the acceptability of data obtained in the remediation validation would generally be in accordance with the appropriate guidelines specified in NEPM (1999) for the collection of environmental samples.

(g) Optimise the Design for Obtaining Data

The sampling programme for the remediation validation is outlined in Section 9 of the RAP. The assessment will be conducted by experienced environmental professionals to ensure that the sampling and analytical regime adopted will result in the collection of accurate, representative data.

Based on a fulfilment of the data quality objectives an assessment of the overall data quality will be presented in the final validation report.

7.2 Remediation Options

The preferred remediation hierarchy for this RAP is in accordance with Section 3.1.8 of the *Australia and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*, ANZECC 1992 and to the principles of the Waste Hierarchy established by the DECC under the *Waste Avoidance and Resource Recovery Act 2001*.

The ANZECC 1992 guidelines state that the preferred order of options for site clean-up and management are:

- on-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level; and
- off-site treatment of excavated soil which, depending on the residual levels of contamination in the treated material is then returned to the site, removed to an approved waste disposal site or facility or used as fill or landfill.

Should it not be possible for either of these options to be implemented, then other options to be considered include:

- removal of the contaminated soil to an appropriate site or facility, followed where necessary by replacement with clean fill;
- Isolation of the soil by covering with a properly designed barrier;
- Choosing a less sensitive land-use to minimise the need for remedial works which may include partial remediation; or
- Leaving contaminated material in-situ providing there is no immediate danger to the environment or community and the site has appropriate controls in place.

The broad categories of commonly employed soil remediation options that have been used to attain remedial objectives are listed below in the order of the preferred remedial hierarchy:

- treatment;
- removal to landfill;
- physical barrier systems;
- institutional controls; and
- no action.

Information on each of the potential remedial options is provided below.

7.2.1 Treatment Technologies

Treatment technologies are used to permanently and significantly reduce the toxicity, mobility or volume of wastes or contaminants. Examples of possible treatment technologies include; bioremediation, thermal treatment, stabilisation, soil screening/washing, chemical treatment and physical treatment.

On-site treatment of the contaminated material would typically involve the excavation, stockpiling, treatment and replacement of the contaminated material. Effectiveness of the treatment process depends on the nature and extent of the contamination. Typically bioremediation will only be effective if the contaminants are simple, organic compounds that are easily biodegradable. Thermal treatment is expensive and the process will potentially result in various forms of environmental impacts (e.g. air emissions, waste and effluent

disposal problems), and is not effective for inorganic contaminants. Stabilisation aims at reducing the leachability (and hence mobility) of the contaminants, and is not effective if the contaminants are already in an immobile form. Soil screening/washing, chemical and physical treatment typically involves massive earthworks and are limited in application if multiple contaminants are involved.

Considering the variable nature of the generally non-leachable contamination within the filling [heavy metals, PAH, TPH] spread over a large area and to known depths up to approximately 4 m, on-site treatment of the contaminated material would not be a feasible nor a practical option.

7.2.2 Removal to Landfill

Removal to landfill involves physically excavating and moving impacted soil to an off-site location for storage, treatment or disposal. Disposal to landfill may require prior treatment of the impacted soil if the chemical levels exceed landfill criteria as determined in the NSW DECC *Waste Classification Guidelines*, April 2008.

Whilst this type of treatment is feasible for the site it may cause potential impacts on the heritage buildings, trees, boundary structures, local community (from waste transport), as well as imposing an unnecessary burden on the capacity of the receiving landfill. Essentially this option would only be suitable under circumstances where there is an elevated potential for unacceptable offsite impacts, such that source removal is critical, or where construction of basements was proposed and which would in any case require to remove the waste soils as part of the site formation process. To undertake such removal when it is not necessary would contravene the principles of the Waste Avoidance and Resource Recovery Act, 2001.

7.2.3 Physical Barrier Systems

Physical barrier systems limit access to the impacted material, mitigate surface water infiltration through the underlying material and control or reduce migration of the contaminants into the surrounding environment. This option can include creating barriers around and/or on top of the impacted material, or relocating the contaminants on-site to a properly constructed, engineered entombment (or containment cell). In addition, the

physical barrier is also used to control the emission of odours, or volatiles (if present) and to reduce erosion, infiltration and improve site aesthetics.

Physical barrier layers can include low permeability soils such as clays, synthetic membranes such as high density polyethylene (HDPE), bituminous materials, paving and concrete. Appropriate site grading and drainage systems may also be required to divert water away from the capped areas (pavements and slabs) and to control surface run-off. Concrete barriers, bituminous pavements and various membranes may be vulnerable to cracking or shearing, depending on their proposed use, loading and exposure but these cracks or ruptures can be repaired providing an appropriate management programme comprising regular inspection and maintenance is developed and implemented as necessary. A combination of barrier types can provide additional security against failures.

Implementation of a barrier system will often require measures to manage the integrity of the barrier system, including works that will require penetration of the barrier system, such as installation / maintenance of underground utilities. These measures are typically outlined in an EMP.

Given the uncontrolled nature of the fill material, the low mobility of the contaminants and the nature of the proposed development (whereby the majority of the site will be paved/sealed), this remedial option is considered to be an appropriate remediation strategy for the site.

7.2.4 Institutional Controls

Institutional controls include measures such as land-use restrictions through zoning controls to preclude certain types of land use, mechanisms of notification such as the Planning Certificate or land title information, site access restrictions, restriction on long term intrusive works or redevelopment and relocation or isolation of potential receptors. Generally, development control is exercised through the development approval process, and any restriction in land-use or the need for ongoing site management can be flagged via the site audit system. Although exposure can be reduced by these means, the impacted media (contaminants) are not subject to appropriate treatment, or management. This option is not considered feasible and is not considered further.

7.2.5 No Action

No action means that no response is considered necessary to remediate the site as there is not considered to be a risk to the environment or the community from the contamination identified. No action represents the current situation in regard to site remediation and will not result in any improvement of the existing site condition or reduction of risk via appropriate management. This option is not considered feasible and is not considered further.

7.3 The Preferred Remediation Strategy

7.3.1 Determination of the Preferred Remediation Strategy

An assessment of remedial options was undertaken in accordance with the ANZECC hierarchy, to nominate the preferred remedial strategy for the site, as follows:

On-Site Treatment of the Soil: DP considers that the bulk excavation and on-site treatment of contaminated soil is not practical for the following reasons:

- The majority of the soil contamination identified on the site appears to be associated with the historical uncontrolled fill present over the whole site. Although various hotspots have been identified it is likely that the real distribution of soil contamination and hotspots in the heterogeneous fill is sporadic in nature and spread across the entire site and it is considered that additional sampling would be unlikely to provide any further insight into the nature and extent of the contamination. It is therefore considered impractical to segregate and remove all hotspots of soil contamination in isolation for on-site treatment, or for removal off-site;
- The range of chemicals detected in the soil material would require a number of treatments to be applied in an attempt to meet suitable validation criteria. Even after the implementation of a series of soil treatment programmes, it is considered likely that the concentrations of substances such as long chain TRH organic compounds, PAHs, and metals are likely to remain elevated within the filling on-site. DP therefore considers that effectiveness of soil treatment would thus be questionable, with a very high level of

uncertainties, and would present an unacceptable time penalty and financial burden to the current project;

- The bulk excavation of materials, noting fills depths of up to about 4 m, would have significant bearing on the structural integrity of heritage buildings (which are to be contained) and boundary structures, some of which are common with neighbouring properties;
- The excavation and on-site treatment processes of the contaminated soil may cause undue environmental impacts such as odour, dust, surface water contamination and sedimentation which under the proposed remediation strategies is unlikely to eventuate. The most effective management strategy to prevent these environmental impacts is to minimise exposure to the contaminated soil during the redevelopment works.

Off-Site Treatment of Excavated Soil: DP considers the off-site treatment of the contaminated soil would be impractical for similar reasons as the on-site treatment of the soil, as detailed above.

Removal of the Contaminated Soil and Disposal to an Appropriate Site or Facility:
DP considered that the extent of contamination may be wide spread and affecting the bulk of the uncontrolled filling. In this regard, piecemeal "hotspot" removal would not be effective. Alternatively it would not be practical to completely excavate and remove all fill from the site for the following reasons:

- bore logs from the previous investigations indicate that fill material is present at considerable thicknesses in some sections of the site and to access these fills would require wholesale removal of the existing buildings and pavements, which is not possible due to heritage listing of a number of the buildings;
- the costs associated with the excavation, transport, off-site disposal and potential treatment of the large volume of fill material contained on the site would be prohibitive.

Isolation of the Soil by Covering with a Properly Designed Barrier: In view of the immobile nature and widespread extent of the contamination, whilst noting the absence of groundwater impacts, the isolation or capping of the soil contamination to create a physical barrier system is considered to be the preferred remedial strategy for the project. Under the proposed development scenario this remedial strategy is considered to pose a lesser

environmental risk than the above mentioned remedial options. Further details of the preferred remedial strategy are provided below.

7.3.2 Assessment of the Suitability of the Physical Barrier System

Based on the contamination issues identified on the site and the impractically of implementing full-scale remediation by bulk removal and/or treatment of the contaminants, DP considers that the management of the contamination by a physical barrier system and via a constructional EMP is the most appropriate remedial strategy. Longer term management relies on the barrier being permanently maintained and by resurfacing where necessary, or being interrupted/removed only during short term events such as the installation of additional services i.e. during the main redevelopment, including the related remedial works, or during future maintenance. Major disruptions to the barrier are anticipated to fall into the category of developments requiring consent.

This option will result in a substantial reduction in health and environmental risk to an acceptable level, whilst also achieving the sustainable development goal of minimisation of waste. The option calls for the construction of an appropriately engineered barrier system over the filling, which is both technically feasible and easy to install, manage and maintain in the long run. The preferred option, therefore, attains an optimal balance amongst the various remediation objectives including risk reduction, environmental integrity, cost and long term manageability.

Barrier system designs have been developed for areas of:

- Heritage buildings;
- New building slabs;
- Paved areas (including service trenches);
- Landscaped areas (including service trenches);
- Trees to be retained; and
- New trees and shrubs.

The various physical barrier system designs are shown in Drawing 2, Appendix A.

8. DESIGN AND CONSTRUCTION OF THE PHYSICAL BARRIER SYSTEM

The investigations undertaken on the site by both DP and Coffey have determined that there is little potential for the identified soil (fill) contaminants to leach and mobilise to the groundwater regime. The testing of groundwater samples recovered from beneath the site has confirmed this statement. As such the physical barrier is designed primarily as a separation between humans and the contaminated soils. However, the grading of the physical barrier, and the provision of adequate surface water drainage, will minimise the infiltration of surface water into the contaminated soils.

As mentioned above, the identified soil contaminants have been determined to be essentially non-leachable. As such, no leachate collection and treatment system is considered necessary as part of the physical barrier design.

