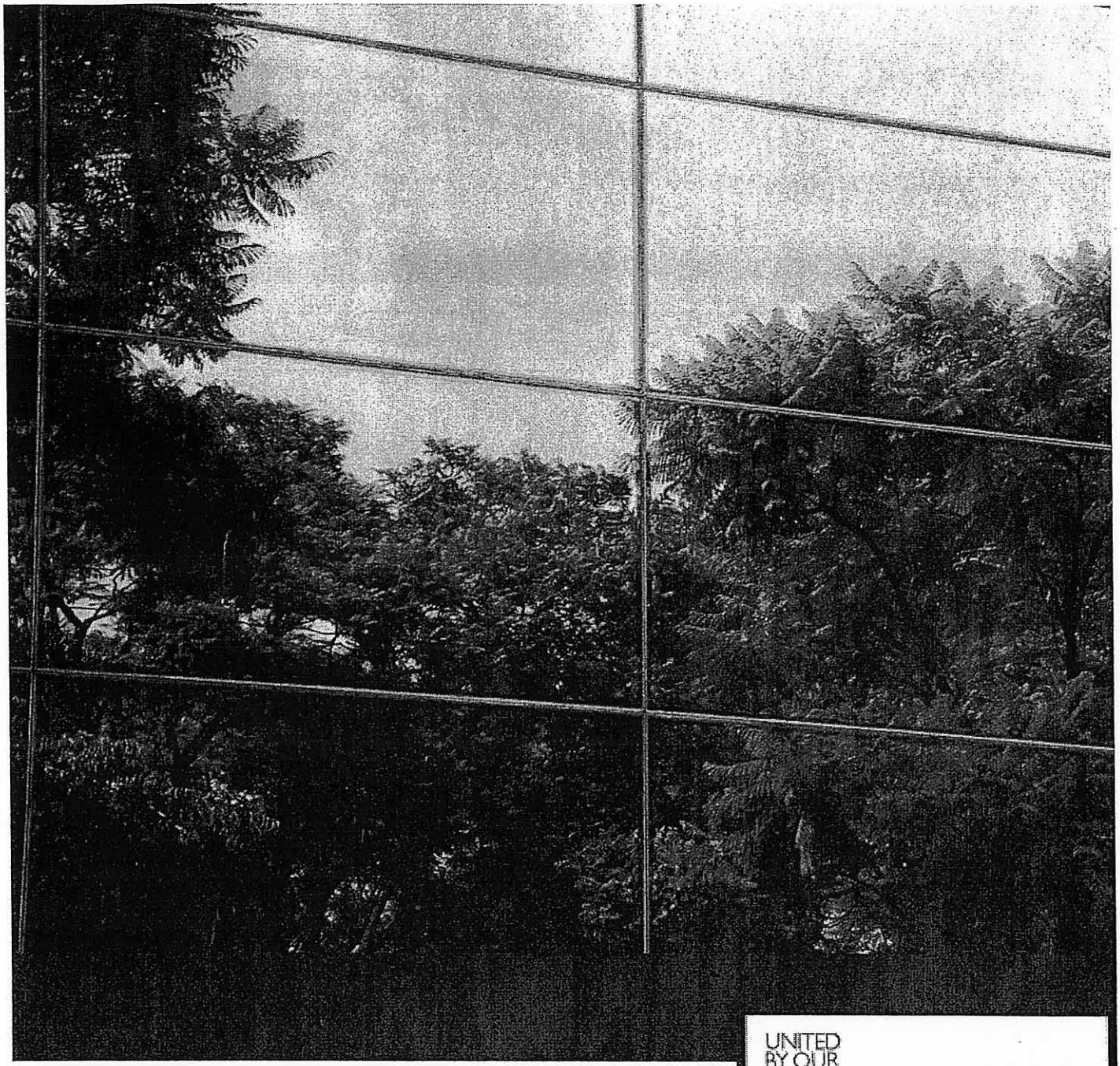

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WSP

PHASE 1 & 2 ENVIRONMENTAL SITE INVESTIGATION

1-13 Grey Street & 32-46 Silverwater Road, Silverwater, NSW

2/11/2012 Revised: _____

Quality Management

Issue/revision	Issue 1	Revision 1	Revision 2
Remarks	Draft for Issue		
Date	2 November 2012		
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Signature			
Checked by	Peter Moore		
Signature			
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Signature			
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Phase 1 & 2 Environmental Site Investigation

1-13 Grey Street & 32-46 Silverwater Road, Silverwater, NSW

2/11/2012

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List of Abbreviations

ANZECC	Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)
bgl	Below ground level
BaP	Benzo a pyrene
BTEX	Benzene, toluene, ethyl benzene and xylene
COC	Chain of custody
COPC	Contaminants of potential concern
DO	Dissolved oxygen
DQI	Data quality indicators
DQO	Data quality objectives
DSI	Stage 2 Detailed Site Investigation as defined in NSW OEH (2011)
EC	Electrical conductivity
HIL	Health-based investigation levels for varying land uses as defined in Appendix II of NSW DEC (2006). Including HIL A (residential with access to gardens), HIL D (residential with minimal soil access), HIL E (parks, playing fields, open space) and HIL F (commercial / industrial)
LoP	Limit of protection as defined under ANZECC (2000)
M8	Eight heavy metals including arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc
NAPL	Non aqueous phase liquid
NSW EPA	Over the past few years the environmental regulatory body has undergone a number of name changes, including: Department of Environment and Conservation (DEC); Department of Environment and Climate Change (DECC); Department of Environment, Climate Change and Water (DECCW); and, Office of Environment and Heritage (OEH). For the purpose of currency, the organisation is referred to as NSW EPA in this report. EPA guidelines are referenced by the name of the organisation at the time of publication.
OCP	Organo chlorine pesticides
OPP	Organo phosphate pesticides
ORP	Oxygen reducing potential
PAH	Polycyclic aromatic hydrocarbons
pH	Unit of measurement for acidity and alkalinity
PID	Photo ionisation detector
PSI	Stage 1 Preliminary Site Investigation as defined in NSW OEH (2011)
PVC	Poly vinyl chloride
QA/QC	Quality assurance / quality control
RAP	Remedial Action Plan as defined in NSW OEH (2011)
RPD	Relative percentage difference
SAP	Sampling and Analysis Plan
SAQP	Sampling Analysis and Quality Plan
SVOC	Semi volatile organic compounds
TCLP	Toxicity criteria leaching potential (laboratory extraction technique)
TPH	Total petroleum hydrocarbons (C10 to C36)
UCL	Upper confidence limit
USCS	Unified soil classification system
VOC	Volatile organic compounds
vTPH	Volatile total petroleum hydrocarbons (C6 to C9)
WSP	WSP Environmental Pty Limited trading as WSP Environment & Energy

Executive Summary

WSP was engaged by Price Waterhouse Coopers, receivers and managers for Finhaven Pty Ltd, to conduct a Phase 1 and 2 Environmental Site Assessment (ESA) to facilitate divestment of the properties located at 1-13 Grey Street and 32-46 Silverwater Road, Silverwater, NSW (the site) (see Figures 1 and 2 in **Appendix A**).

The site consists of thirteen properties and comprises approximately 7,000m^2 of land bounded by Grey Street, Carnarvon Street, Silverwater Road and Bligh Street. The site currently comprises a vacated dry cleaning premises and 12 vacated residential properties.

The key objective of the ESA was to assess the nature and extent of contamination in soil and groundwater at the site and determine its suitability for ongoing commercial landuse.

The scope of works described in this ESA report include completion of a desktop review of historical aerial photographs and publically accessible electronic environmental databases, installation of eighteen soil sampling bores to a maximum depth of 3m and extension of four boreholes to a maximum of 10m bgl to facilitate the installation of groundwater monitoring wells. Soil samples were collected from soil strata at each borehole location and analysis of selected soil and groundwater samples by a NATA registered laboratory. Analytical results for soil and groundwater were assessed against analysis against NSW EPA endorsed criteria for commercial / industrial land use.

