GEOTECHNICAL INVESTIGATION REPORT

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

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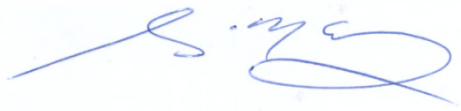

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1 PROJECT INFORMATION

1.1 INTRODUCTION

Geo-Environmental Engineering Pty Ltd (GEE) was commissioned by Tony Soueid to undertake a complete a geotechnical investigation at 307 - 311 Bexley Road & 88 - 96 New Illawarra Road, Bexley North, New South Wales (herein referred to as the 'site'). The site covers a combined area of approximately 4,200m^2 and comprises the following allotments:

- Lots 3, 4, 5 and 6 in Deposited Plan (DP) 508629,
- Lots A and B in DP 388204,
- Lot 1 in DP 1045200,
- Lot 1 in DP 400341, and
- Lot 35 in DP 663036.

A site survey plan is provided for reference in **Appendix A**, while a site location map is provided as **Figure 1**.

The investigation was required to support a planning proposal with Bayside Council which relates to the proposed rezoning of the land to 'R4 – High Density' residential with likely development to include a basement (single or multiple levels) and up to six levels above-ground, and was completed in conjunction with a preliminary contamination investigation, the results of which are reported separately.

1.2 PREVIOUS INVESTIGATIONS

In early 2016, STS GeoEnvironmental Pty Ltd (STS) completed a geotechnical investigation at the northern end of the site (reference 1). The geotechnical report included:

- The drilling of five boreholes (BH1 to BH5 – Refer **Figure 2**) across the northern part of the site (i.e. 307-309 Bexley Road) using a mechanical drilling rig equipped with solid flight augers,
- The performance of Dynamic Cone Penetrometer (DCP) tests at each borehole location to assess the consistency and/or relative density of the soil profile,
- Collection of samples from each of the borehole, and
- Analysis of selective samples for pH, sulphate and chloride content to provide a preliminary assessment of the aggressivity of the soil profile.

The subsurface conditions encountered by the STS boreholes comprised concrete and/or asphalt over fill material which was underlain by natural (i.e. previously undisturbed) sandy clays, clayey sands and weathered sandstone bedrock. The fill layer extended to a maximum depth of 1.6m, while the bedrock formation was encountered at depths of between 2.0m and 4.6m.

1.3 OBJECTIVES AND SCOPE OF WORKS

The objective of the investigation was to provide Council with sufficient information to be satisfied that the site is suitable for the proposed land-use and the likely development. A secondary objective was to provide geotechnical information to assist with the planning and preliminary design of the proposed development.

The scope of works completed by GEE, to achieve the above objectives, is provided below:

- A review of the previous investigation report,
- A review of the environmental and physical setting in which the site lies, including geology, hydrogeology and topography,
- Site inspection,
- Field investigations including:
  - The drilling of nine boreholes (BH101 to BH109) across accessible areas of the site, and
  - The installation of a groundwater monitoring well within three of the nine boreholes. These three wells compliment three existing wells at the northern end of the site within the existing Metro Petroleum Service Station. The origin of the existing wells is not known although they are believed to have been installed during the 2011 contamination assessment mentioned above. For the purpose of this assessment the former wells were labelled as Well GW01, GW02 and GW02 (**Figure 2**),
- Preparation of this report.

2 SITE INFORMATION

2.1 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)[1]
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

2.2 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 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 (**Figure 3**) and the surface predominately comprised concrete or asphalt pavements with some garden beds along the perimeter of the property.

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

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 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.

2.3 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%.

2.4 GEOLOGY AND SOILS

2.4.1 *Regional*

A review of the Sydney 1:100,000 regional geological map (reference 2) 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 3) 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.

2.4.2 *Local*

The subsurface conditions encountered by the STS boreholes (reference 1) comprised concrete and/or asphalt over fill material which was underlain by natural (i.e. previously undisturbed) sandy clays, clayey sands and weathered sandstone bedrock. The fill layer extended to a maximum depth of 1.6m, while the bedrock formation was encountered at depths of between 2.0m and 4.6m.

2.5 HYDROGEOLOGY

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.

2.6 ACID SULFATE SOIL POTENTIAL

Acid Sulfate Soil is naturally occurring sediments and soils containing iron sulfides (principally iron sulfide, iron disulfide or their precursors). Oxidation of these soils through exposure to the atmosphere or through lowering of groundwater levels results in the generation of sulfuric acid.

Land that may contain potential acid sulfate soils was mapped by the NSW Department of Land and Water Conservation (DLWC) and based on these maps local Councils produced their own acid sulfate soil maps to be used for planning purposes.

The Acid Sulfate Soils Map produced by the NSW Department of Planning and Environment, via interactive online mapping, indicates that the site lies within area defined as "*Class 5*". In accordance with Clause 6.1 of Council's Local Environment Plan (LEP) 2011, a preliminary assessment of acid sulfate soil and potentially a management plan is recommended for any "*Works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5 metres Australian Height Datum by which the watertable is likely to be lowered below 1 metre Australian Height Datum on adjacent Class 1, 2, 3 or 4 land*".

Firstly, the surface elevation is greater than 5m AHD (approximately between 10-20m AHD). Secondly, the maximum depth of proposed excavation is expected to be 7m below the ground surface (bgs) which equates to a bulk excavation level which is significantly greater 1m AHD. Additionally, there is no need for de-watering which would reduce the water table in adjoining Class 1 to Class 4 land below 1m AHD, which according to the acid sulphate maps produced by Council, is approximately 250m west of the site. In this regard, there is no need for an acid sulphate soil assessment or management plan

3 FIELD INVESTIGATIONS

Fieldwork was undertaken by Stephen McCormack, an experienced geotechnical engineer from GEE, on the 1st of November 2016 and comprised

- ◊ The drilling of nine boreholes (BH101 to BH109) in accessible areas across the site, and
- ◊ The installation of a groundwater monitoring well within three of the nine boreholes.

3.1.1 *Borehole Drilling Operations and Logging*

Prior to commencement of the bores, a scan for potential underground services and utilities was completed and cross-checked with the results of a Dial Before you Dig (DBYD) search.

The boreholes were drilled using either an 85mm diameter stainless steel hand auger operated by Stephen McCormack from GEE, or with a mechanical Hanjin D&B track rig that was owned and operated by Total Drilling Pty Ltd and equipped with Solid Flight Augers (SFA) and a tungsten-carbide drill bit (TC-bit). The hand auger was used in areas where the mechanical rig could not access which were boreholes BH108 and BH109.

