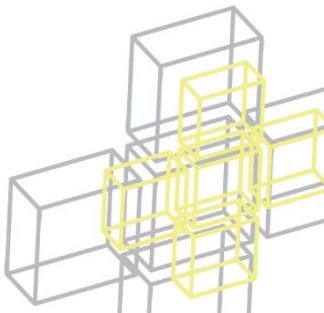
Annexure 14: Geotechnical Report



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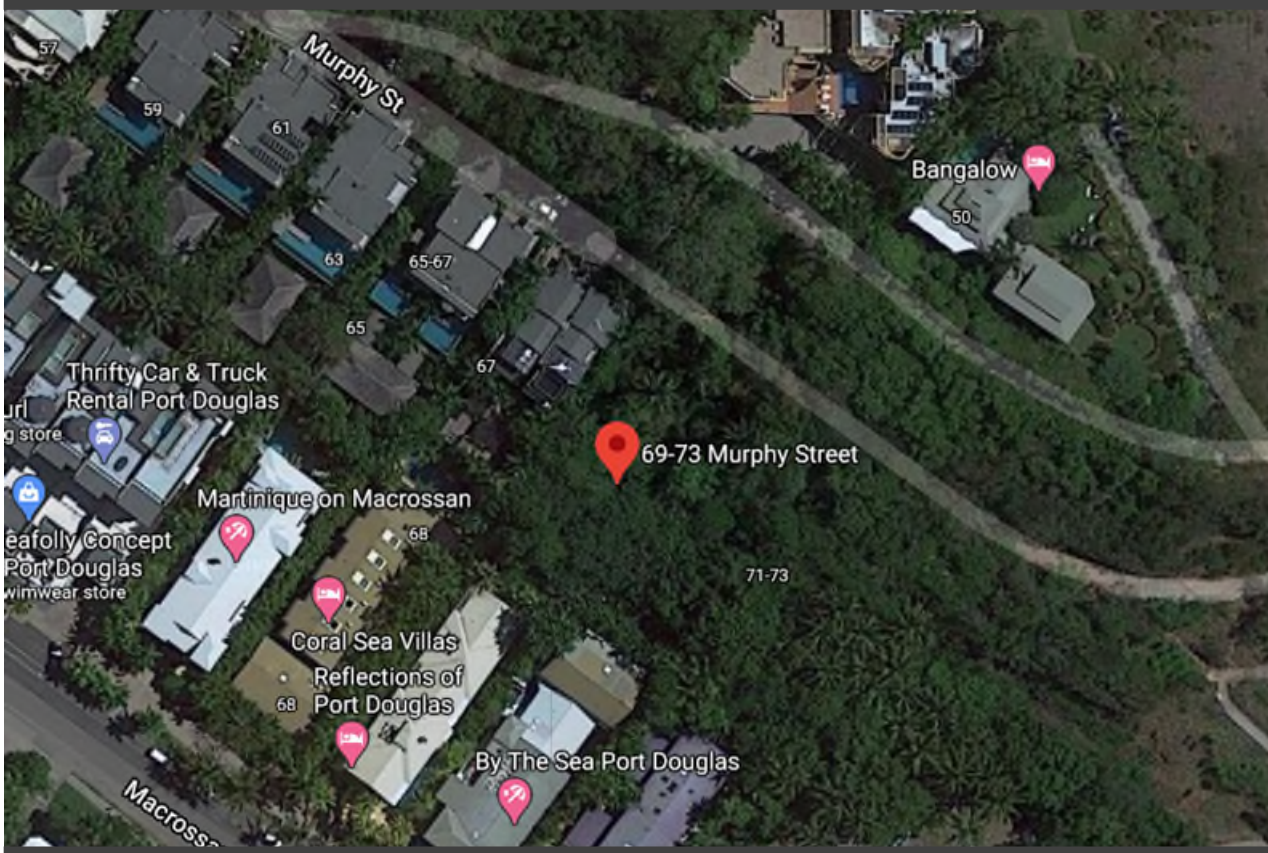
REPORT

Geotechnical Investigation

69-73 Murphy Street
Port Douglas QLD 4865



20039AA-D-R01-v1
Gurner
29 October 2020

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1.0 Introduction

GEO Design has carried out a geotechnical investigation for a proposed development at 69-73 Murphy Street, Port Douglas. From the preliminary plans provided, it is understood that the proposed development comprises multiple level buildings, associated driveways and landscaped areas. It is further understood that the proposed development comprises significant cut earthworks that will form high batters that will require retention.

