REMEDIAL ACTION PLAN

307 - 311 BEXLEY ROAD & 88-96
NEW ILLAWARRA ROAD, BEXLEY NORTH NSW

PREPARED FOR TONY SOUEID
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1 PROJECT INFORMATION

1.1 INTRODUCTION

Geo-Environmental Engineering Pty Ltd (GEE) was commissioned by Tony Soueid to prepare this Remedial Action Plan (RAP) for the site located at 307 - 311 Bexley Road & 88-96 New Illawarra Road, Bexley North NSW (herein referred to as 'the site' – **Figure 1**). The site covers a combined area of approximately 4,200m^2 and comprises nine allotments which are legally referred to as Lots 3, 4, 5 and 6 in Deposited Plan 508629, Lots A and B in DP388204, Lot 1 in DP1045200, Lot 1 in DP 400341 and Lot 35 in DP663036. This RAP relates to the southern portion of the site which is occupied by a Petrol Station (307 – 309 Bexley Road / Lot B in DP388204, Lot 1 in DP1045200 and Lot 35 in DP663036). A site survey plan showing the allotments is provided for reference in **Appendix A**.

The RAP was required to support a planning proposal which relates to the proposed rezoning of the land to R4 – High Density Residential, with the future development to include a basement (single or multiple levels) and up to six levels above ground.

This RAP is based on information contained within a Stage 1 and 2 Environmental site Assessment (ESA) report that was completed by GEE in 2017 (reference 1) and relates to the Underground Petroleum Storage System (UPSS) associated with the petrol station which has the potential to have caused localised contamination.

This RAP addresses the requirements for excavation, removal and validation of the existing UPSS (which includes nine Underground Storage Tanks (USTs), fuel dispensers and associated infrastructure) to ensure that the site will be suitable for the proposed land-use at the completion of the remedial works described in this RAP.

The RAP has been prepared in accordance with relevant guidelines endorsed by the NSW Office of Environment and Heritage (OEH)[1].

[1] Note that NSW Environment Protection Authority (EPA) is part of the OEH, which replaces the NSW Department of Environment and Climate Change and Water (DECCW), NSW Department of Environment and Climate Change (DECC), and NSW Department of Environment (DEC).

1.2 OBJECTIVES

The objectives of this RAP are to:

- ◊ Define the remedial goals that will ensure that the remediated site will be suitable for the proposed land-use,
- ◊ Document the remediation strategy and describe the remediation procedures to be implemented to reduce the contamination risk to an acceptable level for the land-use, including requirements for validating the remedial works,
- ◊ Establish the necessary environmental management procedures to be implemented during the proposed remedial works, and
- ◊ Identify any regulatory approvals or licences required by the proposed works.

1.3 SCOPE OF WORKS

The scope of this RAP is as follows:

- ◊ Identify the extent and type of contamination requiring remediation/management,
- ◊ Definition of remediation goals and Remediation Acceptance Criteria (RAC),
- ◊ Evaluate the feasible remediation strategies and options,
- ◊ Detail the preferred remediation option for the site,
- ◊ Preparation of a validation plan to ensure that the RAC are achieved,
- ◊ Preparation of an OH&S plan to minimise the risk of human exposure to contaminants, and
- ◊ Preparation of an environmental management plan to minimise the impact of remediation works on the surrounding environment.

Following the execution of the remediation process, a validation report will be prepared. The objective of the validation report is to describe the completed remedial works and determine whether the site has been remediated to a standard that is suitable for the proposed land-use.

2 SITE IDENTIFICATION

A summary of the site location details is provided below, while a site location map is provided as **Figure 1**:

Street Address:	307 - 311 Bexley Road & 88 - 96 New Illawarra Road, Bexley North (**Figure 1**)
Legal Description:	Lots 3, 4, 5 and 6 in Deposited Plan 508629, Lots A and B in DP388204, Lot 1 in DP1045200, Lot 1 in DP 400341 and Lot 35 in DP663036.
Coordinates (MGA 56):	325760m E, 6242900m N
Local Government Area:	Bayside (formerly Rockdale)
Site Area:	Approximately 4,200m^2
Current Zoning:	Low Density Residential (R2)[2]
Current Use:	Mixture of low density residential and commercial/industrial (Metro Service Station)
Proposed Zoning:	High Density Residential (R4)
Proposed Use:	Commercial-residential mixed use

[2] Bayside (Rockdale) Local Environment Plan (LEP) 2011

3 PREVIOUS INVESTIGATIONS

3.1 STAGE 1 AND 2 ENVIRONMENTAL SITE ASSESSMENT

In July 2017, GEE completed a Stage 1 and Stage 2 ESA for the site (reference 1). The objective of the ESA was to address the requirements of Council's Contaminated Land Policy (reference 2) and the provisions of the *State Environmental Planning Policy No. 55 – Remediation of Land* (reference 3) by providing a detailed assessment of contamination and in turn an assessment of the suitability of the site for the proposed land-use and possible constraints on future site development.

The scope of work completed by GEE included:

- ◊ Review of the environmental and physical setting in which the site lies, including geology, hydrogeology and topography,
- ◊ Review of the history of the site using readily available records and historical aerial photographs,
- ◊ Detailed site inspection for potential sources of contamination, and
- ◊ A detailed soil and groundwater sampling and analysis program to characterise potential contamination in accessible areas across the site.

A summary of the information obtained and results of this assessment is presented below.

Site History and Potential For Contamination

The historical information indicates that the site was originally part of a larger parcel of land (likely rural/residential) before being progressively subdivided between 1914 and 1940 while owned by NSW Realty Co Limited. Initially the southern part of the site (88 and 90 New Illawarra Road and 311A Bexley Road) was subdivided and sold as two allotments in 1918 and has since been owned by various individuals. The allotments were further subdivided in the late 1960s to create the residential allotment known as 311A Bexley Road (Lot 5 DP508629). Historical aerial photographs suggest that this part of the site has predominately been used for residential purposes (low density). However, the dwelling at No. 90 New Illawarra Road is also known to have been partly used for commercial purposes, including a Butchers in the 1970s and 1980s.

The central part of the site (94 New Illawarra Road and 311 Bexley Road) was subdivided by NSW Realty Co Limited and sold off in 1919 as two allotments which currently exist.

Historical aerial photographs indicate that this part of the site has been occupied by residential dwellings (low density) and associated garages, sheds and pools.

The northern part of the site (including 307 – 309 Bexley Road and 96 New Illawarra Road) was sold by NSW Realty Co Limited in 1940 and subdivided into the existing allotments by 1954. 96 New Illawarra Road (Lot A in DP388204) was developed into a dwelling circa 1954, while the remaining part of the land was developed into a service station (including mechanical repair workshop) soon after (late 1950s).

Of particular significance to this investigation are the activities associated with the service station at the northern end of the site, specifically the storage and use of fuels and mechanical repair of vehicles.

Soil Conditions

Soil conditions across the site were assessed at seventeen borehole locations positioned in accessible areas across the site and targeting areas of potential contamination. The location of the boreholes is shown on **Figure 2** and the number of boreholes (sampling points) exceeds the minimum number of sampling points required for adequate site characterisation as defined by the EPA NSW and Australian Standards, and it is the opinion of GEE that the number of sampling points was sufficient to support the planning proposal.

The majority of the boreholes drilled by GEE were dry during drilling and also upon completion. Exceptions included some seepage water encountered below 1.6m in borehole BH102 and slight seepage noted between a depth of 2.0m and 2.8m depth within borehole BH107.

The subsurface conditions, as observed in the boreholes, typically comprised fill material over sandy clay soil which was underlain by sandstone bedrock. The thickness of the topsoil and/or fill unit ranged from 0.3m to 2.7m depth while the depth to the bedrock formation ranged from 0.75m to 2.7m depth. A copy of the former borehole logs is provided for reference in **Appendix B**.

During the drilling of boreholes, there were no unusual odours (that could be potentially associated with contamination) noted. Additionally, no potentially Asbestos Containing Materials (ACM) was observed below ground during sampling and logging.

GEE submitted a total of 41 primary soil samples from the 17 boreholes to Envirolab for NATA accredited laboratory analysis of metals (arsenic, cadmium, chromium, copper,

nickel, lead, mercury and zinc), TRH, BTEX, PAHs, OCPs, PCBs and asbestos. The analytical results were compared against relevant set of ecological and health-based Site Acceptance Criteria (SAC) appropriate for the proposed land-use (high density residential).

In summary, the fill and natural soil was found to be free of significant contamination which would impact on the proposed development, future users of the site and the environment.

Groundwater Conditions

Groundwater conditions were assessed using three pre-existing monitoring wells (GW01 to GW03) and three recently installed monitoring wells (BH102, BH105, BH107 – **Figure 2**).

The stabilised level of groundwater within the wells installed within BH102, BH107, GW01, GW02 and GW03 was measured on the 14th November 2016 (approximately 13 days after installation of the wells) at depths of 1.28m, 1.78m, 2.21m, 2.13m and 1.34m bgs respectively. The well within borehole BH105 was dry to a depth of 2.4m bgs. Water within the wells was slightly to moderately acidic (4.5<pH<6.5) and low in conductivity.

The water encountered in the wells is considered to be perched water flowing along the soil/bedrock interface and such water is normally significantly influenced by rainfall events and therefore its presence can be intermittent. This is supported by the fact that the well installed within borehole BH105 was dry to a depth of 2.4m.

Taking into account the approximate surface elevation at each of the well locations, it is inferred that the perched water is following the regional topography and flowing in a northerly to north-easterly direction. Although the flow direction is expected to have been significantly altered by the presence of UST tankpit excavations in the northern end of the site.

To assess the presence of contamination within the groundwater, a sample of water was collected and submitted to Envirolab for NATA accredited analysis of dissolved metals (arsenic, cadmium, chromium, copper, nickel, lead, zinc and mercury), TRH, BTEX, PAHs and Phenols. The analytical results were then compared against a set of Groundwater Assessment Criteria (GAC) considered appropriate for the environmental setting of the site.

Conclusion and Recommendations

Based on observations made during the field investigations, the sampling and analysis program conducted at the site (including that completed previously by STS), the proposed land-use and with respect to relevant statutory guidelines, GEE conclude that the site can be made suitable for the proposed land-use described in the planning proposal, subject to the excavation, removal and validation of the existing UPSS. In accordance with Council's Contaminated Lands Policy and SEPP 55, a Remedial Action Plan should be prepared which details the methodology for the excavation, removal and validation of the existing UPSS.

4 SITE CONDITION AND SURROUNDING ENVIRONMENT

This section provides a summary of the site features and surrounding environment and has been extracted from the previous investigation report (reference 1).

4.1 SITE DESCRIPTION

The site bounded by New Illawarra Road to the west, Bexley Road to the east a park/recreational space to the north and residential land to the south.

At the time of the field investigation, a Metro service (petrol) station, with shop and mechanical workshop, occupied the northern end of the site (307-309 Bexley Road). The buildings in this part of the site were constructed of fibro and brick with a corrugated iron roof. Additionally, there was a metal awning extending from the eastern side of the shop over three fuel dispensers. A fourth fuel dispenser was located midway along the northern boundary. There were several underground fuel Storage Tanks (USTs) across the Metro Service station property and the surface predominately comprised concrete or asphalt pavements with some garden beds along the perimeter of the property. The exact number of USTs was not confirmed but based on WorkCover NSW documents it is believed that there are nine tanks present (refer to **Table 1** and **Figure 3**). According the dangerous goods licencing information, LPG is also stored on site in above ground tanks.

Three groundwater monitoring wells were also observed across the Metro Service station forecourt and are likely from the former contamination assessment completed in 2011. As previously mentioned, GEE has not been provided with a copy of this report. Each of these wells were used to sample groundwater as part of this investigation and for the purpose of this investigation they were labelled GW01 to GW03. Their approximate locations are shown on **Figure 2**.

The remainder of the site was occupied by residential dwellings, associated garages, sheds and swimming pools, although the dwelling at 94 New Illawarra Road was being used for commercial purposes (specifically an office for the Mental Health Recovery Institute.

Table 1: UST Details

Tank Number	Location	Installed Date	Contents	Size	Status
Tank 1	Next to main canopy	Approx 1959	Super (now unleaded)	7,500L	In Use
Tank 2	North of Office/Shop	Approx 1959	Super (now diesel)	7,500L	In Use
Tank 3	North of Office/Shop	Approx 1959	Not known	3,700L	Abandoned
Tank 4	North of Office/Shop	Approx 1959	Not known	3,700L	Abandoned
Tank 5	Northern End	Approx 1970	Super (now unleaded)	27,600L	In Use
Tank 6	Northern End	Approx 1979	Super (now unleaded)	27,600L	In Use
Tank 7	West of office/shop	Approx 1979	Kerosene	2,000L	Likely abandoned
Tank 8	South-eastern part of service station	Approx 1995	unleaded	34,000L	In Use
Tank 9	Adjacent to the Workshop	Approx 1995	Waste oil	Not known	In Use

4.2 TOPOGRAPHY

During the site investigation, it was noted that the site was situated on a slope, highest in elevation at the southern end of the site, dipping down towards the north and north-east at approximately 5% to 10%.

4.3 GEOLOGY AND SOILS

4.3.1 *Regional*

A review of the Sydney 1:100,000 regional geological map (reference 4) indicates that the site is situated on the geological contact between the Ashfield Shale and Hawkesbury Sandstone formations. The Ashfield Shale formation comprises "*…black to dark-grey shale and laminite"* whilst the Hawkesbury Sandstone typically consists "*...medium to coarse-grained quartz sandstone, very minor shale and laminite lenses".*

A review of the regional soils map (reference 5) indicates the site is located within the Gymea Soil Landscape Group, recognised by undulating to rolling rises and low hills on Hawkesbury Sandstone. Local reliefs are between 20-80m while slopes are typically

between 10-25% in gradient. Soils of the Gymea Group are typically erosional sands and clays, have very low soil fertility and form a high soil erosion hazard.

4.3.2 Local

The subsurface conditions encountered during the Stage 1 and 2 ESA boreholes (reference 1) typically comprised fill material over sandy clay soil which was underlain by sandstone bedrock. The thickness of the topsoil and/or fill unit ranged from 0.3m to 2.7m depth while the depth to the bedrock formation ranged from 0.75m to 2.7m depth.

4.4 HYDROGEOLOGY / GROUNDWATER

4.4.1 Regional

Permanent groundwater is likely to be confined or partly confined within discrete, water-bearing zones within the bedrock formation. However, intermittent 'perched' water seepage is likely to occur at the soil-bedrock interface following heavy and prolonged rainfall events.

Groundwater flow is dominated by water movement through fractures or joints, where stress has caused partial loss of cohesion in the rock, with evidence of potential water bearing fractures usually the presence of clay or iron-staining along the face of joints.

4.4.2 Local

The stabilised level of groundwater within the wells installed within BH102, BH107, GW01, GW02 and GW03 was measured on the 14th November 2016 (approximately 13 days after installation of the wells) at depths of 1.28m, 1.78m, 2.21m, 2.13m and 1.34m bgs respectively. The well within borehole BH105 was dry to a depth of 2.4m bgs. Water within the wells was slightly to moderately acidic (4.5<pH<6.5) and low in conductivity.

