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GEOTECHNICAL REPORT FOR PROPOSED ALTERATIONS AND ADDITIONS AT 65 DOLPHIN CRESCENT, AVALON BEACH, NSW.

1. INTRODUCTION:

This report details the results of a geotechnical investigation carried out for proposed alterations and additions at 65 Dolphin Crescent, Avalon Beach, NSW. The investigation was undertaken by Crozier Geotechnical Consultants (CGC) at the request of Giles Tribe Architects on behalf of the client Jaedho Two P/L.

The proposed works involves partial demolition of the existing site structures followed by alterations and additions which require bulk excavations within the front and rear for extensions to the existing structure and the construction of a new pool. Maximum bulk excavation is understood to be up to 2.4m depth below the existing ground surface level.

The site is located within the H1 (highest category) landslip hazard zone as identified within Northern Beaches Councils Geotechnical Risk Management Policy for Pittwater - 2009. Due to the depth of bulk excavation required, as part of the DA for the proposed development works a geotechnical report is required. To meet the Councils Policy requirements for land classified as H1 this Geotechnical Report includes a landslide risk assessment to the methods of AGS 2007 for the site and proposed works, plans, geological sections and provides recommendations for construction and to ensure the "Acceptable Risk Management" criteria is maintained for a preferred design life of 100 years. It is recommended that the client make themselves aware of the Policy and its requirements.

This report includes a description of site and sub-surface conditions including groundwater, a geotechnical assessment of the proposed works, a site plan, borehole logs and in-situ test results, a geological cross section, a risk assessment table and recommendations for the design and construction of the proposed development.

The investigation was undertaken as per the Proposal No.: P22-241, dated: 28 April 2022.

The investigation comprised:

a) A detailed geotechnical inspection and mapping of the site and inspection of adjacent properties by a Senior Engineering Geologist/Geotechnical Engineer.
b) Onsite service location and clearing of subsurface test locations by an experienced underground service contractor.
c) Drilling of four boreholes using hand tools along with Dynamic Cone Penetrometer (DCP) testing adjacent to the boreholes and at one additional location to investigate subsurface conditions.
d) Full-time filed supervision .an experienced Geotechnical Professional.

The following plans and drawings were supplied and relied on for the work:

- Architectural Drawings – Giles Tribe, Job Ref: 21102, Drawing No.: DA100, DA101, DA200 to DA204, DA207, DA208, DA301 to DA304, DA401, DA402 and DA701, Revision B, Dated: 24/05/2022
- Survey Drawing – Pinnacle Land Surveyors, Job Ref: 161Det, Sheet 1 of 1, Dated: 16 December 2021

2. PROPOSED WORKS

The proposed work involves partial demolition of the existing site structures and additions to the front and rear of the dwelling to create new living areas, an additional floor level and external access steps. It is also proposed to construct a new pool to the north of the site dwelling within the rear garden. It is understood that the extension to the front and rear will require bulk excavation to approximately 0.9m and 1.90m depth respectively. The proposed pool will require bulk excavation to a depth of 2.4m.

As part of the construction of the new pool, a pool fence which requires a non-climbable zone (NCZ) extending 0.9m horizontally out from the base of the pool fence. The location of the pool fence requires that bulk excavation will be undertaken to a depth of 1.4m up to the east shared boundary.

Bulk excavation for the pool, front and rear additions are proposed to be within 6.5m, 1.5m, 11.5m and 3.5m of the north, east, south and west boundaries respectively.