With the exception of borehole BH104, the boreholes were extended through any fill material into the natural soil profile before terminating on, or within, the underlying sandstone bedrock formation at depths of between 0.75m and 3.8m below ground surface (bgs). Borehole BH104 refused on an obstruction within the fill profile (likely concrete) at a depth of 1.2m bgs.

During drilling, the encountered fill and natural soils were geologically logged by an experienced environmental and geotechnical engineer taking care to describe the presence and depth of fill material / previously disturbed ground, the natural stratum, moisture, seeps or water baring zones, elevation of the water level/hydraulic head, and adverse aesthetics such as discolouration, odours or obvious evidence of contamination.

A summary of the subsurface conditions encountered is provided in Section 3.2, while a summary of the borehole information, including total depth, is provided in **Table 1** and their locations are shown on **Figure 2**. Also included in Table 2 and Figure 2 are details and location of the geotechnical bores completed by STS (reference 1). The borehole logs (including the previous STS bores) are provided in **Appendix B**.

Table 1: Summary of the Borehole Information

Borehole ID	Date Completed	Drilling Method	Total Depth	Depth of Filling [1]	Depth to Bedrock	Well Screen Interval
			(m BGS)	(m BGS)	(m BGS)	(m BGS)
GEE Boreholes 2016						
BH101	1 Nov 2016	Mechanical	3.8	2.7	2.7	--
BH102	1 Nov 2016	Mechanical	2.4	2.0	2.0	1.0 – 2.2
BH103	1 Nov 2016	Mechanical	1.4	1.1	1.1	--
BH104	1 Nov 2016	Mechanical	1.2	>1.2	--	--
BH105	1 Nov 2016	Mechanical	2.4	1.05	2.3	1.15 – 2.35
BH106	1 Nov 2016	Mechanical	2.2	0.6	1.9	--
BH107	1 Nov 2016	Mechanical	2.8	0.7	1.4	1.6 – 2.8
BH108	1 Nov 2016	Hand Auger	0.75	0.3	0.75	--
BH109	1 Nov 2016	Hand Auger	1.35	0.7	1.35	--
STS Boreholes 2015						
BH1	14 Dec 2015	Mechanical	3.2	0.2	3.0	--
BH2	14 Dec 2015	Mechanical	0.6	>0.6	--	--
BH3	14 Dec 2015	Mechanical	5.0	1.6	4.6	--
BH4	14 Dec 2015	Mechanical	2.2	0.6	2.0	--
BH5	14 Dec 2015	Mechanical	0.8	>0.8	--	--

m BGS = metres below ground surface
Note 1: Depth of fill included topsoil, concrete and any soil which had been previously disturbed.

3.1.2 *Monitoring Well Installation*

Groundwater monitoring wells were installed in boreholes BH01, BH02 and BH03 in general accordance with the Land and Water Biodiversity Committee (2012) *Minimum Construction Requirements for Water Bores in Australia* (reference 4), using 50 mm diameter uPVC pipe, with a machine slotted screen section, 2 mm sand pack and a bentonite seal. The depths of the screened section of the wells is provided in **Table 1**.

The purpose of the groundwater monitoring wells was to assess the presence and depth of stabilised groundwater at the site and facilitate the sampling of groundwater beneath the site as part of the separate site contamination assessment.

The groundwater well installation details are shown on the borehole logs in **Appendix B.**

3.2 SUBSURFACE CONDITIONS

The site stratigraphy, as observed in the boreholes (both GEE and STS) typically comprised pavements and/or topsoil over fill material overlying natural clay soils, which in turn was underlain by weathered sandstone bedrock. The depth of filling at the borehole locations was between approximately 0.2m and 2.7m bgs, while the depth to bedrock encountered by the boreholes was between 0.75m and 4.6m bgs.

Detailed descriptions of the subsurface conditions on site are provided in the borehole logs provided in **Appendix B**, while the soil profile is also summarised in **Table 2**.

Table 2: Summary of Subsurface Conditions

Layer / Unit	Description	Depth to Base of Layer (m)[1]	Consistency / Relative Density and estimated Strength[1]
FILL	CONCRETE and/or Asphalt Mix of sand, gravel, silt and clay.	0.2 – 2.7	-- Variable
NATURAL SOIL	Clayey SAND / Sandy CLAY: light grey, orange-brown, red-brown, medium to coarse grained sand, low plasticity clay, moist	0.75 – 2.3	Stiff to very stiff
BEDROCK	SANDSTONE: grey and orange-brown, medium to coarse grained	>5.0	--

Note 1: Estimated from SPT tests and borehole observations

Adverse aesthetics, specifically odours associated with potential contamination, were not noted during the fieldwork. Additionally, no potentially Asbestos Containing Materials (ACM) was observed in the bores during the drilling.

3.2.1 *Groundwater*

The majority of 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 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. As previously mentioned, the well within borehole BH105 was dry to a depth of 2.4m bgs.

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 DISCUSSION

4.1 SITE PREPARATION

Following demolition of the existing structures, and prior to bulk excavation works and construction of any new development, all topsoil with organic matter and any pavement materials, should be removed from the proposed building and pavement areas. Stripped topsoil should be stockpiled for re-use as landscape material, or disposed off-site.

Material removed from site will need to be managed in accordance with the provisions of current legislation and may include segregation by material type classification in accordance with NSW EPA (2014) *Waste Classification Guidelines* (reference 12) and disposal at facilities appropriately licensed to receive the particular materials. GEE notes that the natural undisturbed clay soil and rock may be classified as Virgin Excavated Natural Material (VENM) and re-used on other sites rather than disposed at a landfill. However, the material will require sampling and analysis for a broad suite of potential contaminants to ensure it is free of contamination.

4.2 EARTHWORKS

Based on the preliminary development options, earthworks are likely to comprise excavation of between approximately 3m to 7m to facilitate the construction of a one or two level basement. Locally deeper excavations are also likely for service trenches and lift shafts. For the purpose of this report, it is assumed that the excavation will extend to within close proximity to the property boundaries.

4.2.1 *Excavation*

Based on the fieldwork undertaken as part of this investigation, the excavation will encounter surface fill material and natural sandy clay/clayey sand soil, before encountering weathered sandstone below depths of between 0.75m to 4.60m depth. GEE notes that the strength of the bedrock has not been assessed as part of this geotechnical investigation, however, based on local knowledge it is likely to be initially extremely low to very low strength, becoming at least low to medium strength with depth of the basement. To confirm the strength of the bedrock within the depth of proposed excavation would require more detailed investigations (preferably following demolition of the existing dwelling) including the coring and strength testing of the bedrock formation.