The identified contaminants in the fill, at the concentrations encountered, are not volatile in nature and thus not expected to generate vapors or gases considered potentially harmful to human health. As such, no gas collection and treatment system is considered necessary as part of the physical barrier system.

The designs of the physical barrier systems for the various components of surface cover proposed for the site have been developed with consideration of the following factors:

- Final design ground levels required by Council, which are understood to be similar to those existing;
- Ease of construction;
- Ease of management;
- Likelihood of future penetration of the barrier system and the straightforward nature of the repair of the barrier system;
- The retention of heritage structures;
- The presence of significant boundary walls being retained;
- The retention of a number of large trees, and their primary root zones;
- Aesthetic considerations.

The following subsections outline the specific design details for the physical barrier in each of the areas.

As a general guide, a batter slope of between 30 and 45 degrees will be retained for any excavation adjacent to existing heritage buildings or boundary structures, as shown on Drawing 2, Appendix A.

8.1 Heritage Buildings

The existing heritage listed buildings (Buildings 2, 5, and 7) shown on the Ground Floor Site Plan (Drawing 3532-DA004-P7), Appendix B, will be permanently retained (and refurbished) as part of the redevelopment and therefore a purpose built physical barrier system between the building ground floor and the underlying soils is not feasible, nor deemed necessary (as the soil beneath the building will be effectively covered by the building structure and hence not routinely accessible, whereas access to the subfloor area will be restricted. No sampling has been carried out within these building footprints, however it is anticipated that the nature of filling beneath these buildings is similar to that encountered over the remainder of the site.

The management of human health and environmental exposure to the soils beneath the heritage buildings will comprise the following:

- Preparation of an Environmental Management Plan (EMP);
- Nomination of a person / authority responsible to ensure the implementation of the EMP;
- Upgrading (if required) and maintaining adequate roof and surface water drainage and collection measures (ie. preventing ponding of water around the building peripherals and preventing direction of water beneath the building).

8.2 Building Slabs

The proposed development includes the construction of two new buildings (Buildings 1 and 3) as shown on the Ground Floor Site Plan (Drawing 3532-DA004-P7), Appendix B. In

addition, there will be extensions to existing Building 7 in the construction of a new child care centre. The new buildings will be slab on ground construction, with pier supports.

All surplus materials excavated during the pier boring, footing construction, building platform leveling and service trench excavation will be stockpiled and classified for off-site disposal, in accordance with the NSW DECC *Waste Classification Guidelines*, April 2008. An assessment for acid sulphate potential will also be undertaken on the excavated materials, as recommended in the DP Phase 2 Contamination Assessment report (Ref: 45996.01). The classified soils will be disposed off site at a landfill facility licensed to accept the waste under the classification determined (*Note that a preliminary General Solid Waste (non putrescible) classification has been assigned to the fill materials, but the potential for presence of asbestos contamination in demolition rubble inclusions should be noted*).

The handling of soils during the pier boring, excavation and leveling works will be undertaken in accordance with the management plan presented later in this RAP. Adequate personal protective equipment (PPE), as stipulated in this RAP, will be worn at all times.

Upon installation of the piers and services, excavation of the footings, and preparation of the ground surface (which is likely to include a degree of compaction), a marker layer (geogrid, geotextile or similar) will be laid. Given the anticipated low leachability of the contaminants, the marker layer does not need to be impermeable.

The slab blinding layer (typically comprising sand or a sub-base mix) will be laid directly on the marker layer. The building slab will then be formed directly on the blinding layer.

In summary, the physical barrier at the locations of proposed new buildings (or extensions) will comprise the marker layer, overlain by the blinding layer (building design thickness) and the ground floor slab (building design thickness). The physical barrier thickness design is considered adequate as no future penetration of the concrete slab is anticipated unless the buildings are to be demolished. Under that circumstance the marker layer (together with the EMP) will provide a warning as to the presence of contaminated soils beneath.

The schematic of the building slab physical barrier is shown on Drawing 2, Appendix A.

8.3 Paved Areas

The proposed development includes a variety of paved configurations, as shown on the Landscape Concept Plan in Appendix B. Some of the paved areas will be utilised by both vehicles and pedestrians, some by pedestrians alone, and some will be constructed solely for the child care centre.

Despite the variation in pavement types and uses, a generic physical barrier system has been designed to enable ease of construction and to also marry with the physical barrier system designed for the general landscaped areas. In designing the physical barrier system, consideration has been given to the potential for laying and/or servicing underground utilities in the future, and the likely repair / upgrade of the paving layer itself.

In general, the physical barrier system in areas of proposed paving will comprise the marker layer (as previously discussed), a layer of imported validated materials, the paving sub-base / base-course layer, then the pavers at the surface. The total construction thickness will be at least 500 mm.

The imported validated materials must comprise either Virgin Excavated Natural Materials (VENM) or Excavated Natural Materials (ENM), as defined in Section 9.1 of this RAP.

Construction of the barrier system will comprise the following stages:

- Removal and disposal of existing surface layers (bitumen, grass, concrete);
- Excavation of the existing fill to a depth of at least 500 mm below the design final ground level;
- Excavation of service trenches (where required) to the design invert levels;
- The excavated materials will be stockpiled and assessed for waste classification and acid sulphate soil potential. The classified soils will be disposed off site at a landfill facility licensed to accept the waste under the classification determined (*Note that a preliminary General Solid Waste (non putrescible) classification has been assigned to the fill materials, but the potential for presence of asbestos contamination in demolition rubble inclusions should be noted*);
- The exposed fill materials will be compacted as required;

- The marker layer will be placed over the entire area(s) proposed for paving, including the side walls and base of any service trenches;
- Utilities lines will be placed as required in the lined service trenches;
- Imported VENM or validated ENM materials will be placed and compacted to an appropriate specification, at a thickness equivalent to 500 mm less the paver and sub-base / base-course thickness. A specific grading may be required for backfilling in service trenches. Typically a sand or gravel backfill materials is placed around utilities lines. This form of backfill is considered appropriate in the service trenches;
- The sub-base / base-course will be laid and compacted;
- The pavers will be laid as per design. The final paver surface will be designed with a minimum 2% grade towards purpose built sub-surface drainage systems.

Note that it is important to accurately locate the final positions and alignments of the service trenches, such that minimal disturbance will arise through future maintenance or repair works.

The handling of soils during the removal of the contaminated fill will be undertaken in accordance with the management plan presented later in this RAP. Adequate PPE, as stipulated in this RAP, will be worn at all times.

The schematic of the paving physical barrier, including service trenches, is shown on Drawing 2, Appendix A.

8.4 General Landscaping

The proposed development includes landscaped areas that marry into proposed paved areas, as shown on the Landscape Concept Plan in Appendix B. For the purpose of this report, landscaping refers to proposed lawns, gardens and shrub planting. The planting of trees is discussed in Section 7.6.

A generic physical barrier system has again been designed to enable ease of construction and to also marry with the physical barrier system designed for the paved areas. In

designing the physical barrier system, consideration has been given to the potential for laying and/or servicing underground utilities in the future, and the likely repair / upgrade of lawns, gardens and shrub plantings.

In general, the physical barrier system in areas of proposed landscaping will comprise the marker layer (as previously discussed), a layer of imported validated materials, a topsoil layer and turf. There may be minor variations in the thickness or type of topsoil and/or the use of other suitable planting materials. The total construction thickness will be at least 500 mm.

The imported validated materials must comprise either VENM or ENM, as defined in Section 9.1 of this RAP, and may be selected or enhanced to provide adequate nutrient levels and/or drainage characteristics for improved plant growth.

Construction of the physical barrier system will comprise the following stages:

- Removal and disposal of existing surface layers (bitumen, grass, concrete);
- Excavation of the existing fill to a depth of at least 500 mm below the design final ground level;
- Excavation of service trenches (where required) to the design invert levels;
- The excavated materials will be stockpiled and assessed for waste classification and acid sulphate soil potential. The classified soils will be disposed off site at a landfill facility licensed to accept the waste under the classification determined (*Note that a preliminary General Solid Waste (non putrescible) classification has been assigned to the fill materials, but the potential for presence of asbestos contamination in demolition rubble inclusions should be noted*);
- The exposed fill materials will be compacted as required;
- The marker layer will be placed over the entire area(s) proposed for paving, including the side walls and base of any service trenches;
- Utilities lines will be placed as required in the lined service trenches;
- Imported VENM or ENM materials will be placed and compacted to an appropriate specification, at a thickness equivalent to 500 mm less the paver and sub-base / base-

course thickness. A specific grading may be required for backfilling in service trenches. Typically a sand or gravel backfill materials is placed around utilities lines. This form of backfill is considered appropriate in the service trenches;

- The sub-base / base-course will be laid and compacted;
- The pavers will be laid as per design. The final paver surface will be designed with a minimum 2% grade towards purpose built sub-surface drainage systems.

Note that it is important to accurately locate the final positions and alignments of the service trenches, such that minimal disturbance will arise through future maintenance or repair works. These positions will be included in the EMP.

The handling of soils during the removal of the contaminated fill will be undertaken in accordance with the management plan presented later in this RAP. Adequate PPE, as stipulated in this RAP, will be worn at all times.

The schematic of the paving physical barrier, including service trenches, is shown on Drawing 2, Appendix A.

8.5 Trees to be Retained

Due to heritage and/or "ecological significance" reasons, a number of large existing trees will be retained as part of the proposed development. In all, four trees (Number 1, 2, 19 and 39) within the property boundaries will be retained, as indicated on the *Trees to Retain / Remove / Replace* drawing (Reference LSK 08573-004) in Appendix B of this report.

Excavation of soils around the root zones of significant trees always presents a challenge, as the loss of soils (even if temporary) may have a long term impact on the viability on the future of the tree. In order to minimise the potential impact on the survival of each of the retained trees, whilst also abiding by the objective of the remedial works (ie. appropriately remediated to a condition which would prevent unacceptable risks to human health and/or the environment; and ensure the suitability of the site for it's intended land use) the following procedures will be implemented:

- An arborist will identify the primary root zones (PRZ) of each of the trees to be retained. This will become the zone within which bulk fill excavation will not be permitted. Temporary fencing will be erected around each PRZ during site works;
- Additional soil samples will be recovered by hand within the PRZ (sample numbers to be determined based on the identified PRZ area, but minimum of 4 per tree location). The bores will continue to a maximum depth of 0.5m below existing ground level. Recovered samples (2 from each bore) will be analysed for the identified contaminants of concern, viz. PAH, TPH and Heavy Metals;
- Based on the test results, the following remedial strategies will be implemented within the PRZ:
  - If low to moderate contaminant concentrations are detected, a permeable surface cover (necessary to permit continued water infiltration around the tree roots), such as timber decking, will be erected at or above existing ground level. The decking will be designed to prevent direct human contact with the soils beneath.
  - If high contaminant concentrations are detected, some hand excavation of detected “hot spots” or surface soils will take place, under the direction of the arborist. A marker layer and clean soil (probably topsoil) replacement may be required. Once these works are complete to the satisfaction of the Environmental Consultant, the decking construction as detailed above will be undertaken.
- The EMP will detail management requirements, including the maintenance of the decking materials, in the primary root zones.