The main conclusions of the investigations were as follows:

- The site is underlain by the Blacktown Landscape which is characterised by podzolic soils. These soils are limited by moderately reactive highly plastic subsoil, low soil fertility and poor soil drainage.
- The site is located in an area underlain by Ashfield Shale of the Wianamatta Group comprising black to dark grey shale and laminate.
- Acid sulfate soils are not expected to occur in this environment.
- Based on a review of historical aerial photographs, the property at 32-36 Silverwater Road has undergone several redevelopments and the current property configuration has existed since prior to 1961. Between 1930 and 2012, site changes predominantly involved the redevelopments of 32-36 Silverwater Road, and the erection of additional residential dwellings on Grey Street and Silverwater Road.
- Industrial processes have previously been conducted at 32-36 Silverwater Rd. A dry cleaning business was operated at the property.
- Three ASTs and an elevated drum storage area were identified within and adjacent to the eastern building at 32-36 Silverwater Road. Packaged liquid chemicals were observed to be stored in a bund area adjacent the Bligh St site access driveway and in the western warehouse in various containers and drums. The identified packaged chemicals were likely associated with the former dry cleaning activities. The chemicals included tetrachloroethene (PCE) which is a chlorinated solvent.
- According to the EPA's Contaminated Land Management (CLM) public register there were no prevention, clean-up or prohibition notices for the site.
- The soil profile comprised gravelly sand and clay fill material to a maximum depth of 1.3m bgl (BH10), underlain by natural clays and shales. Some black staining and a hydrocarbon odour were observed at BH7 and some black staining was observed at and a discrete piece of ash material was observed near surface at BH12. No other visual or olfactory signs of contamination were observed.
- The results of the analysis for soils are below either the adopted commercial / industrial (HIL-F) site criteria or laboratory detection limits;
- With the exception of the concentration of lead in sample BH6 (0.2m), analytical results were reported below HIL-A residential criteria.
- Following a survey of the newly installed groundwater wells, relative groundwater levels were calculated, contours were mapped, and the inferred GW flow direction was generally to the west and north-west, with

some groundwater flow in the south east portion of the site identified to be occurring in a southerly direction. (See Figure 5, **Appendix B**). No rate of flow information is available.

- Groundwater collected from monitoring well MW03 was impacted by tetrachlorethene PCE (a chlorinated solvent) at a concentration exceeding the adopted site criteria. Other volatile hydrocarbons were also detected at MW03.
- No other groundwater wells are impacted with PCE.
- Metals concentrations in groundwater exceeded the selected ANZECC (2000) Water Quality criteria, however, this is considered to represent background levels.

WSP considers that the site is suitable for on-going commercial / industrial land use with the following recommended works:

- Delineate the extent of chlorinated solvent and hydrocarbon contamination in groundwater down gradient and in the vicinity of MW03.

1 Introduction

1.1 Background

WSP was engaged by Price Waterhouse Coopers, receivers and managers for Finhaven Pty Ltd, to conduct a Phase 1 and 2 Environmental Site Assessment (ESA) to facilitate divestment of the properties located at 1-13 Grey Street and 32-46 Silverwater Road, Silverwater, NSW (the site) (see Figures 1 and 2 in **Appendix A**).

The site consists of thirteen properties and comprises approximately 7,000m^2 of land bounded by Grey Street, Carnarvon Street, Silverwater Road and Bligh Street. The site currently comprises a vacated dry cleaning premises and 12 vacated residential properties.

This report documents the scope and findings from the combined Phase 1 and Phase 2 assessment.

1.2 Objectives

The key objective of the ESA was to assess the nature and extent of contamination in soil and groundwater at the site and determine its suitability for ongoing commercial landuse, as the current zoning permits.

The environmental site assessment aimed to:

- Investigate historical land use at the site;
- Assess the likely nature and extent of soil and groundwater contamination at the site by conducting intrusive soil and groundwater investigations on site;
- Assess the site suitability for potential future residential landuse; and,
- Recommend management or remediation works (if required) to allow the site to be used for the permitted commercial land use.

1.3 Scope of Works

The scope of works described in this ESA report included the following:

- Completion of a desktop review of historical aerial photographs and publically accessible electronic environmental databases to assist with determining the environmental setting and contamination potential of the site;
- Preparation of Occupational Health and Safety documentation for the site intrusive works;
- A site inspection prior to commencing works;
- Dial B4 U Dig searches were obtained, reviewed and copies provided to the service location contractor;
- A suitably qualified service location contractor was engaged to clear the proposed exploratory hole positions and complete coring of hardstand at several selected investigation locations;
- Installation of eighteen soil sampling bores to a maximum depth of 3m below ground level (bgl);
- Extension of four boreholes to a maximum of 10m bgl to facilitate the installation of groundwater monitoring wells;
- Collection of samples from soil strata at each borehole location;

- Development of groundwater wells to remove drilling sediments and to ensure good connectivity with the targeted aquifer;
- Analysis of selected soil samples by a NATA registered laboratory for asbestos, heavy metals (M8), total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), volatile organic compounds (VOCs) and organochlorine pesticides (OCPs);
- Collection of groundwater samples from the four newly installed groundwater monitoring wells and analysis of the samples by a NATA registered laboratory for heavy metals (M8), TPH, PAHs and VOCs;
- Undertaking of field and laboratory QA/QC procedures in compliance with National Environmental Protection Council (1999) requirements;
- Comparison of results for soil and groundwater analysis against NSW EPA endorsed criteria; and,
- Preparation of a combined Phase 1 and 2 Detailed Site Investigation report in accordance with the NSW OEH (2011) Guidelines for Consultants Reporting on Contaminated Land.

2 Site Condition and Surrounding Environment

2.1 Site Identification

The site is located approximately 18km west of Sydney CBD, as shown on Figure 1 in **Appendix A**. Site identification details are summarised in Table 1 below:

Table 1 Site Identification Details

Street Address:	1-13 Grey Street & 32-46 Silverwater Road, Silverwater, NSW	
Property Description:	**1-13 Grey Street**	**32-46 Silverwater Road**
	1 Grey St, Lot 18 DP 77341	32 Silverwater Rd, Lots 1 and 2 DP 1110059
	3 Grey St, Lot 17 5 DP 979426	38 Silverwater Rd, Lot 1 DP 90071
	5 Grey St, Lot 16 5 DP 979426	40 Silverwater Rd, Lot 5 DP 89550
	7 Grey St, Lot 15 5 DP 979426	42 Silverwater Rd, Lot 6 DP 89550
	9 Grey St, Lot 14 5 DP 979426	44 Silverwater Rd, Lot 7 DP 89550
	11 Grey St, Lot 13 5 DP75209	46 Silverwater Rd, Lot 8 5 DP 979426
	13 Grey St, Lot 12 DP 76894	
Current Site Ownership	Finhaven Pty Ltd	
Current Land Use	The site currently comprises a vacated dry cleaning premises and 12 vacated residential properties.	
Geographical Coordinates (to approximate centre of site)	Easting: 319136 Northing: 6253832	
Property Size:	Total area of approximately 7,000m^2	
Local Government Area:	Auburn City Council	
Zoning – Existing:	B6 – Enterprise Corridor (Auburn Local Environment Plan 2010).	

2.2 Site Condition

The following site condition details were observed by Graeme Malpass during a site walkover survey conducted on 11 October 2012 and by Aaron Young on 15, 16 and 22 October 2012 during the intrusive investigation works. A Photographic record has been provided in **Appendix B**.

Table 2 Site Condition Details

Topography and Drainage	■ The site generally slopes from the east to the west. However, the south-eastern portion of the site is generally level. ■ The south-eastern portion of the site comprises a non-operational vacated commercial dry cleaning premises with concrete and / or asphalt hardstanding comprising the entirety of the surface cover. ■ The remainder of the site comprises vacated residential properties with unkept and overgrown landscaped areas.
Boundary Conditions	■ The dry cleaning property was observed to be securely fenced. ■ 42 and 46 Silverwater Road were observed to be fenced with locked access gates.