The fill and natural soil profile is expected to be readily excavated using standard equipment such as excavators. However, the use of an impact hammer and/or rock saw will be required upon encountering the bedrock formation, especially when combined with unfavourable rock-defect geometry. When using an impact hammer the effects of vibration should be considered and are discussed further in Section 4.2.4.

4.2.2 *Groundwater Inflow*

Groundwater or seepages were encountered at the soil bedrock interface during this investigation and additional seepages should also be expected to occur over time through defects in underlying bedrock formation. The seepage is expected to be intermittent and recharged by rainfall events, and is expected to be sufficiently managed during the earthworks phase by pumping from a sump at the base of the excavation. In the long term, conventional techniques such as strip drains behind basement walls and ag-lines will need to be incorporated into the design of the basement, along with a sump and pump system linked to the regional stormwater system. Alternatively the basement walls will need to be waterproofed.

4.2.3 *Excavation Support*

Considering that the excavation is expected to extend to within close proximity of the site boundaries, temporary shoring, or the early construction of permanent walls designed to shore up the boundaries, will be required.

At this preliminary stage the options for shoring include the use of evenly spaced mass concrete piles, secant piles, soldier piles or contiguous piling. Also, it will be important to protect any soil that is exposed at the boundary during excavation works, to prevent the soil from drying out, shrinking and potentially impacting on shallow footings of any adjoining structures.

The choice of retention system / earth support should be discussed with an experienced and specialist contractor for wall construction and anchor installation, and will primarily depend on cost. However, other factors such as the need for a watertight seal, the appearance of the final wall and whether it can be utilised as structural support as part of the final development, will need to be considered.

The design of the shoring may be undertaken in accordance with AS 4678-2002 *Earth Retaining Structures* (reference 5) and should consider the short and long term configurations. In the short term, should the shoring walls be cantilevered or supported by a single row of anchors and some wall movements can be tolerated (flexible wall),

the pressure acting on the wall can be estimated on the basis of a triangular earth pressure distribution.

When internal props, such as the ground floor slab, restrain retaining wall movement, or where significant movements cannot be tolerated (rigid wall) such as along the eastern boundary, an 'at-rest' earth pressure coefficient (Ko) should be adopted with either a uniform or trapezoidal pressure distribution. It should be noted that shoring which is designed for this 'at rest' coefficient will still undergo some lateral movements, depending on the final configuration of the wall and construction sequence.

The design of any retaining structures should make allowance for all applicable surcharge loadings including construction activities around the perimeter of the excavation and adjacent buildings. Consideration should be given to the possibility of a hydrostatic pressure due to build-up of water behind the wall (*e.g.* from broken services), unless permanent subsurface drainage can be provided.

Toe restraint may be achieved by embedding the retention system below the base of the excavation. If a suitable socket cannot be achieved rock anchors will need to be installed in the toe to provide lateral restraint. Internal props, or anchors, are also likely to be required to restrain the upper sections of the deeper excavations. If anchors are adopted, and they extend beyond the boundary, permission from the neighbours will be required.

Finally, computer aided analysis may be carried out to assess potential ground movements based on different wall designs and construction sequence, so as to control deflections to within tolerable limits. It is also considered prudent to carry out surveys before and after installation to measure the actual movement of the wall or soil.

Geotechnical parameters for the soil and bedrock profile encountered at the site are provided in **Table 3** below.

Table 3: Geotechnical Design Parameters – Retaining Walls

Units	Depth to Top of Layer (m)	Unit Weight (kN/m³)	Active Lateral Earth Pressure (Ka)		Lateral Earth Pressure at Rest (Ko)	Passive Lateral Earth Pressure (Kp)
			Short-Term	Long-Term		
Soil Profile and EL strength Sandstone	Surface	19	0.35	0.4	0.50	--
Sandstone: VL strength (or better)	~1.0 – 4.6	21	0.25	0.30	0.40	3.5

4.2.4 *Construction / Excavation Induced Vibration*

When using a hydraulic hammer, vibrations will be transmitted through the ground and potentially impact on adjoining structures including the buried services. Where possibly the use of other techniques not involving impact (*e.g.* rock saws), should be adopted as they would reduce or possibly eliminate risks of damage due to vibrations.

The structures on the adjacent properties are sensitive to vibrations above certain threshold levels (regarding potential for cracking). Given that the proposed basement excavation will extend to within close proximity of the boundaries, close controls by the excavation contractor over the rock excavation are necessary, and are recommended, so that excessive vibration effects are not generated.

Peak Particle Velocity (PPV) is usually the adopted measure of ground vibration and the safe limits depend on the sensitivity of the adjoining structures and services. There is a number of Australian and overseas publications which provide vibration velocity guideline levels (or safe limits) including:

- ◊ Australian Standard AS2187.2-2006 Explosives - Storage and use - Use of explosives - Appendix J: Ground Vibrations and Airblast Overpressure (reference 6).
- ◊ Australian Standard AS2670.2-1990 Evaluation of human exposure to whole-body vibration - Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz) (reference 7).
- ◊ DIN 4150 – Part 3 – 1999. Effects if Vibration on Structures (reference 8).
- ◊ Department of Environment and Conservation NSW, 2006. Assessing Vibration: a technical guideline (reference 9).

- ◊ British Standard BS 7385-1:1990. Evaluation and measurement for vibration in buildings. Guide for measurement of vibrations and evaluation of their effects on buildings (reference 10).
- ◊ British Standard BS 7385-2:1993. Evaluation and measurement for vibration in buildings. Guide to damage levels from ground-borne vibration (reference 11).

The most appropriate guidelines levels for the proposed excavation work are provided in AS2187.2-2006, which refers to guideline values from BS7385-2 for the prevention of minor or cosmetic damage occurring in structures from ground vibration. Additionally, the guideline levels provided in DIN 4150 Part 3 is considered an appropriate source for guideline levels.

Ideally, safe limits should be determined by a specialist vibration consultant, with consultation with Sydney Water also recommended. However, as a preliminary and conservative guide, and considering the above guidelines and the type of nearby structures (including Sydney Water assets), GEE recommend that excavation methods should be adopted which limit ground vibrations at the adjoining developments to not more than 5mm/sec, and vibration monitoring will be required to verify that this is achieved.