Any imported validated materials used for soil replacement will comprise either VENM or ENM, as defined in Section 9.1 of this RAP, and may be selected or enhanced to provide adequate nutrient levels and/or drainage characteristics for improved plant growth.

The handling of soils during the removal of any contaminated fill will be undertaken in accordance with the management plan presented later in this RAP, and instructions issued by the arborist. Adequate PPE, as stipulated in this RAP, will be worn at all times.

8.6 New Tree and Shrub Planting

As indicated on the *Trees to Retain / Remove / Replace* drawing (Reference LSK 08573-004) in Appendix B of this report, a number of new trees / shrubs will be planted as part of the proposed redevelopment.

A generic physical barrier system has again been designed to enable ease of the planting works and to also marry with the physical barrier system designed for the paved and landscaped areas. In designing the physical barrier system, consideration has been given to the exposure of the new plantings to the contaminated soils, and the potential for maintenance and/or replacement of the plantings in the future.

In general, the physical barrier system in areas of proposed tree and shrub planting will comprise the marker layer (as previously discussed), a layer of imported validated materials, a topsoil layer and turf, or paving layer. There may be minor variations in the thickness or type of topsoil and/or the use of other suitable planting materials. The total construction thickness will be at least 500 mm, with a minimum distance between the contaminated material and tree root bulb of 200 mm.

The imported validated materials will comprise either VENM or ENM, as defined in Section 9.1 of this RAP, and may be selected or enhanced to provide adequate nutrient levels and/or drainage characteristics for improved plant growth.

Construction of the physical barrier system at proposed tree or shrub planting sites will comprise the following stages:

- Removal and disposal of existing surface layers (bitumen, grass, concrete);
- Excavation of the existing fill to the required depth of at least 500 mm below the design final ground level, or to a depth of 200 mm below the proposed base planting level, whichever is greater. The excavation width will be the width of the plant root bulb plus a minimum 200 mm all around;
- The excavated materials will be stockpiled and assessed for waste classification and acid sulphate soil potential. The classified soils will be disposed off site at a landfill facility licensed to accept the waste under the classification determined (*Note that a*

preliminary General Solid Waste (non putrescible) classification has been assigned to the fill materials, but the potential for presence of asbestos contamination in demolition rubble inclusions should be noted);

- The marker layer will be placed over the entire excavation surface, including side walls;
- Imported VENM or ENM materials will be placed in the base of the excavation (minimum 200 mm thickness);
- The plant will be positioned in the centre of the excavation, and then the imported VENM or ENM will be placed and compacted around the annulus, as required;
- Topsoil and/or paving materials will be placed at the surface as required.

Note that the minimum thickness of the physical barrier system adjacent to and beyond the tree or shrub planting excavation will be 500 mm.

The handling of soils during the removal of the contaminated fill will be undertaken in accordance with the management plan presented later in this RAP. Adequate PPE, as stipulated in this RAP, will be worn at all times.

The schematic of the tree and shrub planting physical barrier, is shown on Drawing 2, Appendix A.

9. WASTE DISPOSAL

9.1 Waste Classification

DP conducted a preliminary waste classification as part of the Phase 2 Contamination Assessment. Reference should be made to that document for full details. In summary, in-situ samples were selected for analysis of potential contaminants and TCLP testing. Based on the overall results, the fill was assigned a preliminary classification of General Solid Waste (non-putrescible) as defined under the DECC *Waste Classification Guidelines*, April 2008, provided that the material is not cross-contaminated with other material. However, further *ex situ* waste classification of the filling was recommended upon excavation and stockpiling. It

was also noted that building rubble was encountered in the test bores, thus, there was considered to be a potential for asbestos to be present in the filling materials.

Preliminary test results also indicted a low potential for the presence of Acid Sulphate Soils (ASS) which is in agreement with the risk map classification indicating that no known ASS occurrences were previously recorded in the area. However, due to the slight potential for the presence of ASS recorded in one of the tested samples collected from the grey clay filling, it was recommended that further ASS analysis should be conducted during the additional *ex situ* waste classification assessment of excavated material.

Upon excavation and stockpiling of the fill materials proposed for off-site disposal, sampling and testing will be undertaken to assign specific waste classifications. In general, depending upon the volume of stockpiled soils being classified at any one occasion; samples will generally be recovered at a rate of 1 in 100 m^3, or a minimum of 3 samples per stockpile. Each recovered sample will be analysed for the following:

- Heavy Metals;
- PAH;
- Asbestos;
- TCLP (PAH and metals);
- SPOCAS.

A waste classification report will be issued, providing a classification for each stockpile in accordance with the DECC *Waste Classification Guidelines, April 2008, Part 1: Classifying Waste and Part 4: Acid Sulphate Soils* (if applicable).

Once classified, the nominated licensed landfill facility will be contacted to arrange receipt of the materials. A check will be conducted to ensure the nominated landfill has the appropriate license in place for receipt of the materials.

Appropriate pre-treatment may be required (on site or off site) if the materials are found to be either ASS or classified as Hazardous Materials (refer to Section 8.2). Under these circumstances, appropriately licensed contractors will be engaged to undertake the necessary works in accordance with appropriate guidelines.

Similarly, if asbestos is encountered within the materials, an appropriately licensed contractor may be required to carry out the soil removal works.

9.2 Spoil Contingency Plan

Materials which fail to meet the NSW DECC disposal criteria (ie. general or restricted solid waste) following waste testing will require to be segregated and separately stockpiled pending further testing and possibly treatment. The contingency plan to cater for the storage, treatment and disposal of excavated spoil which fails to meet landfill criteria is as follows:-

- Materials will be carefully excavated and placed in well delineated and contained locations;
- Stockpiles of excavated materials will be appropriately bunded with hay bales/sandbags and if required, covered and/or lined with impermeable plastic sheeting;
- Sampling and analysis of segregated stockpiles will be conducted in accordance with Section 8.1;
- Disposal arrangements will be determined based on sampling results as follows:-
  - material which falls below the disposal guidelines for General or Restricted Solid Waste shall be collected and disposed direct to landfill;
  - those materials which exceed the criteria for landfill disposal shall remain segregated in stockpiles and await treatment/alternate disposal arrangements.
- Stockpiled materials which cannot be directly disposed at landfill (i.e. those which fail the combined specific concentration and TCLP test, or materials which require to be stored pending treatment) will be covered by anchored geotextile to prevent erosion and wind blow of contaminated materials;
- A suitably qualified and hazardous materials remediation contractor will be engaged to assess the contamination and develop an appropriate treatment method, which may involve chemical or physical stabilisation / immobilisation methods;

- Approval as to the appropriateness of the treatment and disposal method for materials exceeding the guidelines will be obtained from the NSW DECC, and a disposal consent will be sought from the DECC prior to the removal of such wastes from the site;
- Treatment of the materials may be carried out either on-site or off-site at an appropriately licensed facility, subject to DECC approval.

9.3 Stockpiling of Contaminated Material

Excavated contaminated material shall be stockpiled at a suitably segregated location(s) away from the main construction area(s). These areas will be fenced off in order to maintain separation from the remediated (capped) and validated areas to prevent inadvertent access.

All stockpiles of contaminated material shall be surrounded by star pickets and marking tape or other suitable material to clearly delineate their boundaries. Stockpiles shall be lightly conditioned by sprinkler or covered by geotextile or similar cover to prevent dust blow. Should the stockpile remain on-site for over 48 hours, geotextile silt fences or hay bales should be erected around each stockpile to prevent losses by surface erosion. Any stockpile to remain on-site overnight should be adequately secured in order to reduce the risk of sediment runoff.

9.4 Loading and Transport of Contaminated Material

Transport of contaminated material from the site shall be via a clearly delineated haul route and this route shall be used exclusively for entry and egress of vehicles used to transport contaminated materials within and away from the site.

Removal of waste materials from the site shall only be carried out by a licensed contractor holding appropriate license, consent or approvals to dispose the waste materials according to the classification outlined in the DECC *Waste Classification Guidelines, April 2008* and with the appropriate approvals obtained from the NSW DEC, if required.

Details of all contaminated and spoil materials removed from the site (including VENM) shall be documented by the contractor with copies of weighbridge slips, trip tickets and consignment disposal confirmation (where appropriate) provided to the Environmental Consultant. A site log shall be maintained by the Principal's Representative (PR) based on discrete excavation (numbered) locations to track disposed loads against on-site origin, location of the materials and sample numbers.

The proposed waste transport route will be notified to the local Council and truck dispatch shall be logged and recorded by the contractor for each load leaving the site. A record of the truck dispatch will be provided to the Environmental Consultant via the PR.

9.5 Disposal of Contaminated Material

All contaminated materials excavated and removed from the site shall be disposed of to an appropriately licensed landfill. Copies of all necessary approvals shall be given to the Environmental Consultant via the PR prior to any contaminated material being removed from the site. Copies of all consignment notes for the transport, receipt and disposal of the materials will be maintained as part of the site log and made available to the Environmental Consultant for inspection and reporting purposes upon request.

All relevant analysis results shall be made available to the contractor to enable selection of a suitable disposal location. Holding arrangements, treatment and disposal requirements for excavated materials which fail to meet the landfill disposal guideline levels for moderately contaminated fill are discussed elsewhere.

10. SITE VALIDATION PLAN

Validation requirements for the physical barriers including pavements and capping soils include:

- Surveyed site levels following excavation (prior to construction of the physical barrier system);
- Surveyed site levels upon completion of physical barrier system construction;
- as-built engineering plans indicating the details of any new barrier system for each type (ie. building slab, paving, service lines, general landscaping, retained trees, and new tree plantings);
- Photographic record of the excavations, construction and completion of each physical barrier type;
- Validation reports confirming the VENM or ENM classification of imported materials;
- Inspection records for the works, prepared by a suitably qualified Environmental Consultant;
- Compaction certification (where required, such as pavement areas)
- stormwater control plans and details and evidence relating to the installation of the stormwater controls (ie surface drainage); and

Information from the above will require to be compiled in a suitable format and presented in the validation report to be prepared by the Environmental Consultant.

10.1 Imported Materials

Any imported materials proposed for use as filling within the site must be appropriately validated prior to being used within the site. Only the following materials will be permitted for use within the site (upon meeting appropriate checking and validation, see below):

- Virgin Excavated Natural Materials (VENM) as defined under the Protection of the Environment Operations Amendment (Scheduled Activities and Waste) Regulation 2008;

- Excavated Natural Material (ENM) as defined under the Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption Under Part 6, Clause 51 and 51A – The excavated natural material exemption 2008;
- Quarried natural aggregates / gravels such as blue metal;
- Recycled aggregates meeting the criteria outlined in the Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption Under Part 6, Clause 51 and 51A – The recovered aggregate exemption 2008.