Further to our proposal, GEO offered to carry out a staged geotechnical investigation based upon our understanding of the project requirements. On this basis, GEO originally proposed the following stages:

Stage 1 - Preliminary Geotechnical Investigation - for submission for town planning.

Stage 2 - Detailed Geotechnical Investigation – for final design completed architectural drawings and in accordance with council request.

However, the above stages were combined as requested by the client into a single geotechnical investigation.

The aims of the combined geotechnical investigation generally comprised the following:

- Review the existing available information for the site (as provided by Gurner and in house).
- Evaluate the subsurface conditions in the area of the proposed development.
- Comment on suitable footings and provide geotechnical design parameters to allow structural design of footings.
- Comment on potential settlements based on the selection of footing options and potential loads.
- Comment on likely retaining wall design and provide geotechnical design parameters.
- Comment on earthworks including recommended cut and fill batters, and site preparation.
- Comment on excavation conditions and requirement for temporary support.
- Provide geotechnical design parameters for basement construction and comments on dewatering requirements.
- Comment on slope stability issues at the subject allotments and provide comments in regards to the development's adherence to the State Planning Policy 1/03-Mitigating the Adverse Impacts of Flood, Bushfire and Landslide (Landslides only).
- Comment on the requirement of slope stabilisation works including potential options.
- Comment on the likely presence of any Acid Sulfate Soils (ASS) at the site and potential management plans.

This report presents the results of the geotechnical investigation together with the engineering comments outlined above. At the time of report preparation laboratory test results were not available. As such, this report represents a draft that will be updated based on the results of the laboratory testing.

2.0 Fieldwork

The fieldwork carried out as part of the geotechnical investigation comprised the following:

- A walkover assessment, carried out by an experienced geotechnical engineer.
- Field mapping of the exposed batters.
- Excavation of six test pits (TP1 to TP6) to depths of between about 0.3 m to 2.9 m below the surface. Test pits were advanced until refusal was reached.
- Drilling of two geotechnical boreholes (BH1 and BH2). BH1 was extended to a maximum depth of about 8.0 m and BH2 to about 8.8 m below the current surface of the formed near level building pad. Rock core drilling commenced at 0.56 m and 1.0 m in BH1 and BH2 respectively.

The results of the fieldwork are presented in Appendix A. The approximate locations of the field tests are shown in Figure 1.

3.0 Method of Investigation

3.1 Fieldwork

3.1.1 Surface Conditions

The site of the proposed development is located at 69-73 Murphy Street, Port Douglas (Lot 2 on PTD2094 and Lot 516 on RP724386). The site is bound to the south west by Macrossan Street, to the east by an undeveloped section of the Esplanade and in-turn by Jalun Park, and to the west by an existing development. The northern and north western boundary of the site is bound by a largely undeveloped section of Murphy Street. The section of Murphy Street is dominated by an unsealed road bound by a cut batter upslope of the road.

Access to the site is provided by a gravel driveway that extends from an existing car park area adjacent to Jalun Park.

The site is dominated by a large cut batter located along the sites northern and north western boundary. The cut batter extends to a height of about 10 m and varies from about 30-40° in the lower portions of the batter up to about 70-80° in the upper sections along the Murphy Street boundary, with some locally steeper sections. The cut batter is dominated by numerous small scale slumps and structurally controlled failures within the exposed rock. The instability has resulted in near vertical areas within the cut batter. Areas of erosion were also noted within the batter resulting in some trees and other vegetation being undercut and destabilised.

A large near level platform has been formed in the central portion of the site. The platform appears to have been formed through cut and fill earthworks. The platform extends nearly the length of the subject allotments and is bound to the south by a fill batter of up to about 5 m in height formed at about 25-30° overall.