The water encountered in the wells is considered to be perched water flowing along the soil/bedrock interface and such water is normally significantly influenced by rainfall events and therefore its presence can be intermittent. This is supported by the fact that the well installed within borehole BH105 was dry to a depth of 2.4m.

Taking into account the approximate surface elevation at each of the well locations, it is inferred that the perched water is following the regional topography and flowing in a northerly to north-easterly direction. Although the flow direction is expected to have been significantly altered by the presence of UST tankpit excavations in the northern end of the site.

4.5 AREAS AND TYPE OF CONTAMINATION

As detailed in the Stage 1 and 2 ESA report (reference 1), GEE identified no significant soil or groundwater contamination associated with the site. Notwithstanding this, there is an operational petrol station located at the southern end of the site and it was impossible to investigate immediately adjacent and beneath the Underground Petroleum Storage System (UPSS). In this regard, there is potential for soil contamination (primarily petroleum Hydrocarbons) to exist immediately below and surrounding the UPSS.

This RAP covers the excavation, removal and validation of the service station, including UPSS, which will be required prior to any future redevelopment of the site.

5 REMEDIATION STRATEGY

This section provides the remediation goal, the extent of remediation required and discusses the remedial options to determine the preferred remedial option.

5.1 REMEDIATION GOAL

The goal of the remediation activities is to render the site suitable for the proposed mixed use development with a basement covering the majority of the site, commercial land-use on the ground floor and residential land-use above.

5.2 EXTENT OF REMEDIATION

As summarised in Section 4.5, the remediation work relates to the UPSS associated with the Metro service (petrol) station located at the southern end of the site. The exact extent of any soil contamination will not be known until the UPSS is removed from site. However, based on previous field investigations, there is no widespread contamination present and the soil contamination (if any) would be restricted to the soil immediately below and surrounding the UPSS.

5.3 REMEDIATION OPTIONS

The current policy of the Australian and New Zealand Environment Conservation Council (ANZECC) and National Health and Medical Research Council (NHMRC) is provided within the Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (reference 7) and is endorsed in NSW OEH. The policy requires that soil remediation and management in NSW should be implemented in the following preferred order:

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

Additionally, NSW OEH (reference 6) states that *remediation should not proceed in the event that it is likely to cause a greater adverse effect than leaving the site undisturbed*. Additionally, *in cases where it is not viable to remediate large quantities of soil with low levels of contamination, alternative remediation strategies should be considered or developed*.

Given the type and extent of potential contamination present on the site, remediation is not expected to cause a greater adverse effect compared to leaving the contamination undisturbed.

As detailed in the NSW EPA technical note relating to the investigation of service station sites (reference 8), remediation options that could typically be considered for service station sites following the appropriate removal of the UPSS include:

- *"on-site in-situ remediation of soil and groundwater, such as multi-phase vacuum extraction, air sparging with or without soil vapour extraction, and injections to enhance site-specific naturally occurring degradation processes*
- *on-site ex-situ treatment and remediation of soil and groundwater, such as enclosed bioremediation cells and pump and treat systems with emission controls*
- *on-site treatment, using enhanced bioremediation (with appropriate odour and stormwater controls), where high concentrations of VOCs are present, or passive bioremediation without the addition of organic matter at sites where the soils are contaminated with low concentrations of volatiles – note, however, that the EPA does not consider treatment by removing volatile fractions through exposure of the mass to atmosphere to be a legitimate form of bioremediation: refer to Landfarming: Best practice note (EPA 2014) and Soil Bioremediation Guidelines (SA EPA 2005)*
- *off-site controlled soil treatment*
- *off-site controlled remediation of soil at a licensed waste facility and subsequent use as cover material*
- *off-site disposal to a licensed waste facility as contaminated soil as per the NSW Waste Classification Guidelines: Part 1 – Classifying waste (DECC 2009)*
- *'cap and contain' strategy with human health/ecological risk assessment to confirm remediation is appropriate: refer to Guidelines for the Assessment of On-site Containment of Contaminated Soil (ANZECC 1999)*
- *monitored natural attenuation."*

5.4 PREFERRED REMEDIATION OPTION

In consideration of the proposed future development which is expected to comprise at least one basement level, the preferred and most viable option is off-site disposal of any contamination to a licensed waste facility. FEE notes that the contaminated fill will require classification for off-site disposal in accordance with NSW EPA *Waste Classification Guidelines* (reference 9).

6 REMEDIATION METHODOLOGY

This section outlines the scope of the remediation works and provides detail of the proposed methodology of each of the required remediation tasks.

6.1 REMEDIATION SCOPE OF WORK

The scope of remediation works that is required to be undertaken on the site under this RAP comprises the following:

1. Appropriate removal of the contaminant source (i.e. existing UPSS).
2. Assessment of any perched water within the UST tankpit excavations,
3. Pumping out of any perched water within the UST tankpit excavations.
4. Excavation and stockpiling of contaminated soil immediately surrounding the UPSS.
5. Waste classification of the stockpiled soil followed by off-site disposal at a suitably licensed landfill facility.
6. Validation of remediation works and characterisation of materials remaining *in-situ* for preparation of the Validation Report.
7. Preparation of a validation report.

6.2 REMEDIATION METHODOLOGY

The methodologies to be undertaken on the site for the various components of the remediation works are presented in detail in the sections below.

6.2.1 Task 1: Removal of the primary contaminant source (existing UPSS).

Primary contamination refers to the sources of potential fuel contamination, which is the existing UPSS. Removal of the UPSS is to be completed by an experienced contractor in accordance with the following relevant publications:

- ◊ Protection of the Environment Operations (Underground Recoverable Storage Systems) Regulation 2008,
- ◊ AS 4976 (2008): The Removal and Disposal of Underground Recoverable Storage Tanks,
- ◊ AS 1940 – 2004: The Storage and Handling of Flammable and Combustible Liquids

6.2.2 Task 2: Assessment of any perched water within the UST tankpit excavations.

Following removal of the UPSS, any water present within the tankpit excavations will be sampled for assessment prior to treatment and/or off-site disposal. The sample will be analysed for contaminants of concern which are TRH, BTEX, Naphthalene, Ethanol, Methyl *tert*-butyl ether (MTBE)) and Lead.

6.2.3 Task 3: Pumping out of any perched water within the UST tankpit excavations.

Any water that is perched within the tankpit excavations will be extracted and subjected to off-site treatment by a NSW EPA licensed contractor licensed to remove, transport and treat groundwater impacted by petroleum hydrocarbons (e.g. Worths Recycling or similar).

Alternatively a treatment plant will be set up on site to allow treatment of the water before disposal to sewer. This option will require approval by Sydney Water.

6.2.4 Task 4: Excavation and stockpiling of secondary contamination sources (i.e. soil).

Following the removal of the existing UPSS and any perched water, the contaminated soil (secondary source of contamination) will be delineated using odour and the assistance of a calibrated PID. Once delineated, the impacted soil will be excavated under the direction of an experienced environmental scientist or engineer. The material will be stockpiled on a nearby concrete sealed surface and sampled for waste classification purposes prior to off-site disposal at a suitably licenced landfill facility.

6.2.5 Task 5: Waste classification and Disposal of the Excess Soil.

Excavated and stockpiled material will be classified in accordance with NSW Waste Guidelines (reference 9) prior to off-site disposal at a suitably licensed facility. Sampling and analysis will be undertaken as described in Section 8. Once the soil is classified, it will be removed by an appropriately licensed waste transporter. Dockets from tip weighbridges and liquid waste disposal contractors are to be provided as a record of the disposal of the material.

6.2.6 Task 6: Validation of remediation works.

During the removal and replacement of existing infrastructure, GEE will undertake validation sampling and analysis of soil and/or sandstone bedrock in accordance with the requirements of the NSW EPA (2014) *Technical Note: Investigation of Service Station Sites* (reference 8). Further detail about the validation program is provided in Section 8.

6.2.7 Task 7: Preparation of a validation report.

At the completion of the remediation works, a validation report will need to be prepared in accordance with NSW EPA (reference 10) which outlines the results of the remediation works undertaken at the site and an assessment of the suitability of the site for the proposed use.

7 REMEDIATION WORKS CONTINGENCY PLAN

GEE anticipates that remediation methodology described in Section 6 above will ensure that the site is suitable for the proposed land-use. However, the following potential issues and proposed actions will be taken:

Table 2: Contingencies

Issue	Action
1. Failure of the validation testing, indicating a greater amount of contamination than anticipated.	Additional excavation and validation sampling.
2. Generation of unacceptable odours from the excavation works.	Refer to section 11.2
3. The generation of unacceptable levels of dust during excavation and reinstatement works.	Refer to section 11.2
4. Generation of unacceptable noise during site works.	Refer to section 11.3
5. Unexpected find of asbestos containing material (ACM), volatile contamination and unexpected USTs	Refer to section 7.1

7.1 UNEXPECTED FINDS PROTOCOL

During excavation work an experienced contaminated land consultant should be present to ensure that there is no evidence of other contaminants i.e. discolouration, staining, detectable organic odours, residues, asbestos containing material (e.g. fibrous cement sheeting) or underground storage tanks.

If evidence of contamination is observed, the following procedure should be adopted:

- ◊ Cease disturbance of the material.
- ◊ Contact the Site Foreman or appropriate Manager and their environmental consultant/representative.
- ◊ If the asbestos or tank/drum or volatile odour are suspected then adopt the protocols in the following sub-sections. Otherwise, conduct a visual assessment of the potential contamination in the presence of the site foreman / sit manager and collected samples as necessary for analysis by a NATA accredited laboratory. This should include appropriate waste classification if it is to be removed from site,
- ◊ Define the location using a GPS, or measurements from the boundaries or existing structures, which are likely to remain in the long term.

- ◊ While waiting for the results of the assessment, arrange for the area to be barricaded to provide a ten (10) metre exclusion zone. Work can recommence in adjacent areas outside the exclusion zone.
- ◊ Once the results of the assessment are known then the waste material should be removed to a landfill facility licenced to accept the waste.

◊ Cease disturbance of the material.

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◊ If the asbestos or tank/drum or volatile odour are suspected then adopt the protocols in the following sub-sections. Otherwise, conduct a visual assessment of the potential contamination in the presence of the site foreman / sit manager and collected samples as necessary for analysis by a NATA accredited laboratory. This should include appropriate waste classification if removed from site,

◊ Define the location using a GPS or measurements from the boundaries or existing structures which are likely to remain in the long term.

◊ While waiting for the results of the assessment, arrange for the area to be barricaded to provide a ten (10) metre exclusion zone. Work can recommence in adjacent areas outside the exclusion zone.

◊ Once the results of the assessment are known then the waste material should be removed to a landfill facility licenced to accept the waste.

7.1.1 Asbestos

If Asbestos Containing Material (ACM) such as fibrous cement sheeting is detected beneath the surface slab prior to, or during, site development works the following 'Unexpected Finds Protocol' will apply:

1. Upon discovery of suspected ACM, the site manager 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. An Occupational Hygienist or licenced asbestos assessor is to be notified to inspect the area and confirm the presence of asbestos and to determine the extent of remediation works to be undertaken. A report detailing this information would be compiled by the Occupational Hygienist and provided to the Principal (or their representative) and the site manager.

3. The location of the ACM will be surveyed using a GPS or marked out using measurements from the boundaries or existing structures which are likely to remain in the long term. The asbestos waste will be classified in accordance with the NSW EPA's Waste Classification Guidelines (reference 9) and disposed of, as a minimum, as asbestos contaminated waste to a suitably licensed landfill. In dry and windy conditions the stockpile would be lightly wetted and covered with plastic sheet whilst awaiting disposal.
4. All work associated with asbestos in soil would be undertaken by a contractor holding a class A Licence. Under this licence, the contractor is required to notify WorkCover NSW five working days before asbestos removal work is commenced.
5. Monitoring for airborne asbestos fibres is to be carried out during the removal of the asbestos waste.
6. Documentary evidence (weighbridge dockets) of correct disposal is to be provided to the Principal (or their representative).
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. If required, the filling material remaining in the inspected area can be covered/sealed by an appropriate physical barrier layer of non-asbestos containing material prior to sign–off.
8. Validation samples would be collected from the remedial excavation to confirm the complete removal of the asbestos containing materials. If the asbestos pipes/conduits are uncovered, then sampling density would typically comprise one sample per 10-20 linear meter (depending on the length of the pipe). If asbestos debris are found, then the sampling density would typically comprise 1 sample per 5 metre x 5 metre grid.
9. The sampling locations should be surveyed using a GPS or marked out using measurements from the boundaries or existing structures which are likely to remain in the long term.
10. Details are to be recorded in the site record system.
11. Following clearance by an Occupational Hygienist or licenced asbestos assessor, the area may be reopened for further excavation or construction work.

7.1.2 Volatile Contaminants

In the highly unlikely event that significant quantities of volatile compounds are detected, then appropriate gas mitigation strategies may be required.

If impacts due to volatile contaminants are detected in the area to be capped, the nature and extent of the impacts of the volatile contaminants should be established as a first step before an appropriate remedial strategy is to be established. If feasible the source material should be removed for off-site disposal.

7.1.3 USTs

In the unlikely event that another UST is encountered during site works, the structure(s) and any associated pipe-work should be managed / removed as per the existing UPSS and the resulting tankpit excavation validated in the manner outlined in Section 8.

8 VALIDATION PLAN

A validation plan will be implemented on the site to ensure that RAP has been followed and that the remediation goal has been achieved. The purpose of the validation plan is to develop a framework for the validation of the site to verify the suitability of the site for the proposed use.

Requirements for the sampling and analytical plan, sampling methodology and quality control/quality assurance procedures to be adopted for the validation works are presented below.

8.1 SCOPE OF THE VALIDATION WORKS

The scope of work that is required to be undertaken during the validation on the site comprises the following:

1. Field screening soil contamination.
2. The sampling and analysis of the soil surrounding and beneath the UPSS infrastructure resulting from the remediation works, and
3. Preparation of a Validation Report.

8.2 FIELD SCREENING OF SOILS

Field screening will be required in order to delineate the lateral and vertical extent of any TPH-impacted soil around the site, including within the UST tankpits and beneath other UPSS infrastructure. Field screening will be used to reduce delays of several days associated with laboratory testing, and helps to ensure that residual contamination is detected during the excavation.

Field screening will be conducted using a Flame Ionisation Detector (FID), Photo-Ionisation Detector (PID) or similar instrument capable of measuring Volatile Organic Compounds (VOCs) in air. An appropriately trained person will operate the instrument in accordance with the documented GEE procedure using the controlled headspace method. Full documentation relating to the calibration of the instrument, the samples analysed in relation to gas screening results and site observations, will be provided. These results will be compiled and presented in the validation report. NOTE: Field screening data from FIDs/PIDs must be verified by laboratory data.

Following removal of the UPSS infrastructure, the appointed environmental scientist will make regular field screening and visual inspection of the fuel line excavations to demonstrate impact has been adequately chased out. Visual inspection will be conducted on the entire length of the fuel line excavation while field screening samples will be collected every 5 m for head-space VOC monitoring using a calibrated PID meter. If the PID result exceeds 50 ppm, additional material will be removed and separated for bioremediation or treatment with Biosolve. Results below 50 ppm will be considered acceptable, however, validation samples for chemical analysis will be required for confirmation.