As a guide, the PPV limits of 5mm/sec are expected to be achievable if rock breaker equipment or other excavation methods are restricted as indicated in **Table 4**.

Table 4: Recommendations for Rock Hammer Equipment

Distance from adjoining structure (m)	**Maximum Peak Particle Velocity 5mm/sec**	
	Equipment	**Operating Limit (% of Maximum Capacity)**
1.0 to 2.0	Hand operated jackhammer only	100
2.0 to 5.0	300 kg rock hammer	50
5.0 to 10.0	300 kg rock hammer or 600 kg rock hammer	100 50

GEE notes human discomfort levels caused by vibration are typically less than the levels that are likely to cause cosmetic or structural damage to structures. Therefore, complaints may be lodged by neighbours before any cosmetic or structural damage

occurs. In this regard, consideration may be given to adopting more stringent vibration limits recommended for human amenity or, as a minimum, ensuring that vibration monitoring is undertaken as reassurance to confirm that vibrations are within safe limits. Acceptable vibration limits for human comfort caused by construction and excavation equipment are provided in DEC (2006) (reference 9). Specifically maximum acceleration limits as specified in Table 2.2 of the guideline should be adopted.

Finally, at all times, the excavation equipment should be operated by experienced personnel, according to the manufactures instructions, and in a manner consistent with minimising vibration effects. Measures which may be used to minimise vibration include:

- ◊ Progressive breakage from open excavated faces,
- ◊ Selective breakage along open joints, where present,
- ◊ Use of rock hammers in short bursts to prevent generation of resonant frequencies,
- ◊ Orientation of the rock hammer pick away from property boundaries and into the existing open excavation,
- ◊ Commencement of excavation as far away from other structures as possible, and
- ◊ The use of a rock sawing or grinder adjacent to the site boundaries. GEE notes that this equipment also reduces the possibility of overbreak and loosening of the rock mass.

4.3 FOUNDATIONS

GEE recommends that footings for the proposed development be founded on a consistent medium to minimise any potential for differential settlements. Following excavation of the basement level, the subgrade (or bulk excavation level) will likely comprise weathered sandstone bedrock, regardless of there being a single or double basement.

The sandstone formation is considered to be a suitable founding medium for the proposed development, however, further investigations are recommended to minimise uncertainty about the depth, strength and quality of the sandstone formation beneath the site and this should include coring and logging of the bedrock, followed by strength testing of recovered rock cores.

The serviceability end bearing pressures, ultimate end bearing pressures and ultimate shaft adhesion, for the various classes of Hawkesbury sandstone, are provided for reference in **Table 5** and is based on the recommendations of Pells et al (reference 13).

Table 5: Preliminary Foundation Design Parameters

Founding Stratum	Ultimate End Bearing Pressure (kPa)	Serviceability End Bearing Pressure (kPa)	Ultimate Shaft Adhesion (kPa)
Sandstone Class V	3000	1000	150
Sandstone Class IV	4000	1000	250
Sandstone Class III	20,000	3500	800
Sandstone Class II	60,000	6000	1500

The above design parameters assume that the piles are socketed at least 0.3m into the desired sandstone class. Additionally, settlements for footings on rock are anticipated to be less than about 1% of the pile diameter.

Finally, footing systems should be designed by a suitably qualified and experienced structural engineer and GEE recommends that inspection by a geotechnical engineer is undertaken during the pier construction stage, to confirm that the design founding conditions have been achieved.

4.4 EARTHQUAKE DESIGN

Structural design for earthquake loads should be carried out in accordance with the relevant provisions in AS1170.4–2007 (reference 14). Based on the encountered subsurface soil profile and expected regional geology, and with reference to Table 4.1 of AS1170.4, the site sub-soil class is considered to be C_e.

5 CONCLUSION AND RECOMMENDATIONS

GEE considers that sufficient information has been gained to be confident of the subsurface conditions across the site, to assist with the planning and preliminary design of the proposed development and to provide Council with assurances regarding the geotechnical feasibility of the proposed development.

Based on the results of the investigation, the planning proposal is considered to be feasible. Additionally, GEE concludes that the existing sandstone rock formation is capable of withstanding the proposed loads to be imposed, and standard shoring works (provided they are designed by a structural engineer), will ensure the stability of the excavation and provide protection and support of adjoining properties and other infrastructure (e.g. buried services).

The geotechnical issues associated with the proposed development have been addressed by the investigation and are discussed in this report. However, further investigation should be undertaken (once the plans for the proposed development have been finalised and preferably post demolition) to more accurately define the strength and quality of the bedrock and minimise the uncertainty for earthworks contractors and structural design engineers when planning and designing the proposed excavation and foundations.

GEE will be pleased to assist with any further advice or geotechnical services required in regard to the proposed development.

6 GENERAL LIMITATIONS

Soil and rock formations are variable. The logs or other information presented as part of this report indicate the approximate subsurface conditions only at the specific test locations. Boundaries between zones on the logs or stratigraphic sections are often not distinct, but rather are transitional and have been interpreted.

The precision with which subsurface conditions are indicated depends largely on the frequency and method of sampling, and on the uniformity of subsurface conditions. The spacing of test sites also usually reflects budget and schedule constraints. Groundwater conditions described in this report refer only to those observed at the place and under circumstances noted in the report. The conditions may vary seasonally or as a consequence of construction activities on the site or adjacent sites.

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that GEE be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of changed soil and rock conditions requires experience and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

The comments given in this report are intended only for the guidance of the design engineer, or for other purposes specifically noted in the report. The number of boreholes or test excavations necessary to determine all relevant underground conditions which may affect construction costs, techniques and equipment choice, scheduling, and sequence of operations would normally be greater than has been carried out for design purposes. Contractors should therefore rely on their own additional investigations, as well as their own interpretations of the borehole data in this report, as to how subsurface conditions may affect their work.