Mounds of soil and rock debris are located along the northern section of the building platform, adjacent to the toe of the cut batter. It appears that the soil and rock debris located at the toe of the cut batter are related to uncontrolled filling and stockpiling of materials, together with debris from small scale failures within the cut batter.

At the time of fieldwork the site was generally covered by trees and shrubs with some low level sparse grass.

3.1.2 Subsurface Conditions

The subject area is generally located on the lower margins of Flagstaff Hill. This area is dominated by thin colluvium and residual soils overlying rocks of the Hodgkinson Formation. The Hodgkinson Formation is dominated by metamorphosed fine grained sedimentary rocks and Greywacke. Greywacke rock is known to outcrop in the area of the proposed development and is exposed in the cut batter below Murphy Street.

The lower regions of Port Douglas along Four Mile Beach etc. are dominated by alluvial soils such as sands, soft marine clays and other clays.

The subsurface conditions encountered within the boreholes BH1 and BH2 generally comprised a thin layer of variable fill and minor clayey soils over Greywacke rock to the depths investigated. A summary of the subsurface conditions encountered within the boreholes is summarised in the following table. Geotechnical logs are presented in Appendix A.

Depth From (m)	Depth To (m)	Approx. RL (m) From	Approx. RL (m) To	Material Description
0	0.6/1.0	10.4/10.6	9.8/9.6	Variable Fill and Sandy Clay, Stiff to Hard.
0.6/1.0	3.3/5.1	9.8/9.6	7.1/5.5	Extremely Low to Distinctly Weathered, Extremely Low to Very Low Strength Greywacke rock.
3.3/5.1	5.8/6.0	7.1/5.5	4.4/4.6	Distinctly Weathered to Slightly Weathered, Low to Medium Strength Greywacke rock.
5.8/6.0	8.0/8.8	4.4/4.6	2.4/1.8	Fresh, High to Very High Strength Greywacke rock.

The subsurface conditions encountered within BH1 and BH2 are consistent with the previous works carried out at the site and with the published data.

The subsurface conditions encountered within the test pits TP1 and TP4, excavated near the crest of the fill batter along the southern boundary of the existing building platform, generally comprised Gravelly Fill to depths of about 0.9 m below the surface, over Very Stiff to Hard Sandy CLAY to a depth of about 1.6/1.7 m, over Extremely Weathered to Distinctly Weathered, Extremely Low to Very Low Strength Greywacke to the maximum depths investigated. Refusal was reached at depths of 2.6 m and 2.9 m for TP1 and TP4 respectively.

The subsurface conditions encountered within test pits TP2, and TP5 generally comprised some minor filling over Extremely Weathered, Extremely Low to Very Low Strength Greywacke. Test pits TP3 and TP6 encountered Extremely Weathered, Extremely Low to Very Low Strength Greywacke rock at the surface. Test pits TP3 and TP6 were excavated near the northern boundary of the existing building platform.

The subsurface conditions exposed in the existing cut batter are dominated by a thin soil cover overlying Extremely Weathered to Distinctly Weathered, Extremely Low to Very Low Strength Greywacke.

Groundwater was not encountered within the test pits to the depths investigated.

3.2 Laboratory Testing

Laboratory testing was carried out on selected samples collected form the investigation works. At the time of preparation of this report the results were not available. The results of the laboratory testing, and any subsequent changes to the engineering comments will be provided in our final report.

4.0 Stability

It is known that some significant slope stabilisation issues are present at the site, particularly within the existing high cut batter located along the northern boundary of the site adjacent to Murphy Street.

It is considered that significant stabilisation works will be required to be carried out on the cut batter to allow the construction of the proposed development together with reducing any possible landslide risks that may be present for the future development.

As part of this investigation, a landslide risk assessment was carried out on the existing cut batter and fill batter in general accordance with the guidelines of the Landslide Risk Management Concepts and Guidelines published by the Australian Geomechanics Society in March 2000. Further landslide risk assessments should be completed, along with detailed slope stability analyses in the preparation of possible retaining structures to support new and existing cut batters.