If PID screening levels within the tank pit excavation and under the removed associated infrastructure are above 50 ppm, additional material will be removed in 100 mm increments across the area between the screening point and the adjacent field screening points and will then be re-screened.

8.3 SOIL SAMPLING AND ANALYTICAL PLAN

Once field screening, together with visual and olfactory observations, indicate that contaminated material has been removed from the excavations, validation samples will be collected to confirm whether adequate remediation has been accomplished.

Also, in accordance with AS4482 - Part 2 (reference), Quality Control (QC) samples will be collected as appropriate (refer to Section 8.4.1).

8.3.1 Sampling Locations and Frequency

Validation sampling requirements for the site will be undertaken in general accordance with the NSW EPA *Technical Note: Investigation of Service Station Sites* (reference 8). It should be noted that additional material will need to be removed if the initial round of validation sampling yields results that do not conform to the RAC (refer to Section 9). In addition, if particular evidence of potential contaminants other than TRH and BTEX are identified during the remediation works, samples of this material will be collected and analysed for an expanded suite of analytes.

8.3.2 Sampling Methodology

Samples should be collected in accordance with the documented GEE procedure by appropriately trained staff to ensure that they are collected in a consistent manner and in accordance with internal GEE QA/QC requirements.

General soil sampling procedures are summarised below:

1. Label sample containers with unique sample identification, project details, date and sampling personnel;
2. Decontaminate sampling equipment using phosphate-free detergent solution (Decon 90) followed by a distilled water rinse;
3. Collect samples in laboratory-prepared glass jars with Teflon-lined lids in accordance with USEPA methods SW846, using a decontaminated stainless steel trowel;
4. Complete record of samples collected and Chain of Custody form;
5. Place samples in coolers containing ice bricks;
6. Seal coolers with security seal at the conclusion of sampling;
7. Transport samples to the analytical laboratory under GEE chain of custody; and
8. Sample holding times, container and preservation requirements are to be in accordance with laboratory specifications.

8.4 QUALITY ASSURANCE

Quality Assurance (QA) involves all of the actions, procedures, checks and decisions undertaken to ensure the representativeness and integrity of samples and accuracy and reliability of analysis results (reference 12).

In accordance with reference 13 and 14, a series of QA procedures will be integrated within the sampling and analysis plan and include:

◊ The collection of Quality Control (QC) samples (i.e. blind replicates).

◊ The use of standardised field sampling forms developed by GEE.

◊ Documentation of calibration and use of field instruments.

To ensure QA in the field, samples will be collected by experienced and trained personnel using appropriate methods detailed herein, including appropriate sample handling, containment and transport, and calibrated equipment.

To ensure QA in the laboratory, GEE intend to use laboratories that are NATA accredited for the analytical tests carried out, therefore it is reasonable for GEE to rely on the laboratories to be proficient in all tests conducted. This encompasses all actions,

procedures, checks and decisions undertaken, to ensure the accuracy and reliability of the analysis results.

To measure the effectiveness of the QA procedures Quality Control (QC) samples will be collected and analysed as described below.

8.4.1 Quality Control

QC involves those parts of QA which serve to monitor and measure the effectiveness of QA procedures. QC samples assess sample integrity, accuracy and precision and can be separated into field and laboratory QC.

Table 3 provides a description and objective of each of the field and laboratory QC samples to be used during the remediation program.

Table 3: QC Sample Types, Descriptions and Frequency of Analysis

Type	Description	Purpose	Recommended Frequency
	FIELD QC SAMPLES		
Blind Replicate	A sample collected at the same time and from the same sampling point as the corresponding primary sample[3], and analysed at the same laboratory. Blind replicates are collected, preserved, stored, transported and analysed in the same manner as the primary sample, with the laboratory having no knowledge of the source of the replicate sample. The assessment of blind replicates samples is undertaken by calculating the Relative Percent Difference (RPD) which is defined as: $RPD\ (\%) = 100 \times \frac{\text{Result No. 1 – Result No. 2}}{\text{Mean Result}}$	Used to evaluate total sampling and analysis precision and, in the case of soil samples, sample variability.	In accordance with AS4482.1 (reference **13**) and NEPM (reference **14**) it is recommended that 1 blind replicate sample is collected for every 20 primary samples.
Split Duplicate	A sample collected at the same time and from the same sampling point as the corresponding primary sample, and analysed at a separate laboratory. Split duplicates are collected, preserved, stored, transported and analysed in the same manner as the primary sample, with the laboratories having no knowledge of the purpose of the sample. The assessment of split duplicates samples is undertaken by calculating the Relative Percent Difference (RPD) which is defined as: $RPD\ (\%) = 100 \times \frac{\text{Result No. 1 – Result No. 2}}{\text{Mean Result}}$	Used to provide a check on the analytical proficiency of the laboratories and hence precision and comparability.	In accordance with AS4482.1 (reference **13**) and NEPM (reference **14**) it is recommended that 1 split duplicate sample is collected for every 20 primary samples.
Trip Blank	Trip blanks are laboratory supplied test samples of analyte-free media (either washed sand or de-ionised water) which remain in the sample storage eskies during sampling activities and returned to the laboratory unopened. For soil sampling programs, the trip blank consists of acid-washed quartz sand that has been heated to 400ºC. For water sampling programs trip blanks comprise pre-washed glass vials containing distilled or de-ionised water with appropriate preservatives. The USEPA has shown that cross-contamination only occurs with volatile organics (reference 12), therefore, trip blanks are only analysed for volatile organics.	Used to measure cross-contamination during sampling, transport, sample preparation and analysis.	Industry standard is 1 trip blank per batch of primary samples.

[3] Primary samples are the original representative samples of soil or groundwater collected for analysis to determine aspects of their chemical composition. Primary samples are the original sample taken from a particular location and other samples from the same location are duplicates, replicates or splits.

Table 3 (Continued)**:** QC Sample Types, Descriptions and Frequency of Analysis

Trip Spike	Trip spikes, like trip blanks, are supplied by the primary laboratory using analyte-free media (either washed sand or de-ionised water) and remain in the sample storage eskies during sampling activities and returned to the laboratory unopened. The sample media, however, is spiked with BTEX. For water sampling programs the BTEX concentration is known and standardised by each laboratory, while for soil sampling programs the exact spike concentration is not known, rather two identical jars of sand are spiked the same concentration with one sample becoming the trip-spike and the other becoming a control sample, which remains in a refrigerator at the laboratory. The trip spike is analysed after returning from the field and the % recovery of the known spike (for water sampling programs), or of the control sample (for soil sampling programs), is calculated.	Used to monitor VOC losses during transit.	Industry standard is 1 trip spike per batch of primary samples where volatile concentrations are being measured.
	LABORATORY QC SAMPLES		
Laboratory Duplicate	Laboratory duplicates are field samples which are prepared and analysed in the same manner twice. The assessment of laboratory duplicates is undertaken by calculating the (RPD) which is defined as: $\text{RPD (\%)} = 100 \times \frac{\text{Result No. 1 – Result No. 2}}{\text{Mean Result}}$	Determines analytical precision for a sample batch	NATA specifies 1 per 10 samples for trace element and inorganic analysis
Laboratory Control Sample (LCS)	Laboratory Control Samples (LCS) are analyte-free matrices (de-ionised water or clean sand) spiked with a known concentration of target analytes and carried through the entire preparation and analysis. Assessment of LCS is undertaken by calculating the percent recovery (%R) of the spike which is defined as: $\text{Percent Recovery (\%R)} = 100 \times \frac{\text{Spikes Sample Result (SSR) – Sample Result (SR)}}{\text{Concentration of Spike Added (SA)}}$	Determines analytical accuracy and precision for a batch of samples	NATA specifies 1 per batch of up to 20 samples
Surrogates	Surrogates are organic compounds added to field samples and laboratory QC samples prior to preparation. They are similar in chemical behavior to the target analytes and are not expected to be present in samples. They form part of the laboratory QC for organic analyses, and are used to indicate the presence of sample specific interferences. The surrogate is added at the extraction stage then analysed with the batch of samples. Like LCSs, surrogates are assessed by calculating the percent recovery (%R), although the definition is slightly different as shown below: $\text{Percent Recovery (\%R)} = 100 \times \frac{\text{Spiked Sample Result (SSR)}}{\text{Concentration of Spike Added (SA)}}$	Used to demonstrate that the surrogate does not interfere with the target analytes, therefore determines analytical accuracy for each sample	Added to every blank, field and laboratory QC sample

Table 3 (Continued)**:** QC Sample Types, Descriptions and Recommended Frequency of Analysis

Type	Description	Purpose	Recommended Frequency
	LABORATORY QC SAMPLES		
Matrix Spikes	Field samples spiked with a known concentration of a target analytes and carried through the entire preparation and analysis. Matrix spike samples are assessed by calculating the percent recovery (%R) of the spike which is defined as: $\text{Percent Recovery (\%R)} = 100 \times \frac{\text{Spikes Sample Result (SSR)} - \text{Sample Result (SR)}}{\text{Concentration of Spike Added (SA)}}$	Determine the effects of matrix interferences on analytical accuracy of a sample.	Performed at least 1 per batch of up to 20 samples.
Method Blank	Method blanks are an analyte-free matrices (reagent water or clean sand) that is carried through the entire preparation and analysis.	Establishes that laboratory contamination does not cause false positives.	Prepared with every batch of up to 20 samples for all organic and inorganic analyses.

8.4.2 Evaluation of QC Sample Results

The QC Acceptance Criteria adopted for this investigation is provided in **Table 4** and is in general accordance with AS4482.1 (reference 13) and NEPC (reference 14).

Table 4: QC Sample Acceptance Criteria

QC Sample	Criteria / Acceptable Range
FIELD QC SAMPLES	
Blind Replicates	RPD < 50 % When average concentration is > 10 x LOR/PQL[4] RPD < 75 % When average concentration is 5 to 10 x LOR/PQL RPD < 100 % When average concentration is< 5 x LOR/PQL
Trip Blank	Analytical Result < LOR/PQL
Trip Spike	± 30%
LABORATORY QC SAMPLES	
Laboratory Duplicates	RPD < 30 % When average concentration is > 10 x LOR/PQL RPD < 50 % When average concentration is 4 to 10 x LOR/PQL RPD < 100 % When average concentration is< 4 x LOR/PQL
Laboratory Control Samples	%R of 70 – 130% (General analytes) %R of 50 – 130% (Phenols) %R of 60 – 130% (OCP/OPPs) %R of 62 – 130% (Chromium)
Surrogates	%R of 70 – 130% (General analytes) %R of 50 – 130% (Phenols) %R of 60 – 130% (OCP/OPPs)
Matrix Spikes	%R of 70 – 130% (General analytes) %R of 50 – 130% (Phenols) %R of 60 – 130% (OCP/OPPs) %R of 62 – 130% (Chromium)
Method Blanks	Analytical Results < LOR/PQL

If data do not meet the QC Acceptance Criteria then a judgement is made as to whether the exceedance is critical in relation to the suitability of the data set. Otherwise the following steps will be taken:

◊ Request that the laboratory re-check or even re-analyse the sample.

◊ Inspect the sample for anomalies which may be causing the failure.

◊ If necessary, undertake additional sampling and analyses.

[4] Both the LOR and PQL are interchangeable terms used by laboratories and is defined as the lowest concentration that can be reliably achieved within specific limits of precision and accuracy during routine laboratory operating conditions (Popek, 2003 – reference 16).

8.5 VALIDATION REPORT

Consistent with NSW OEH requirements, a validation report will be prepared at the conclusion of remediation works. The validation report, prepared in accordance with the requirements of EPA guidelines (reference 10), will outline the results of the remediation works undertaken at the site and an assessment of the suitability of the site for the proposed use.

9 REMEDIATION ASSESSMENT CRITERIA

To determine the success of the proposed remediation plan it is necessary to define appropriate Remediation Assessment Criteria (RAC).

9.1 SOIL REMAINING ON-SITE

For any site, it is necessary to assess the human health and ecological risks associated with the presence of site contamination. Also, in accordance with Appendix I of DEC, 2006 guidelines (reference 6), residential sites need to address aesthetics such as highly malodorous soils.

9.1.1 Aesthetics

Aesthetics will be assessed in the field during an inspection of the site and during validation sampling. Validation of the site will not only be based on chemical test results but the remaining soil will need to be free of adverse odour.

9.1.2 Ecological Risk

To address potential ecological risks, GEE will compare the soil analytical results against the Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs) appropriate for the land-use as detailed in NEPM (2013), *Schedule B(1) – Guidelines on Investigation Levels for Soil and Groundwater* (reference 17).

Ecological Investigation Levels (EILs)

EILs were derived for common contaminants in soil (specifically Arsenic, Copper, Chromium (III), DDT, naphthalene, Nickel, Lead and Zinc) and are based on a species sensitivity distribution (SSD) model developed for Australian conditions. They consider the physicochemical properties of soil (e.g. Cation Exchange Capacity, pH and clay content), contaminants and the capacity of the local ecosystem to accommodate increases in contaminant levels (referred to as the 'added contaminant limit' or ACL) above ambient background. Also, EILs consider various land use scenarios and generally only apply to the top 2m of soil which corresponds to the root zone and habitation zone of many species.

Finally, different EILs apply for 'fresh' contamination and 'aged' contamination. 'Fresh' contamination is usually associated with current activity and chemical spills, while a contaminant that has been incorporated into a soil for more than 2 years is considered to be 'aged'. For the purpose of this report 'aged' EILs have been adopted because any contamination present at the site is likely to have been present for more than 2 years.

To assist with determining appropriate EILs to screen the soil analytical results, particularly for Copper, Chromium -III, Nickel and Zinc, the Cation Exchange Capacity (CEC) and pH of the soil was analysed for each of the samples. The CEC values from the Stage 1 and 2 ESA ranged from <1.0 to 29.0 meq/100g, while the pH values ranged from 3.5 to 9.6. For the purpose of this screening the validation results, GEE has adopted the lowest values for both CEC and pH which was a CEC of 1.0 meq/100g and pH of 3.5. Additionally, a value of 1% clay composition has been adopted when determining the EIL for chromium (III).

When determining the EILs for Copper, Nickel, Chromium and Zinc, ambient background concentrations can be used to increase the final EIL, however, for the purpose of this investigation zero ambient background concentrations have been adopted.

The broad land-use scenarios are areas of ecological significance, urban residential/ public space, and commercial/industrial. Each land-use scenario assumes different exposure scenarios and are generally based on the primary land-use activity of the exposed soils (i.e. any deep soil areas). For the proposed development, which includes a basement, commercial land-use on ground floor with residential living areas above, the most appropriate land use scenario is commercial / industrial, however, to be conservative, residential land-use has been adopted.

A summary of the EILs appropriate for the site is provided in **Table 5**.

Ecological Screening Levels (ESLs)

ESLs have been developed for selected petroleum hydrocarbon compounds (specifically TRH[5], BTEX and Benzo(a)pyrene) and are applicable for assessing risk to terrestrial ecosystems. ESLs broadly apply to coarse- and fine-grained soils and like EILs the ESLs consider various land use scenarios, only apply to the top 2m of soil and differ for 'fresh' contamination and 'aged' contamination. For the purpose of this report, coarse-grained soil and 'aged' ESLs have been adopted. Coarse grained soil was adopted over fine grained soil because it provides the most conservative criteria and if an exceedance occurs then the criteria will be adjusted to suit the actual soil type.