7 REFERENCES

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13. Pells et al, 1998: *Foundations on Sandstone and Shale in the Sydney Region*, Australian Geomechanics Society, 1998.
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FIGURES

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

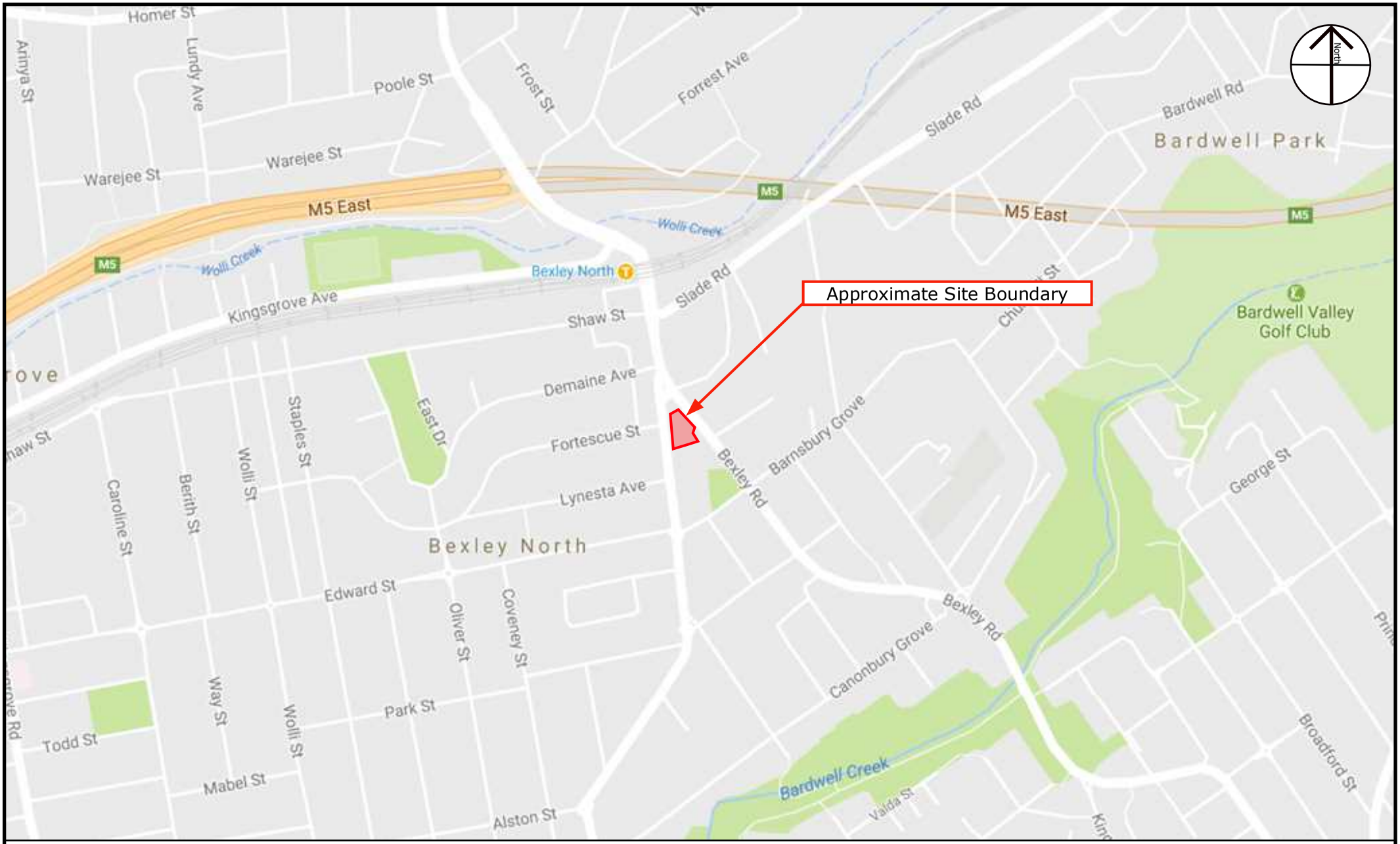

Image Source: ©2016 Google - Google Maps, retrieved 05/08/2016

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82 BRIDGE STREET
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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: **8 Nov 2016**	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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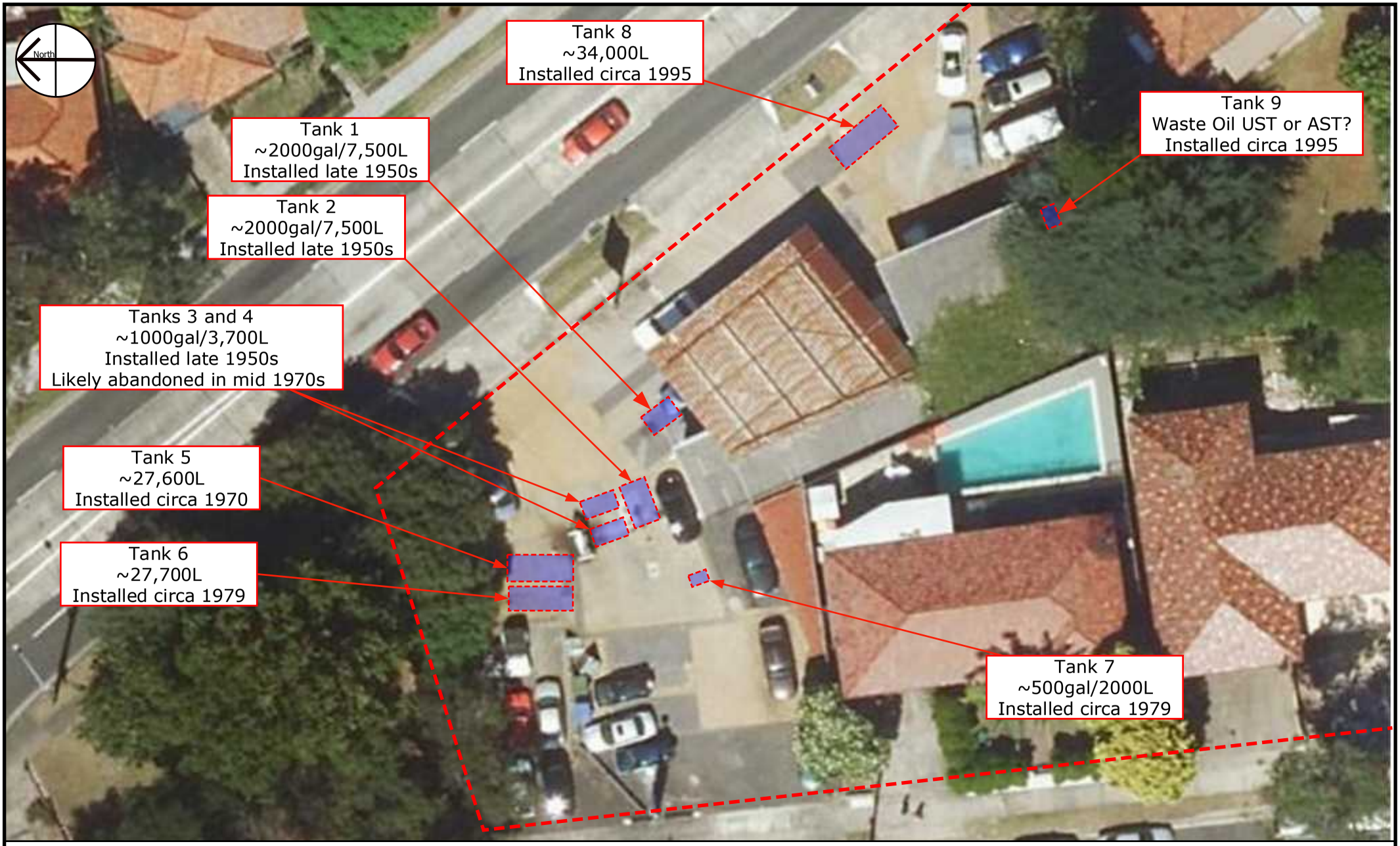
TITLE: SITE PLAN 307-311 Bexley Rd & 88-96 New Illawarra Rd Bexley North NSW	SCALE: **N.T.S**	DATE: **10 Dec 2016**	FIGURE No. **2**
	DRAWN: **A. Chiem**	JOB No.: **E16016BN**	REVISION: **A**