4.1 Stability Analysis

Stability analyses were previously carried out at the site by others. The results of the analyses indicate that the existing cut batter is marginally stable under normal conditions and is either unstable to near unstable under the extreme conditions modelled.

The stability analyses carried out for the existing fill batter indicate that the batter is generally stable under the normal conditions modelled and marginally stable under the extreme conditions modelled.

The methodology and results of the stability analyses are presented in Golder Associates report 01672037(B) dated June 2001.

4.2 Landslide Risk

The Landslide Risk Management Concepts and Guidelines published by the Australian Geomechanics Society in March 2000 are based on the approach suggested in the Landslide Risk Management Concepts and Guidelines and to those outlined in the Australian Geoguide LR7 (Landslide Risk).

The landslide risk assessment generally involves the evaluation of slopes enabling the identification of potential hazards ("a condition with the potential for causing an undesirable consequence", for example, rockfall or slump type failure) and analyses the identified hazards with respect to likelihood and consequences using prescribed risk matrices.

The risk assessment procedure generally uses estimated conditional probabilities designed to characterise a sequence of events which must occur for slope instability to result in a fatality or injury to the community, damage to structures or buildings, and/or economical costs that may be associated with the effects of instability.

The principal conditional probabilities used in the risk assessment include the following:

- Temporal Probability (T)
- Vulnerability (V)
- Likelihood of instability (L)

In terms of the Guidelines for Landslide Risk Management outlined in Australian Geomechanics, Volume 42, No. 1 March 2007 (AGS 2007) the risk to property is defined as Very Low to Very High. In general terms risks of very low to low are tolerable for regulatory bodies in relation to developments, while higher risks are generally unacceptable without detailed investigation and implementation of risk reduction strategies to enable the reduction of risk to an acceptable level. The risk system matrix outlined in AGS 2007 is presented in Appendix B.

A full description of the risk analyses procedures are presented in the AGS 2007 documents. For further information the reader is directed to these documents.

The landslide risk assessment carried out as part of this investigation was based on the results of the stability analyses (outlined in the previous section), the walkover survey, site observations, and based on experience in this area of Port Douglas.

The hazards evaluated as part of the risk analysis comprised the following:

1. Instability within the existing batters or natural slopes resulting in downward migration of >2m^3 of soil or rock debris impacting Murphy Street, existing residences or surrounding structures.

2. Instability within the existing batters or natural slopes resulting in downward migration of >20m^3 of soil debris impacting Murphy Street, existing residences or surrounding structures.

Based on the above, the following AGS 2007 risk classifications have been assessed for the proposed development:

Hazard	AGS 2007 Risk Rating
1	Medium
2	High

Very Low to Low risks are generally considered acceptable to regulators for development approval in accordance with the relevant guides. Higher risks require stabilisation or remediation works to be carried out to reduce the risks to acceptable levels. As such further risk reduction measures are required at the site.

5.0 Engineering Comments

5.1 Proposed Development

Based on the plans provided, is understood that the proposed development generally comprises the following:

- A main building of up to about 8 levels founded at about RL 6.0 m. The main building is to be constructed in the northern portion of the allotment.
- A smaller three level building founded at about RL 3.5 m in the southern portion of the allotment.
- Construction of a new cut batter along the northern boundary of the site up to a height of about 15 m to 17m at the rear of the main building.
- Construction of temporary and low cut batters as part of the site preparation.
- Landscaped areas and elevated pools.
- Access roads and outdoor areas.

Further to the above, it is understood that the new cut batter along the northern boundary, together with new cut batters along the western and eastern boundaries of the proposed building will require retention works.

Engineering comments relating to site preparation and earthworks procedures, foundation options, slope stabilisation and retention options, and comments on construction issues are presented in the following sections.