All materials used as filling, including topsoil and pavement basecourse, must be certified within one of the abovementioned categories. The Environmental Consultant for the UTS Blackfriars site must review and be satisfied with the certification provided prior to allowing the materials to be imported to the site.

Additional confirmatory sampling and testing of the materials may be required by the Environmental Consultant prior to allowing the materials to be imported to the site.

10.2 Validation Sample Collection and Analysis

It is proposed that any validation, waste classification or additional site characterisation samples be collected and analysed at the following frequency:-

- STOCKPILED MATERIAL - 1 sample per 100 m^3 will be taken (or minimum of 3 samples per stockpile) for waste classification. Sample materials to be logged and described in each case. Recovered samples will be analysed for Heavy Metals, PAH, asbestos and TCLP (if required).
- SAMPLES FROM EXCAVATIONS (IF REQUIRED) – 1 sample per 25 m^2 on the excavation base and 1 sample per 15 liner metres along the excavation side walls. Sample depths and materials to be logged in each case. Samples to be analysed for Heavy Metals, PAH, TPH, BTEX and asbestos. *Note that, in general, validation sampling of excavations is not required. May be required in circumstances where the physical barrier system cannot be constructed to specification*.

- IMPORTED VENM or ENM (IF REQUIRED) – 1 sample per 100 - 250 m^3 of imported fill plus certification that the material comprises VENM or ENM including details of the source site. Samples to be analysed for Heavy Metals, PAH, TPH, BTEX, OCP, PCB, Phenols and asbestos.
- TREES TO BE RETAINED – Minimum of 4 samples in the primary root zone, maximum depth 500 mm. Sample depths and materials to be logged in each case. Samples to be analysed for Heavy Metals, PAH, TPH, BTEX and asbestos.

10.3 Sample Collection and Handling

Sampling data shall be recorded to comply with routine Chain of Custody requirements.

The general sampling, handling, transport and tracking procedures comprises:-

- the use of stainless steel sampling equipment;
- washing of all sampling equipment, including drills or excavator parts in contact with the sample, in a 3% solution of phosphate free detergent (Decon 90) then rinsing with distilled water prior to each sample being collected; transfer of the sample into new glass jars, sealed with a teflon lined lid to eliminate cross contamination during transportation to the laboratory;
- labelling of the sample containers with individual and unique identification including Project No. and Sample No.;
- placement of the containers into a chilled, enclosed and secure container for transport to the laboratory; and
- use of chain of custody documentation to ensure that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to hand-over to the laboratory.

10.4 Quality Assurance Plan

10.4.1 Field QA

Quality assurance (QA) and quality control (QC) procedures will be adopted throughout the field sampling programme to ensure sampling precision and accuracy and prevent cross contamination.

DP will ensure sampling accuracy and precision through the analysis of 10% field duplicate/replicate samples (with 5% inter-laboratory duplicate/replicate and 5% intra-laboratory duplicate/replicates) as well as the collection of field rinsate samples of sampling equipment at a rate of one per 20 samples, or one per day of sampling operations.

Appropriate sampling procedures will be undertaken to ensure that cross contamination does not occur and will follow DP's Standard Operating Procedures Manual. This specifies that:-

- Standard operating procedures are followed;
- Site safety plans are developed prior to commencement of works;
- Duplicate or replicate field samples are collected and analysed;
- Equipment rinsate samples are analysed as part of the QA/QC programme;
- Samples are stored under secure, temperature controlled conditions;
- Chain of custody documentation is employed for the handling, transport and delivery of samples to the selected laboratory; and that
- Proper disposal of contaminated soil, fill or groundwater originating from the site area is completed.

10.4.2 Laboratory Quality Assurance and Quality Control

DP's preferred laboratory will undertake in-house QA/QC procedures involving the routine testing of:-

- Reagent blanks;
- Spike recovery analysis;
- Laboratory duplicate analysis;

- Analysis of control standards;
- Calibration standards and blanks; and
- Statistical analysis of QC data including control standards and recovery plots.

10.5 Achievement of Data Quality Objectives

The DQO process for the remediation and validation works is outlined in Section 6.1.1 of this report.

10.6 Validation Reporting

A validation assessment report will be prepared by a qualified environmental consultant in accordance with NSW DEC Contaminated Sites *Guidelines for Consultants Reporting on Contaminated Sites* (1997) and other appropriate guidance documentation. The report will be submitted to the appropriate certifying authority at the completion of the remediation works program.

The validation report will confirm that the site has been remediated to a suitable standard for the proposed land-use and that no related adverse human health and environmental effects have occurred as a result of the temporary works. The validation report will also include a summary of the information from previous investigations, particularly the materials that remain on-site.

The validation report will record the nature of the physical barrier system at all locations on the site with suitable supporting documentation being provided in regard to barrier thickness, integrity, capping materials, and other treatments applied.

The validation report will include details of the total volume of contaminated materials removed from site, present detailed analytical results where applicable, confirm that placed fill is clean and indicate the final disposal destination of the materials removed from site.

The validation report will also include, or accompanied by an Environmental Management Plan (EMP) which will include details on the management procedures to be adopted in ensuring the integrity of the physical barrier system, and health and safety precautions to be implemented when accessing (or potentially accessing) the capped contaminated materials.

11. ENVIRONMENTAL MANAGEMENT DURING REMEDIATION AND CONSTRUCTION

It is envisaged that the remediation and construction works will be carried out in the following general sequence:

- Demolition and removal of existing buildings (non heritage listed);
- Preparation of proposed new building platforms;
- Construction of new buildings;
- Excavation of fill materials and construction of physical barrier system.

This generic EMP applies generally to each of the abovementioned works phases, and should be followed in conjunction with any other environmental management protocols stipulated in relevant WorkCover NSW, Australian Standard, and/or Council requirements.

A site specific Construction Environmental Management Plan (CEMP) shall be provided by the remediation and construction contractors. The site specific CEMP shall be reviewed by the environmental consultant. As a minimum, the site specific CEMP shall detail the following:

- Works sequence and timeline;
- Health and Safety Protocols;
- Dust minimisation measures;
- Noise minimisation measures;
- Environment protection measures;
- Equipment to be used;

- Stockpiling locations, including nominated areas for materials not meeting landfill disposal requirements / classifications;
- Nominated landfill(s);
- Truck movements / site access / site egress;
- Proposed source(s) of materials for import, and methods of certification;
- Method(s) for surveying before and after physical barrier construction;
- Measures to prevent cross contamination between areas being remediated (capped) and those already capped;
- Method(s) for inspecting and certifying construction of the physical barrier systems, including any hold points (*may be organised and commissioned by the Principal*).

The remediation and construction works shall be undertaken with all due regard to the minimisation of environmental effects and to meet all statutory requirements. The successful contractor shall have in place the site specific CEMP such that work on the site complies with the requirements as laid down in relevant legislation, guidelines and codes, including, *inter alia*, provisions from the following Acts:-

- Hazardous Chemicals Act;
- Environmentally Hazardous Chemicals Act;
- Dangerous Goods Act;
- Protection of the Environment Operations Act;
- Construction Safety Act;
- Occupational Health and Safety Act (WorkCover);
- All relevant DECC guidelines;
- Council DCPs.

The contractor shall also be responsible to ensure that the site works comply with the following conditions:-

- fugitive dust leaving the confines of the site is minimised;
- no water containing any suspended matter or contaminants leaves the site in a manner which could pollute the environment;

- vehicles shall be cleaned and secured so that no mud, soil or water are deposited on any public roadways or adjacent areas; and
- noise and vibration levels at the site boundaries comply with the legislative requirements.

The appointed remediation and construction contractors will be provided with a copy of this RAP so that they are aware of the contamination status of the soils and the remediation methodology to be adopted.

The environmental consultant will also review the CEMP and conduct an induction to ensure adequate understanding of the RAP.

The following sub-sections provide details of the environmental management practices to be employed as a minimum at the site in order to minimise and/or prevent environmental impact as a result of the remediation and/or construction works. Again, it is noted that other statutory requirements must also be followed.

11.1 Dust Control

Although no asbestos has been identified in the fill materials at the site, the presence of various amounts of building rubble in the fill suggests there is a potential for asbestos of some form to be present in the fill.

Generation of dust, therefore, will be kept to a minimum at all times.

During working hours, water sprays will be used to keep the surface of any works areas and stockpiled soils (which will be kept to a minimum) reasonably damp, in order to suppress any dust. Water used for dust suppression will be only the minimum required to reduce dust generation and will not be allowed to escape the confines of the works areas. If excessive dust is being generated, works will cease until the dust is sufficiently suppressed.

During non-working hours, all soil stockpiles will be covered with industrial strength plastic and/or tarpaulins, securely weighted to ensure they are not blown away by strong winds.

Note that should asbestos be encountered in the fill during any stage of remediation and/or construction works, air monitoring may be required. Air monitoring devices would be kept at locations nominated by an appointed Occupational Hygienist. The Hygienist would check the filters regularly for asbestos fibres. If asbestos fibres are detected during the course of the works, the remediation works will cease and dust prevention measures improved. The Occupational Hygienist will provide instruction.

11.2 Soil / Sediment Containment

Industry standard sediment control measures, such as sediment fencing and/or hay bales, shall be installed where there is a potential for sediment to spill onto neighbouring properties, public roads or the stormwater drainage lines.

The sediment control measures shall be regularly inspected and maintained by the site foreman. The environmental consultant will also carry out regular inspections.

11.3 Noise Management

Noise impacts will generally result from the excavators, truck movements and construction equipment within the site and surrounding streets, all of which have noise levels within levels normally expected at a construction site.

In order to minimise noise impacts during the remediation works, the following measures shall be implemented:

- Construction noise will be confined to the hours stipulated by Council. No machinery / trucks will be permitted to access the site outside these hours of operation;
- Signage at the site entrance providing contact details for the site superintendent, so that noise complaints can be readily addressed;
- Establishment and monitoring of a complaints log;

- All equipment and machinery will comply with regulatory standards for noise generation;
- Fitting mobile equipment with exhaust mufflers, when and if required;
- Adopting traffic management measures to reduce noise.

11.4 Odour Control

In order to control odours at the site boundaries, the following processes shall be adopted:

- All plant and equipment exhaust levels will be monitored by the site foreman / superintendent to ensure acceptable levels. If unacceptable levels are determined, the equipment will be replaced or repaired;
- If strong hydrocarbon odours are detected from any of the machinery a hydrocarbon mitigating agent will be used;
- A complaints register will be set up on-site for recording complaints from residents or tenants, with respect to odours or dust. The complaints register will be completed by the Site Superintendent, as well as the corrective actions implemented;
- Once a complaint is received, the site superintendent will implement a corrective action to rectify any problems associated with the odour or dust source.