	■ 1 Bligh St was accessible via a gate adjacent the locked driveway entrance. ■ The remaining properties were and remain accessible from Grey St, Bligh St or Silverwater Rd.
Visible Signs of Contamination, Drums, Wastes and Fill Materials	A photographic record has been provided in **Appendix B.** No visible staining was noted on surrounding ground surface, however, some anthropogenic rubbish was observed on the surface of some of the vacated residential properties and the dry cleaning premises in particular (including visible plastic, metal and wood). No other visible signs of contamination were observed at the residential properties. The following observations were noted at the former dry cleaning premises: ■ Two ASTs and an elevated drum storage area were identified in the eastern warehouse. ■ An AST was observed in southeast portion of the site adjacent to the eastern warehouse building. ■ No signs of USTs were observed. ■ Liquid chemicals were observed to be stored in a bund area adjacent to the Bligh St site access driveway and in the western warehouse in various containers and drums. Stored chemicals were identified to be associated with the former dry cleaning activities. The chemicals included tetrachloroethene or perchloroethylene (PCE). ■ Redundant equipment remained within the eastern warehouse. No spillage of stored packaged chemicals or contents from ASTs was observed. No visual evidence of potential contamination was noted within the buildings or the site. Fill materials were encountered at most investigation locations during the intrusive investigation to a maximum depth of 1.3m bgl (BH10). Encountered fill materials comprised gravelly sands and clays. Some black staining and a hydrocarbon odour were observed at BH7 between 0.14m and 1.0m bgl. Some black staining was also observed at BH10 between 0.7 and 1.3m bgl. Light brown, homogeneous sand was encountered at BH11 to a depth of 0.7m bgl where refusal occurred. No visual or olfactory signs of contamination were noted, and it is considered likely that the material was backfill sand used to fill a serve trench. PID readings ranged between 0.0ppm and 1.0 ppm (BH1 - 0.5m).
Visible Signs of Plant Stress	No visible signs of plant stress were noted.
Odours	Hydrocarbon odours were observed in BH7 during the intrusive investigations. No odours were noted at other investigation locations during the investigations or site inspections.
Condition of Buildings & Roads	All buildings at the site have been vacated and are not inhabited. The residential properties were generally observed to be aged and in poor condition. The concrete and asphalt surfaced roads bounding the site were observed to be in good condition providing access to all properties comprising the site.
Quality of Surface Water	No surface water is present on site.
Flood Potential	No Information available.
Relevant Local Sensitive Environments	The nearest sensitive receptors are Duck River, located approximately 950m north-west of the site, and Haslams Creek, located approximately 950m east of the site. Both Duck River and Haslams Creek flow in a northerly direction to Parramatta River. Both of these receptors are marine systems.
Other Relevant Information	There are no registered heritage items at the site.

2.3 Surrounding Land Use

Based on the observations made during the site visit and intrusive investigation works conducted by WSP during October 2012, the surrounding land use can be summarised as follows:

Table 3 Surrounding Land Use

North	Carnarvon Street with commercial properties beyond.
East	Silverwater Road with commercial and residential properties beyond.
South	Residential properties, beyond which is Deakin Park and the M4 Motorway.
West	Grey Street and Residential Properties, beyond which is Hume park and a church. Further to the west lie more residential properties.

3 Site History

3.1 Summary of Historical Information

To assist with compilation of the history of the site, the following additional desktop searches were completed (provided in **Appendix C**):

- Historic aerial photographs;
- EPA records; and,
- Council records.

Results of enquiries conducted by WSP (see **Appendix C**) have been summarised and included in the following table.

Table 4 Summary of Historical Information

Summary of Council Records	A Section 149 Certificate was not to be undertaken as part of this investigation. No information regarding previous zoning was available from Council.
EPA Records	According to the EPA's Contaminated Land Management (CLM) public register there were no prevention, clean-up or prohibition notices for the site.
Current Land Use	The site comprises a vacated dry cleaning property and 12 vacated residential properties.
Summary of Aerial Photographs	WSP conducted a review of historic aerial photographs sourced from the NSW Department of Land and Property Information (provided in **Appendix C**). The 2012 aerial photograph was obtained from Near Maps. The review of aerial photography is summarised below. ■ In 1930 a large portion of the site was undeveloped. Residential dwellings occupied 3, 5 and 9 Grey Street and 38 Silverwater Road. Furthermore, 32-36 Silverwater Road was developed and was occupied by one building structure. The site was bounded by Grey Street, Carnarvon Street, Silverwater Road and Bligh Street. Beyond site boundaries, residential properties occupied adjacent properties in all directions. There were many vacant lots surrounding the site. ■ In 1943, the property at 32-36 Silverwater Road had been redeveloped, with two building structures observed. With the exception of above, the site and immediate surroundings remained unchanged from 1930. ■ In 1951 several properties located on Grey Street and Silverwater Road had been developed to accommodate residential dwellings. ■ In 1961, 32-36 Silverwater Road had again undergone redevelopment. Two large warehouse structures were observed to occupy the property. 13 Grey Street was occupied by a residential dwelling. Some commercial and residential properties were located to the north and east of the site. Residential properties occupied properties to the west and south. ■ In 1978, no changes to the site were observed. The commercial property located east of the site was redeveloped. The property previously comprised a large building structure with two residential properties and in 1978 comprised a larger building structure and associated car parking. ■ In 1991, no changes to the site were observed. The commercial properties to the north and the east of the site were observed to have been redeveloped and the M4 motorway was being constructed to the south. ■ In 2012, no changes to the site were observed, with the exception of the property

	located at the south western corner of Silverwater Road and Carnarvon Street which was observed to be undeveloped. This lot was previously occupied by a residential dwelling.
Chronological List of Site Uses	A Certificate of Title search was not undertaken as part of this investigation.
Summary of Historical Site Photos (where available)	No information available.
WorkCover Dangerous Goods Licenses & Inventory of Chemicals and Wastes and their Location	Due to limited time constraints for this project, a WorkCover search of the Stored Chemical Information Database was unable to be conducted.
Description of Manufacturing / Industrial Processes and Location	Industrial processes have previously been conducted at 32-36 Silverwater Rd. A dry cleaning business was operated at the property.
Product Spill and Loss History	No information available.
Discharges to Land, Air & Water	No information available.
Complaint History	No information available.
Sewer & Service Plans	Telstra and Sydney Water services are located at and / or beneath the site.
Local Site Knowledge	Client has not provided information relating to previous site usage.
Local Literature Review	A local literature review was not undertaken as part of this investigation as it was unlikely to provide any additional information on the historical use of the site and potential for contamination.
Permits, Licenses and Approvals	Not available.

3.2 Integrity Assessment

The sources of information referenced in Table 4 above were in general agreement. This degree of consistency suggests that the historical assessment described above has an appropriate level of accuracy necessary to achieve the objectives of this combined Phase 1 and Phase 2 report.

4 Geology and Hydrogeology

4.1 Summary of Geology and Hydrogeology Information

Table 5 Summary of Ground and Groundwater Conditions

Soil Map Conditions	Based on the 1:100,000 Sydney Soil Landscape Series Sheet 9130 (Third Edition), the site is underlain by the Blacktown Landscape. The Blacktown Landscape is characterised by shallow to moderately deep (<100cm) red and brown podzolic soils on crests, upper slopes and well drained areas and characterised by deep (150-300cm) yellow podzolic soils and Soloths on lower slopes and in areas of poor drainage. These soils are limited by moderately reactive highly plastic subsoil, low soil fertility and poor soil drainage.
Topography	Based on the NSW Department of Land and Property Information's interactive SIXViewer topographic map, the site has an approximate elevation of 10m AHD.
Geology Map Conditions	Based on the Sydney 1:100,000, Geological Series Sheet (9130), the site is located in an area underlain by Ashfield Shale of the Wianamatta Group (Triassic period) comprising black to dark grey shale and laminate.
Soil Classification Method	USCS
Acid Sulfate Soils	Based on the Prospect/Parramatta Acid Sulfate Risk Maps covering the site and surrounding areas, acid sulfate soils are not expected to occur in this environment.
Ground Conditions Summary from Borehole Records & Location of Fill Materials	Soil samples were collected from eighteen boreholes from across the site (refer to Figure 3, **Appendix A**). The soil profile generally comprised gravelly sand and clay fill material to a maximum depth of 1.3m bgl (BH10). Encountered fill materials were underlain by natural clays and shales. Some black staining and a hydrocarbon odour were observed at BH7 between 0.14 and 1.0m bgl. Also, some black staining was observed at BH10 between 0.7m bgl and 1.3m bgl and a discrete piece of ash material was observed near surface at BH12. No other visual or olfactory signs of contamination were observed. No potential ACM fragments were observed on the ground at the site.
Summary of Monitoring Wells & Depth to Groundwater	Four groundwater monitoring wells MW01, MW02, MW03 and MW04 were installed. Groundwater was encountered during drilling at MW01 and MW02 only at approximately 8.5m btoc (MW01) in shale layers. Perched groundwater was encountered at BH18 at 1m bgl. All groundwater wells contained water at the time of sampling. During groundwater sampling 1 week after installation of the groundwater wells, depth to groundwater was recorded between 2.33mbtoc (MW04) and 2.72mbtoc (MW02).
Direction and Rate of Groundwater Flow	Following a survey of the newly installed groundwater wells, relative groundwater levels were calculated, contours were mapped and the inferred GW flow direction was generally to the west and north west. No rate of flow information was available.
Uses of Water Abstraction	Two groundwater bores were identified within 1.5km of the subject site. GW100682, located 1.4km to the southwest, identified a standing water level of 6.77m bgl. GW102250, located 1.3km northeast, identified a standing water level of 0.25m bgl, natural clays at 1.8m bgl and shale bedrock at 6.5 m bgl. Copies of the bore map and groundwater works reports are provided in **Appendix C**.
Nearest Water Body	The nearest surface water bodies are Duck River, located approximately 950m north-west of the site, and Haslams Creek, located approximately 950m east of the site. Both Duck River and Haslams Creek flow into the Parramatta River.