5.2 Site Preparation and Earthworks

5.2.1 Filling

It is envisaged that only minor filling works will be required as part of the works. On this basis, where required, site preparation and earthworks procedures should involve the following:

- Strip and remove existing topsoil and soil containing significant amounts of organic materials from the surface.
- Compact the subgrade with a heavy roller to reveal soft or loose materials. Soft or loose material that cannot be improved by compaction should be removed and replaced with engineered fill.
- Place fill where required in uniform horizontal layers not exceeding 200 mm loose thickness and compact to achieve a relative dry density ratio of at least 95% using Standard Compaction.

Imported fill materials should have a Plasticity Index less than 20 and a soaked CBR value of >15%.

It is recommended that all earthworks procedures be carried out in accordance with AS 3798-2007 "Guidelines on Earthworks for Commercial and Residential Developments" and local authority requirements. It is recommended that the earthworks contractor be familiar with site conditions.

Unsupported permanent fill batters should be limited to a height of 2.0 m and formed at an angle of 1.5H:1V. Higher or steeper fill batters should be supported by retaining structures. All unsupported fill batters require protection from erosion through the placement of erosion matting or suitable vegetation.

5.2.2 Cut Batters

As outlined above, it is understood that significant cut earthworks are proposed. It is considered that any permanent unsupported batters should be limited to a maximum 3 m high formed at 1H:1V. Higher or steeper batters will require to be retained.

Temporary cut batters formed within the overlying soils and extremely weathered rock could be formed up to 1H:2V for heights up to about 3 m. Temporary cuts formed within the Very Low to Stronger Greywacke rock can be formed at about 1H:3V to a maximum height of 5 m. It is considered that temporary batters that are proposed to be in place for over 3 months, and/or are to be in place during the wet season months, should have a shotcrete covering placed over the batter surface and batter crest. The aim of the shotcrete would be to limit surface erosion, water ingress and rain induced damage to the batters.

It should be noted that all unsupported cut batters should be protected from erosion. Erosion protection could comprise the placement of erosion matting, placement of suitable vegetation and the formation of lined drains above all batter crests. All stormwater should be collected and not allowed to flow directly around or over cut batters. All collected stormwater should be discharged into designated drainage paths or over flow spreaders or energy dissipaters.

5.2.3 Excavation Conditions

The proposed new cut batter along the northern boundary of the site is expected to mainly encounter Greywacke rock. The Extremely Low to Medium Strength Greywacke rock near the surface down to about RL4.2/4.4 m should be achievable using a large excavator with a ripper. An impact breaker may be required to remove harder zones.

Excavation of the Fresh, High to Very High Strength Greywacke below about RL4.2/4.4 m will require an impact breaker to remove. Alternatively rock splitters or chemical rock fracturing methods may be required to break up the rock to allow removal. Rock blasting may be required for deep excavations into the Fresh Greywacke.

5.3 Footings

Based on the results of the investigation and the proposed founding levels of the buildings, the main eight level building and lower three level building will likely be founded within the Distinctly to Slightly Weathered, Low to Medium Strength to stronger Greywacke rock. On this basis it is considered that the building could be founded on a high level footings system.

High level footings such as strip, pad, slab on ground or raft founded on the Low to Medium Strength or stronger Greywacke could be designed using an allowable bearing pressure of 1.5 MPa.

Settlements are expected to be minor (<20 mm).

For other structures founded in Very Stiff to Hard Clays or Extremely Weathered, Extremely Low to Very Low strength Greywacke rock, or engineered fill placed in accordance with Section 5.2.1, high level footings can be designed using an allowable bearing pressure of 100 kPa. Settlements for structures founded in this manner are expected to be <20 mm.

For the purposes of AS2870-2011, high level footings as outlined above could be designed in accordance with the guidelines of a Class S site.

5.4 Retaining Walls

Where required, conventional retaining walls to be constructed as part of the proposed development can be designed using the earth pressure coefficients outlined in the following table.

Material	Lateral Earth Pressures		
	K_a	K_0	K_p
Clays and Extremely Weathered Greywacke	0.4	0.6	2.5
Distinctly Weathered to Fresh Greywacke	0.10	0.11	10

Retaining walls could be founded on high level footings. High level footings founded on Very Stiff to hard clays, Extremely Low Strength Greywacke or engineered fill placed in accordance with Section 5.2.1 could be designed using an allowable bearing pressure of 100 kPa. High level footings founded in

the Low strength to stronger Greywacke could be designed using an allowable bearing pressure of 1.5 MPa.