Investigations performed to date have not identified any volatile contaminants in the soil that could generate odours and, therefore, odours are not anticipated or expected to be significant. If, however, odours are detected during the works the following protocol will be applied:

- Odour source and type of odour to be investigated by the environmental consultant. This could include air monitoring or sampling of any suspect media in addition to observations of physical conditions;
- Temporary covering of the source to mitigate odours whilst waiting for monitoring/analytical results. This could include the temporary reinstatement of ground conditions;

- Assessing more permanent ways of dealing with the issue. This could include disposal of odorous material off site, the use of masking agents or the controlled progressive excavation etc;
- The re-use of odorous soils for construction purposes will not be undertaken unless the material has been aerated or suitably treated and the odorous material assessed to be suitable and the odour to have adequately attenuated.

12. OCCUPATIONAL HEALTH & SAFETY

A site specific Occupational Health & Safety (OHS) Plan is to be prepared and submitted for approval by the appointed remediation and construction contractor(s). The following protocols are to be observed during the works and are to be incorporated into the appropriate contractors' plan.

- Site Induction. As part of the site induction, site workers are to be advised on:
  - the contamination status of the site including the location, nature, type and concentration of contaminants present;
  - the risks associated with the contaminants;
  - the location and the methods of field identification of contamination hot-spots;
  - the occupational health and safety monitoring to be undertaken (as required by site conditions);
  - the occupational health and safety controls to mitigate the risks (including personal protective equipment [PPE] and, as required, air monitoring).

- Small scale earthmoving activities (for example, trenching) will not create a significant dust problem, however, dust levels must be kept to a minimum at all times and water suppression techniques are to be available and used as appropriate (Refer to Section 10.1).

- All earthworks plant to incorporate air-conditioned cabs and:
  - Cabs to be enclosed at all times during operation;
  - Cabs to be cleaned daily to remove accumulated dust and dirt;
  - Cabs to be monitored for dust and, in the case of asbestos works, asbestos;
  - Appropriate personal PPE to be available within the cab.

- Work to cease immediately when odours, unusual discolouration or fibro (or other asbestos-based materials) found within the fill (in the case of asbestos, refer to Section 12, Asbestos Finds Protocol). When asbestos, odours or other indicators of environmental concern are noted, the project Environmental Manager must be informed immediately. He will assess the situation and make a determination on the steps to be taken to make the situation safe and to resolve the issue. This would include seeking advice from the environmental consultant and/or an occupational hygienist (for asbestos);

- NO material containing asbestos-based materials is to be left exposed for an extended period or compacted when exposed.

12.1 Personal Protective Equipment (PPE)

All personnel working where contact can be made with contaminated soil (dust or direct contact), will comply with a minimum level of PPE. The minimum level is in addition or complementary to PPE required for the project generally and will include the following:

- Hard hat complying with AS 1801 (type 1);
- Coloured reflective vest or high visibility work clothing complying with AS 462 and 1906.4;
- Steel-capped safety boots;
- Leather or nitrile gloves or similar when working directly in contaminated soil such as trench excavations and laying services;

- Long sleeved shirt and long trousers (may be combined with safety vest as per above).

All staff shall be provided with safety goggles and a P2 disposable dust mask with a valve complying with AS 1716, for use as conditions dictate (e.g. dusty conditions).

In addition to PPE there are also management measures which should be observed. These will include observing a no smoking, eating or drinking rule when outside of site sheds, washing hands and face before eating etc. Toolbox sessions and inductions will also emphasise the need to limit hand-to-mouth gestures.

12.2 PPE in Asbestos Affected Areas (if encountered)

As discussed earlier in this report, asbestos has not been identified as a specific contaminant associated with the site. However, as building rubble has been found at some sampled locations there is considered to be a possibility of asbestos being present within the fill.

WorkCover classifies the presence of fragments of asbestos-cement sheet (fibro) in soil as friable asbestos and soil containing fibro needs to be removed by a contractor with a Class AS1 licence. Should asbestos be encountered during the works (refer to Section 12), the PPE for works associated with areas containing asbestos also needs to conform to the requirements of the Code of Practice for the Safe Removal of Asbestos, NOHSC, 2005 but generally as follows:

- Masks suitable for asbestos removal work will be worn at all times during removal work by those involved and should be a P2 disposable dust mask or a particulate half-face mask with a P3 filter as determined for the asbestos removal task to be undertaken;
- Disposable coveralls, preferably orange in colour. Coveralls shall not be used more than once. A reflective orange vest needs to be worn if coveralls not coloured orange;
- Suitable gloves;
- Steel capped boots.

12.3 Air Monitoring (if Asbestos Encountered)

Air monitoring for asbestos fibres will be carried out within the site and on its borders during asbestos-contaminated soil removal (if asbestos is found) and will include monitors placed at the perimeter of the asbestos work zone and/or the site.

The sampling locations will be determined by the extent of the potential source of airborne fibres (area of disturbed fill), the nature of down-gradient receptors (sensitive receptors such as residences) and potential fibre generating activities taking place (plant movement).

Air monitoring (if required) will be carried out by a qualified Occupational Hygienist. Filter analysis (fibre counting) will be carried out by a NATA accredited laboratory. Monitoring results must be available the day after sampling. The action level of asbestos air monitoring will be as shown below:

- < 0.01 fibres per millilitre – Continue with control measures
- > or = 0.01 fibres per millilitre – Review control measures
- > or = 0.02 fibres per millilitre – Stop removal work and find the cause

Concentrations exceeding the action level will require that operations are temporarily ceased and an Occupational Hygienist is consulted to investigate the exceedance and to provide a specific protocol or management plan for continued safe work.

13. UNEXPECTED ASBESTOS FINDS PROTOCOL

Whilst investigations to date have not determined the presence of asbestos in the fill / soils, it is possible (due to the presence of building rubble in the fill) that asbestos-based materials may be uncovered during the remediation and/or construction works. This is likely to be in the form of asbestos-cement sheet fragments (fibro) and is only likely to occur.

The physical barrier system proposed for the site is also considered suitable for soils containing asbestos. As such, the remediation approach will not change upon the identification of asbestos in the soil. The only changes will be in the execution of the works

(ie. worker and public protection, monitoring, and licensing) and the classification of any soils requiring off-site disposal.

In the event that asbestos-containing material is encountered, the following 'Asbestos Finds Protocol' has been established:

1. Upon discovery of suspected asbestos containing material, 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.
2. The Environmental Consultant or an Occupational Hygienist is to be notified to inspect the area and confirm the presence of asbestos and determine extent of remediation works and confirm the protocols to be adopted. A report detailing this information will be compiled and provided to the construction manager.
3. The impacted soil (where it forms part of the required construction or remediation excavation process) will be stockpiled for waste classification purposes (including sampling and chemical analysis) and will be disposed of, as a minimum, as asbestos contaminated waste at an appropriately licensed solid waste landfill site. The stockpile will be lightly wetted and covered with a plastic sheet whilst awaiting disposal.
4. All work associated with asbestos in soil will be undertaken by a contractor holding a class AS1 Licence. The AS1 licensed contractor will liaise with WorkCover as required and obtain all necessary permits to undertake the work. Works will be carried out in accordance with the *Code of Practice for the Safe Removal of Asbestos*, 2nd Edition, 2005.
5. Monitoring for airborne asbestos fibres is to be carried out during the soil excavation.
6. Documentary evidence (weighbridge dockets) of correct disposal is to be provided to the construction manager.
7. At the completion of the excavation, a clearance inspection is to be carried out and written certification is to be provided by an Occupational Hygienist that the area is safe to be accessed and worked.
8. The area may be reopened for further general excavation or construction work.

Although the presence of fibro in soil is potentially classifiable as friable asbestos by WorkCover (the actual classification status is to be verified by the occupational hygienist), the removal and disposal of soil containing fibro will not include a formal, wet decontamination procedure, encapsulation of the affected area or the use of negative air unit. The licensed contactor must establish, however, a separate area where employees can safely and securely leave clothing and change into disposable suits as necessary.

14. CONTINGENCY PLAN

In some circumstances, remediation works can be unpredictable. The following Table 4 presents anticipated potential problems or events and the corresponding corrective actions to be implemented:

Table 4 - Contingency Plan

Incident / Event	Corrective Action
Design physical barrier thickness cannot be achieved	Environmental consultant to ascertain the risk associated with a reduced barrier thickness and/or determine an alternative, including possibly a more permanent hardstand cover.
Underground storage tank uncovered during excavation works (not anticipated)	Area to be fenced off from remainder of works UST to be decommissioned and removed by a licensed contractor in accordance with WorkCover guidelines. Environmental consultant to investigate the likely nature and extent of soil and groundwater contamination at the location of the UST and advise appropriate remediation, if considered necessary. Remediation to be undertaken and validated by environmental consultant.
Area of potentially significant contamination encountered during excavations (ie. visible or odorous indicators)	Area to be fenced off from remainder of works Environmental consultant to investigate soil and groundwater contamination at the location of the potentially significant contamination and advise appropriate remediation, if considered necessary.

Incident / Event	Corrective Action
	Remediation to be undertaken and validated by environmental consultant.
Asbestos-containing materials encountered during excavation works	Action outlined in Section 12
Spillage/leakage of oil, hydraulic fluid, or other fuels from the excavator/backhoe and trucks	For major spill; place sandbags down slope, cover area in sand, excavate impacted sand and soils and dispose of at an appropriate DECC approved facility. For minor spill; cover area in sand, excavate impacted sand and soils and dispose at a DECC approved facility. Stop spillage/leakage where apparent.
Failure of sediment control measures	Replace or repair failed control measure Determine reason for failure and ensure no repeat Clean up any materials penetrating the safeguard and return to either the stockpile or excavation (origin).

Other contingency plans are outlined in various sections of this RAP.

15. SITE PERSONNEL AND RESPONSIBILITIES

The project CEMP will outline the environmental responsibilities and authorities for the Project Manager, Project Environmental Manager, Site Manager and Foremen. The environmental responsibilities and authorities for the implementation of this RAP must comply with the approved CEMP requirements.

The objective of this section is to define a clear line of responsibility and to ensure that the function of the role of each of the personnel is identified in order to maximise the safety of all site users and occupants with respect to environmental and OH&S issues.

Figure 1, below, shows the overall organisational structure and responsibility for the remedial works.

All designated personnel and contractors working on the site must be made aware of the line of responsibility for implementing the RAP and must follow environmental management and health and safety procedures. Each of the designated individuals must be aware of their own responsibilities on the site and who to contact in the event of an incident, or for advice on procedures and protocols to maximise;

- OH&S to all site users, occupants and surrounding community, and
- environmental protection for the site and surrounding areas.