Direction of Surface Water Run Off	Across the majority of the site, it is likely that rainwater would infiltrate the surface of the site. At the dry cleaning property surface run off would follow the topography in a southerly direction towards Bligh Street.
Background Water Quality	No information was available.

4.2 Integrity Assessment

The sources of information referenced in Table 5 above were in general agreement. This degree of consistency suggests that the geological, hydrology and hydrogeological summary described above has an appropriate level of accuracy necessary to achieve the objectives of this combined Phase 1 and Phase 2 report.

5 Conceptual Site Model

5.1 Potential Sources of Contamination

Based on the summary of historical information detailed in Section 3 above, and observations made during the site inspection, the following potential sources of contamination have been identified:

Table 6 Potential Sources of Contamination

Source No.	Potential Sources of Contamination	Contaminants of Potential Concern
1	Uncontrolled fill materials	TPH, vTPH, BTEX, PAHs, M8, Asbestos, OCPs
2	Dry Cleaning Premises – use of cleaning agents / liquids.	TPH, vTPH, BTEX, PAHs, VOCs, M8, Asbestos, OCPs
3	ACM fragments on site surface	Asbestos
4	Above Ground Storage Tanks (ASTs)	TPH, BTEX, PAHs, Lead, VOCs
5	Bund Area – Chemical Storage	TPH, VOCs, PAHs

5.2 Potential Migration Pathways

The potential for contaminants to migrate off site is a combination of:

- The nature of the contaminants (i.e. solid / liquid and mobility characteristics)
- The extent of the contaminants (i.e. isolated or widespread)
- The location of the contaminants (i.e. on the site surface or at depth)
- The topography, geology, hydrology and hydrogeology at the site

Based on the information available to date, it is considered that the following potential off site migration pathways may exist for the potential sources of contamination detailed in Section 5.1 above:

- The topographical gradient and hardstand surface cover at the dry cleaning premises allows for the potential surface water migration of contaminants from sources 2, 4 and 5 from the site to the stormwater network on Bligh Street.
- There is potential for contaminants from sources 1, 2, 4 and 5 to percolate through the soil profile and migrate with the underlying aquifer.

5.3 Potential Exposure Pathways

The exposure pathways considered to be potentially complete include the following:

- Inhalation, ingestion and / or dermal contact of contaminants from Sources 1, 2, 3, 4 and 5.
- Inhalation of volatile contaminants from Sources 2 and 5.
- Ingestion or dermal contact with impacted groundwater resulting from Source 2, 4 or 5.
- Ingestion or dermal contact with impacted groundwater resulting from surface water infiltration and leaching from Source 1

5.4 Potential Receptors

Potential receptors of COPC that may be present at the site could include the following:

- Future Site users and visitors.
- Current and future Site neighbours and visitors.
- Construction workers.
- Groundwater flow direction is towards Duck River (950m north-west from Site). Duck River flows in a northerly direction to Parramatta River.
- Surface water flow to Bligh Street and Grey Street and enter the stormwater drainage network.

6 Sampling Analysis and Quality Plan

6.1 Data Quality Objectives

The DQO process is a systematic planning tool based on the scientific method for establishing criteria for data quality and for developing data collection designs. The DQO defines the experimental process required to test a hypothesis.

The DQO process has been developed to ensure that efforts relating to data collection are cost effective, by eliminating unnecessary, duplicative or overly precise data whilst at the same time, ensuring the data collected is of sufficient quality and quantity to support defensible decision making.

It is recognised that the most efficient way to accomplish these goals is to establish criteria for defensible decision making before data collection begins and develop a data collection design based on these criteria. By using the DQO process to plan the investigation effort, the relevant parties can improve the effectiveness, efficiency and defensibility of a decision in a resource and cost effective manner.

6.1.1Guidance Documents

DQO have been developed to detail the type of data that is needed to meet the overall objectives of this project (refer to Section 1.2). The DQO have been developed in general accordance with procedures stated in the guidelines presented in Section 12 of this report.

6.1.2Process for DQO Development

The DQO process consists of seven steps, which are designed to clarify the study objectives, define the appropriate type of data and specify tolerable levels of potential decision errors. The seven-step DQO process that is to be adopted for the works is as follows:

- Step 1 – Defining the Problem. The first step in the DQO process is to 'define the problem' that has initiated the investigation
- Step 2 – Identify the Decision. The second step in the process is to define the decision statement that the study will attempt to resolve
- Step 3 – Identify Inputs to the Decision. In this step, the different types of information needed to resolve the decision statement are identified
- Step 4 – Define the Study Boundaries
- Step 5 – Develop a Decision Rule
- Step 6 – Specify Limits on Decision Errors
- Step 7 – Optimise the Design for obtaining the Data

6.1.3 Step 1 – Defining the Problem

6.1.3.1 Concise Description of the Problem

The potential sources of contamination (Section 5.1) required assessment to determine the actual presence of contamination and suitability of the site for the proposed continued commercial land use.

6.1.3.2 Planning Team Members and Decision Maker

The project was commissioned by Price Waterhouse Coopers, who was the ultimate decision maker for this project. The WSP team included:

WSP Project Director:	Stephen Barnett
WSP Project Manager:	Peter Moore
WSP Project Scientist:	Aaron Young

6.1.3.3 Summary of Available Resources, Constraints and Relevant Deadlines

The project team above were assigned to conduct the Phase 1 and Phase 2 works based on familiarity with Price Waterhouse Coopers' requirements and relevant project experience.

The interior of the warehouses at the dry cleaning property could not be accessed with the drill rig due to the presence of physical structures including hanging racks and structural support pillars.

The site inspection was conducted on 11 October 2012 and fieldwork was conducted on 15, 16 and 22 October 2012.

6.1.4 Step 2 – Identify the Decision

6.1.4.1 Decision Statement Linking the Principal Study Question to Possible Actions that will Solve the Problem

Based on the decision making process for assessing urban redevelopment sites detailed in Appendix I of DEC (2006) and modified to relate to the specific redevelopment requirements for this DSI report, the following decisions were required to be made:

- Do the soils at the site exceed the adopted site assessment criteria detailed in Appendix II of DEC (2006)?
- If soils are surplus to site requirements, what category of waste do they fall into?
- Are there any issues relating to the local background area soil concentrations that exceed the adopted site criteria?
- Are there any aesthetic issues relating to the soils at the site?
- Are there any impacts of chemical mixtures?
- Is there evidence of, or the potential for, migration of contaminants from the site?
- Is any management or remediation required to render the site suitable for the current and / or future land use?
- "Does any contamination at the subject site occur at concentrations that pose an unacceptable liability or risk to the environment and / or human health (including any potential for off-site migration of contaminants) under commercial / industrial landuse?"

6.1.4.2 What is the Alternative Action

Do nothing – not acceptable, as the site is required to be characterised to answer the study questions above.

6.1.5 Step 3 – Identification of Inputs into the Decision

6.1.5.1 List of Informational Inputs Needed to Resolve the Decision Statement

Key data required to resolve the project problem included concentrations of contaminants of concern in soil and groundwater collected in the study area, the pathways for contaminant movement (underlying geological and hydrogeological conditions) and the location of sensitive receptors.

The results of QA/QC sampling and analysis assisted in determining whether the data collected as part of the Environmental Assessment was of an acceptable quality for comparison against the adopted assessment criteria.

6.1.5.2 Identification of the Media to be Assessed

The media to be sampled as part of these works will be underlying fill or natural soil horizons encountered in the upper 3m of the subsurface soil profile, and groundwater from the underlying shallow aquifer.

6.1.5.3 List of Environmental Variables or Characteristics that will be Measured

The contaminants of concern identified were based on the review of historical and current land uses, data and observations on site condition and operations as identified in the site walkover, as well as WSP's experience of completing projects of a similar nature.

Proposed Sampling and Analytical Schedule

Media	Sampling Method(s)	Proposed maximum sampling depth (m)	Number of Sampling Locations	No. Samples for Analysis
Soil	Drill Rig/ auger	3.0m	17	Heavy Metals – 17 plus 2 QA PAHs – 10 plus 2 QA TPH – 10 plus 2 QA Volatile Organic Compounds (VOCs) – 10 Plus 2 QA OCPs (Pesticides) – 17 surface samples plus 2 QA Asbestos – 17 surface samples only
Ground water	Drill Rig	6.0m	4	Heavy metals – 4 plus 2 QA VOCs – 4 plus 3 QA TPH – 4 plus 2 QA PAHs – 4 plus 2 QA

6.1.5.4 Identification of Site Criteria for Each Medium of Concern

Soil guidelines were selected on the basis of the current commercial zoning and proposed continuation of commercial landuse.