Alternatively retaining walls could be founded on bored pier footings. Bored pier footings for retaining walls should be extended at least three times their diameter into the Very Low strength to stronger rock. Bored pier footings founded in the above manner can be designed using an allowable end bearing pressure of 800 kPa and an allowable shaft adhesion of up to 60 kPa, neglecting the contribution of the upper 1 m of the shaft.

All retaining walls should be designed by a Structural Engineer.

Comments on retaining structures for the proposed new cut batters are presented in the following sections.

5.5 Retention of Cut Batters

As outlined above, the proposed development includes the formation of significant cuts to allow construction of the lower portions of the buildings.

It is considered that the existing and proposed main cut batter along the northern boundary of the site will need stabilisation as works progress. Given the proximity and proposed height of the batter to be retained, the options for stabilisation are somewhat limited. On this basis, the following stabilisation works are considered to be most appropriate:

1. Remove existing trees and vegetation from batter.

2. Trim existing batter to form the proposed profile in maximum 2 m high cuts/lifts.

3. Install soil nails/passive dowels on a nominated grid pattern on each cut/lift into the prepared batter face. For initial estimation purposes, soil nails/passive dowels are likely to be between 6-8 m in length and installed on a 1.0-1.5 m grid.

4. Install sub-horizontal drains in the exposed batter to alleviate potential pore pressures behind the retained face. For estimation purposes, sub-horizontal drains are likely to be 4-6 m in length on a 3 m grid.

5. Place a reinforced shotcrete surface over the exposed portion of the batter. The shotcrete should include strip drains, steel reinforcement and weep holes.

6. Continue this process to base of proposed excavation.

A detailed investigation, analyses and design should be carried out to develop a suitable retention system for the cut batter.

For the smaller cut batters along the western and eastern boundaries of the site along the margins of proposed main cut batter, will also require retention. The above approach should be adopted for permanent batters over about 5 m in height.

For lower batters, and temporary batters that are to be in place for over 3 months and/or during the wet season months, retention options including the installation of sub-vertical micropiles or short passive dowels/soil nails and placement of shotcrete could be adopted. Suitable designs should be developed following confirmation of proposed batter heights, geometries and limitations including the installation of underground elements outside the property boundary.

5.6 Acid Sulphate Soils

Based on the results of the investigation, together with our experience in this area of Port Douglas, no Acid Sulphate Soils (Actual Acid Sulphate Soils (AASS) or Potential Acid Sulphate Soils (PASS) are expected in the excavations at the site. As such, no Acid Sulphate Soils management plan is required.

5.7 Dewatering

Groundwater was not encountered to the depths investigated. However, seepage through the weathered rock is likely during or following prolonged periods of rain. The groundwater inflows into the open excavation are expected to be low and should not adversely affect the construction works.

It is considered that if required, groundwater seepage into the proposed open excavation at the site should be able to be managed using small drains and minor sump pumping.

5.8 Drainage Measures

Together with the sub-horizontal drains that will be required in the proposed new cut batter, other drainage measures that should be implemented include:

- Provision of lined drains at the crest of the cut/fill batters and on interim berms.
- Provision of lined drains and kerbing or similar along the downhill margin of the concrete driveway and building areas
- Provision of subsurface drainage behind retaining walls and lined drains above the crest of any retaining walls over 1.5 m in height.

All stormwater should be collected and discharged from the site via pipes into designated drainage paths and not allowed to flow on to the ground or around footings or structures. Where this is not possible, stormwater should be directed into flow spreaders or energy dissipaters to prevent concentrated flows.

It is considered that considerable surface water flow could be expected to reach the building area. On this basis, in addition to the above, it is recommended that a lined concrete drain is formed at the base of the proposed cut batters along the northern boundary of the site to collect surface water and divert into a lined drainage path.