All designated personnel must have read and/or understood the provisions of the RAP prior to entry to the site, commencement of site works or monitoring works which may have health and safety or environmental implications. All personnel will have to undergo a site induction, and will have to sign a statement to that effect.

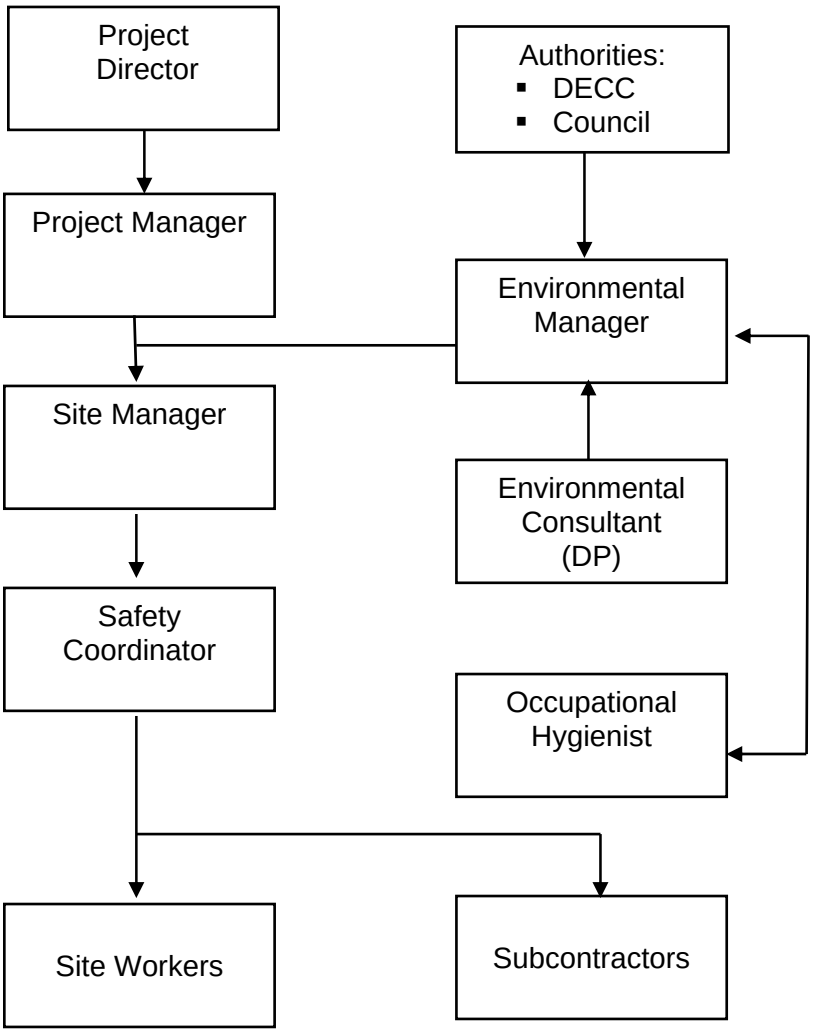
Similarly, all contractors employed to carry out the works on or near contaminated spoil at the site will be responsible for ensuring that their employees are aware of, and comply with, the requirements of the approved CEMP.

The above provisos clearly do not pertain to casual users and visitors of the facility once it is operational.

The personnel involved in implementing the CEMP during remedial works are:

- Hutchinson Builders Construction Manager;
- Hutchinson Builders Project Manager;
- Hutchinson Builders Site Manager;
- Hutchinson Builders Environment Manager
- Hutchinson Builders Site Safety Coordinator;
- Individual sub-contractors.

FIGURE 1: Line of Responsibility



16. CONCLUSION

Subject to proper implementation of the RAP and validation reporting, DP consider that the site can be made suitable for the proposed redevelopment.

The site remediation is to involve the construction of a suitable physical barrier system. The system will effectively cap the underlying fill materials which have been found to be sporadically contaminated, primarily with some metals, PAH and TPH.

Based on the contamination assessment findings, short term exposure during remediation and construction works is not expected to pose an unacceptable risk to workers. An EMP will be developed as part of the final validation process, which will be used as an instrument to manage the integrity of the physical barrier system and protect workers who may become exposed to the contaminated materials in the future.

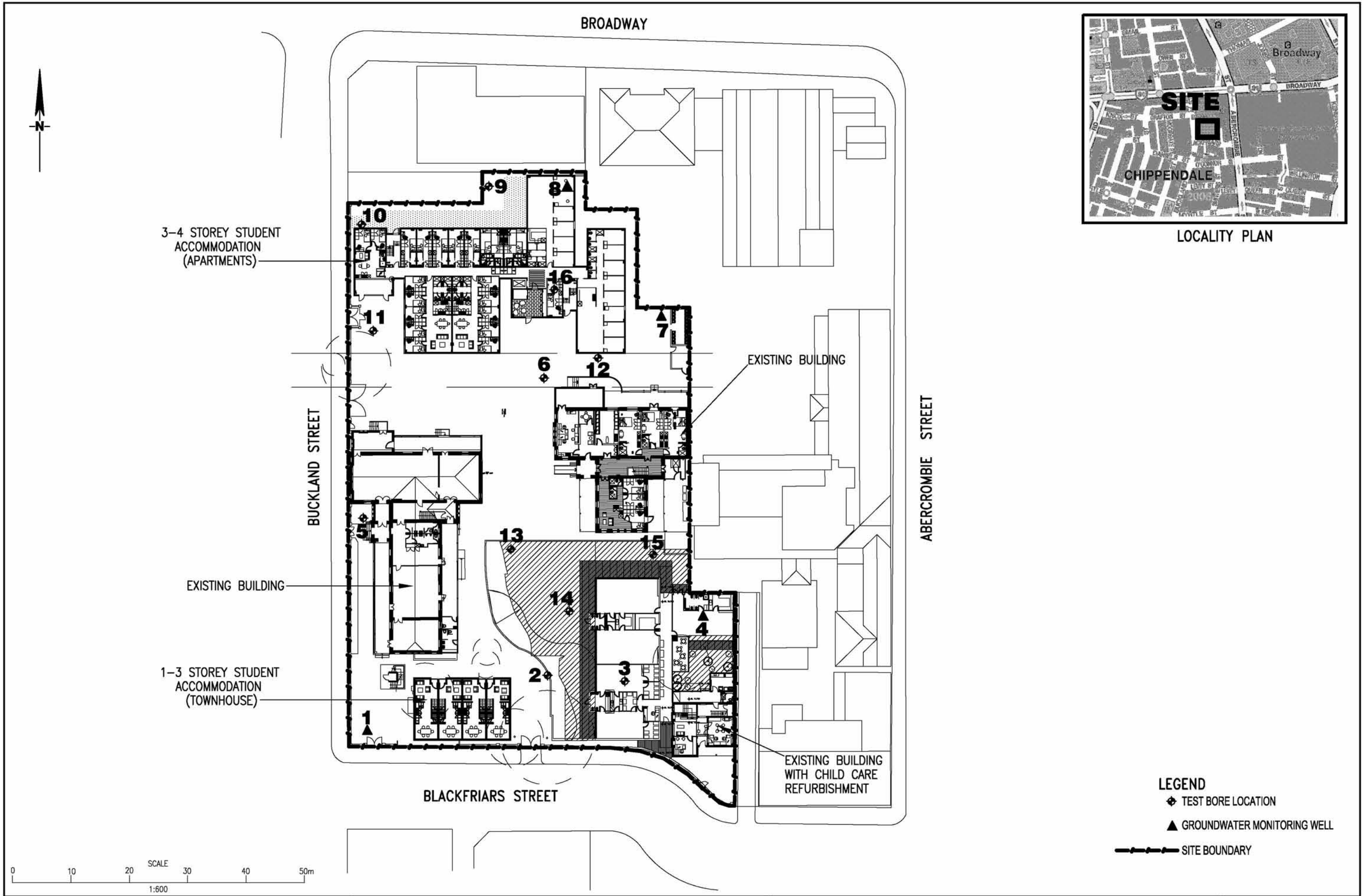
DOUGLAS PARTNERS PTY LTD

Reviewed by:

Paul Gorman
Senior Associate

Ronnie Tong
Principal

APPENDIX A
Site Drawings



LOCALITY PLAN

LEGEND

- TEST BORE LOCATION
- GROUNDWATER MONITORING WELL
- SITE BOUNDARY

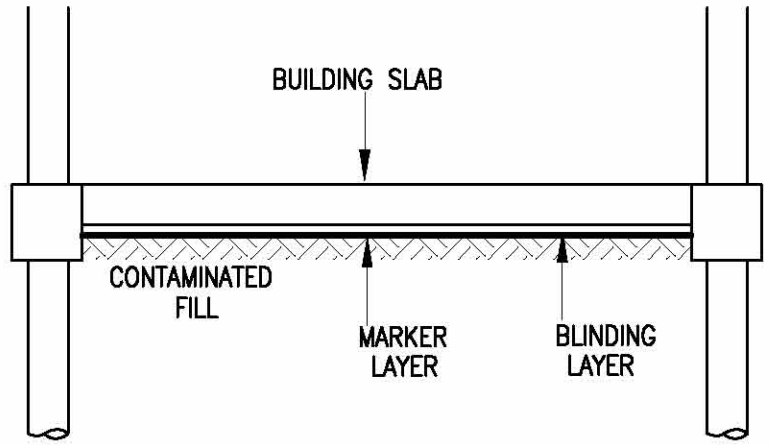
Douglas Partners
Geotechnics · Environment · Groundwater

CLIENT: Hutchinson Builders		
DRAWN BY: PSCH	SCALE: As shown	OFFICE: Sydney
APPROVED BY:		DATE: 3.3.2009

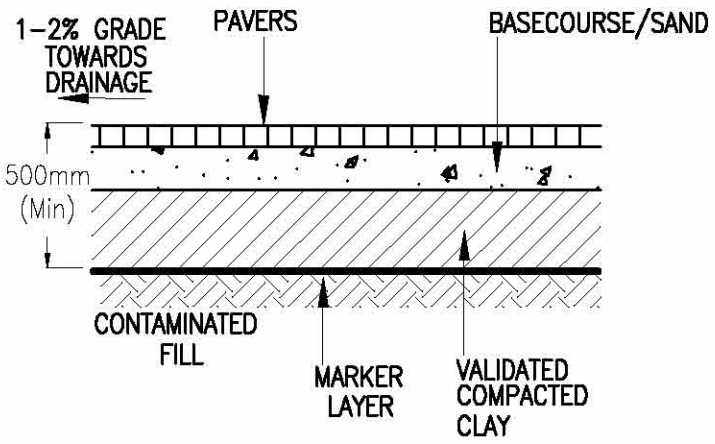
TITLE: **Location of Test Bores and Monitoring Wells**
Proposed Student Accomodation and Childcare Centre
Buckland Street, CHIPPENDALE