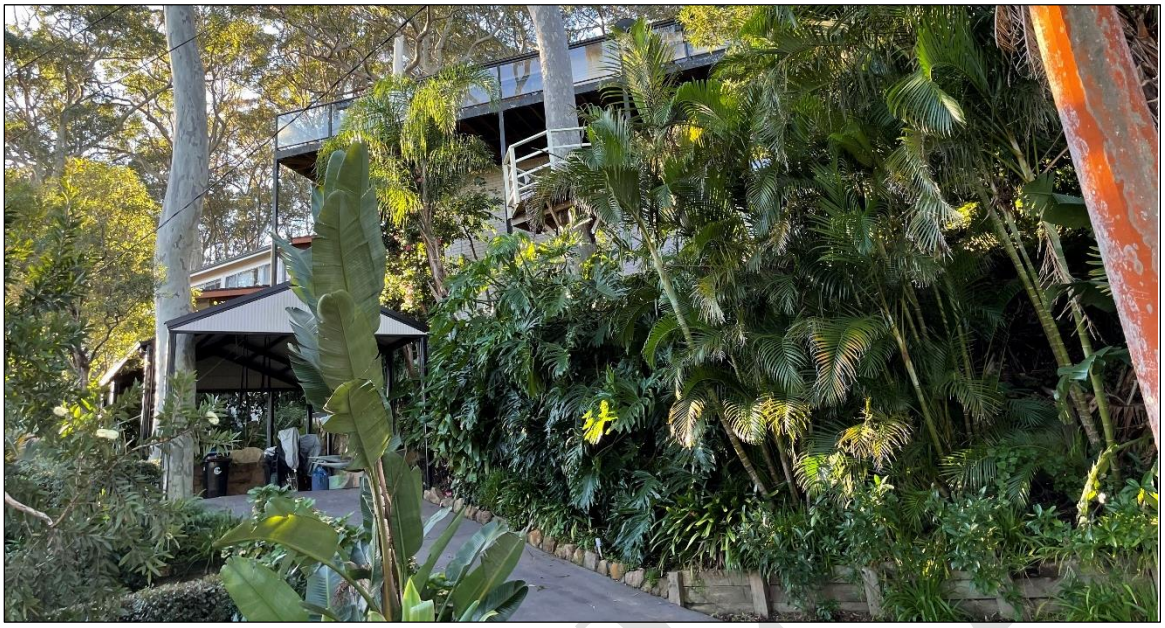
3. SITE FEATURES:

3.1. Description:

The site is a rectangular shaped block located on the high north side of Dolphin Crescent within moderate to steep south dipping topography. The site has front and rear boundaries of approximately 18.3m and side boundaries of approximately 37.0m, as referenced from the provided Survey Plan. An aerial photograph of the site and its surrounds is provided in Photograph 1, as sourced from NSW Government Six Map spatial data.

Extract 1: Aerial view of the site

The site contains of two storey brick residence towards the middle of the property with a suspended deck and balcony around the north, south and west of the dwelling. A steep concrete driveway extends between Dolphin Crescent and a covered car port near the southwest corner of the residence. Access to the site residence and rear of the property can be obtained via a set of concrete steps to the east and west of the structure. The rear of the site was moderately densely vegetated and contains a paved patio elevated above the timber deck approximately 1.0m. General views of the site are provided in Photograph 1 and 2.



Photograph 2: Front of the property, looking broadly north

Photograph 3: Rear view of the property, looking broadly southwest

The property is bordered to the north, east south and west by No.106 – No.108 Whale Beach Road, No.67 Dolphin Crescent, Dolphin Crescent carriageway and easement and No.63 Dolphin Crescent.

No.106 – No.108 Whale Beach Road both share similar steeply south sloping topography and contain residential dwellings/structures approximately 15m- 17m from the shared boundary.

No.67 Dolphin Crescent shares similar south sloping topography and is up to approximately 0.5m above site levels and contains a two-storey brick residence approximately 1.5m east of the shared boundary.