5.9 Pavement Design

It is envisaged that new concrete pavements and hardstand areas will be founded near the current ground surface. On this basis and in accordance with the results of the investigation, the subgrade materials will comprise very stiff to hard clays and perhaps some surficial sands near the entry of the access road. On this basis, and in accordance with Austroads guidelines, it is recommended that a subgrade CBR of 15% could be adopted for the clay and sandy subgrades for design of pavements at the site.

6.0 Limitations

GEO Design has prepared this report for the use of Gurner for design purposes in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for use by parties other than Gurner and their client or their other consultants. It may not contain sufficient information for purposes of other parties or for other uses.

Your attention is drawn to the document - "Important Information About Your Geotechnical Engineering Report". This document has been prepared by the ASFE (Professional Firms Practicing in the Geosciences). The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the ground works for this project. The document is not intended to reduce the level of responsibility accepted by GEO Design Pty Ltd, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

We would be pleased to answer any questions that you may have regarding this matter.

Regards,

Steve Ford

Principal Geotechnical Engineer
BSc (Geo) BSc Hons (Geo) MEngSc (Geotechnical)

SITE PLAN DEVELOPED FROM IMAGES FROM QUEENSLAND GLOBE

GEO | design

Client: GURNER	**GEOTECHNICAL INVESTIGATION**
Drawn: DHALL	**69 - 73 MURPHY STREET, PORT DOUGLAS**
Scale: NTS	**FIGURE 1** **SITE PLAN**
Project No: 20039AA-D-Figure 1-v1	

Appendix A

Results of Fieldwork

BOREHOLE: BH1

GEO
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Project	Geotechnical Investigation	East	336511.0 m		
Site	69 - 73 Murphy Murphy Street	North	8176825.0 m MGA94 55	Sheet	1 OF 1
Location	Port Douglas	Surface RL	10.40 m AHD		
Position	Refer to Site Plan	Contractor	Geo Investigate	Date Started	16/10/20
Job No.	20039AA-D	Drill Rig	EVH3300	Date Completed	16/10/20
Client	Gurner	Inclination	-90° Hole Dia. 76/127 mm	Logged	DHall

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	L-M	Not Encountered	0	10.40 *0.20* 10.20 *0.56* 9.84				CL	FILL SANDY CLAY: brown, low plasticity, fine to coarse grained sand, with fine to coarse gravel	M	St to VSt	
								CL	GRAVELLY SANDY CLAY: yellow-brown, low plasticity, fine to coarse grained sand, fine to coarse gravel	D	VSt to H	
NMLC	M-H		1						GREYWACKE: pale grey, fine grained; extremely weathered to distinctly weathered, extremely low to very low strength			
			2									
			3	*3.26* 7.14					GREYWACKE: grey, fine grained; distinctly weathered to slightly weathered, low to medium strength			
			4									
			5									
			6	*6.00* 4.40					GREYWACKE: dark grey, fine grained; fresh, high to very high strength			
			7									
			8	*8.00*					BOREHOLE TERMINATED AT 8.00 m Target depth			
			9									

Comments

Checked SRF
Date 27/10/20

GEO Ref:	20039AA-D - Core Photographs - BH1
Project Address:	69-73 Murphy Street, Port Douglas
Client:	Gurner
Drawn:	Steve Ford, Engineering Geologist

Core Photographs – BH1

0.56 m – 5.0 m

5.0 m – 8.0 m

BOREHOLE: BH2

investigate | design | construct

Project	Geotechnical Investigation	East	336497.0 m		
Site	69 - 73 Murphy Murphy Street	North	8176832.0 m MGA94 55	Sheet	1 OF 1
Location	Port Douglas	Surface RL	10.60 m AHD		
Position	Refer to Site Plan	Contractor	Geo Investigate	Date Started	16/10/20
Job No.	20039AA-D	Drill Rig	EVH3300	Date Completed	17/10/20
Client	Gurner	Inclination	-90° Hole Dia. 75/127 mm	Logged	DHall