PROJECT No:	45996.01
DRAWING No:	1
REVISION:	A

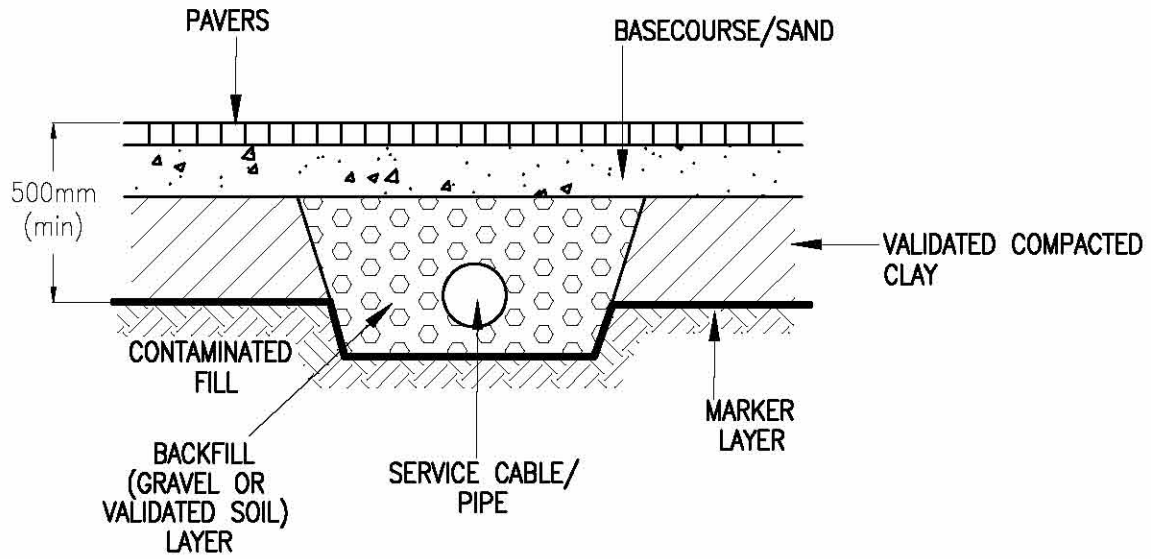
P:\45996.01 CHIPPENDALE, UTS - Blackfriars & Buckland Sts - Environmental PG\Drawings\45996.01-1.dwg, 3/4/2009 7:53:06 AM



BUILDING SLAB

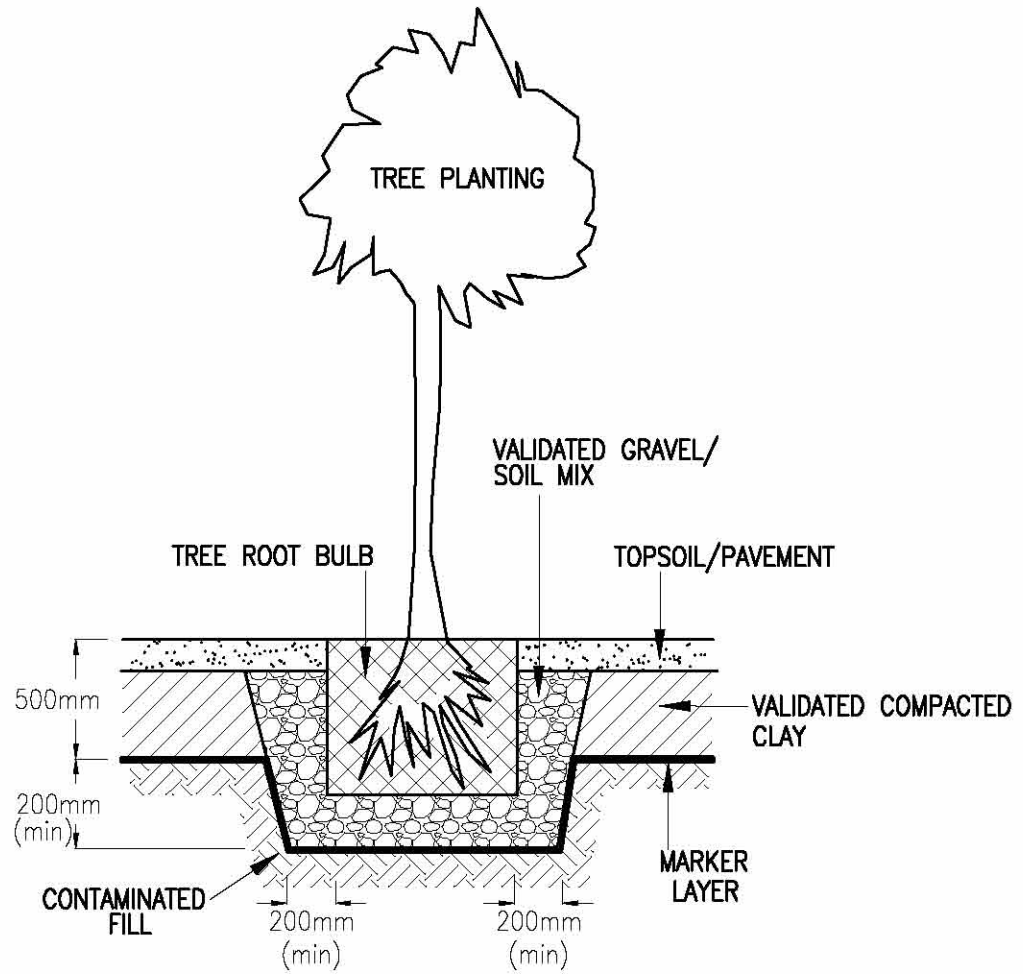


PAVING

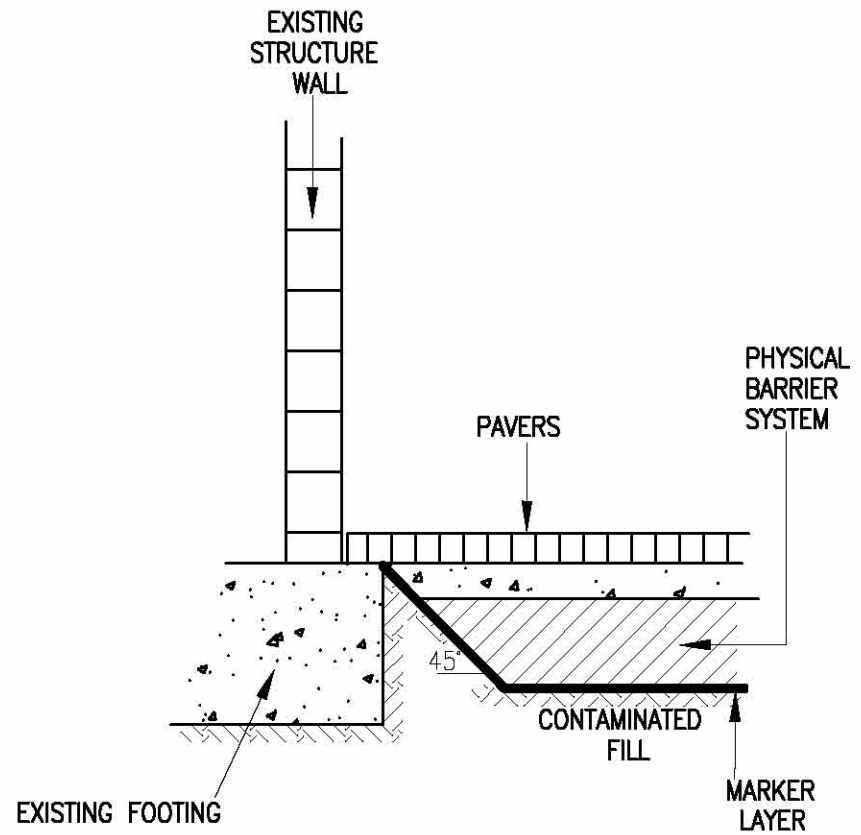


SERVICE LINE

GENERAL LANDSCAPING



NEW TREE PLANTING
(Refer to Context plans for more detail)



EXCAVATIONS ADJACENT TO EXISTING STRUCTURES

Douglas Partners
Geotechnics · Environment · Groundwater

CLIENT: Hutchinson Builders		
DRAWN BY: PSCH	SCALE: N.T.S.	OFFICE: Sydney
APPROVED BY:		DATE: 6.3.2009

TITLE: **Barrier System Details**
UTS Blackfriars Campus
CHIPPENDALE

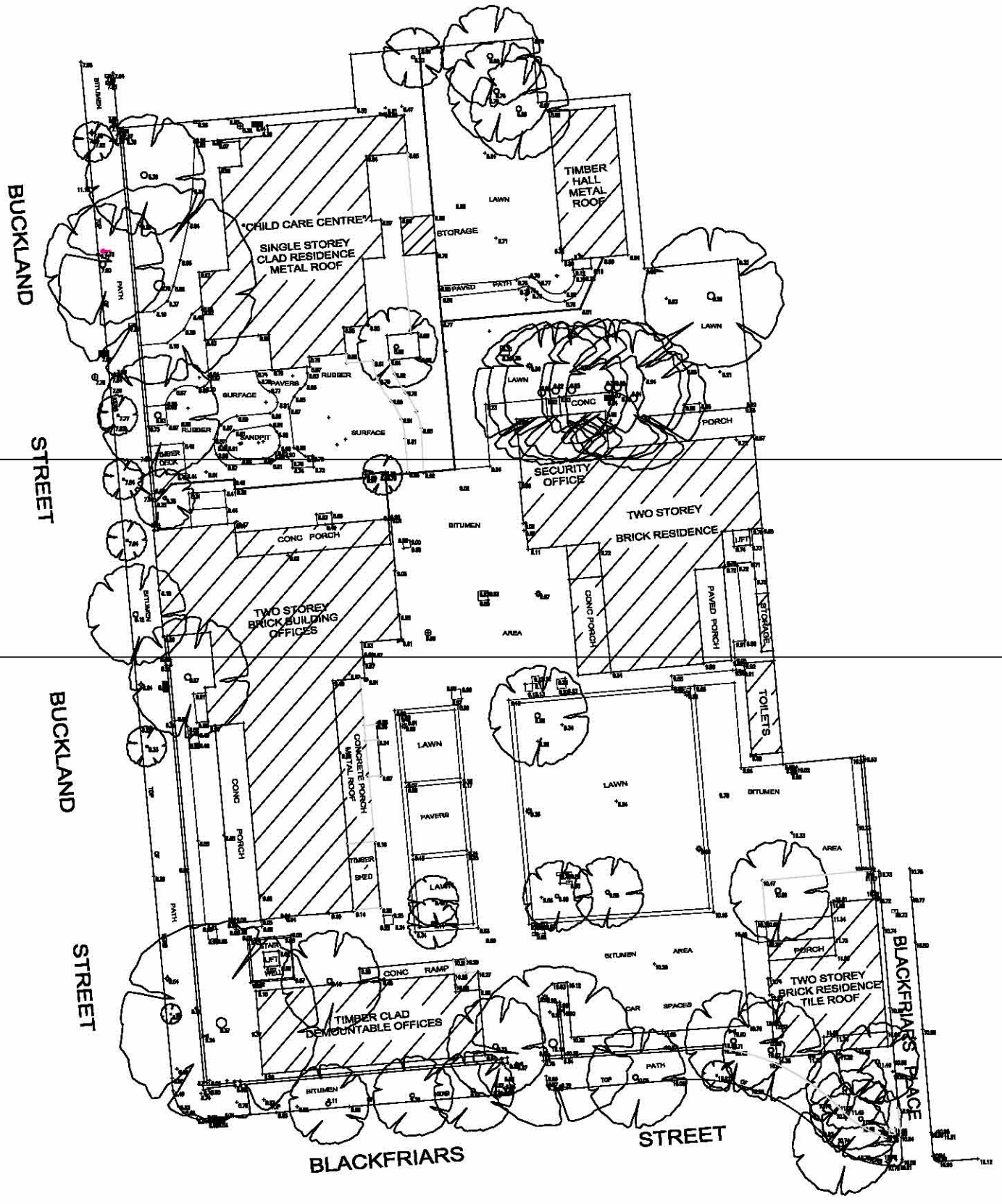
PROJECT No:	45996.02
DRAWING No:	2
REVISION:	A