[5] ESLs for the various carbon fractions are based on TRH analysis with F1 (C6-C9) being obtained after subtraction of BTEX.

With respect to land-use, residential ESLs have been adopted and like with EILs, these are considered to be conservative considering the proposed development is expected to include a basement with commercial tenancies on ground floor.

A summary of the ESLs appropriate for the site is provided in **Table 5.** GEE notes that screening levels are the concentrations of a contaminant above which will require further evaluation and consideration.

9.1.3 Human Health Risk

To address potential health impacts at the site, GEE will compared the analytical results against Health Investigation Levels (HILs) and Health Screening Levels (HSLs), provided in NEPM (2013), *Schedule B(1) – Guidelines on Investigation Levels for Soil and Groundwater* (reference 17).

Health Investigation Levels (HILs)

The HILs are scientifically based, generic assessment criteria to be used as a first stage (or tier 1) screening of potential risks to human health from chronic exposure to contaminants. They are intentionally conservative and are based on four different and generic land use scenarios (i.e. HIL-A described as residential with accessible soils, HIL-B which includes residential with minimal opportunities for soil access, HIL-C for public space such as parks and HIL-D for commercial/industrial sites). Each land-use scenario assumes different exposure scenarios and when land is used for more than one purpose, the HILs that are relevant to the more sensitive land-use should be adopted. In this regard, the most appropriate land-use scenario is HIL-B.

HILs for soil contaminants are provided in Table 1A(1) of the NEPM guidelines and includes metals, PAHs, Pesticides and PCBs. Petroleum hydrocarbons are not included.

A summary of the HILs appropriate for the site is provided in **Table 5**.

Health Screening Levels (HSLs)

Health Screening Levels (HSLs) were developed for selected petroleum hydrocarbons (specifically TRH $C_6 – C_{10}$ or F1 fraction, TRH $>C_{10} – C_{16}$ or F2 fraction and BTEX) by the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) and have been adopted and are referenced in Schedule B(1) of NEPM (2013 – reference 17) and Friebel & Nadebaum (2011 – reference 18).

The assessment of petroleum hydrocarbon contamination is primarily driven by human health concerns relating to volatile components (e.g. TRH $C_6 – C_{10}$, TRH $>C_{10} – C_{16}$ and Benzene) which have the potential to cause health issues via vapour intrusion. HSLs also apply for direct human contact (Table A4 – reference 18) but only where this is likely.

For vapour intrusion and direct contact, different HSLs apply for different land use scenarios, different soil types (i.e. sand, silt and clay) and different depths. For the purpose of this investigation, criteria relevant for shallow (0m to 1m) sandy soils has been adopted to screen the soil analytical results because they are most conservative. If a sample exceedance occurs at greater depth then the criteria will be adjusted to suit.

With respect to land-use there are four scenarios:

◊ HSL-A for low density residential sites

◊ HSL-B for high density residential sites

◊ HSL-C for recreational/open space areas

◊ HSL-D for commercial and industrial sites

The land use setting is based on ground floor occupation because if the vapour exposure is acceptable at ground level then it can be assumed to be acceptable on the floors above. As previously mentioned it is proposed to construct a mixed-use development with commercial land-use at ground level and a one or two level basement. In this regard HSL-D is considered to be appropriate.

Where there is a HSL for vapour intrusion as well as direct contact, the lowest criteria has been adopted, which is the vapour intrusion HSLs. Where there are no direct contact or vapour intrusion HSLs available, GEE has adopted management limits (Table 1B(7) – reference 17) which apply for TRH. The management limits are designed to avoid or minimise potential effects of petroleum hydrocarbons including:

◊ The formation of observable light non-aqueous phase liquids (LNAPL),

◊ Fire and explosive hazards, and

◊ The effects on buried infrastructure e.g. penetration of, or damage to, in-ground services by hydrocarbons.

Again, there are different management limits for the various land use scenarios and GEE has adopted the management limits appropriate for high density residential sites have been adopted. Finally, where there are HILs or management limits available for a

particular contaminant, GEE has adopted HSLs recommended for direct contact on high density residential sites (Table A4 – reference 17). A summary of the petroleum hydrocarbon HSLs adopted for the site is provided in **Table 5**.

Table 5: Soil Site Assessment Criteria (SAC)

Analyte	Health Investigation/Screening Levels (HILs/HSLs) (mg/kg)		Ecological Investigation/Screening Levels (EILs/ESLs) (mg/kg)	
	HIL-B / HSL-D	Reference	**Residential EIL/ESL**	Reference
Total Metals				
Arsenic	500	Table 1A – Reference 17	100	Table 1B(5) – Reference 17
Cadmium	150	Table 1A – Reference 17	--	--
Chromium (VI)	500	Table 1A – Reference 17	--	--
Chromium (III)	--	--	190	Table 1B(3) – Reference 17
Copper	30,000	Table 1A – Reference 17	35	Table 1B(2) – Reference 17
Lead	1,200	Table 1A – Reference 17	1,100	Table 1B(4) – Reference 17
Mercury (inorganic)	120	Table 1A – Reference 17	--	--
Nickel	1,200	Table 1A – Reference 17	6	Table 1B(3) – Reference 17
Zinc	60,000	Table 1A – Reference 17	95	Table 1B(1) – Reference 17
Polycyclic Aromatic Hydrocarbons (PAHs)				
Naphthalene	11,000	Table 1A(3) – Reference 17	170	Table 1B(5) – Reference 17
BTEX				
Benzene	3	Table 1A(3) – Reference 17	50	Table 1B(6) – Reference 17
Toluene	99,000	Table 1A(3) – Reference 17	85	Table 1B(6) – Reference 17
Ethylbenzene	27,000	Table 1A(3) – Reference 17	70	Table 1B(6) – Reference 17
Xylenes	230	Table 1A(3) – Reference 17	45	Table 1B(6) – Reference 17
Total Recoverable Hydrocarbons (TRH)				
(F1) C6 – C10	260	Table 1A(3) – Reference 17	180	Table 1B(6) – Reference 17
(F2) >C10 - C16	1,000	Table 1A(3) – Reference 17	120	Table 1B(6) – Reference 17
(F3) >C16 – C34	3,500	Table 1A(3) – Reference 17	300	Table 1B(6) – Reference 17
(F4) >C34 – C40	10,000	Table 1B(7) – Reference 17	2,800	Table 1B(6) – Reference 17

9.2 GROUNDWATER REMAINING ON SITE

Assessment criteria for water samples were derived from the NEPM (2013), *Schedule B(1) – Guidelines on Investigation Levels for Soil and Groundwater* (reference 17) which are based on the ANZECC/ARMCANZ (2000) *water quality guidelines (reference* 19*)*. However, with respect to specific petroleum hydrocarbons the assessment criteria provided in NEPM (2013) are based on Health Screening Levels (HSLs) developed by the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) and published by Friebel & Nadebaum (2011 – reference 18).

Typically the assessment of petroleum hydrocarbon contamination is driven by human health concerns relating to volatile components (e.g. TRH $C_6 – C_{10}$ (F1), TRH $>C_{10} – C_{16}$ (F2), BTEX and Naphthalene) which have the potential to cause health issues or explosive risks via vapour intrusion. The HSL criterion depends on the soil type, the depth to groundwater and land-use scenario where the groundwater exists. The HSLs change depending on the soil type and depth to groundwater and for the purpose of this assessment GEE have adopted the most conservative criteria which relates to sand and a depth of less than 2.0 metres. Also, an exposure scenario of residential land use with limited accessible soil (HSL-B) has been adopted, which is considered conservative for the proposed development.

For other analytes not covered by HSLs, GEE has adopted the Groundwater Investigation Levels (GILs) which are derived from the from ANZECC/ARMCANZ (2000) *water quality guidelines (*reference 19). GILs for fresh water were adopted for this study rather than marine water guidelines, on the basis that the receiving system for groundwater at the site is most likely to be either Wolli Creek or Bardwell Creek. Also the electrical conductivity of the water within the groundwater wells was relatively low. A search of registered groundwater bores in the vicinity of the site did not reveal any drinking water extraction wells and therefore drinking water guidelines levels were not appropriate.

ANZECC/ARMCANZ (2000) specifies four sets of trigger values corresponding with different levels of protection for ecosystem conditions. Trigger values, derived using the statistical distribution method, relate to the protection of 99%, 95%, 90% and 80% of species in an aquatic ecosystem. Three "categories of ecosystem conditions" are developed in the guidelines and the level of protection afforded to a particular ecosystem should be determined following consideration of site conditions in consultation with key stakeholders. Additionally, for each chemical, ANZECC/ARMCANZ (2000) provides three grades of guideline trigger values: high, moderate or low reliability trigger values. The

grade depends on the data available and hence the confidence or reliability of the final figures.

The groundwater investigation levels (GILs) in NEPM (2013) relate to "slightly to moderately disturbed" aquatic ecosystems and adopt trigger values based on a 95% level of protection, however, this is increased to 99% for some chemicals that have the potential to bioaccumulate or where the 95% value may not provide sufficient protection for key species. In the absence of high or moderate reliable fresh water criteria, GEE has adopted the high or moderate reliable criteria for marine water. Then, in the absence of high or moderate trigger values, GEE has applied low reliability trigger levels from ANZECC/ ARMCANZ (2000) as 'first pass' criteria. It should be noted that low reliability trigger values were originally derived from insufficient data sets and should not be used as final guidelines but as indicative interim figures, which if exceeded, suggest the need to obtain further data.

Finally, in all cases where the laboratory limit of reporting exceeds the ANZECC/ARMCANZ (2000) trigger value, the detection limit of that analyte is used as a trigger for further investigation.

A summary of the Groundwater Assessment Criteria (GAC) adopted for this site is provided in **Table 6**.

Table 6: Groundwater Assessment Criteria (GAC)

Analyte	Units	**GILs [1]**	**Source**
Metals			
Arsenic V	µg/L	13	Table 1C (fresh) - Reference 17
Cadmium	µg/L	0.2	Table 1C (fresh) - Reference 17
Chromium VI	µg/L	1	Table 1C (fresh) - Reference 17
Copper	µg/L	1.4	Table 1C (fresh) - Reference 17
Lead	µg/L	3.4	Table 1C (fresh) - Reference 17
Nickel	µg/L	11	Table 1C (fresh) - Reference 17
Zinc	µg/L	8	Table 1C (fresh) - Reference 17
Mercury (inorganic)	µg/L	0.06	Table 1C (fresh) - Reference 17
Polycyclic Aromatic Hydrocarbons (PAHs)			
Naphthalene	µg/L	16	Table 1C (fresh) - Reference 17
Phenols			
Phenol	µg/L	*320*	Table 1C (fresh) - Reference 17
Total Petroleum Hydrocarbons (TPH)			
(F1) C6 – C10	µg/L	1,000 [2]	Table 1A(4) - Reference 17
(F2) >C10 - C16	µg/L	1,000 [2]	Table 1A(4) - Reference 17
(F3) >C16 – C34	µg/L	--	--
(F4) >C34 – C40	µg/L	--	--
BTEX			
Benzene	µg/L	800	Table 1A(4) - Reference 17
Toluene	µg/L	*180*	Reference 19 (fresh)
Ethylbenzene	µg/L	*80*	Reference 19 (fresh)
para-Xylene	µg/L	200	Table 1C (fresh) - Reference 17
ortho-Xylene	µg/L	350	Table 1C (fresh) - Reference 17

Notes:

[1] Criteria shown in italics are low reliability trigger values used as a first pass assessment in the absence of more reliable trigger values.

[2] Criteria depends on the type of soil and depth of sample. Criteria adopted is for sandy soil which is the most conservative and residential land use (HSL-B).

NL – Criteria Not Limiting

9.3 ASSESSMENT OF EXCAVATED MATERIAL FOR OFF-SITE DISPOSAL

Prior to removing soil from site it will require classification. Waste classification criteria have been adopted from the NSW EPA (2014) *Waste Classification Guidelines Part 1: Classifying Waste* (reference 9 – herein referred to as the *'Waste Guidelines')*. Under the *Waste Guidelines*, non-liquid waste may be classified in the following groups:

- ◊ General Solid Waste (Putrescibles);
- ◊ General Solid Waste (Non-putrescibles);
- ◊ Restricted Solid waste;
- ◊ Hazardous Waste; and
- ◊ Special Waste.

The *Waste Guidelines* contain a classification process for liquid and non-liquid waste. The process includes the comparison of total or Specific Contaminant Concentrations (SCC) with Contaminant Threshold (CT) values. The CT values are highly conservative and are based on the assumption that all the contaminants present in a sample are leachable and would leach completely. CT values are used largely in the early stages of waste-classification activities.

The waste classification process can also involve the determination of leachable contaminant concentrations using the TCLP. In this stage of the process, both SCC and leachable concentrations are used to classify waste. The waste classification can be determined jointly by SCC and leachable concentrations. It should be noted that in the instance that either SCC or leachable concentration criteria for one contaminant are exceeded, then the higher waste category must be adopted. SCC values for waste classification refer to total contaminant concentrations measured as part of the investigation.

Waste criteria for contaminants measured as part of the remediation works are presented in **Table 7.**

Table 7: Waste Classification Criteria[1]

Parameter	Maximum Values of Specific Contaminant concentrations for classification without TCLP		Maximum Values for Leachable (TCLP) Concentration and Specific Contaminant Concentration (SCC)			
	General Solid Waste	Restricted Solid Waste	General Solid Waste		Restricted Solid Waste	
	CT1 mg/kg	CT1 mg/kg	SCC1 mg/kg	TCLP1 mg/L	SCC2 mg/kg	TCLP2 mg/L
Metals						
Arsenic	100	400	500	5	2000	20
Cadmium	20	80	100	1	400	4
Chromium (VI)	100	400	1900	5	7600	20
Lead	100	400	1500	5	6000	20
Mercury	4	16	50	0.2	200	0.8
Nickel	40	160	1050	2	4200	8
TRH						
TPH C_6-C_9	---[4]	---[4]	650	N/A [2]	N/A [2]	N/A [2]
TPH C_{10}-C_{36}	---[4]	---[4]	10,000	N/A [2]	N/A [2]	N/A [2]
BTEX						
Benzene	10	40	18	0.5	72	0.2
Toluene	288	1152	518	14.4	2073	57.6
Ethylbenzene	600	2400	1,080	3	4320	120
Total Xylenes	1000	4000	1,800	5	7200	200
PAHs						
Benzo(a)pyrene	0.8	3.2	10	0.04	23	160
Total PAHs	---[4]	---[4]	200	N/A [2]	800	N/A [2]
Other Chemicals						
Scheduled Chemicals [3]	---[4]	---[4]	<50	N/A [2]	<50	N/A [2]

Note 1: NSW EPA (2014) Waste Classification Guidelines (Part 1 - Tables 1, 2 and 3)
Note 2: TPH, Total PAHs and scheduled chemicals are evaluated on the basis of total concentrations (SCC) only. No TCLP required
Note 3: Scheduled chemicals include some pesticides. The sum of the SCC for all of the scheduled chemicals must not exceed the criteria
Note 4: Assessed using SCC only

10 INTERIM SITE MANAGEMENT PLAN (SITE PREPARATION)

10.1 SERVICES AND UTILITIES

The only underground service on the site is a sewer pipe, the location of which is known and will be avoided.