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

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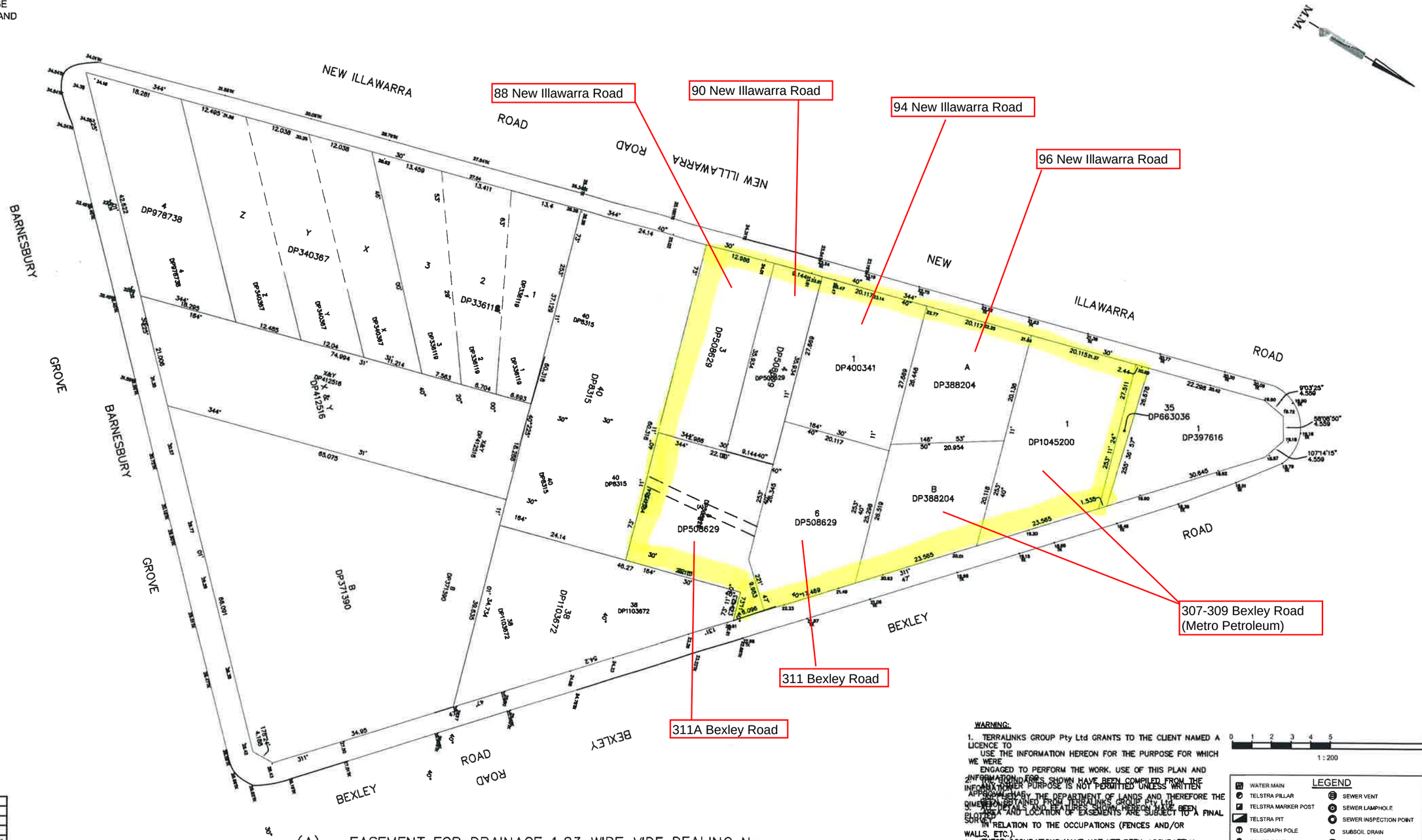
TITLE:	SCALE:	DATE:	FIGURE No.
UST Locations	N.T.S	21 Dec 2016	3
	DRAWN: A. Chiem	JOB No.: E16016BN	REVISION: A

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	SOUED
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: 16.05.19	DATE: 19.05.19	DATE: 19.05.19

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

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 POWER AND TELEPHONE SERVICES SHOWN HEREON HAVE BEEN PLOTTED FROM INFORMATION SUPPLIED BY THE DEPARTMENT OF LANDS AND THEREFORE THE ACCURACY AND LOCATION OF EASEMENTS ARE SUBJECT TO A FINAL SURVEY.
3. NO INVESTIGATION WAS MADE IN RELATION TO THE OCCUPATIONS (FENCES AND/OR WALLS, ETC.).
4. THESE DOCUMENTS ARE NOT TO BE USED FOR ANY PURPOSE OTHER THAN THAT FOR WHICH THEY WERE COMMISSIONED AND NO RESPONSIBILITY IS ACCEPTED FOR USE OUTSIDE OF THAT PURPOSE OR BY ANY PERSON OTHER THAN THE PERSON FOR WHOM THEY WERE PREPARED.
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 SCALE, LOCATION DATA IS NOT SUITABLE FOR SETTING OUT CONSTRUCTION.
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 LEVELS FOR BOTH THE SUBJECT AND ADJOINING BUILDINGS HAVE BEEN DETERMINED USING INDIRECT SURVEY METHODS AND ARE THEREFORE 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 (Ø 0.225)
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