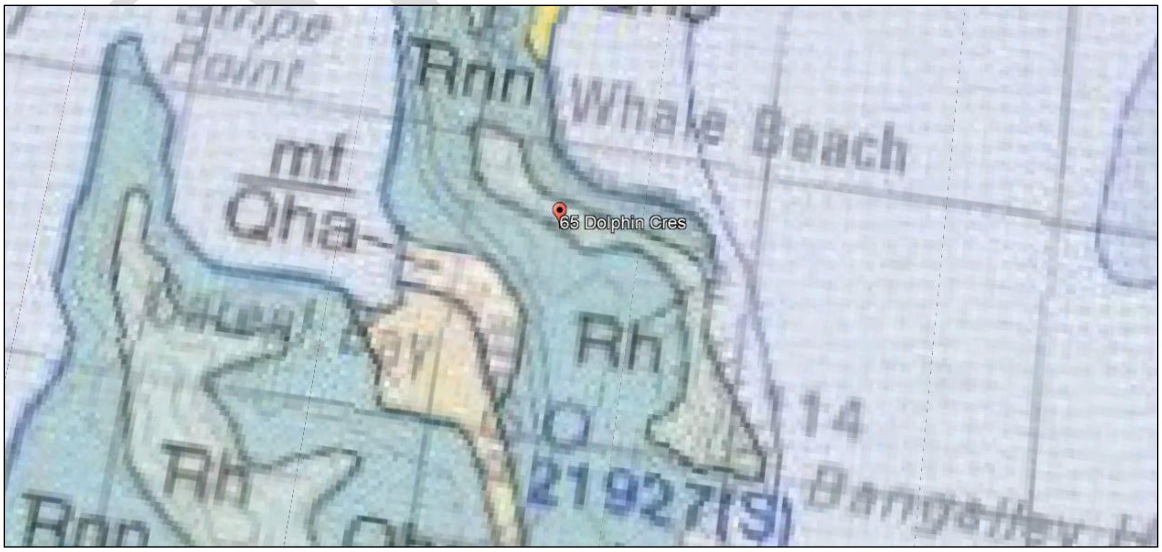
Dolphin Crescent comprised an asphalt pavement with concrete kerb and is broadly west sloping where it passes the site.

No.63 Dolphin Crescent contains a two-storey brick residence and shares similar south sloping topography The site dwelling is up to 1.5m below site surface levels within the rear of the property.

3.2. Geology:

Reference to the Sydney 1:100,000 Geological Series sheet (9130) indicates that the site is located near the boundary between the Hawkesbury Sandstone (Rh) and underlying Upper Narrabeen Group Shales (Rnn). The Hawkesbury sandstone unit typically comprises medium to coarse grained quartz sandstone with minor lenses of shale and laminate. The Newport Formation typically comprises interbedded laminite, shale and quartz to lithic quartz sandstones and pink clay pellet sandstones.

Narrabeen Group rocks are dominated by shales and thin siltstone/sandstone beds and often form rounded convex ridge tops with moderate angle (<20°) side slopes. These side slopes can be either concave or convex depending on geology, internally they comprise of interbedded shale and siltstone beds with close spaced bedding partings that have either close spaced vertical joints or in extreme cases large space convex joints. The shale often forms deeply weathered profiles with silty or medium to high plasticity clays and a thin silty colluvial cover. The bedrock may be thinly interbedded with very low to low strength siltstone/shale units and medium to high strength sandstone horizons.



Extract 1: Extract of 9130 Geology Series Map with site indicated

4. FIELD WORK:

4.1. Investigation Methods:

The field investigation comprised geotechnical inspection/mapping and a subsurface investigation which were both undertaken/supervised by a Senior Engineering Geologist/Geotechnical Engineer on the 16 May 2022.

The geotechnical mapping comprised a visual inspection of the site and adjacent properties to assess potential geotechnical issues relevant to the proposed development. It involved a photographic record of site conditions as well as geological/geomorphological mapping of the site and adjacent land with examination of soil slopes, vegetation, excavations and existing structures to assess the stability of the site.

The sub-surface investigation comprised the drilling of four boreholes (BH1 to BH4) using a hand auger to investigate sub-surface geology. A hand auger was used as access to the site for a conventional drilling rig was unavailable.

Soil samples were recovered from the auger for geotechnical logging purposes which was undertaken in accordance with AS1726:2017 'Geotechnical Site Investigations'.

DCP testing was carried out from ground surface adjacent to the boreholes and at one additional location in accordance with AS1289.6.3.2 – 1997, "Determination of the penetration resistance of a soil – 9kg Dynamic Cone Penetrometer" to estimate near surface soil conditions and depths to bedrock.