10.2 SITE SECURITY, RESTRICTED ACCESS AND SIGNAGE

Access to site will be restricted during site redevelopment works as required by Council Development Application conditions.

10.3 STORMWATER CONTROL MEASURES

No stormwater control measures are proposed during the site preparation phase since it is expected that the transportation of contaminated soil will occur immediately after excavation and there will be no need to form stockpiles for any length of time.

10.4 OCCUPATIONAL HEALTH & SAFETY PLAN

A Workplace Health and Safety Plan (WASP) will be prepared for all personnel and contractors performing on-site works associated with this RAP. Contractors would be required to read and understand the WASP, however, contractors would be responsible for formulating and monitoring their own Health and Safety.

All work associated with the decommissioning and remediation of the site would conform at a minimum, to the requirements of the NSW Occupational Health and Safety Act.

10.5 LICENCES AND APPROVALS

No specific licences and approvals are required for the remediation work proposed. However, for Category 2 remediation work Council will need to be notified 30 days prior to commencing remediation (i.e. removal of the fill layer). Also, according to Marrickville Councils DCP 2011, *The notification for the Category 2 remediation works must:*

i. Provide the name, address and telephone number of the person who has the duty of ensuring that the notice is given;

ii. Provide details of the remediation work (including a RAP, where appropriate, and a soil and water management plan);

iii. Explain why the work is Category 2 remediation work by reference to SEPP 55 and this DCP;

iv. Specify the land on which the work is to be carried out and provide a map of the location of the land; and

v. Estimate the dates for the commencement and completion of the work.

10.6 COMMUNITY RELATIONS PLAN / CONSULTATION

A community relations plan is not considered necessary for the site.

11 SITE MANAGEMENT PLAN (OPERATIONAL PHASE)

Remediation works shall be conducted in a manner that minimises environmental impacts and that meets statutory requirements. Site works should comply with the following legislation:

- ◊ Contaminated Land Management Act (1997);
- ◊ Contaminated Land Management Amendment Act (2008);
- ◊ Protection of the Environment Operations Act (1997);
- ◊ Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation (2008);
- ◊ Environmentally Hazardous Chemicals Act (1985);
- ◊ Dangerous Goods Act (1975);
- ◊ Waste Avoidance and Resource Recovery Act (2001);
- ◊ Clean Air (Plant and Equipment) Regulation (1997);
- ◊ Occupational Health and Safety Act (2001); and
- ◊ Local Government Act (1993).

The contractor shall endeavour to:

1. Minimise fugitive dust emissions;
2. Minimise the volume of water containing suspended sediment leaving the site;
3. Prevent vehicles from tracking mud on local roads; and
4. Ensure that noise and vibration levels conform to legislative requirements.

A preliminary site management plan is provided below.

11.1 STORMWATER MANAGEMENT

Stormwater will be diverted away from excavations by a series of bunds to be retained until excavations are backfilled or until permanent stormwater infrastructure is installed on the site. Similarly, low (nominal 0.5 m) earthen bund walls will be constructed around stockpiles (where placed in uncovered areas of the site) to prevent the erosion and off site transport of contaminated soil. Management measures for the site will include:

- ◊ Stormwater diversion bunds and appropriate erosion controls around excavations (as required) and stockpiles;
- ◊ Minimising surface disturbance and maximising the retention of existing surface cover (pavements) during the works;
- ◊ Stockpiles to be located away from concentrated stormwater flow paths including drainage lines, gutters or stormwater pits and inlets;
- ◊ No stockpiles to be placed on footpaths unless prior Council approval has been obtained;
- ◊ Construction of sediment controls downstream of diversion bunds, stockpile and traffic areas to minimise the off-site migration of sediment; and
- ◊ Soil, earth and mud shall be removed from the roadway by sweeping, shovelling or a means other than washing on a daily basis or as required.

If required, stormwater at site discharge points will be inspected on each day of discharge. Where necessary, samples will also be collected during the works where necessary. Samples will be analysed for Total Suspended Solids (TSS) and Total Oil and Grease (TOG). Corrective action will be required if concentrations of these parameters exceed 50 and 10 mg/L respectively.

Hay bales will be installed around excavations, stockpiles and stormwater pits in accordance with Landcom (2004) requirements (reference 17). Visually contaminated seepage water in the excavations will be removed by a licensed liquid waste contractor for disposal. Seepage without visible signs of contamination (*e.g.*, oily sheen) may be pumped onto stockpiles for dust suppression or directly into the stormwater system subject to Council approval. Excavation pump-outs must be sampled and analysed for pH, concentrations of TSS, TOG and priority contaminants. Analytical results must comply with relevant EPA and ANZECC standards for water quality prior to discharge. Limit concentrations for TSS and TOG of 50 and 10 mg/L respectively may be adopted. Council may impose additional discharge criteria for water released into the stormwater system at the site.

11.2 CONTROL OF DUST AND ODOUR

Works will be undertaken in a manner that minimises fugitive dust and odour emissions.

Measures to control dust and odour will include:

- ◊ Careful handling of material in a manner that minimises dust emissions;
- ◊ Placement of screening material (*e.g.*, hessian) on perimeter fences adjacent to excavations;
- ◊ Water spraying across dusty areas of the site;
- ◊ Keeping excavations moist (where practical);
- ◊ The use of tarpaulins or similar to cover loads (incoming and outgoing); and
- ◊ The restriction of stockpile heights to less than 2 m.

Where visual inspection indicates that dust levels may be unacceptable, work will cease until measures are taken to reduce emissions or until weather conditions improve. The site supervisor will be responsible for dust management.

Local Government requirements state that no odours shall be detected at the site boundary during remedial works by an authorised Council officer relying solely on the sense of smell. The following procedures may be engaged in order to minimise odours:

- ◊ Covering of stockpiles (where practical);
- ◊ Use of fine mist sprays and hydrocarbon mitigating agent on impacted areas and materials; and
- ◊ Adequate maintenance of equipment and machinery to minimise exhaust emissions.

11.3 NOISE CONTROL

Minor increased noise levels may result from the use of machines on site during the course of the project, which is expected to take less than 1 week day. To mitigate any noise which may arise as a result of site works, all works would be carried out in accordance the EPA NSW *Interim Construction Noise Guideline* (reference 21).

Working hours will be restricted to those specified in the DA consent conditions for the proposed development.

11.4 VIBRATION CONTROL

Excavation proposed as part of the remediation works is unlikely to cause any significant vibrations to be transmitted through the ground and potentially impact on adjoining structures.

11.5 TRAFFIC AND TRANSPORT

Traffic disruptions may potentially be an issue as a result of site remediation works mostly associated with the excavation and disposal of the fill material. Methods such as using a skip or transporting materials to and from site using a barge should be considered in order to alleviate traffic impact.

All machinery will be transported to the site in accordance with regulatory requirements.

All haulage routes for trucks transporting soil, materials, equipment or machinery to and from the site are to be selected to meet the following requirements:

- ◊ Comply with all road traffic rules;
- ◊ Minimise noise, vibration and odour to adjacent properties; and
- ◊ Utilise State Roads and minimise the use of local roads.

The site supervisor shall ensure that all vehicles:

- ◊ Conduct deliveries of soil, materials, equipment of machinery during the allowed hours of remediation work;
- ◊ Securely cover all loads to prevent/minimise any dust or odour emissions during transport; and
- ◊ Do not track soil, mud or sediment onto the roads and footpaths.

11.6 UNDERGROUND SERVICES

All underground services are to be located and either removed or avoided.

11.7 RESTRICTED ACCESS

Contractors only will be allowed on site whilst excavation and removal of soil to trucks is in progress. No members of the public will be allowed on site during this time.

During remediation works, the site will be designated as a construction area. Consequently, access will be restricted to authorised staff and contractors equipped with appropriate

Personal Protective Equipment (PPE). The site supervisor will control site access. All visitors will report to the site supervisor to be inducted into the site safety programme and environmental protection programme prior to entering the site.

12 OCCUPATIONAL HEALTH AND SAFETY PLAN

The purpose of the OHS plan is to ensure that the RAP is conducted in a controlled and safe manner with due regard for potential hazards and safe work practices. The OHS plan will be implemented and enforced by the appointed site supervisor following a brief induction by GEE. The following preliminary plan contains minimum OHS requirements at the site. Contractors must be required to produce their own project-specific Project Safety Plans prior to the commencement of any works at the site, under which their employees are to operate at all times whilst at the site.

12.1 PERSONNEL AND RESPONSIBILITY

All personnel will be made aware of the person responsible for implementing health and safety procedures. All personnel should read and understand the OHS plan prior to commencing work and have signed a statement to verify this understanding. Contractors shall be responsible for ensuring that their employees are aware of and comply with the Project Safety Plans developed for each task and with all relevant statutes and regulations.

12.2 IDENTIFICATION OF POTENTIAL HAZARDS

12.2.1 Chemical Hazards

Chemicals or compounds that may be present at the site include, but are not limited to:

- ◊ TRH
- ◊ BTEX
- ◊ PAHs (Includes Naphthalene)
- ◊ MTBE
- ◊ Ethanol
- ◊ Lead

Potential risks to personnel associated with these compounds, if present at the site, include:

1. Ingestion of soil or liquids;
2. Dermal (skin) contact with contaminated soil or liquids; and
3. Inhalation of dust, vapours or aerosols containing contaminants;

12.2.2 Physical Hazards

The following physical hazards may exist at the site:

- ◊ Heavy equipment (mobile and stationary);
- ◊ Light vehicles with associated traffic and vehicle hazards;
- ◊ Excavations;
- ◊ Heat exposure;
- ◊ Buried Services;
- ◊ Noise;
- ◊ Dust;
- ◊ Electrical equipment.

Personnel should also be aware of the necessary precautions with respect to hoisting of people, smoking, drugs and alcohol, first aid, privacy of information, environmental considerations, health surveillance, working alone, incident reporting, OHS consultation, discrimination and sexual harassment.

12.3 MEDICAL SURVEILLANCE

It is expected that all personnel on the site have undergone specific training for working on contaminated sites. A site-specific medical surveillance scheme is not considered necessary for this project.

12.4 SITE WORK PRACTICES

12.4.1 Personal hygiene

No smoking, eating or drinking will be permitted on site in areas where the possibility of contamination exists. In particular, smoking will be prohibited in areas were volatile hydrocarbons or other inflammable materials have accumulated. In these areas, a designated clean location should be allocated for smoking and the consumption of food or drink. These areas should be equipped with hand washing facilities which must be used prior to engaging in these activities. Personnel should be made aware of the location of these facilities.

12.4.2 Decontamination

Contaminated equipment should not be removed from the work area to avoid contaminating other parts of the site.

12.4.3 Restricted Access

A perimeter fence exists and will remain during the remediation work. Signs should be erected to notify personnel of the presence of excavations on the site. Site visitors must report to the site office prior to entering the site.

12.4.4 Personal protection

Personnel will take measures to avoid coming into direct contact with contaminated material. Workers are to ensure that soil, surface water or groundwater are not ingested or swallowed and that direct contact with skin is avoided. Personnel should wear the following Personal Protective Equipment (PPE):

- ◊ Steel-capped boots meeting AS2210.3 requirements (reference 22);
- ◊ Fluorescent safety vest or other high visibility clothing conforming to AS/NZS 4602:1999 (reference 23);
- ◊ Hard hat meeting AS1801-1981 (reference 24) requirements when working within close proximity to the excavator;
- ◊ Safety glasses or goggles with side shields meeting AS1337.6-2007 (reference 25) requirements as necessary; and
- ◊ Disposable latex gloves for personnel involved in soil or groundwater sampling.

In the unlikely event that personnel are required to work in areas with highly-contaminated soil or other hazardous materials, the following additional protection will be required:

- ◊ Disposable coveralls (if necessary) to prevent contact with splashed soil or materials; and
- ◊ Nitrile gloves meeting AS2161-2000 (reference 26) requirements or heavy-duty gauntlet gloves.

12.5 EMERGENCY RESPONSE PLAN

12.5.1 Resources

The following emergency numbers can be called in the event that medical or other emergency services are required:

Hospital: St George Hospital
Gray Street
Kogarah NSW 2217

(02) 9113 1111

Police, fire, ambulance: 000

Electrical: Energy Australia
13 13 18

Council: Bayside Council
444-446 Princes Highway,
Rockdale NSW 2216
(02) 9562 1777

Water: Sydney Water
132 090

Gas: Jemena Gas
131 909

Utilities: Telstra
1800 653 935

12.5.2 Responsibilities

The site supervisor will be responsible for ensuring that site personnel are aware of emergency services available. A site safety officer must be available during remedial works.

13 REFERENCES

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23. Australian / New Zealand Standard (AS/NZS) 4602 (1999): *High visibility safety garments.*
24. Australian / New Zealand Standard (AS/NZS) 1801 (1997): *Occupational protective helmets.*
25. Australian / New Zealand Standard (AS/NZS) 1337.6 (2007): *Personal eye protection Part 6: Prescription eye protectors against low and medium impact.*
26. Australian / New Zealand Standard (AS/NZS) 2161.1 (2000): *Occupational protective gloves - Selection, use and maintenance.*