The following criteria have been adopted to assess potential human health and ecological risks:

- National Environment Protection Measure (1999) HIL – F (commercial / industrial); and,

- The NSW EPA (1994) Guidelines for Assessing Service Station Sites for BTEX and TPH in soil.

Furthermore, the National Environment Protection Measure (1999) HIL A (residential) soil guidelines were selected to assess results against residential land use for existing use rights.

In determining the most appropriate groundwater guideline values, consideration was given to Appendix 2 of the NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination as outlined in Table 4.1. As such, the following criteria have been adopted to assess potential human health and ecological risks:

- ANZECC (2000) Australian and New Zealand Guidelines for Marine Water Quality (95% Protection Levels); and,
- The National Environment Protection (Assessment of Site Contamination) Measure (1999) Schedule B(1) Groundwater Investigation Levels, Aquatic Ecosystems, Marine Waters given that the nearest receptors for groundwater in a westerly or north westerly direction are Duck River and / or Parramatta River which are both marine systems.

In the absence of relevant state and national guidance for TPH and some VOCs (BTEX) in groundwater, the following guidelines were adopted:

- NSW EPA (1994) Contaminated Sites: Guidelines for Assessing Service Station Sites;
- ANZECC (2000) Australian and New Zealand Guidelines for Fresh Water Quality (95% Protection Levels).

The site criteria to be adopted for this study are presented in the following tables below:

Table 7 Soil Criteria based on NSW DEC (2006) Guidelines for NSW Site Auditor Scheme

Contaminant	HIL F (mg/kg)	HIL A (mg/kg)	NSW EPA (1994) (mg/kg)
Metals			
Arsenic	**500**	100	
Cadmium	**100**	20	
Chromium (VI)	**500**	100	
Copper	**5,000**	1,000	
Lead	**1,500**	300	
Mercury	**75**	15	
Nickel	**3,000**	600	
Zinc	**35,000**	7,000	
PAHs			
PAH (total)	**100**	20	
BaP	**5**	1	
TPH			
VTPH (C6-C9)			**65**
TPH (C10-C36)			**1000**
BTEX			
Benzene			**1**
Toluene			**1.4**
Ethyl benzene			**3.1**
Xylene			**14**
VOCs	Not presented as all analytical results for VOCs were reported below the laboratory detection limits.		
OCPs	Not presented as all analytical results for VOCs were reported below the laboratory detection limits.		
Asbestos	No NSW guideline. The detection limit of the test has been adopted (0.1g/kg)		

Table 8 Water Criteria based on ANZECC (2000) Guidelines for Marine Water Quality

Contaminant	ANZECC 2000 Marine Water 95% LoP (µg/L)	EPA 1994 (µg/L)
Metals		
Arsenic	**13***	
Cadmium	**5.5**	
Chromium (VI)	**4.4**	
Copper	**1.3**	
Lead	**4.4**	
Mercury	**0.1 (99% LoP)**	
Nickel	**70**	
Zinc	**15**	
PAHs		
PAH (total)		**3**
BaP	ns	ns
TPH		
vTPH (C_{6-9})	ns	ns
TPH (C_{10-36})	ns	ns
BTEX		
Benzene	**700**	
Toluene		**300**
Ethyl benzene		**140**
Xylene (o + p)	**550***	
VOCs		
Tetrachloroethene (PCE)	ANZECC (2000) Low Reliability Guidelines – **70**µg/L	
All other analysed VOCs	Not presented as there are no assessment criteria for all detected VOCs, with the exception of PCE and BTEX (listed above)	
OCPs	Not presented as all analytical results for OCPs were reported below laboratory detection limits.	

*Freshwater criteria adopted due to lack of published marine water criteria

ns - not specified

Table 9 Analytical Reference Methods

Analyte	Envirolab Reference	ALS Reference
Asbestos	PLM Dispersion Staining (AS4964-2004)	PLM Dispersion Staining (AS4964-2004)
Mercury	Cold Vapour AAS (USEPA 7471A)	Cold Vapour / FIM (APHA 3112)
Metals	ICP-AES (USEPA 200.7)	ICP-AES (USEPA 200.2 mod)
OCP	GC/ECD (USEPA 8081)	GC/ECD/MS (USEPA 3510/8270)
PAH	GC/MS (USEPA 8270)	GC/MS – SIM (USEPA 8270)
VOC	P&T GC/MS (USEPA 8260)	P&T GC/MS (USEPA 5030/8620)
vTPH/BTEX	P&T GC/MS GC /FID (USEPA 8620/8000)	P&T GC/MS (USEPA 5030/8620)
TPH	GC/FID (USEPA 8260)	GC/FID (USEPA 3510/8015)

6.1.5.5 List of Informational Inputs Required to Resolve the Decision Statement

- Field measurements of soil and groundwater quality
- Laboratory analyses of soil and groundwater quality
- Equipment calibration logs
- Field logs
- Interpretation of soil and groundwater characteristics

6.1.6 Step 4 – Defining the Study Boundaries

6.1.6.1 Detailed Description of the Spatial and Temporal Boundaries of the Problem

The study area boundary can be described as the 7,000m^2 area as shown in Figure 2, **Appendix A**. The vertical extent of the investigations was limited to 3m below existing ground level for soils at selected investigation locations and 10m bgl for groundwater.

The temporal boundaries for the study were limited to the period over which the field investigation was undertaken (15, 16 and 22 October 2012).

6.1.6.2 Any Practical Constraints that May Interfere with the Study

Practical constraints may include:

- Severe weather conditions
- Difficulties in accessing some of the properties and / or proposed investigation locations.

Bearing the above in mind, WSP conducted the intrusive investigation works in the following manner:

- Pre-work Briefing
- Provide an experienced Environmental Consultant to coordinate installation of a minimum of 17no. machine augered boreholes formed across the site to a maximum depth of 3m
- Extension of four boreholes to a maximum of 10m bgl to facilitate the installation of groundwater monitoring wells.

- Describe and log soil encountered with reference to the Unified Soil Classification System
- Obtain representative soil samples from all strata encountered.
- Develop the newly installed groundwater monitoring wells to remove drilling sediments.
- Collect representative groundwater samples.
- Field screening of soil samples using visual and olfactory observations and a PID to assess potential presence of volatile contaminants (if encountered, additional laboratory analysis may be recommended).

6.1.7 Step 5 – Developing Decision Rules

The decision rules adopted to answer the decisions outlined in Section 6.1.4.1 are summarised in the following table

Table 10 Summary of Decision Rules

No.	Decision to be Made	Decision Rule
1	Do the soils at the site exceed the adopted guidelines presented in Table 7	For the soils to be considered suitable for commercial / industrial land use, the following criteria were adopted with respect to the decision making process: ■ If the soil results were less than the adopted site criteria then the site was deemed suitable for use ■ If the soil results were greater than the adopted guideline and the statistical analysis demonstrates that the upper 95% confidence limit on the average concentration falls below the adopted site criteria; with no single analyte concentration exceeding 250% of the adopted site criteria; and, the standard deviation of the results being less than 50% of the site criteria then the site was deemed suitable for use ■ If the statistical analysis does not satisfy the requirements of the above point then further assessment and/or remediation and/or management will be required to facilitate the proposed land use Statistical analysis of results was only applied for contaminants that were consistent across a single stratum (i.e. not be applied to point sources of contamination).
2	If soils are surplus to site requirements, what category of waste do they fall into?	To determine the waste classification, the results were compared to the guidelines presented in Table 10 and the following criteria were adopted with respect to the decision making process: ■ If asbestos is present, the soils were classified as Special Waste (Asbestos) ■ If the soil results were less than TCLP1 and SCC1 criteria and did not contain asbestos then the materials were classified as General Solid Waste ■ If the soil results were greater than the TCLP1 and SCC1 criteria but did not contain asbestos and the statistical analysis demonstrates that the upper 95% confidence limit on the average concentration falls below the adopted criteria; with no single analyte concentration exceeding 250% of the adopted criteria; and, the standard deviation of the results being less than 50% of the adopted criteria then the materials were classified as General Solid Waste ■ If the statistical analysis does not satisfy the requirements of the above point then the waste materials will either be classified Restricted Solid or Hazardous Wastes. Statistical analysis of results was only applied for contaminants that were consistent across a single stratum (i.e. not be applied to point sources of contamination).