Explanatory notes are included in Appendix: 1. Mapping information and test locations are shown on Figure: 1, along with detailed Borehole Log sheets and Dynamic Penetrometer Test Sheet in Appendix: 2. A geological model/section is provided as Figure: 2, Appendix: 2.

4.2. Field Observations:

The site is situated on the high north side of Dolphin Crescent, situated within moderate to steep south sloping topography.

The site dwelling is situated broadly within the middle of the block and observed to be supported via brick columns which appeared in good condition. The external brickwork of the dwelling also appeared to be in good condition with no signs of significant cracking or settlement observed. Stormwater gutters were observed within the rear of the property.

Sandstone block retaining walls up to approximately 1.0m in height supporting access steps and/or garden beds were observed within the front and the rear of the property. Adjacent to the carport a retaining wall which supports the front access stairs displayed signs of cracking. Photograph 4 shows the retaining wall adjacent to the carport.

Phorograph 4: Sandstone block retaining wall located towards the front of the property

Minor cracking was also observed with a paved area witthin the rear of the property and is shown . Photograph 5.

Photograph 5: Cracks within the rear patio of the property.

The concrete slab adjacent to the stairs adjacent to the front of the dwelling displayed signs of movement and a gap was observed in between the slab and the external wall of the dwelling which can be seen in Photograph 6.

Photograph 6: Gap between concrete slab and external wall of the dwelling

The properties to the north of the site (No. 106 and No. 108 Whale Beach Road) share similar south dipping topography. The structures within the properties to the north of the site could not be inspected due to site/property conditions however it is understood the properties contain residential structures and pool (within No.106) which are approximately 15m-17m north of the shared boundary.

The neighbouring property to the east (No.67 Dolphin Crescent) contained a two-storey brick dwelling located within in the middle of the property with shared similar south dipping topography and was broadly at a similar elevation with the e4xception of the rear of the site which appeared up to approximately 0.5m higher in elevation compared to the site. The dwelling appeared to be in good condition with no visible cracks. During the investigation work the property was undergoing construction work and an excavation had been undertaken adjacent to the front of the property dwelling. The excavation comprised a vertical cut and appeared to be approximately 1.5m – 2.0m in depth and is shown in Photograph 7. The ground conditions exposed in the excavation within No.67 Dolphin Crescent comprised approximately 0.5m thickness of clayey topsoil/colluvial deposits underlain by approximately 1.5m depth of extremely low strength to very low strength bedrock. An interbed of apparently competent bedrock was observed with the excavation and is indicated on Photograph 7.

Photograph 7: View of the front of the excavation adjacent No.67 Dolphin Crescent with an interbed of competent bedrock (circled red).

Dolphin Crescent comprised an asphalt pavement with concrete kerb. Longitudinal cracking was observed with the carriageway surface, likely representing some settlement of sub-base material/degradation with age.

The neighbouring property to the west (No. 63 Dolphin Crescent) consists of a two-storey brick residence which is located to the middle of the property and was shared similar south dipping topography. The property is at a lower elevation than the site and the house appeared to be in a good condition with no visible cracks.

No signs of back scars/tilting trees etc. were observed within the site or adjacent properties to indicate signs of geotechnical instability.

4.3. Ground Conditions:

For a detailed description of the ground conditions encountered underlying the site, the individual borehole logs should be referred to however, the sub-surface conditions at the project site can be broadly classified as follows:

- **Topsoil/Fill** – This layer was encountered in all boreholes to depths of 0.45m (BH1 & BH4), 0.75m (BH2) and 0.55m (BH3). It is classified as dark, moist organic sandy clay
- **Sandy/Silty Clay –** Firm sandy clay was identified directly underlying the topsoil/fill within BH1 to maximum depth of 0.5m which is classified as dark grey, fine grained, low to medium plasticity and moist. Silty clay was encountered underlying the fill within the remaining boreholes between depths of 0.45m (BH4) and 0.75m (BH1) and extended to the maximum depth of the boreholes (BH3.1.65m). The deposit predominately comprises as light brown to brown very low to medium plasticity, dry with sub angular ironstone gravel.