BOREHOLE LOGS

Borehole Log Report

Geo Environmental Engineering
82 Bridge St
Lane Cove NSW 2066
T 02 9420 3361

geo-environmental ENGINEERING

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, Bexley North NSW**
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	**FILL**- Gravelly SAND / Sandy GRAVEL, brown, fine to coarse grained sand, fine to coarse gravel.	loose		SMC011116-1 0.2-0.3m	
		0.6				Natural	**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					**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**

GEE DAVIES BH LOG BEXLEY NORTH.GPJ GEE.GDT 20/12/16 9:29:35 AM

Monitoring Well Log Report

Geo Environmental Engineering
82 Bridge St
Lane Cove NSW 2066
T 02 9420 3361

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, Bexley North NSW**
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		**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					

Material Type: Fill; Natural

Well Details: Gatic; 0.30; Bentonite; 0.80; 1.00; Coarse Sand; 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**

GEE DAVIES BH LOG BEXLEY NORTH.GPJ GEE.GDT 20/12/16 9:29:36 AM

Borehole Log Report

Geo Environmental Engineering
82 Bridge St
Lane Cove NSW 2066
T 02 9420 3361

geo-environmental ENGINEERING

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, Bexley North NSW**
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	Depth (m)	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
Solid Flight Auger	0.2	**ASHALT**.				
	0.4	**FILL**- Gravelly Clayey SAND, dark grey and brown. (Fill)	loose	moist	SMC011116-11/12 0.1-0.25m	
	0.6	**FILL**- Silty SAND, dark brown / dark grey, fine to coarse grained sand, trace clay. (Fill)	loose	moist	SMC011116-13/14 0.5-0.7m	
	1.0					
	1.2	**SANDSTONE**- grey & orange brown, medium to coarse. (Natural)				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**

GEE DAVIES BH LOG BEXLEY NORTH.GPJ GEE.GDT 20/12/16 9:29:37 AM

Borehole Log Report

Geo Environmental Engineering
82 Bridge St
Lane Cove NSW 2066
T 02 9420 3361

geo-environmental ENGINEERING

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, Bexley North NSW** 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**

GEE DAVIES BH LOG BEXLEY NORTH.GPJ GEE.GDT 20/12/16 9:29:38 AM

Monitoring Well Log Report

Geo Environmental Engineering
82 Bridge St
Lane Cove NSW 2066
T 02 9420 3361

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, Bexley North NSW**
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	
	0.6	**FILL**- Sandy CLAY, dark brown & brown, trace sand.	firm to stiff	moist	SMC011116-19 0.5-0.6m	
	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	
	1.6	Becoming red brown & orange brown from 1.6m, medium to coarse grained sand.			SMC011116-23 1.8-2.0m	
	2.4	**SANDSTONE**- grey & orange brown, medium to coarse.				
		Hole Terminated at 2.40m Practical refusal.				Bore dry upon completion.

Well Details: 0.50 Gatic; 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**

GEE DAVIES BH LOG BEXLEY NORTH.GPJ GEE.GDT 20/12/16 9:29:39 AM

Borehole Log Report

Geo Environmental Engineering
82 Bridge St
Lane Cove NSW 2066
T 02 9420 3361

geo-environmental ENGINEERING

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, Bexley North NSW**
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				Natural	**Sandy CLAY**- orange brown, fine to medium grained sand.	stiff	moist	SMC011116-25/26 0.7-0.9m	
		0.8									
		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**

GEE DAVIES BH LOG BEXLEY NORTH.GPJ GEE.GDT 20/12/16 9:29:40 AM

Monitoring Well Log Report

Geo Environmental Engineering
82 Bridge St
Lane Cove NSW 2066
T 02 9420 3361

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, Bexley North NSW**
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	Well Details	Well Construction
							Surface: Grass						
Solid Flight Auger		0.2				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			Gatic
		0.4											
		0.6								SMC011116-30 0.5-0.6m			
		0.8				Natural	**Silty CLAY**- red brown & orange brown, some fine to medium grained sand.	firm to stiff	moist	SMC011116-28 0.7-0.8m			
		1.0										1.00	
		1.2					**Sandy CLAY**- red brown & orange brown, medium to coarse grained sand, medium to coarse gravel.	stiff	moist				Bentonite
		1.4										1.45	
		1.6					**SANDSTONE**- grey & orange brown, medium to coarse.			SMC011116-31 1.5-1.6m		1.60	
		1.8											
		2.0											Coarse Sand
		2.2					**SANDSTONE**- pale grey, medium to coarse, weak zone, increased moisture.				Likely water bearing zone between 2.0 and 2.8m.		
		2.4											50mm Ø Screen
		2.6								SMC011116-35 2.5-2.8m			
		2.8											
		3.0					**Hole Terminated at 2.80m** Practical refusal.						

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**

GEE DAVIES BH LOG BEXLEY NORTH.GPJ GEE.GDT 20/12/16 9:29:41 AM

Borehole Log Report

Geo Environmental Engineering
82 Bridge St
Lane Cove NSW 2066
T 02 9420 3361

geo-environmental ENGINEERING

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, Bexley North NSW** 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**

GEE DAVIES BH LOG BEXLEY NORTH.GPJ GEE.GDT 20/12/16 9:29:42 AM

Borehole Log Report

Geo Environmental Engineering
82 Bridge St
Lane Cove NSW 2066
T 02 9420 3361

geo-environmental ENGINEERING

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, Bexley North NSW**
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	Depth (m)	Material Description	Consistency / Density	Moisture	Samples / Tests ID No.	Observations / Comments
Hand Auger	0.2	**TOPSOIL / FILL. Clayey SILT**- dark brown, trace fine to coarse sandstone and coal gravel, roots. (Fill)	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	**Sandy CLAY**- orange brown & red brown. (Natural)	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**

GEE DAVIES BH LOG BEXLEY NORTH.GPJ GEE.GDT 20/12/16 9:29:42 AM

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Tony Soueid
Project: 307-309 Bexley Road, Bexley North
Location: Refer to Drawing No. 15/3507