No.	Decision to be Made	Decision Rule
3	Are there any issues relating to the local background area soil concentrations that exceed the adopted site criteria?	If the 95% UCL of natural soils exceeded published background criteria then the decision was yes. Otherwise, the decision was no.
4	Are there any aesthetic issues relating to the soils at the site?	If the proposed land use is commercial / industrial then this does not apply. If there are any odours, discoloration or debris in shallow or surface soils then the decision was yes. Otherwise the decision was no.
5	Are there any impacts of chemical mixtures?	Were more than one group of chemicals present above the adopted guidelines and if so did their combined presence increase the risk of harm? If there were, then the decision was yes. Otherwise, the decision was no.
6	Is there evidence of, or the potential for, migration of contaminants from the site?	Were contaminants present at concentrations above the adopted guidelines AND were the same contaminants detected in leachate or groundwater analysis. If there were, then the decision was yes. Otherwise, the decision was no.
7	Is any management or remediation required to render the site suitable for the current and / or future land use?	If the answer to any of the above questions was yes then a site management / remediation strategy will be required. Otherwise, the site can be deemed as being suitable for use in its current state.

6.1.8 Step 6 – Specify Limits on Decision Errors

6.1.8.1 Decision-maker's Tolerable Decision Error Rates Based on a Consideration of the Consequences of Making an Incorrect Decision

NSW EPA (1995) states that *"Unless a site investigator can demonstrate otherwise, the EPA maintains that all statistical interpretation should be carried out at a confidence level of no lower than 95%"*. To ensure compliance with this guideline, an overall acceptable error rate of <= 5% was adopted for this project.

The pre-determined data quality indicators (DQIs) established for the project are discussed below in relation to precision, accuracy, representativeness, comparability and completeness (PARCC parameters) as required by Step 6 of the DQO process.

Table 11 Data Quality Objectives and Indicators

Data Quality Objective	Frequency conducted	Data Quality Indicator[2]
Precision		
Intra-laboratory field duplicates	1/20 samples	<5xLOR : <100% RPD[1] 5-10xLOR : <75% RPD or >5xLOR: M8 <30% RPD >5xLOR: Other <50% RPD
Inter-laboratory field duplicates	1/20 samples	
Laboratory duplicates (Envirolab and ALS)	1/20 samples	<5xLOR : no limit[1] 5-10xLOR : <70% RPD or >5xLOR: M8 <30% RPD >5xLOR: Other <50% RPD
Laboratory method blanks	1/20 samples	< LOR[1]
Accuracy		

Data Quality Objective	Frequency conducted	Data Quality Indicator[2]
Matrix spikes	1/20 samples	60 to 140%
Laboratory control samples	1/20 samples	70 to 130% (inorganic) As specified by lab (organic)
Representativeness		
Sampling handling storage and transport appropriate for media and analytes	-	Yes
Rinsate blanks	1 per day per equipment	<LOR
Laboratory blanks	1 per sampling event	<LOR
Trip Spike	1 per media	70 to 130% (inorganic) As specified by lab (organic)
Samples extracted and analysed within holding times.	-	Hold Times: 14 days - organics 6 months – inorganics
Comparability		
Standard operating procedures used for sample collection and handling (including decontamination)	All Samples	Yes
Standard analytical methods used for all analyses	All Samples	Yes
Consistent field conditions, sampling staff and laboratory analysis	All Samples	Yes
Limits of reporting appropriate and consistent	All Samples	Yes
Completeness		
Soil description and COCs completed and appropriate	All Samples	Yes
Appropriate documentation for testing	All Samples	Yes
Data set to be 95% complete after validation	All Samples	Yes

[1] **- If the RPD between duplicates is greater than the pre-determined data quality indicator, a judgment will be made as to whether the excess is critical in relation to the validation of the data set or unacceptable sampling error is occurring in the field.**

6.1.9 Step 7 – Optimise Design

6.1.9.1 The Optimum Manner in which to Collect the Data Required to meet the Objectives for the Assessment and which will meet the Project DQOs

With consideration to NSW EPA (1995); the review of existing environmental data; and, the evaluation of operational decision rules, a resource-effective SAP and sampling methodology is outlined in the following Section.

6.2 Sampling and Analysis Plan

The rationale for the selection of the SAP is presented below:

6.2.1 Sampling Pattern

A combination of judgemental (i.e. targeted to suspected sources of contamination identified in Section 5) and systematic (i.e. to provide good site coverage) sampling was adopted as it was considered to best meet the project objectives and satisfy the requirements of NSW EPA (1995). Investigation locations are shown in Figure 3, **Appendix A**.

6.2.2 Sampling Density and Estimated Size of Residual Hotspots Remaining

Based on Table A in NSW EPA (1995), a minimum of 17 sampling points are recommended for a site comprising 0.7 hectares in size. Bearing this in mind, WSP formed 18 sampling points which ensures that potential contamination hotspots of greater than 24.2m in diameter were detected with 95% confidence.

6.2.3 Sampling Depths

WSP obtained samples from the following depths during the intrusive investigation works:

- At the surface (0 to 0.2m)
- Where contamination appears to begin
- At the zone of highest contamination
- Where the contamination appears to cease
- At any changes in the strata targeting fill and natural material respectively

6.3 Sampling Methodology

6.3.1 General

A description of the sampling methods adopted for the investigations are presented below. Field forms and calibration certificates are presented in **Appendix D**. Borehole and installation details are presented on the logs in **Appendix E**:

- Soil samples were collected between 15 and 16 October 2012 using push tube techniques.
- Ground conditions were described using the USCS and details of any discolouration, staining, odours or other indicators of contamination noted.
- Soil and groundwater samples were placed in laboratory supplied sample containers.
- All sample containers were labelled with the sample number, name of person sampling, project number and date obtained. This information was recorded on the COC form.
- Filled sample containers were checked to ensure that they were free of headspace and then placed in an iced Esky to keep samples below 4°C.
- Samples were transported directly to the primary (Envirolab) and secondary (ALS) laboratories in Sydney within adequate time to allow technical holding times for analysis to be achieved.
- COC forms and custody seals were attached to the Esky for delivery to the laboratory.
- Sample receipts were checked against COC carbon copies and filed.
- Groundwater monitoring bores consisted of Class 18 PVC machine slotted pipe installed for the bottom 3m portion of the bore. The upper portion of the monitoring well consisted of Class 18 PVC pipe. The bore annulus was backfilled with 1-2mm clean graded sand to allow for the ingress of groundwater, if present. A bentonite plug was installed at the upper end of the bore to seal the well. The bore was completed with a cap and a roadbox flush with ground level. A total of four boreholes were converted into wells for this purpose.

- Wells were developed using a stainless steel bailer to remove sediment from within the well. Wells were considered to be developed once purged water became clear, showed stabilised field parameters or were purged dry. Development equipment was decontaminated between wells with a phosphate free detergent (Decon 90). Development of wells occurred within 24 hours of installation.
- Monitoring wells were gauged, purged and sampled on 22 October 2012. Prior to purging, standing water levels were determined in all monitoring wells using an interface probe, which can also detect the thickness of any NAPL if present.
- Prior to sampling, groundwater was purged from each well using a low flow (minimal draw down) peristaltic pump. Field parameters including DO, temperature, pH, EC and ORP were measured during purging. Purging was considered complete once the field parameters stabilised to + / -10% of the previous readings. A total of approximately 15-25 litres were purged from each well before field parameters stabilised and allowing a sample to be collected.
- Well Purge Data Record Sheets were completed for each well which detail the sampling date, project number, operator, well ID, weather, gauge data (including depth to water and depth to bottom and depth to product if present), water quality data and general comments
- Reusable sampling equipment was decontaminated or replaced between sampling events. The decontamination procedure comprised brushing off loose soil / debris; scrubbing using a Decon 90 solution; rinsing with water; and, drying.

6.3.2 Field Screening

The following outlines the procedure adopted for use of the PID in the field:

Preliminary:
- Daily calibration of the PID instrument with isobutylene gas (100ppm)

Screening:
- Placement of a soil sample into a re-sealable plastic bag until half filled, then sealed
- Measurement of background VOC concentrations in ambient air prior to each reading to account for sensor drift. Record on a field data sheet along with date, location details and depth
- The point of the PID will be inserted into the bag containing the soil. The readout will be monitored and the maximum concentration during the recording period will be recorded.

Elevated PID readings, visual and olfactory indicators were used to aid in scheduling samples for chemical analysis.

6.3.3 Field QA/QC Sampling

The methodology for obtaining QA/QC samples was conducted as follows:

Duplicate Samples

In accordance with AS4482.1 (2005) Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil, at least 1 in every 20 samples (5%) was submitted from a larger quantity of sample collected from the same sampling point, removed by a single action, where possible, and divided into two or three separate and unrelated sample containers for analysis at the same laboratory (intra-laboratory precision).