- **Bedrock –** Based on the results of the DCP tests very low strength bedrock (or stronger) has been interpreted as being encountered between depths of 0.95m (DCP5/5a) and 2.6m (DCP1) underlying the site. DCP2/2a encountered refusal at depths of 0.92 and 1.1m respectively however DCP1 undertaken a short distance away from DCP2/2a and around 1.0m higher in elevation encountered interpreted bedrock at 2.6m depth. Therefore, the refusal encountered within DCP2/2a has been interpreted as representing either a boulder or zone of more competent bedrock as observed within the adjacent property in an open excavation (see section 4.2).

A freestanding groundwater table or significant seepage was not identified within the boreholes during drilling. Groundwater was observed on the rods following extraction at test location DCP1 at a depth of 2.30m.

5. COMMENTS:

5.1. Geotechnical Assessment:

The investigation encountered sandy clay fill underlying the site to depths of between 0.45m and 0.75m under which firm to very stiff sandy/silty clay was encountered to the maximum auger depth of 1.65m (BH3). Bedrock was not encountered within the augured boreholes, however the results of the DCP testing indicated very low strength bedrock is likely to be encountered between depths of 0.95m (DCP5/5a) and 2.6m (DCP1) underlying the site which correlates well with the ground conditions observed within the excavation in No.67 Dolphin Crescent to the east of the site.

The proposed work involves bulk excavation to depths of between 0.9m (rear addition) and 2.4m (proposed pool) as well as an excavation to approximately 1.4m depth associated with the establishment of a NCZ adjacent to the pool fence.

Based on the separation distances to the adjacent boundaries from the proposed excavation (See Section 5.3) it appears that safe temporary batters can be formed to the north, east, south and west boundaries. However, as excavation is to occur directly to the north and south of the existing dwelling it is envisaged support prior to excavation may be required within these areas subject to structural design. Additionally, it will be necessary to confirm the depth of existing footings supporting the site house prior to bulk excavation to prevent undermining existing structures.

Where excavation is required up to the shared boundary with No.67 to allow the creation of a NCZ next to the pool fence, localised support of the boundary prior to the construction of a permanent retaining structure will be required to maintain boundary integrity.

Where excavation below existing footing is required, geotechnical inspection will be necessary (subject to structural design) to assess the existing founding strata and the potential requirement for underpinning

It is envisaged that standard mechanical plant (e.g. hydraulic excavator fitted with bucket) will be sufficient to complete the required bulk excavations proposed within the site. Potentially, excavation of bedrock stronger than low strength may be exposed within the base of the pool excavation. If 'hard' bedrock is encountered the use of heavy rock hammers (>200kg) should be avoided to minimise the potential of damage due site and adjacent property structures due to vibrations.

The groundwater table was not intersected during excavation, however the extracted rod within DCP1 indicated water seepage at 2.30m depth from the existing ground surface. Therefore, during the excavation work within the new pool area, water seepage may be encountered particularly following periods of rainfall.

The site dwelling appeared to be in a good condition without any major cracks or settlement evident to suggest deep seated instability issues exist. However, the existing retaining walls and the pavement indicated some settlement which is likely a result of downhill creep of colluvial soils and typical of 'normal' slope movement and unlikely indicative of a deep-seated stability issue.

Due to the potential for downslope creep movements of the colluvial soils, it is recommended all footings found within bedrock of a least very low strength interpreted to be encountered between 0.95m (DCP5) and 2.6m (DCP1) depth underlying the site.

The recommendations and conclusions in this report are based on an investigation utilising only surface observations and hand auger boreholes. This test equipment provides limited data from small, isolated test points across the entire site with limited penetration into rock, therefore some minor variation to the interpreted sub-surface conditions is possible, especially where tests were not conducted. The results of the investigation provide a reasonable basis for the analysis and preliminary design of the proposed works.