FIGURES

1 – Site Location Map
2 – Site Plan
3 – UST Locations

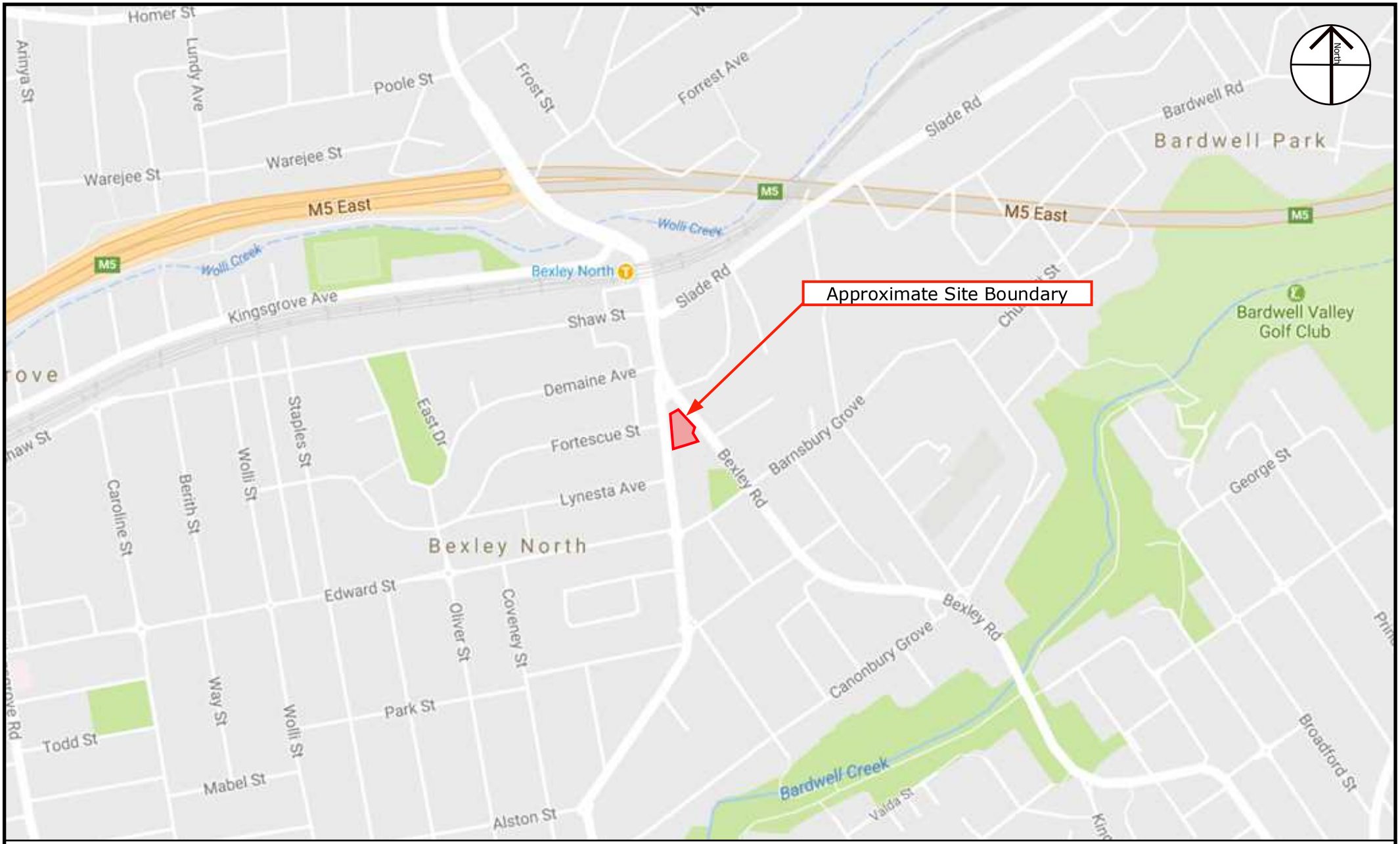

Image Source: ©2016 Google - Google Maps, retrieved 05/08/2016

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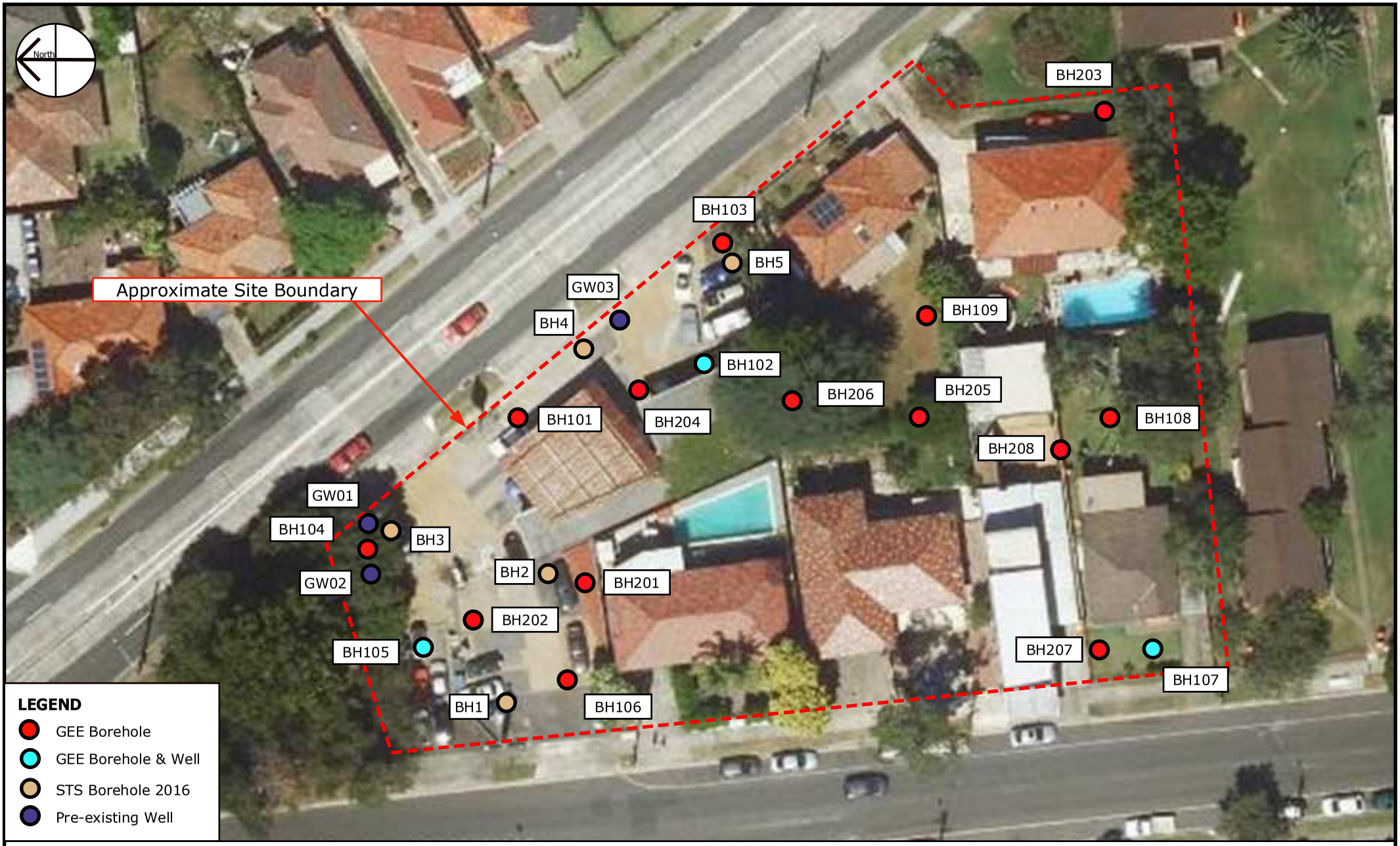
TITLE: SITE LOCATION MAP: 307-311 Bexley Rd & 88-96 New Illawarra Rd, Bexley North NSW	SCALE: **N.T.S**	DATE: **25 July 2017**	FIGURE No. **1**
	DRAWN: **A. Chiem**	JOB No.: **E16016BN**	REVISION: **A**



Aerial image: provided by SIXmaps (NSW LPI) - retrived 03/11/2016

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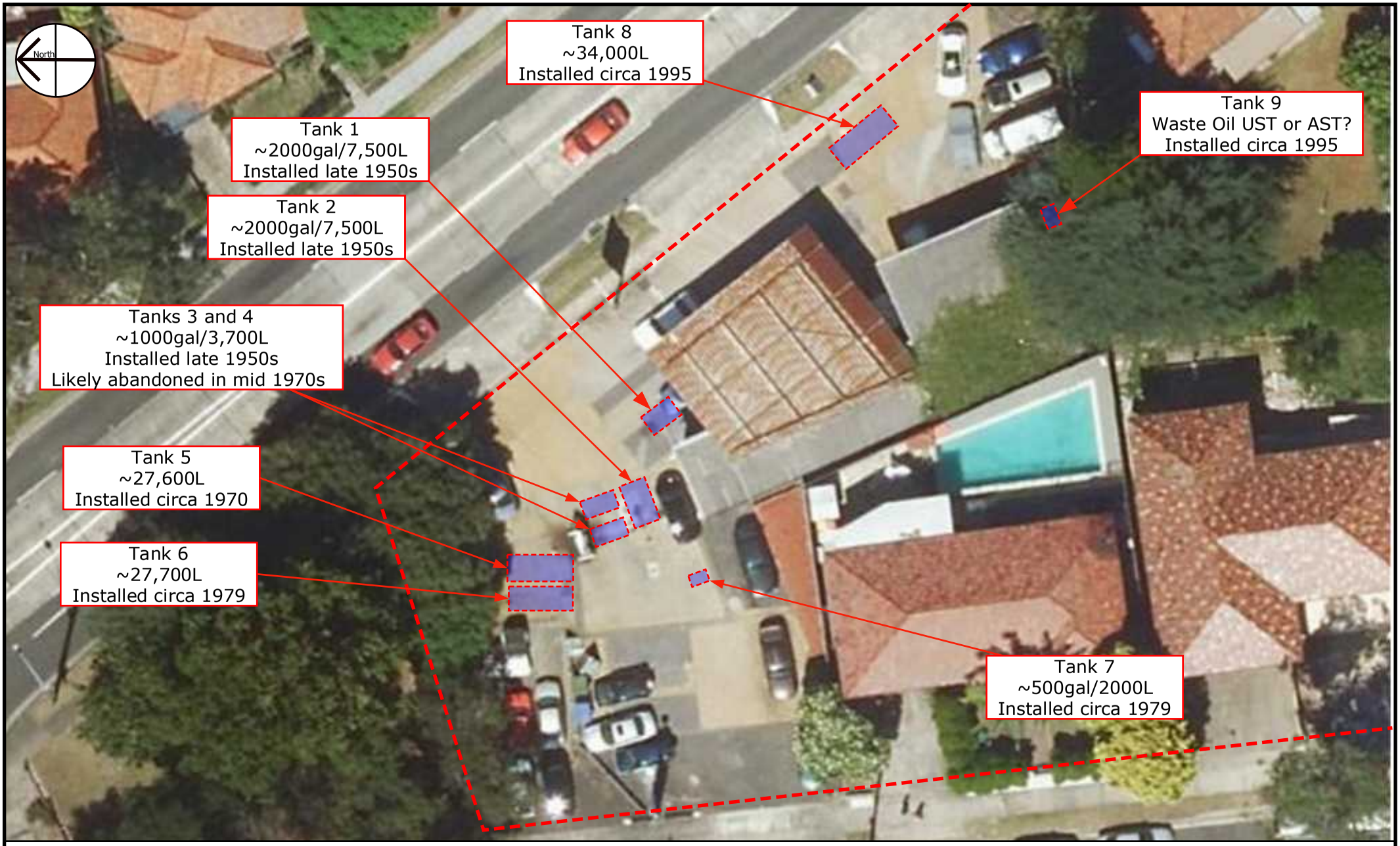
TITLE: SITE PLAN 307-311 Bexley Rd & 88-96 New Illawarra Rd Bexley North NSW	SCALE: **N.T.S**	DATE: **19 Jul 2017**	FIGURE No. **2**
	DRAWN: **J. Long**	JOB No.: **E16016BN**	REVISION: **A**



Aerial image: provided by SIXmaps (NSW LPI) - retrived 03/11/2016

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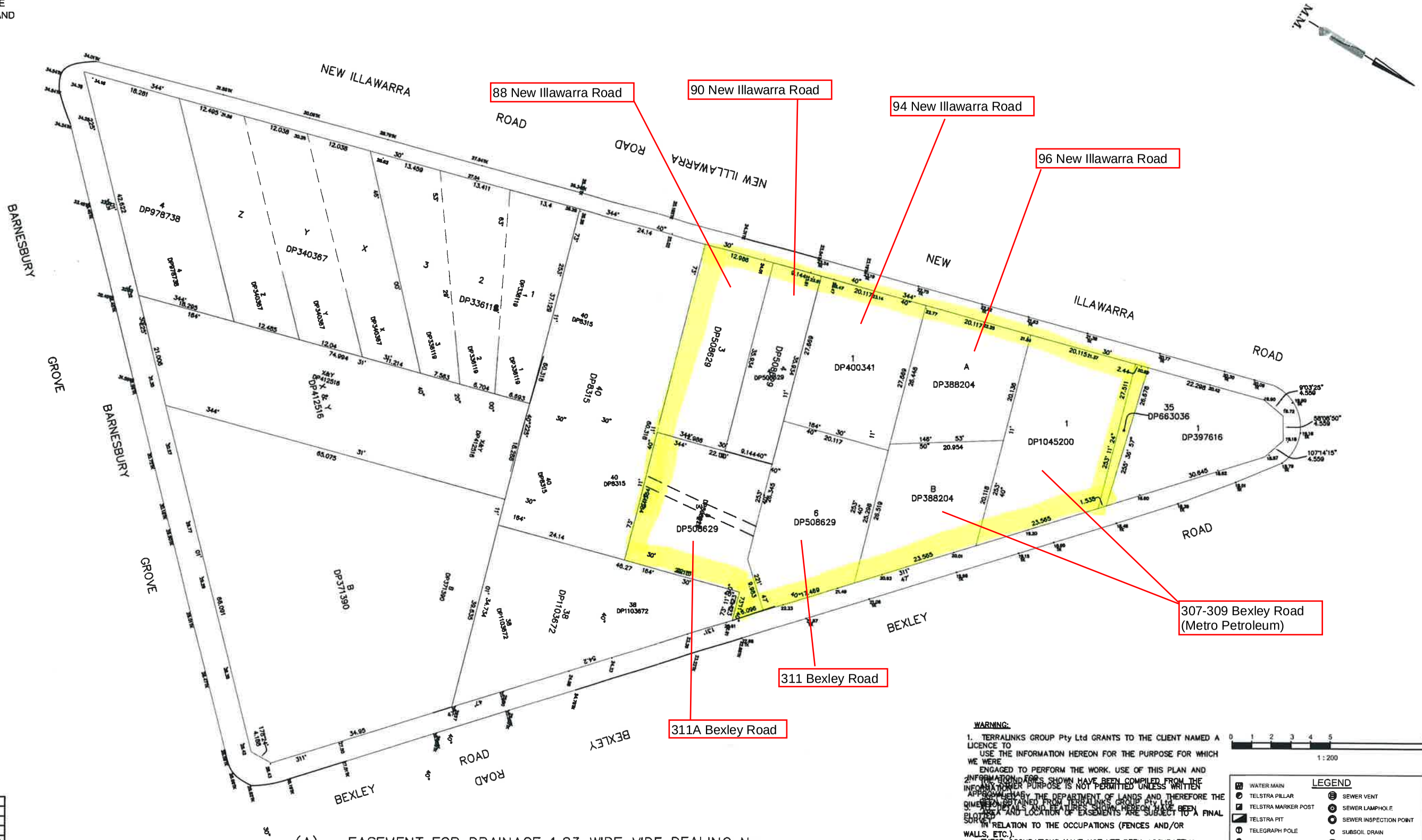
TITLE:	SCALE:	DATE:	FIGURE No.
UST Locations	N.T.S	21 Dec 2016	3
	DRAWN: A. Chiem	JOB No.: E16016BN	REVISION: A

APPENDIX A

Site Survey

A1

L.G.A. : ROCKDALE
PARISH : ST GEORGE
COUNTY : CUMBERLAND



(A) ~ EASEMENT FOR DRAINAGE 1.83 WIDE VIDE DEALING No. J601625 AND J601626.

Rev.	Amendments	Date

PLAN SHOWING THE BOUNDARIES AND KERB LEVELS FOR No. 307–311A BEXLEY ROAD & No. 94–100 ILLAWARRA ROAD, BEXLEY NORTH FOR REZONING PURPOSES AND TO SUPPORT A D.A.