Triplicate Split Samples

In accordance with AS4482.1 (2005) at least 1 in every 20 samples (5%) was submitted from a larger quantity of sample collected from the same sampling point, removed by a single action, where possible, and divided into two or three separate and unrelated sample containers for analysis at the check laboratory (inter-laboratory precision).

Trip Blanks

No trip blank were utilised.

7 Evaluation of QA/QC

The QA/QC results are summarised in Tables 12 and 13 below and the laboratory testing certificates are presented in **Appendix H.** A detailed QA/QC report and RPD calculations are provided in **Appendix F**.

Table 12 Soil QA/QC Results Summary

Data Quality Objective	Sampling Frequency	Frequency Achieved?	DQI	95% DQI Met ?
Precision				
Intra-laboratory field duplicates	1/ 19	Yes	<5xLOR : <100% RPD 5-10xLOR : <75% RPD or >5xLOR: M8 <30% RPD >5xLOR: Other <50% RPD	No
Inter-laboratory field duplicates	1/ 19	Yes		No
Laboratory duplicates (Envirolab and ALS)	2/19	Yes	<5xLOR : no limit 5-10xLOR : <70% RPD or >5xLOR: M8 <30% RPD >5xLOR: Other <50% RPD	Yes
Laboratory method blanks	-	-	< LOR[1]	Yes
Accuracy				
Matrix spikes	1/19	Yes	60 to 140%	Yes
Laboratory control samples	3/19	Yes	70 to 130% (inorganic) As specified by lab (organic)	Yes
Representativeness				
Sampling handling storage and transport appropriate for media and analytes	-	-	Yes	Yes
Rinsate blanks	Not applicable	Not Applicable	<LOR	Push tube techniques used
Trip blanks	0/19	No	<LOR	No
Trip Spike	0/19	No	70 to 130% (inorganic) As specified by lab (organic)	No
Samples extracted and analysed within holding times.	-	-	Hold Times: 14 days - organics 6 months – inorganics	Yes
Comparability				
Standard operating procedures used for sample collection and handling (including decontamination)	All samples	Yes	Yes	Yes
Standard analytical methods	All	Yes	Yes	

Data Quality Objective	Sampling Frequency	Frequency Achieved?	DQI	95% DQI Met ?
used for all analyses	samples			Yes
Consistent field conditions, sampling staff and laboratory analysis	All samples	Yes	Yes	Yes
Limits of reporting appropriate and consistent	All samples	Yes	Yes	Yes
Completeness				
Soil description and COCs completed and appropriate	All samples	Yes	Yes	Yes
Appropriate documentation for testing	All samples	Yes	Yes	Yes
Data set to be 95% complete after validation	All samples	Yes	Yes	Yes

DQI were achieved, with the following exceptions:

- RPD exceedances were reported for copper, lead and zinc in both the intr-laboralory and inter-laboratory duplicate samples;
- No trip spike was utilised; and,
- No Trip blank was utilised.

These DQI non-conformities are not expected to affect the outcomes of this environmental assessment.

Table 13 Groundwater QA/QC Results Summary

Data Quality Objective	Sampling Frequency	Frequency Achieved?	DQI	95% DQI Met ?
Precision				
Intra-laboratory field duplicates	1/4	Yes	<5xLOR : <100% RPD 5-10xLOR : <75% RPD or >5xLOR: M8 <30% RPD >5xLOR: Other <50% RPD	No
Inter-laboratory field duplicates	1/4	Yes		Yes
Laboratory duplicates (Envirolab and ALS)	0/4	No	<5xLOR : no limit 5-10xLOR : <70% RPD or >5xLOR: M8 <30% RPD >5xLOR: Other <50% RPD	No
Laboratory method blanks	-	-	< LOR[1]	Yes
Accuracy				
Matrix spikes	0/4	No	60 to 140%	No
Laboratory control samples	1/4	Yes	70 to 130% (inorganic) As specified by lab (organic)	Yes

Data Quality Objective	Sampling Frequency	Frequency Achieved?	DQI	95% DQI Met ?
Representativeness				
Sampling handling storage and transport appropriate for media and analytes	-	-	Yes	Yes
Rinsate blanks	Not Applicable	Not Applicable	<LOR	-
Trip blanks	1 per 2 events	no	<LOR	Yes
Trip Spike	0/4	No	70 to 130% (inorganic) As specified by lab (organic)	No
Samples extracted and analysed within holding times.	-	-	Hold Times: 14 days - organics 6 months – inorganics	Yes
Comparability				
Standard operating procedures used for sample collection and handling (including decontamination)	All samples	Yes	Yes	Yes
Standard analytical methods used for all analyses	All samples	Yes	Yes	Yes
Consistent field conditions, sampling staff and laboratory analysis	All samples	Yes	Yes	Yes
Limits of reporting appropriate and consistent	All samples	Yes	Yes	Yes
Completeness				
Soil description and COCs completed and appropriate	All samples	Yes	Yes	Yes
Appropriate documentation for testing	All samples	Yes	Yes	Yes
Data set to be 95% complete after validation	All samples	Yes	Yes	Yes

- An RPD exceedance for zinc was reported in the intra-laboratory sample;
- A trip spike was not utilised; and,
- Due to the small batch size, laboratory duplicates and matrix spikes were not performed by the laboratory.

These DQI non-conformities are not expected to affect the outcomes of this environmental assessment.

Laboratory QA/QC comprised of chain-of-custody requirements, sample integrity and holding times, use of acceptable NATA-registered laboratory methods and laboratory QA/QC results. For this project, the Laboratory QA/QC was considered to be acceptable.

8 Results

8.1 Field Observations

The soil profile comprised gravelly sand and clay fill material to a maximum depth of 1.3m bgl (BH10), underlain by natural brown, red, orange and white clays and shales.

Some black staining and a hydrocarbon odour were observed at BH7 between 0.14 and 1.0m bgl. Also, some black staining was observed at BH10 between 0.7m bgl and 1.3m bgl and a discrete piece of ash material was observed near surface at BH12. No other visual or olfactory signs of contamination were observed.

Light brown, homogeneous sand was encountered at BH11 to a depth of 0.7m bgl where refusal occurred. No visual or olfactory signs of contamination were noted, and it is considered likely that the material was backfill sand used to fill a service trench.

No potential ACM fragments were observed on the ground at the site.

PID readings ranged between 0.0ppm and 1.0 ppm (BH1 - 0.5m).

Monitoring wells were sampled on 22 October 2012. The groundwater was observed to be turbid brown in MW01 and clear in the remaining three wells. No odours or sheens were observed, with the exception of a film on the purged water from MW01. No PSH was identified while sampling.

The groundwater field parameters and water level survey data for the site are summarised in Table 6.1.

Table 14: Groundwater Field Parameters

Well ID	SWL (m TOC)	Temp (°C)	pH (pH units)	Dissolved Oxygen (ppm)	Redox/ORP (mV)*	Conductivity (µS/cm)
MW01	2.47	18.8	5.79	0.24	248	6050
MW02	2.72	18.1	5.24	0.36	304	2262
MW03	2.70	19.4	5.90	4.45	312	4420
MW04	2.33	18.7	6.19	3.98	338	4800

* ORP field results converted to Standard Hydrogen Electrode (SHE) readings by adding 199mV to each field value.

Date of sampling: 22 October 2012

TOC: Top of well casing

SWL: Standing water level

Table 16 indicates the following:

- The temperature of the groundwater ranged between 18.1 and 19.4oC;
- pH ranged between 5.24 and 6.19 pH units indicating slightly acidic groundwater conditions;
- Dissolved oxygen ranged between 0.24 and 4.45ppm and ORP (oxidation reduction potential) levels ranged between 348 to 338mV. The parameters indicate oxidising conditions. ORP (or Redox) is a measure of a water system's capacity to either release or gain electrons in chemical reactions. The process of oxidation involves losing electrons while reduction involves gaining electrons; and
- Conductivity levels were between 2262 and 6050 microSiemens/cm (µS/cm), which indicates moderately saline groundwater conditions across the site.

8.2 QA/QC

Quality Assurance and Quality Control procedures and results are discussed in detail in **Appendix F**. Minor RPD exceedances in soil were noted and are attributable to heterogeneity of the fill material. Additionally, some minor DQI non-compliances were also noted. These are not expected to affect the validity of the results of the investigation.

8.3 Soil Analytical Results

Laboratory results for soil samples obtained by WSP are presented on Table 1 in **Appendix G**.

The results of the analysis conducted falls below either the adopted commercial / industrial (HIL-F) site criteria detailed in Section 6 or laboratory detection limits.