P:\45996.02 CHIPPENDALE, Remedial Action Plan PGI\Drawings\45996.02-2.dwg, 3/11/2009 7:49:41 AM

PRELIMINARY

LEGEND

- ELECTRICITY PIT
- ELECTRICITY POLE WITH LIGHT
- ELECTRICITY POLE
- GAS VALVE
- HYDRANT
- LIGHT POLE
- MANHOLE (UNSPECIFIED)
- POLE (UNSPECIFIED)
- PIT (UNSPECIFIED)
- SEWER PIT
- SEWER MANHOLE
- STOP VALVE
- STORMWATER GRATE
- STORMWATER MANHOLE
- STORMWATER PIT
- TELECOM PIT
- TELECOM PILLAR
- TRAFFIC SIGNAL
- WATER VALVE
- E —— UNDERGROUND ELECTRICITY
- G —— UNDERGROUND GAS
- E —— OVERHEAD POWER LINES
- S —— UNDERGROUND SEWER
- UNDERGROUND STORMWATER
- W —— UNDERGROUND WATER
- T —— UNDERGROUND TELECOMMUNICATIONS



PRELIMINARY

LEGEND

- ELECTRICITY PIT
- ELECTRICITY POLE WITH LIGHT
- ELECTRICITY POLE
- GAS VALVE
- HYDRANT
- LIGHT POLE
- MANHOLE (UNSPECIFIED)
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- TELECOM PIT
- TELECOM PILLAR
- TRAFFIC SIGNAL
- WATER VALVE
- E —— UNDERGROUND ELECTRICITY
- G —— UNDERGROUND GAS
- E —— OVERHEAD POWER LINES
- S —— UNDERGROUND SEWER
- UNDERGROUND STORMWATER
- W —— UNDERGROUND WATER
- T —— UNDERGROUND TELECOMMUNICATIONS

NOTES:

LOCALITY

L.G.A.

CAD REFERENCE –

REFERENCE No.	PLAN No.	DATE	SHEET No. –
72875	72875.DGN	28/09/2007	OF – SHEETS

REV.	DATE	AMENDMENTS

RYGATE & COMPANY PTY. LIMITED

SURVEYORS, TOWN PLANNERS
ROAD & DRAINAGE ENGINEERS
81 YORK STREET, SYDNEY 2000

PHONE 9262 6900 ABN 81 001 204897 www.rygate.com.au
FAX 9262 6843 Email: surveyors@rygate.com.au

SURVEYOR	DRAWN	CHECKED	APPROVED
SF	SC		

0 20
REDUCTION RATIO 1:200 @ A1

DATUM : AUSTRALIAN HEIGHT DATUM
CONTOUR INTERVAL :
ORIGIN OF LEVELS : P.M.109010 R.L.6.615 A.H.D

THIS TITLE BLOCK AND NOTES FORM AN INTEGRAL PART OF THE PLAN AND MUST BE REPRODUCED IN ANY USE, DUPLICATION OR AMENDMENT.

CLIENT
UNIVERSITY OF TECHNOLOGY SYDNEY

LOCALITY
CHIPPENDALE

L.G.A.
SYDNEY

PLAN
SHOWING DETAIL & LEVELS
BLACKFRIARS CAMPUS

APPENDIX B
Proposed Development Drawings

MIXED USE

GRAFTON LANE

BUCKLAND HOUSE

GRAFTON STREET

CARWASH

BACKPACKER ACCOMMODATION

ST.BENEDICTS CHURCH

BOUNDARY

SECURED ENTRY GATE

BIKE RACKS

PROPOSED BUILDING 3

PLANT

BIN ENCLOSURE

NOTRE DAME UNIVERSITY

EXISTING BUIDING 5

EXISTING BUILDING 7

BUCKLAND STREET

RESIDENTIAL APARTMENTS

CHILD CARE OUTDOOR PLAY AREA

PROPOSED NEW ADDITION

EXISTING BUIDING 7 CHILDCARE

PROPOSED BUILDING 1

BLACKFRIARS STREET

ABERCROMBIE STREET

FUTURE CUB DEVELOPMENT

Client

University of Technology, Sydney

Project

student accommodation blackfriars

proposed alterations and additions

Ground Floor Site Plan

1:250 @ A1

March 2009

3532_DA004 – P7

context
52-58 William Street East Sydney NSW 2011
PO Box A866 Sydney South NSW 1235
T. 8244 8900 F. 8244 8988 E. context@context.net.au

Scale: 1:250 @ A1

Dwg Ref No: LSK 08573 - 002
Date: 9th Feb, 2009
Client: Hutchinson Builders

Landscape Concept Plan

UTS Blackfriars Student Accommodation

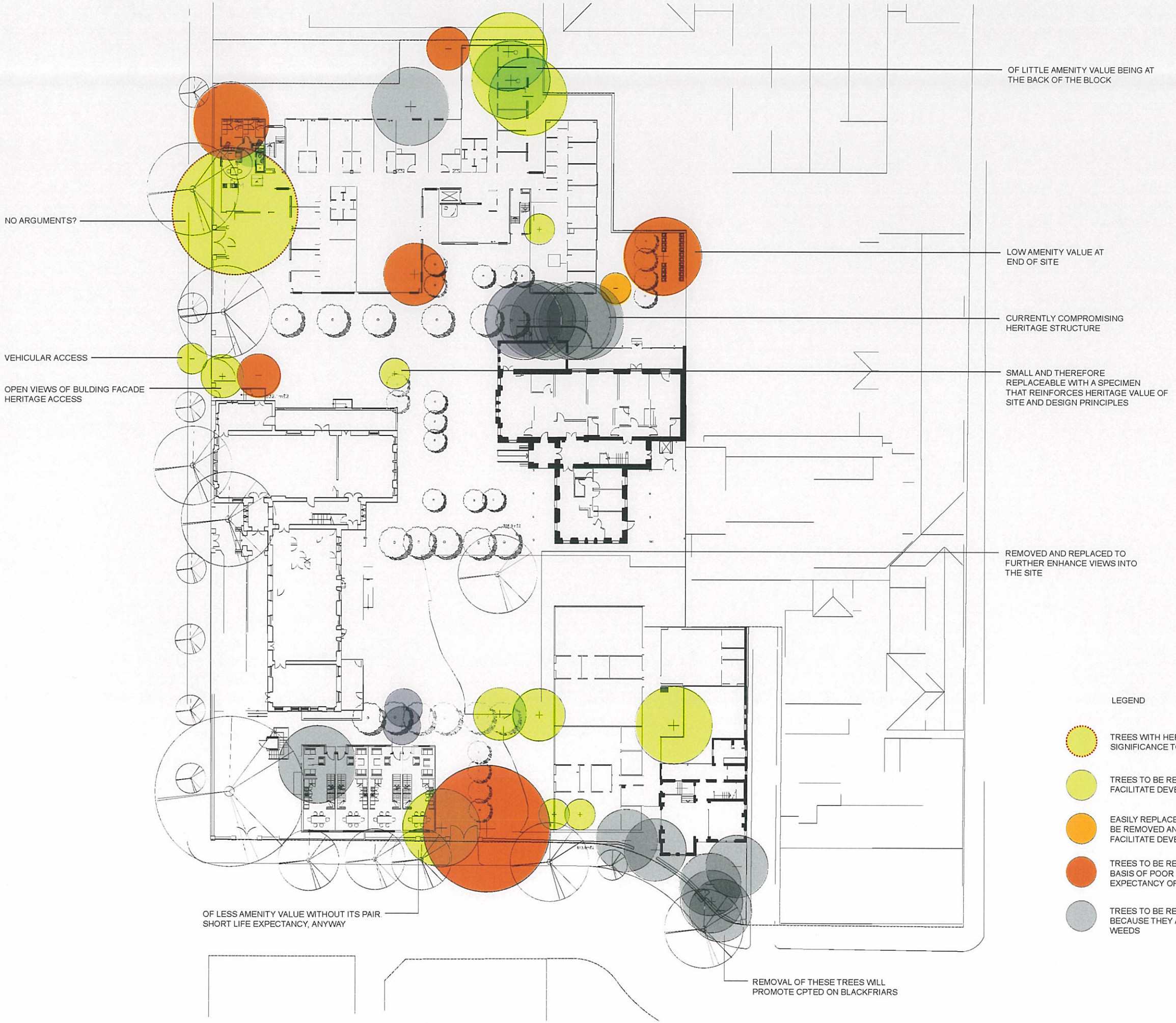
context
52-58 William Street East Sydney NSW 2011
PO Box A866 Sydney South NSW 1235
T. 8244 8900 F. 8244 8988 E. context@context.net.au

0 10m
Scale: 1:500 @ A3

Dwg Ref No: LSK 08573 - 004 - A
Date: February, 2009
Client: Hutchinson Builders

Trees to Retain/Remove/Replace

UTS Blackfriars Student Accommodation



context
52-58 William Street East Sydney NSW 2011
PO Box A866 Sydney South NSW 1235
T. 8244 8900 F. 8244 8988 E. context@context.net.au

0 10m
Scale: 1:500 @ A3

Dwg Ref No: LSK 08573 - 005
Date: February, 2008
Client: Hutchinson Builders

Analysis: Trees to be Removed

UTS Blackfriars Student Accommodation