TERRALINKS
ABN 52 159 137 907
UNIT 16/429 THE BOULEVARDE, KIRRAWEE NSW 2232
c/– PO Box 559, SUTHERLAND NSW 1499
PH 1300 525 584 FAX (02) 9521 6315 MOB 0418 417 341
Email: mail@terralinks.com.au

JOB No.	YOUR REF:
4912	SOUEID
DRAWING No.	CLIENT:
4912CO.dwg	JS ARCHITECTS PTY LTD

SCALE: 1:200 (A1)	SURVEYED	DRAWN	CHECKED
DATUM: AHD	M.M.	M.M.	J.P.
SHEET: 1 OF 4	DATE: 18.05.19	DATE: 19.05.19	DATE: 19.05.19

JACE THOMAS PEARSON
SURVEYOR REGISTERED
UNDER SURVEYING & SPATIAL
INFORMATION ACT, 2002
IDENTIFICATION No. 1827

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TOTAL AREA OF SITE
VIDE DP's: 3,774.9m²
BY CALC : 3,870.9m²

ORIGIN OF LEVELS :
SSM 112399 RL=22.32 (AHD) FOUND NEAR THE INTERSECTION OF NEW ILLAWARRA ROAD & FORTESCUE STREET.
ACCURACY OF ORIGIN : ± 0.01m

DIAL 1100 BEFORE YOU DIG
www.1100.com.au

WARNING:

1. TERRALINKS GROUP Pty Ltd GRANTS TO THE CLIENT NAMED A LICENCE TO USE THE INFORMATION HEREON FOR THE PURPOSE FOR WHICH WE WERE ENGAGED TO PERFORM THE WORK. USE OF THIS PLAN AND INFORMATION FOR ANY OTHER PURPOSE IS NOT PERMITTED UNLESS WRITTEN APPROVAL IS OBTAINED FROM TERRALINKS GROUP PTY LTD.
2. THE BOUNDARIES SHOWN HAVE BEEN COMPILED FROM THE PLANS LISTED HEREON BY THE DEPARTMENT OF LANDS AND THEREFORE THE DIMENSIONS, AREAS AND FEATURES SHOWN HEREON HAVE BEEN ADOPTED.
3. THE WIDTH AND LOCATION OF EASEMENTS ARE SUBJECT TO A FINAL SURVEY.
4. THE SET OUT OF BUILDINGS AND CONTOURS ACQUISITION TO OUTSIDE IN
5. SERVICES SHOWN HEREON ARE THOSE THAT WERE VISIBLE AT THE TIME OF SURVEY AND HAVE BEEN LOCATED BY FIELD SURVEY.
FURTHER SERVICES MAY BE PRESENT. PRIOR TO ANY CONSTRUCTION OR EXCAVATION ON SITE, THE RELEVANT AUTHORITIES SHOULD BE CONTACTED.
6. CONTOUR INTERVAL IS 0.2 m.
7. DUE TO THE LOCATION DATA NOT ALWAYS BEING SUITABLE FOR DRAWING AND REVISED LOCATIONS OF ALL SERVICES
8. THE CONTOURS HAVE BEEN DERIVED FROM INTERPOLATION METHODS USING COMPUTER SOFTWARE PROGRAM AND WHEREVER POSSIBLE SPOT LEVELS SHOULD BE USED IN PREFERENCE TO CONTOURS.
9. THE RIDGE HEIGHTS, ROOF LINE, GUTTER AND WINDOW SILL HEIGHTS HAVE BEEN DETERMINED USING INDIRECT SURVEY METHODS AND ARE APPROXIMATE ONLY.
10. THE MEASUREMENT OF ALL TREE TRUNK DIAMETERS WAS IN ACCORDANCE WITH AS4970-2009 PROTECTION OF TREES ON DEVELOPMENT SITES.
11. THESE NOTES ARE AN INTEGRAL PART OF THIS PLAN.

0 1 2 3 4 5 10m
1 : 200

LEGEND

WATER MAIN	SEWER VENT
TELSTRA PILLAR	SEWER LAMPHOLE
TELSTRA MARKER POST	SEWER INSPECTION POINT
TELSTRA PIT	SUBSOIL DRAIN
TELEGRAPH POLE	STORMWATER PIT
POWER POLE	STORMWATER GRATE
ELECTRICAL PILLAR	SURFACE INLET PIT
POWER LIGHT POLE	LINTEL-KERB INLET PIT
LIGHT POLE	LINTEL-KERB INLET PIT WITH GRATE
HYDRANT	STORMWATER PIPE INCLUDING PIPE SIZE
RECYCLED WATER	HEADWALL
WATER METER	CLOTHES LINE
STOP VALVE	TREE: Ø DIAMETER S SPREAD
WATER TAP	OVERHEAD ELECTRICITY LINE
GAS METER	OVERHEAD TELECOM LINE
GAS DIRECTION MARKER	SEWER LINE
GAS INSPECTION POINT	
SEWER MANHOLE	
STREET SIGN	
PRAM CROSSING	
VEHICLE CROSSING	

APPENDIX B

Former Borehole Logs

Borehole Log Report

Geo Environmental Engineering Pty Ltd
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Lane Cove NSW 2066
T 02 9420 3361

Hole ID. **BH101**
Hole Depth: **3.80 m**
Sheet: **1 of 1**

Project Name: **Geotechnical and Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **Total Drilling** Date Started: **1/11/2016** Ground Level: ----------
Drill Method: **CC to 0.19m, SFA (TC-Bit) to EOH** Date Completed: **1/11/2016** Easting: ----------
Equipment: **Hanjin D&B** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
CC		0.2				Fill	**CONCRETE SLAB**.				
Solid Flight Auger		0.4					**FILL**- Gravelly Sand / Sandy Gravel, brown, fine to coarse grained sand, fine to coarse gravel.	loose		SMC011116-1 0.2-0.3m	
		0.6					**SAND**- grey brown, fine to coarse grained sand.	loose	moist	SMC011116-2 0.4-0.5m	Possible Fill.
		0.8									
		1.0								SMC011116-3 0.9-1.0m	
		1.2									
		1.4								SMC011116-4 1.3-1.5m	
		1.6							very moist		
		1.8									
		2.0									
		2.2									
		2.4									
		2.6									
		2.8				Natural	**Weathered SANDSTONE**- orange brown & pale grey, medium to coarse.				
		3.0									
		3.2								SMC011116-5 3.0-3.3m	
		3.4									
		3.6									
		3.8									
		4.0					**Hole Terminated at 3.80m** Target depth.				Bore dry upon completion.

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Stephen McCormack** Date: **1/11/2016**
Checked By: **Stephen McCormack** Date: **10/12/2016**

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Monitoring Well Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
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Hole ID. **BH102**
Hole Depth: **2.40 m**
Sheet: **1 of 1**

Project Name: **Geotechnical and Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **Total Drilling** Date Started: **1/11/2016** Ground Level: ----------
Drill Method: **CC to 0.15m, SFA (TC-Bit) to EOH** Date Completed: **1/11/2016** Easting: ----------
Equipment: **Hanjin D&B** Northing: ----------

Method	Depth (m)	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
CC	0.0	**CONCRETE SLAB**.				
Solid Flight Auger	0.2	**FILL**- Silty Clay, dark grey to black, low to medium plasticity, pockets of sand and gravel (shale and slag).	soft to firm	moist	SMC011116-6 0.2-0.3m	
	0.4					
	0.6				SMC011116-7 0.6-0.7m	
	0.8					
	1.0				SMC011116-8 0.9-1.0m	
	1.2					
	1.4					
	1.6					Water seepage noted below 1.6m.
	1.8					
	2.0				SMC011116-9/10 1.8-2.0m	
	2.2	**SANDSTONE**- orange brown & pale grey, medium to coarse.				
	2.4					
	2.6	**Hole Terminated at 2.40m** Practical refusal.				
	2.8					
	3.0					

Well Details: Gatic 0.30; Bentonite 0.80; Coarse Sand 1.00; 50mm Ø Screen 2.20

Well Construction

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Stephen McCormack** Date: **1/11/2016**
Checked By: **Stephen McCormack** Date: **10/12/2016**

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Borehole Log Report

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Hole ID. **BH103**
Hole Depth: **1.40 m**
Sheet: **1 of 1**

Project Name: **Geotechnical and Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **Total Drilling** Date Started: **1/11/2016** Ground Level: ----------
Drill Method: **SFA (TC-Bit) to EOH** Date Completed: **1/11/2016** Easting: ----------
Equipment: **Hanjin D&B** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
Solid Flight Auger		0.2				Fill	**ASPHALT**.				
							FILL- Gravelly Clayey Sand, dark grey and brown.	loose	moist	SMC011116-11/12 0.1-0.25m	
		0.4									
		0.6				Fill	**FILL**- Silty Sand, dark brown / dark grey, fine to coarse grained sand, trace clay.	loose	moist	SMC011116-13/14 0.5-0.7m	
		0.8									
		1.0									
		1.2				Natural	**SANDSTONE**- grey & orange brown, medium to coarse.				Insufficient quality sandstone for sampling.
		1.4									
		1.6					**Hole Terminated at 1.40m** Practical refusal.				Bore dry upon completion.
		1.8									
		2.0									
		2.2									
		2.4									
		2.6									
		2.8									
		3.0									

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Stephen McCormack** Date: **1/11/2016**
Checked By: **Stephen McCormack** Date: **10/12/2016**

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Borehole Log Report

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Hole ID. **BH104**
Hole Depth: **1.20 m**
Sheet: **1 of 1**

Project Name: **Geotechnical and Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **Total Drilling** Date Started: **1/11/2016** Ground Level: ----------
Drill Method: **CC to 0.15m, SFA (TC-Bit) to EOH** Date Completed: **1/11/2016** Easting: ----------
Equipment: **Hanjin D&B** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
CC							**CONCRETE SLAB**.				
Solid Flight Auger		0.2				Fill	**FILL**- Sandy Gravel, dark grey / black, fine to coarse grained sand, fine to coarse gravel.	loose	moist	SMC011116-15 0.2-0.3m	Coal-like fragments.
		0.4									
		0.6					**FILL**- Sand, yellow brown, fine to coarse grained sand.	loose	moist	SMC011116-16 0.5-0.65m	
		0.8									
		1.0					**FILL**- Sand, dark brown, fine to coarse grained sand, trace gravel.	loose	moist	SMC011116-17 0.8-0.95m	
		1.2									
		1.4					**Hole Terminated at 1.20m** Refusal on concrete.				Bore dry upon completion.
		1.6									
		1.8									
		2.0									
		2.2									
		2.4									
		2.6									
		2.8									
		3.0									

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Stephen McCormack** Date: **1/11/2016**
Checked By: **Stephen McCormack** Date: **10/12/2016**

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Monitoring Well Log Report

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Hole ID. **BH105**
Hole Depth: **2.40 m**
Sheet: **1 of 1**

Project Name: **Geotechnical and Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **Total Drilling** Date Started: **1/11/2016** Ground Level: ----------
Drill Method: **CC to 0.1m, SFA (TC-Bit) to EOH** Date Completed: **1/11/2016** Easting: ----------
Equipment: **Hanjin D&B** Northing: ----------

Method	Depth (m)	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
CC	0.0	**CONCRETE SLAB**.				
Solid Flight Auger	0.2	**FILL**- Gravelly Clay, dark brown, fine to coarse gravel, some sand.	firm	moist	SMC011116-18 0.1-0.2m	
	0.4					
	0.6				SMC011116-19 0.5-0.6m	
	0.8	**FILL**- Sandy Clay, dark brown & brown, trace sand.	firm to stiff	moist		
	1.0				SMC011116-20 0.9-1.0m	
	1.2	**Sandy CLAY**- orange brown, fine to medium gravel.	stiff to very stiff	moist	SMC011116-21/22 1.1-1.25m	
	1.4					
	1.6	Becoming red brown & orange brown from 1.6m, medium to coarse grained sand.				
	1.8				SMC011116-23 1.8-2.0m	
	2.0					
	2.2					
	2.4	**SANDSTONE**- grey & orange brown, medium to coarse.				
	2.6	**Hole Terminated at 2.40m** Practical refusal.				Bore dry upon completion.
	2.8					
	3.0					

Well Details: Gatic; 0.50 Bentonite; 1.00; 1.15 Coarse Sand; 50mm Ø Screen; 2.35

Well Construction

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Stephen McCormack** Date: **1/11/2016**
Checked By: **Stephen McCormack** Date: **10/12/2016**

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Borehole Log Report

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Hole ID. **BH106**
Hole Depth: **2.20 m**
Sheet: **1 of 1**

Project Name: **Geotechnical and Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **Total Drilling** Date Started: **1/11/2016** Ground Level: ----------
Drill Method: **SFA (TC-Bit) to EOH** Date Completed: **1/11/2016** Easting: ----------
Equipment: **Hanjin D&B** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
Solid Flight Auger		0.2				Fill	**ASPHALT**.				
		0.4					**FILL**- Clayey Sandy Gravel, dark grey & brown, fine to coarse grained sand, fine to coarse gravel.	firm to stiff	moist	SMC011116-24 0.1-0.3m	
		0.6									
		0.8				Natural	**Sandy CLAY**- orange brown, fine to medium grained sand.	stiff	moist	SMC011116-25/26 0.7-0.9m	
		1.0									
		1.2									
		1.4								SMC011116-27 1.3-1.5m	
		1.6									
		1.8									
		2.0					**SANDSTONE**- grey & orange brown, medium to coarse.				
		2.2									
		2.4					**Hole Terminated at 2.20m** Practical refusal.				Bore dry upon completion.
		2.6									
		2.8									
		3.0									

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Stephen McCormack** Date: **1/11/2016**
Checked By: **Stephen McCormack** Date: **10/12/2016**

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Hole ID. **BH107**
Hole Depth: **2.80 m**
Sheet: **1 of 1**

Project Name: **Geotechnical and Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **Total Drilling** Date Started: **1/11/2016** Ground Level: ----------
Drill Method: **SFA (TC-Bit) to EOH** Date Completed: **1/11/2016** Easting: ----------
Equipment: **Hanjin D&B** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
							Surface: Grass				
Solid Flight Auger		0.2–0.6				Fill	**TOPSOIL / FILL**- Sandy Silt, dark brown, fine to medium gravel, becoming pale brown with depth.	loose to medium dense	moist	SMC011116-29 0.1-0.2m SMC011116-30 0.5-0.6m	
		0.8–1.0					**Silty CLAY**- red brown & orange brown, some fine to medium grained sand.	firm to stiff	moist	SMC011116-28 0.7-0.8m	
		1.2–1.4					**Sandy CLAY**- red brown & orange brown, medium to coarse grained sand, medium to coarse gravel.	stiff	moist		
		1.6–2.0				Natural	**SANDSTONE**- grey & orange brown, medium to coarse.			SMC011116-31 1.5-1.6m	
		2.2–2.8					**SANDSTONE**- pale grey, medium to coarse, weak zone, increased moisture.			SMC011116-35 2.5-2.8m	Likely water bearing zone between 2.0 and 2.8m.
		3.0					**Hole Terminated at 2.80m** Practical refusal.				