Analytical results were also compared to HIL-A residential criteria detailed in Section 6. The results of the analysis conducted falls below the HIL-A criteria with the exception of the concentration of lead in sample BH6 0.2m (410 mg/kg) which exceeded the guideline value of 300mg/kg.

8.4 Groundwater Analytical Results

Laboratory results for groundwater samples obtained by WSP are presented on Table 2 in **Appendix G**.

The results of the analysis conducted falls below either the adopted site criteria or laboratory detection limits, with the following exceptions:

- The concentration of tetrachloroethene (PCE) at MW03 (1,900µg/L) exceeded the ANZECC (2000) Low Reliability trigger Value of 70 µg/L;
- The concentrations of copper at MW03 (2 µg/L) and MW04 (4 µg/L) exceeded the ANZECC (2000) criteria of 1.4 µg/L;
- The concentrations of zinc exceeded the ANZECC (2000) criteria of 8µg/L at all locations with concentrations ranging between 23 µg/L (MW02) and 150 µg/L (MW04).

Notably, 2,200 µg/L of TPH C_6-C_9 was detected in MW03. There are no criteria for TPH C_6-C_9 in groundwater.

The locations of the above exceedances are presented on Figure 4 in **Appendix A**.

9 Site Characterisation

9.1 Assessment of Soil Concentrations against Investigation Levels

Concentrations of contaminants in soil fall below the adopted Investigation Levels for a commercial / industrial land use.

With the exception of the concentration of lead at BH6 at 0.2m bgl, concentrations of contaminants in soil fall below the adopted Investigation Levels for a residential land use.

9.2 Assessment of Waste Classification

A waste classification of soils was not required as part of the agreed scope of this investigation.

9.3 Assessment of Background Soil Concentration against Investigation Levels

No data pertaining to the local background area soil concentrations was available.

9.4 Assessment of Aesthetic Issues

There are no aesthetic issues relating to the soils at the site.

9.5 Assessment of Chemical Mixtures

Based on the available information, WSP do not consider that further assessment of chemical mixtures in soils is required. In soils, commercial/industrial site assessment criteria were met. In groundwater, the contaminant of concern is PCE. Although TPH C_6-C_9 was detected in MW03, this is considered to be associated with the chlorinated hydrocarbon impact rather than of petroleum hydrocarbon origin. Detection of metals in groundwater is considered to be representative of regional water quality rather than being associated with site derived contamination.

9.6 Assessment of Contaminant Migration

Based on a review of the groundwater results, WSP consider that metal concentrations (copper, lead, nickel and zinc) are likely to be regional and not linked to current or historic site activities.
Groundwater collected from monitoring well MW03 was impacted by chlorinated solvents, namely PCE, which was above the adopted site criteria. Groundwater from monitoring well MW03 also had volatile TPH C_6-C_9 concentrations of 2,200ug/L, which are likely to be associated with chlorinated solvents.
While PCE was not detected in any other groundwater monitoring wells, off site migration of chlorinated solvents cannot currently be entirely discounted, given that MW03 is adjacent the southern site boundary.
WSP recommends a further assessment of groundwater be undertaken to delineate the area of impact.

9.7 Requirement for Site Management / Remediation Strategy

9.7.1 Soils

The results of the analysis conducted falls below either the adopted commercial / industrial (HIL-F) site criteria detailed in Section 6 or laboratory detection limits.

9.7.2 Groundwater

It is considered that further investigation and sampling will be required to delineate chlorinated solvent impact. No volatile vapour monitoring is considered necessary at this stage as the potential for volatile vapours to accumulate is likely to be limited. However, if the extent of chlorinated hydrocarbons is identified as being more widespread, this potential exposure pathway will require further consideration.

10 Conclusions and Recommendations

WSP has completed a combined Phase 1 and 2 Environmental Site Assessment (ESA) to facilitate redevelopment of the properties located at 1-13 Grey Street and 32-46 Silverwater Road, Silverwater, NSW (the site).

The site consists of thirteen properties and comprises approximately 7,000m2 of land and the site currently comprises a vacated dry cleaning premises and 12 vacated residential properties.

The main conclusions of the intrusive investigations are as follows:

- The site is underlain by the Blacktown Landscape which is characterised by podzolic soils. These soils are limited by moderately reactive highly plastic subsoil, low soil fertility and poor soil drainage.
- The site is located in an area underlain by Ashfield Shale of the Wianamatta Group comprising black to dark grey shale and laminate.
- Acid sulfate soils are not expected to occur in this environment.
- Following a survey of the newly installed groundwater wells, relative groundwater levels were calculated, contours were mapped, and the inferred GW flow direction was generally to the west and north-west, with some groundwater flow in the south east portion of the site identified to be occurring in a southerly direction. (See Figure 5, **Appendix B**). No rate of flow information is available.
- Based on a review of historical aerial photographs, the property at 32-36 Silverwater Road has undergone several redevelopments and the current property configuration has existed since prior to 1961. Between 1930 and 2012, site changes predominantly involved the redevelopments of 32-36 Silverwater Road, and the erection of additional residential dwellings on Grey Street and Silverwater Road.
- Industrial processes have previously been conducted at 32-36 Silverwater Rd. A dry cleaning business was operated at the property.
- According to the EPA's Contaminated Land Management (CLM) public register there were no prevention, clean-up or prohibition notices for the site.
- Three ASTs and an elevated drum storage area were identified within and adjacent to the eastern building at 32-36 Silverwater Road. Packaged liquid chemicals were observed to be stored in a bund area adjacent the Bligh St site access driveway and in the western warehouse in various containers and drums. The identified packaged chemicals were likely associated with the former dry cleaning activities. The chemicals included tetrachloroethene (PCE) which is a chlorinated solvent.
- The soil profile comprised gravelly sand and clay fill material to a maximum depth of 1.3m bgl (BH10), underlain by natural clays and shales. Some black staining and a hydrocarbon odour were observed at BH7 and some black staining was observed at and a discrete piece of ash material was observed near surface at BH12. No other visual or olfactory signs of contamination were observed.
- The results of the analysis for soils are below either the adopted commercial / industrial (HIL-F) site criteria or laboratory detection limits;
- With the exception of the concentration of lead in sample BH6 (0.2m), analytical results were reported below HIL-A residential criteria.
- Groundwater collected from monitoring well MW03 was impacted by tetrachlorethene PCE (a chlorinated solvent) at a concentration exceeding the adopted site criteria. Other volatile hydrocarbons were also detected at MW03.
- While the possibility of offsite migration of PCE cannot be ruled out, it is noted that no other groundwater wells are impacted with PCE.
- No volatile vapour monitoring is considered necessary at this stage as chlorinated solvents have been detected beneath an outdoor area and adjacent to a large open plan warehouse building that is likely to limit the potential for volatile vapours to accumulate. However, if the extent of chlorinated hydrocarbons is identified as being more widespread, this potential exposure pathway will require further consideration.

- Laboratory QA/QC comprised of chain-of-custody requirements, sample integrity and holding times, use of acceptable NATA-registered laboratory methods and laboratory QA/QC results. For this project, the Laboratory QA/QC was considered to be acceptable.

Bearing the above in mind, WSP considers that the site is suitable for on-going commercial / industrial land use with the following recommended works to manage the identified impacts:

- Delineate the extent of chlorinated solvent and hydrocarbon contamination in groundwater down gradient and in the vicinity of MW03.

The above conclusions and recommendations are subject to the limitations presented in Section 10 below and relate to a commercial and industrial land use only. If the site layout is changed or a more sensitive land use is proposed then a reassessment of the contamination status of the site will be required.

11 Limitations

The findings of this report are based on the scope of work outlined in Section 1.4. WSP performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environmental assessment profession. No warranties, express or implied, are made.

Subject to the scope of work, WSP's assessment was limited strictly to identifying typical environmental conditions associated with the subject property area and does not include evaluation of any other issues. This report does not comment on any regulatory obligations based on the findings. This report relates only to the objectives stated and does not relate to any other work undertaken for the Client. It is a report based on the conditions and concentrations observed in soil, water and air at the time of the sample collection. These conditions may change with time and space.

The absence of any identified hazardous or toxic materials on the subject property should not be interpreted as a guarantee that such materials do not exist on the site.

All conclusions regarding the property area are the professional opinions of the WSP personnel involved with the project, subject to the qualifications made above. While normal assessments of data reliability have been made, WSP assumes no responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside of WSP, or developments resulting from situations outside the scope of this project.

WSP is not engaged in environmental assessment and reporting for the purpose of advertising sales promoting, or endorsement of any Client interests, including raising investment capital, recommending investment decisions, or other publicity purposes.

The Client acknowledges that this report is for their exclusive use. Other parties may only gain reliance on this report following receipt of written approval from WSP.

12 References

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