5.2. Stability Risk Assessment:

Based on our site investigation we have identified the following credible geological/geotechnical hazards which need to be considered in relation to the existing site and the proposed works.

The hazards are:

A. Landslip (earth slide <3m^3) from soils within side walls of site excavation
B. Landslip (boulder roll <1m^3) from detached boulders/floaters within side walls of excavations

A qualitative assessment of risk to life and property related to these hazards is presented in Table A and B, Appendix: 3, and is based on methods outlined in Appendix: C of the Australian Geomechanics Society

(AGS) Guidelines for Landslide Risk Management 2007. AGS terms and their descriptions are provided in Appendix: 4.

The **Risk to Life** from **Hazard A** to **B** were estimated to be up to **1.04×10^{-6}** for a single person, whilst the **Risk to Property** from the hazards were considered to be up to **'Very Low'** to '**Low'**.

Provided the recommendations of this report are implemented the likelihood of any failure becomes 'Rare' and the risks further reduce. As such the project is considered suitable for the site provided the recommendations of this report are implemented.

5.3. Design & Construction Recommendations:

Design and the construction recommendations are tabulated below:

5.3.1. New Footings:	
Site Classification as per AS2870 – 2011 for new footing design	Class 'P' due to the thickness of fill and sloping topography
Type of Footing	Strip, Pads or piers
Sub-grade material and Maximum Allowable Bearing Capacity (presumptive)	- Very Stiff Sandy/Silty Clay: 200kPa - Extremely Low Strength bedrock: 500kPa - Very Low Strength bedrock: 750kPa
Site sub-soil classification as per *Structural design actions AS1170.4 – 2007, Part 4: Earthquake actions in Australia*	B_e – rock site
Remarks: All footings for each structure should be founded off material of similar strength to reduce the potential for differential movement. All new footings must be inspected by an experienced geotechnical professional before concrete or steel are placed to verify their bearing capacity and the in-situ nature of the founding strata. This is mandatory to allow them to be 'certified' at the end of the project.	

5.3.2. Excavation:

The below shows the properties potentially affected by the proposed excavations and the separation distances to the shared property boundary and structure.

Property Separation Distances from Proposed Excavations

Direction	Property	Bulk Excavation Depth/New Structure (m bgl)	Separation Distances (m)	
			Boundary	Structure
North	No.8 Whale Beach Road	2.4/pool	6.5	>15.0 (house)
East	No.67 Dolphin Cres.	1.9/front addition	4.0	5.5 (house)
		1.4/NCZ	0.0	2.5 (shed)
South	Dolphin Crescent easement	1.9 (front addition)	11.5	11.5 (possible services)
West	No. 63 Dolphin Cres	1.9 depth (front addition)	3.5	10.0 (house)

Type of Material to be Excavated	Fill to depths ≤ 0.75m Sandy/Silty Clay to depths ≤2.6m depth Possible VLS-LS bedrock

Guidelines for un-surcharged batter slopes for this site are tabulated below:

	Safe Batter Slope (H: V) *	
Material	Short Term/Temporary	Long Term/Permanent
Fill	1.5:1	2:1
Sandy/Silty Clay and Extremely low strength bedrock	1:1	2:1
Very Low to Low strength or fractured bedrock	1:1	1.5:1

* Dependent on assessment by engineering geologist/geotechnical engineer

Remarks:

Seepage through the soils can reduce the stability of batter slopes and invoke the need to implement additional support measures. Where safe batter slopes are not implemented the stability of the excavation cannot be guaranteed until the installation of permanent support measures. This should also be considered with respect to safe working conditions.

Geotechnical inspection of batters will be required at regular intervals during construction to assess their stability, especially for permanent batters. Groundwater seepages can reduce batter slope stability and ponded water must be prevented from accumulating at the base or crest of any batter slope.