Well Details / Well Construction: Gatic; 1.00 Bentonite; 1.45; 1.60 Coarse Sand; 50mm Ø Screen

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Stephen McCormack** Date: **1/11/2016**
Checked By: **Stephen McCormack** Date: **10/12/2016**

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Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
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Hole ID. **BH108**
Hole Depth: **0.75 m**
Sheet: **1 of 1**

Project Name: **Geotechnical and Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **GEE** Date Started: **1/11/2016** Ground Level: ----------
Drill Method: **Hand Auger to EOH** Date Completed: **1/11/2016** Easting: ----------
Equipment: **Manual** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
							Surface: Grass				
Hand Auger		0.2				Fill	**TOPSOIL / FILL**- Sandy Gravelly Silt, dark grey, fine to medium grained sand, fine to coarse gravel.	loose to medium dense	slightly moist	SMC011116-32 0.0-0.15m	
		0.4				Natural	**Sandy CLAY / Clayey SAND**- red brown & orange brown, medium to coarse grained sand, with sandstone gravel.	stiff	moist	SMC011116-33 0.3-0.5m	
		0.6									
		0.8					**Hole Terminated at 0.75m** Practical refusal on weathered sandstone.				Bore dry upon completion.
		1.0									
		1.2									
		1.4									
		1.6									
		1.8									
		2.0									
		2.2									
		2.4									
		2.6									
		2.8									
		3.0									

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Stephen McCormack** Date: **1/11/2016**
Checked By: **Stephen McCormack** Date: **10/12/2016**

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Borehole Log Report

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Hole ID. **BH109**
Hole Depth: **1.35 m**
Sheet: **1 of 1**

Project Name: **Geotechnical and Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **GEE** Date Started: **1/11/2016** Ground Level: ----------
Drill Method: **Hand Auger to EOH** Date Completed: **1/11/2016** Easting: ----------
Equipment: **Manual** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
Hand Auger		0.2				Fill	**TOPSOIL/FILL**- Clayey Silt, dark brown, trace fine to coarse sandstone and coal gravel, roots.	firm	moist	SMC011116-34 0.0-0.15m	Coal gravel.
		0.4									
		0.6								SMC011116-36 0.5-0.6m	Geofabric at 0.65m.
		0.8				Natural	**Sandy CLAY**- orange brown & red brown.	firm to stiff	moist	SMC011116-37 0.7-0.85m	
		1.0									
		1.2									
		1.4					**Hole Terminated at 1.35m** Practical refusal on weathered sandstone.				Bore dry upon completion.
		1.6									
		1.8									
		2.0									
		2.2									
		2.4									
		2.6									
		2.8									
		3.0									

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Stephen McCormack** Date: **1/11/2016**
Checked By: **Stephen McCormack** Date: **10/12/2016**

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Borehole Log Report

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Hole ID. **BH201**
Hole Depth: **1.60 m**
Sheet: **1 of 1**

Project Name: **Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **GEE** Date Started: **19-JUL-17** Ground Level: ----------
Drill Method: **Hand Auger** Date Completed: **19-JUL-17** Easting: ----------
Equipment: **Manual** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
							Surface: bark mulch				
Hand Auger					SP	Fill	**FILL**- Gravelly Sand, brown, fine to coarse grained, with fine to coarse gravel present.	loose	moist	JL190717-01 0.05-0.15m	
					SC	Fill	**FILL**- Clayey Sand, brown, fine to coarse grained, with fine to coarse gravel (including fragments of metal).	loose	moist	JL190717-02 0.40-0.50m JL190717-03 0.70-0.80m	
		1.0			SC	Natural	**Clayey SAND**- orange-brown, fine to coarse grained.	loose to medium dense	moist	JL190717-04 1.00-1.10m	
					CL	Natural	**Sandy CLAY**- grey, low plasticity, fine to coarse grained. becoming yellow-brown from 1.4m.	firm to stiff	moist very moist	JL190717-05 1.40-1.50m	
		2.0					**Hole Terminated at 1.60m** Target Depth Reached				Borehole dry upon completion

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Joshua Long** Date: **19-Jul-17** Checked By: **Stephen McCormack** Date: **19-JUL-17**

GEE DAVIES BH LOG BEXLEY NORTH STAGE 2 EXTRA.GPJ GEE.GDT 28-7-17 8:11:04 AM

Monitoring Well Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
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Hole ID. **BH202**
Hole Depth: **1.80 m**
Sheet: **1 of 1**

Project Name: **Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **GEE** Date Started: **19-JUL-17** Ground Level: ----------
Drill Method: **Hand Auger** Date Completed: **19-JUL-17** Easting: ----------
Equipment: **Manual** Northing: ----------

Method	Depth (m)	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
				Surface: concrete				
CC			Fill	**FILL**- Concrete, 150mm.				
Hand Auger		SP	Fill	**FILL**- Gravelly Sand, brown, fine to coarse grained, with fine to coarse gravel (including concrete fragments and plastic).	loose	moist	JL190717-06 / 07 0.25-0.35m	
Hand Auger		SP	Fill	**FILL**- Sand, pale brown, fine to coarse grained, with clumps of brown silty clay present.	loose	moist	JL190717-08 0.60-0.70m	
Hand Auger	1.0	CL	Fill	**FILL**- Silty Clay, dark brown, low to medium plasticity, with fine to coarse sand and fine to coarse gravel.	firm to stiff	moist	JL190717-09 1.10-1.20m	
Hand Auger		CL	Natural	**Sandy CLAY**- dark grey, low plasticity, fine to coarse grained. becoming pale brown from 1.5m.	firm to stiff	moist	JL190717-10 1.40-1.50m	
	2.0			**Hole Terminated at 1.80m** Target Depth Reached				Borehole dry upon completion

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Joshua Long** Date: **19-Jul-17** Checked By: **Stephen McCormack** Date: **19-JUL-17**

GEE DAVIES BH LOG BEXLEY NORTH STAGE 2 EXTRA.GPJ GEE.GDT 28-7-17 8:11:05 AM

Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
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Hole ID. **BH203**
Hole Depth: **1.20 m**
Sheet: **1 of 1**

Project Name: **Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **GEE** Date Started: **19-JUL-17** Ground Level: ----------
Drill Method: **Hand Auger** Date Completed: **19-JUL-17** Easting: ----------
Equipment: **Manual** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
							Surface: concrete				
CC						Fill	**FILL**- Concrete, 90mm.				
Hand Auger					SM	Fill	**FILL**- Silty Sand, dark brown, fine to medium grained.	loose	moist	JL190717-11 0.15-0.25m	
		1.0			SC	Natural	**Clayey SAND**- brown / yellow-brown, fine to coarse grained.	loose to medium dense	moist	JL190717-12 0.70-0.80m	
										JL190717-13 1.10-1.20m	
		2.0					**Hole Terminated at 1.20m** Target Depth Reached				Borehole dry upon completion

Moisture	
D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Joshua Long** Date: **19-Jul-17** Checked By: **Stephen McCormack** Date: **19-JUL-17**

GEE DAVIES BH LOG BEXLEY NORTH STAGE 2 EXTRA.GPJ GEE.GDT 28-7-17 8:11:06 AM

Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

Hole ID. **BH204**
Hole Depth: **0.70 m**
Sheet: **1 of 1**

Project Name: **Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **GEE** Date Started: **19-JUL-17** Ground Level: ----------
Drill Method: **Hand Auger** Date Completed: **19-JUL-17** Easting: ----------
Equipment: **Manual** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
							Surface: concrete				
CC						Fill	**FILL**- Concrete, 150mm.				
Solid Flight Auger					CL	Fill	**FILL**- Silty Clay, dark grey / dark brown, low plasticity, with fine to coarse sand and fine to coarse gravel (including large concrete and brick fragments).	firm to stiff	moist	JL190717-14 0.20-0.30m JL190717-15 0.60-0.70m	
		1.0 2.0					**Practical Hand Auger Refusal at 0.70m** Caused by large large obstructions within fill layer				Borehole dry upon completion.

Moisture	
D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Joshua Long** Date: **19-Jul-17** Checked By: **Stephen McCormack** Date: **19-JUL-17**

GEE DAVIES BH LOG BEXLEY NORTH STAGE 2 EXTRA.GPJ GEE.GDT 28-7-17 8:11:07 AM

Monitoring Well Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

Hole ID. **BH205**
Hole Depth: **1.00 m**
Sheet: **1 of 1**

Project Name: **Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **GEE** Date Started: **19-JUL-17** Ground Level: ----------
Drill Method: **Hand Auger** Date Completed: **19-JUL-17** Easting: ----------
Equipment: **Manual** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
							Surface: grass				
Hand Auger					SM	Fill	**TOPSOIL/FILL**- Silty Sand, dark brown, fine to coarse grained, with fine to coarse gravel (including crushed sandstone).	loose	moist	JL190717-16 / 17 0.05-0.15m	
					CL	Natural	**Sandy CLAY**- light grey, low plasticity, fine to coarse grained. becoming orange-brown from 0.8m.	firm to stiff	moist	JL190717-18 0.60-0.70m	
		1.0									
							Hole Terminated at 1.00m Target Depth Reached				Borehole dry upon completion.
		2.0									

Moisture	
D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Joshua Long** Date: **19-Jul-17** Checked By: **Stephen McCormack** Date: **19-JUL-17**

GEE DAVIES BH LOG BEXLEY NORTH STAGE 2 EXTRA.GPJ GEE.GDT 28-7-17 8:11:08 AM

Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

geo-environmental ENGINEERING

Hole ID. **BH206**
Hole Depth: **1.10 m**
Sheet: **1 of 1**

Project Name: **Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **GEE** Date Started: **19-JUL-17** Ground Level: ----------
Drill Method: **Hand Auger** Date Completed: **19-JUL-17** Easting: ----------
Equipment: **Manual** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
							Surface: grass				
Hand Auger					SM	Fill	**TOPSOIL/FILL**- Silty Sand, dark brown, fine to coarse grained, with fine to coarse gravel.	loose	moist	JL190717-19 0.05-0.15m	
					SP	Natural	**SAND**- pale grey, fine to coarse grained, with clay.	loose to medium dense	moist	JL190717-20 0.70-0.80m	
		1.0			CL		**Sandy CLAY**- pale orange-brown, fine to coarse grained.	firm to stiff	moist		
		2.0					**Hole Terminated at 1.10m** Target Depth Reached				Borehole dry upon completion.

Moisture	
D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Joshua Long** Date: **19-Jul-17** Checked By: **Stephen McCormack** Date: **19-JUL-17**

GEE DAVIES BH LOG BEXLEY NORTH STAGE 2 EXTRA.GPJ GEE.GDT 28-7-17 8:11:09 AM

Monitoring Well Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

Hole ID. **BH207**
Hole Depth: **1.00 m**
Sheet: **1 of 1**

Project Name: **Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **GEE** Date Started: **19-JUL-17** Ground Level: ----------
Drill Method: **Hand Auger** Date Completed: **19-JUL-17** Easting: ----------
Equipment: **Manual** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
							Surface: grass				
Hand Auger					ML	Fill	**TOPSOIL**- Clayey Silt, dark brown, low plasticity, with fine to medium grained sand and a trace of fine to coarse gravel.	firm	moist	JL190717-21 0.05-0.15m	
					CL	Natural	**Sandy CLAY**- pale grey-brown, low plasticity, fine to coarse grained.	firm to stiff	moist	JL190717-22 0.50-0.60m	
		1.0					becoming pale orange-brown from 0.7m.				
							becoming pale grey / orange-brown / red-brown with fine to coarse ironstone gravel from 0.9m.			JL190717-23 0.90-1.00m	
							Hole Terminated at 1.00m Target Depth Reached				Borehole dry upon completion
		2.0									

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Joshua Long** Date: **19-Jul-17** Checked By: **Stephen McCormack** Date: **19-JUL-17**

GEE DAVIES BH LOG BEXLEY NORTH STAGE 2 EXTRA.GPJ GEE.GDT 28-7-17 8:11:10 AM

Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

Hole ID. **BH208**
Hole Depth: **1.00 m**
Sheet: **1 of 1**

Project Name: **Contamination Assessment** Project Number: **E16016BN**
Location / Site: **307-311 Bexley Rd & 88-96 New Illawarra Rd** Client: **Tony Soueid**

Drilling Company: **GEE** Date Started: **19-JUL-17** Ground Level: ----------
Drill Method: **Hand Auger** Date Completed: **19-JUL-17** Easting: ----------
Equipment: **Manual** Northing: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
							Surface: grass				
Hand Auger					ML	Fill	**TOPSOIL**- Clayey Silt, dark brown, low plasticity, with fine to medium grained sand and a trace of fine to coarse gravel.	firm	moist	JL190717-24 / 25 0.05-0.15m	
		1.0			CL	Natural	**Sandy CLAY**- brown / orange-brown, low plasticity, fine to coarse grained. becoming grey / red-brown / orange-brown with fine to coarse ironstone gravel from 1.0m.	firm to stiff	moist	JL190717-26 0.50-0.60m	
		2.0					**Hole Terminated at 1.00m** Target Depth Reached				Borehole dry upon completion

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

No adverse odour or staining and no obvious ACM.

Logged By: **Joshua Long** Date: **19-Jul-17** Checked By: **Stephen McCormack** Date: **19-JUL-17**

GEE DAVIES BH LOG BEXLEY NORTH STAGE 2 EXTRA.GPJ GEE.GDT 28-7-17 8:11:10 AM

Geo Environmental Engineering
82 Bridge Street
Lane Cove NSW 2066
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Log Report Legend

MATERIAL SYMBOL

FILL	CONCRETE	ASPHALT	TOPSOIL
ORGANICS	ESTUARINE MUD		

CLAY	SAND	SILT	GRAVEL
Sandy CLAY	Clayey SAND	Clayey SILT	Clayey GRAVEL
Silty CLAY	Silty SAND	Sandy SILT	Sandy GRAVEL
Gravelly CLAY	Gravelly SAND	Gravelly SILT	Silty GRAVEL
CLAY & SAND	SAND & CLAY	SILT & CLAY	GRAVEL & CLAY
CLAY & SILT	SAND & SILT	SILT & SAND	GRAVEL & SAND
CLAY & GRAVEL	SAND & GRAVEL	SILT & GRAVEL	GRAVEL & SILT
Sandy Silty CLAY	Clayey Silty SAND	Sandy Clayey SILT	Sandy Clayey GRAVEL
Silty Sandy CLAY	Silty Clayey SAND	Clayey Sandy SILT	Clayey Sandy GRAVEL
Sandy Gravelly CLAY	Clayey Gravelly SAND	Sandy Gravelly SILT	Silty Clayey GRAVEL
Silty Gravelly CLAY	Silty Gravelly SAND	Clayey Gravelly SILT	Clayey Silty GRAVEL
Gravelly Silty CLAY	Gravelly Silty SAND	Gravelly Clayey SILT	Sandy Silty GRAVEL
Gravelly Sandy CLAY	Gravelly Clayey SAND	Gravelly Sandy SILT	Silty Sandy GRAVEL

SANDSTONE	SHALE	GRANITE	BASALT	SHALE / SANDSTONE
PORCELLANITE	GNEISS	SHALE / CLAYSTONE	MUDSTONE	
CLAYSTONE	MUDSTONE / CLAYSTONE	SHALE / SILTSTONE	IRONSTONE	

WATER LEVELS

Encountered Water

Standing Water

ABBREVIATIONS

PT	Pushtube
SFA	Solid Flight Auger
PWS	Percussion Window Sampler
HA	Hand Auger
HFA	Hollow Flight Auger

WELL GRAPHICS

Cuttings	Bentonite	Screen
Gravel Pack	Grout	Cave-in

GEE LEGEND * * 29/10/09 5:04:07 PM