Project: 20749/6466C
Date : December 14, 2015
Logged: JK

BOREHOLE NO.: BH 1

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S1		ASPHALT/SANDY GRAVEL: dark grey, fine to medium grained sand, gravel FILL	GW		D
	@ 0.3 m		SILTY CLAY: dark grey with orange brown and light grey, medium to high plasticity, trace of gravel	CL	FIRM TO STIFF	M
	S2					
	@ 1.0 m	1.0	FILL			
			CLAYEY SAND: orange brown, fine to medium grained	SC	STIFF	M
	S3		SANDY CLAY: red brown/orange brown with light grey, fine to medium grained sand,	CL	VERY STIFF	M-VM
	@ 2.0 m	2.0	medium plasticity, trace of gravel			
		3.0	WEATHERED SANDSTONE: light grey with orange brown, fine to medium grained		EXTREMELY LOW STRENGTH	M-D
			AUGER REFUSAL AT 3.2 M ON WEATHERED SANDSTONE			
		4.0				
		5.0				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Tony Soueid	Project: 20749/6466C	**BOREHOLE NO.: BH 2**
Project: 307-309 Bexley Road, Bexley North	Date : December 14, 2015	Sheet 1 of 1
Location: Refer to Drawing No. 15/3507	Logged: JK	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			ASPHALT/SANDY GRAVEL: dark grey, fine to medium grained sand, gravel FILL	GW	-	D
	S4 @ 0.5 m		SILTY CLAY: dark grey with dark brown and orange brown, medium to high plasticity, trace of gravel FILL	CL	-	M
			AUGER REFUSAL AT 0.6 M IN FILL			
		1.0				
		2.0				
		3.0				
		4.0				
		5.0				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Tony Soueid
Project: 307-309 Bexley Road, Bexley North
Location: Refer to Drawing No. 15/3507

Project: 20749/6466C
Date : December 14, 2015
Logged: JK

BOREHOLE NO.: BH 3

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S5/S6/S7 @ 0.3 m		CONCRETE: (220 mm thick)			
			GRAVELLY CLAY: dark brown/grey with light grey, red brown and orange brown, medium plasticity, trace of fine grained sand, some gravel	CL	VARIABLE	M
	S8 @ 1.0 m	1.0	FILL			
	S9 @ 1.8 m		SANDY CLAY: orange brown/red brown, fine to medium grained sand, medium plasticity, trace of gravel	CL	STIFF	M-VM
		2.0	SANDY CLAY: light grey with orange brown, fine to medium grained sand, medium plasticity	CL	STIFF	M
WT						
		3.0	SANDY CLAY: red brown, fine to medium grained sand, medium plasticity	CL	VERY STIFF	M
	S10 @ 4.0 m	4.0				
WT						W
			WEATHERED SANDSTONE: orange brown with light grey, fine to medium grained, clay seams		EXTREMELY LOW STRENGTH	M
		5.0	AUGER REFUSAL AT 5.0 M ON WEATHERED SANDSTONE			

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Tony Soueid	Project: 20749/6466C	**BOREHOLE NO.: BH 4**
Project: 307-309 Bexley Road, Bexley North	Date : December 14, 2015	Sheet 1 of 1
Location: Refer to Drawing No. 15/3507	Logged: JK	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S11		CONCRETE: (100 mm thick)			
	@ 02 m		GRAVELLY CLAY: dark grey with light grey and some orange brown, fine to medium grained sand, low plasticity, some gravel, ash	CL	VARIABLE	M
	S12		FILL			
	@ 0.7 m		CLAYEY SAND: orange brown, fine to medium grained	SC	FIRM TO STIFF	M-VM
		1.0				
			SANDY CLAY: red brown, fine to medium grained sand, low plasticity	CL	FIRM TO STIFF	M-VM
WT	S13					W
	@ 1.8 m				STIFF	
		2.0				
			WEATHERED SANDSTONE: red brown, fine to medium grained		EXTREMELY LOW STRENGTH	D
			AUGER REFUSAL AT 2.2 M ON WEATHERED SANDSTONE			
		3.0				
		4.0				
		5.0				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Tony Soueid
Project: 307-309 Bexley Road, Bexley North
Location: Refer to Drawing No. 15/3507

Project: 20749/6466C
Date : December 14, 2015
Logged: JK

BOREHOLE NO.: BH 5

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S14 @ 0.2 m		GRAVELLY CLAYEY SAND: dark brown with light brown, fine to medium grained, some gravel	CL	VARIABLE	D
	S15 @ 0.6 m		FILL SILTY CLAY: dark brown with dark grey and orange brown, medium plasticity, trace of gravel	CL	VARIABLE	M
		1.0	FILL AUGER REFUSAL AT 0.8 M ON CONCRETE			
		2.0				
		3.0				
		4.0				
		5.0				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Dynamic Cone Penetrometer Test Report

Project: 307-309 BEXLEY ROAD, BEXLEY NORTH — Project No.: 20749/6466c
Client: TONY SOUEID — Report No.: 15/3507
Address: 47 Beaufort Street, Croydon Park — Report Date: 14/12/2015
Test Method: AS 1289.6.3.2 — Page: 1 of 1

Site No.	P1	P2	P3	P4	P5	
Location	Refer to Drawing No. 15/3507	Refer to Drawing No. 15/3507	Refer to Drawing No. 15/3507	Refer to Drawing No. 15/3507	Refer to Drawing No. 15/3507	
Starting Level	Surface Level	Surface Level	Surface Level	Surface Level	Surface Level	
Depth (m)	Penetration Resistance (blows / 150mm)					
0.00 - 0.15	*	*	*	*	2	
0.15 - 0.30	*	*	*	*	5	
0.30 - 0.45	2	2	4	3	22	
0.45 - 0.60	3	22	10	10	Refusal	
0.60 - 0.75	2	Refusal	22	22		
0.75 - 0.90	10		R	R		
0.90 - 1.05	11		*	*		
1.05 - 1.20	4		*	2		
1.20 - 1.35	4		*	2		
1.35 - 1.50	5		*	2		
1.50 - 1.65	5		3	3		
1.65 - 1.80	5		4	3		
1.80 - 1.95	10		5	4		
1.95 - 2.10	14		5	14		
2.10 - 2.25	16		5	22		
2.25 - 2.40	12		6	Refusal		
2.40 - 2.55	18		7			
2.55 - 2.70	17		10			
2.70 - 2.85	19		17			
2.85 - 3.00	22		22			
3.00 - 3.15	Refusal		Refusal			
3.15 - 3.30						
3.30 - 3.45						
3.45 - 3.60						
3.60 - 3.75						

Remarks: * Pre drilled prior to testing

NATA Accredited Laboratory Number 2750
Accredited for compliance with ISO/IEC 17025
The results of tests, calibrations and / or measurements included in this document are traceable to Australian / national standards

Technician: JK

Approved Signatory.....
Laurie Ihnativ - Manager