Equipment for Excavation	Fill/clay soils	Excavator with bucket

	VLS-LS bedrock	Excavator with bucket and ripper
ELS – extremely low strength, VLS – very low strength, LS – low strength, MS – medium strength		
Recommended Vibration Limits (Maximum Peak Particle Velocity (PPV))	5mm/s if heavy (>250kg) hammers proposed for use	
Vibration Calibration Tests Required	If heavy hammers proposed for use	
Full time vibration Monitoring Required	Pending proposed equipment and vibration calibration testing results	
Geotechnical Inspection Requirement	Yes, recommended that these inspections be undertaken as per below mentioned sequence: • During installation of support systems, • Upon clearing of all soils from the bedrock surface, • Inspection of temporary and permanent batter slopes, • Any unsupported excavation at 1.5m depth excavation intervals, • At completion of the excavation and for footings.	
Dilapidation Surveys Requirement	Recommended within 10m of excavation perimeter	
Remarks: Water ingress into exposed excavations can result in erosion and stability concerns in both soil and rock portions. Drainage measures will need to be in place during excavation works to divert any surface flow away from the excavation crest and any batter slope.		

5.3.3. Retaining Structures:

Required	Any fill/natural soils within the proposed excavation will require support prior to excavation where safe batters cannot be constructed.
Types	Bored piles or similar where support prior to excavation is required. Steel reinforced concrete walls or conventional gravity walls post excavation where temporary batters are achievable

Parameters for calculating pressures acting on retaining walls for the materials likely to be retained:

Material	Unit Weight (kN/m3)	Long Term (Drained)	Earth Pressure Coefficients		Passive Earth Pressure Coefficient *
			Active (Ka)	At Rest (K_0)	
Fill (clayey) (soft)	18	$\phi' = 28°$	0.36	0.53	N/A
Clay (firm to stiff)	20	$\phi' = 30°$	0.33	0.50	N/A
Clay (very stiff to hard)	22	$\phi' = 35°$	0.27	0.40	3.75

ELS to VLS bedrock	22	$\phi' = 38°$	0.15	0.20	200 kPa

Remarks:

In suggesting the support parameters, it is assumed that the retaining walls will be fully drained with suitable subsoil drains provided at the rear of the wall footings. If this is not done, then the walls should be designed to support full hydrostatic pressure in addition to pressures due to the soil backfill. It is suggested that the retaining walls should be back filled with free-draining granular material (preferably not recycled concrete) which is only lightly compacted in order to minimize horizontal stresses.

Retaining structures near site boundaries or existing structures should be designed with the use of at rest (K_0) earth pressure coefficients to reduce the risk of movement in the excavation support and resulting surface movement in adjoining areas. Backfilled retaining walls within the site, away from site boundaries or existing structures, that may deflect can utilize active earth pressure coefficients (Ka).

5.3.4. Drainage and Hydrogeology		
Groundwater Table or Seepage identified in Investigation		DCP1 indicated possible water seepage at 2.30m depth
Excavation likely to intersect	Water Table	No
	Seepage	Minor (<0.5L /min) probable at soil/bedrock interface
Site Location and Topography		High north side of Dolphin Cres within moderately to steeply south dipping topography
Impact of development on local hydrogeology		Negligible
Onsite Stormwater Disposal		Possible via dispersion only

Remarks:

Any seepage encountered during the excavation work needs to be disposed of away from site structures.

5.4. Conditions Relating to Design and Construction Monitoring:

To comply with Councils conditions and to enable us to complete Forms: 2b and 3 required as part of construction, building and post-construction certificate requirements of the Councils Geotechnical Risk Management Policy 2009, it will be necessary for Crozier Geotechnical Consultants to:

1. Review and approve the structural design drawings for compliance with the recommendations of this report prior to construction,
2. Inspection of site and works as per Section 5.3 of this report
3. Inspect all new footings and earthworks to confirm compliance to design assumptions with respect to allowable bearing pressure, prior to the placement of steel or concrete,

4. Inspect completed works to ensure construction activity has not created any new hazards and that all retention and stormwater control systems are completed.

The client and builder should make themselves familiar with the Councils Geotechnical Policy and the requirements spelled out in this report for inspections during the construction phase. Crozier Geotechnical Consultants cannot sign Form: 3 of the Policy if it has not been called to site to undertake the required inspections.

5.5. Design Life of Structure:

We have interpreted the design life requirements specified within Council's Risk Management Policy to refer to structural elements designed to support the existing structures, control stormwater and maintain the risk of instability within acceptable limits. Specific structures and features that may affect the maintenance and stability of the site in relation to the proposed and existing development are considered to comprise:

- stormwater and subsoil drainage systems,
- retaining walls and instability,
- maintenance of trees/vegetation on this and adjacent properties.

Man-made features should be designed and maintained for a design life consistent with surrounding structures (as per AS2870 – 2011 (100 years)). It will be necessary for the structural and geotechnical engineers to incorporate appropriate design and inspection procedures during the construction period. Additionally, the property owner should adopt and implement a maintenance and inspection program.

If this maintenance and inspection schedule are not maintained the design life of the property cannot be attained. A recommended program is given in Table: C in Appendix: 3 and should also include the following guidelines.

- The conditions on the block don't change from those present at the time this report was prepared, except for the changes due to this development.
- There is no change to the property due to an extraordinary event external to this site
- The property is maintained in good order and in accordance with the guidelines set out in;
  a) CSIRO sheet BTF 18
  b) Australian Geomechanics "Landslide Risk Management" Volume 42, March 2007.
  c) AS 2870 – 2011, Australian Standard for Residential Slabs and Footings

Where changes to site conditions are identified during the maintenance and inspection program, reference should be made to relevant professionals (e.g. structural engineer, geotechnical engineer or Council). Where the property owner has any lack of understanding or concerns about the implementation of any component of the maintenance and inspection program the relevant engineer should be contacted for advice or to complete the component. It is assumed that Council will control development on neighbouring properties,

carry out regular inspections and maintenance of the road verge, stormwater systems and large trees on public land adjacent to the site so as to ensure that stability conditions do not deteriorate with potential increase in risk level to the site.

Also, individual Government Departments will maintain public utilities in the form of power lines, water, and sewer mains to ensure they don't leak and increase either the local groundwater level or landslide potential.

6. CONCLUSION:

The site investigation identified the presence of clayey fill to depths of 0.45m (BH1 and BH3), 0.75m (BH2) and 0.55m (BH3). Sandy/Silty Clay was encountered underlaying the fill to a maximum depth of 2.60m. Water table or see page was not encountered in the borehole however minor seepages could be anticipated at the bedrock surface and at the interface between the fill and natural soils.

The proposed development will include extension of the property towards the front and rear and the construction of a pool which will require excavation to approximately 2.4m depth.

The materials encountered during the investigation are likely to be readily excavated using standard mechanical plant.

Temporary safe batter appears to be achievable for the excavations and the shared property boundaries except the proposed excavation to create a NCZ adjacent to the pool fence where a 1.4m deep excavation is proposed directly adjacent to the shared boundary. Support prior to excavation will be required where any existing footings (e.g. site house) may be undermined.

Provided the recommendations of this report and any future geotechnical directive are implemented, the proposed development can be maintained with negligible impact to neighbouring or site structures as such the site is considered suitable for the proposed construction works provided that the recommendations outlined in this report are followed.

Prepared by:
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Senior Engineering Geologist

Reviewed by:

7. REFERENCES:

1. Australian Geomechanics Society 2007, "Landslide Risk Assessment and Management", Australian Geomechanics Journal Vol. 42, No 1, March 2007.
2. Australian Standard AS 3798 – 2007, Guidelines on Earthworks for Commercial and Residential Developments.
3. Australian Standard AS 2870 – 2011, Residential Slabs and Footings – Construction
4. Australian Standard AS1170.4 – 2007, Part 4: Earthquake actions in Australia
5. Pells, PJN et al. Foundations on Sandstone and shale in the Sydney Region. Australian Geomechanics. December, 1998.