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	L-M	Not Encountered	0	10.60				CL	SANDY CLAY: brown, low plasticity, fine to coarse grained sand	M	St	
				0.20								
				10.40				CL	SANDY CLAY: yellow-brown, low plasticity, fine to coarse grained sand, with fine to coarse gravel, trace cobbles	D	VSt to H	
			1	*1.00*								
NMLC	M-H			9.60					GREYWACKE: red-brown, fine grained; extremely weathered to distinctly weathered, extremely low strength			
			2									
			3									
			4									
			5	*5.13*								
				5.47					GREYWACKE: grey, fine grained; distinctly weathered to fresh, very low to very high strength			
			6	*6.42*								
				4.18					GREYWACKE: dark grey, fine grained; fresh, high to very high strength			
			7									
			8	*8.80*								
			9						BOREHOLE TERMINATED AT 8.80 m Target depth			

Comments

Checked SRF

Date 27/10/20

GEO Ref:	20039AA-D - Core Photographs - BH2
Project Address:	69-73 Murphy Street, Port Douglas
Client:	Gurner
Drawn:	Steve Ford, Engineering Geologist

Core Photographs – BH2

1.0 m – 5.0 m

5.0 m – 8.8 m

TEST PIT: TP1

GEO
investigate | design | construct

Project	Geotechnical Investigation	East	336506.0 m		
Site	69 - 73 Murphy Murphy Street	North	8176814.0 m MGA94 55	Sheet	1 OF 1
Location	Port Douglas	Surface RL	9.80 m AHD		
Position	Refer to Site Plan	Contractor	Geo Investigate	Date	17/10/20
Job No.	20039AA-D	Machine	>6t Excavator	Logged	SRF
Client	Gurner	Bucket Size	450mm Bucket		

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L	Not Encountered	0.0	9.80				GC	FILL CLAYEY SANDY GRAVEL: brown, fine to coarse gravel, fine to coarse grained sand, low plasticity clay	M	L to MD	
			0.5	*0.90*								
	L-M		1.0	8.90				CL	SANDY CLAY: red-brown, low plasticity, fine to coarse grained sand		VSt to H	
			1.5	*1.70*								
				8.10					GREYWACKE: orange-brown, fine grained; extremely weathered, extremely low to very low strength			
			2.0	*2.30*								
	H			7.50					GREYWACKE: brown, fine grained; extremely weathered to distinctly weathered, very low strength			
			2.5	*2.60*								
									TEST TERMINATED AT 2.60 m Refusal			
			3.0									

Sketch & Other Observations

Comments

Checked SRF
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TEST PIT: TP2

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Project	Geotechnical Investigation	East	336509.0 m		
Site	69 - 73 Murphy Murphy Street	North	8176827.0 m MGA94 55	Sheet	1 OF 1
Location	Port Douglas	Surface RL	10.40 m AHD		
Position	Refer to Site Plan	Contractor	Geo Investigate	Date	17/10/20
Job No.	20039AA-D	Machine	>6t Excavator	Logged	SRF
Client	Gurner	Bucket Size	450mm Bucket		

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L	Not Encountered	0.0	10.40				CL	FILL GRAVELLY SANDY CLAY: brown, low plasticity, fine to coarse grained sand, fine to coarse gravel	M	St to VSt	
				0.30								
	H		0.5	10.10					GREYWACKE: brown, fine grained; extremely weathered to distinctly weathered, very low strength			
				0.80								
			1.0						TEST TERMINATED AT 0.80 m Refusal			
			1.5									
			2.0									
			2.5									
			3.0									

Sketch & Other Observations

Comments

Checked SRF

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GEO

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TEST PIT: TP3

Project	Geotechnical Investigation	East	336515.0 m		
Site	69 - 73 Murphy Murphy Street	North	8176835.0 m MGA94 55	Sheet	1 OF 1
Location	Port Douglas	Surface RL	10.80 m AHD		
Position	Refer to Site Plan	Contractor	Geo Investigate	Date	17/10/20
Job No.	20039AA-D	Machine	>6t Excavator	Logged	SRF
Client	Gurner	Bucket Size	450mm Bucket		

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L	Not Encountered	0.0	10.80					GREYWACKE: brown, fine grained; extremely weathered to distinctly weathered, very low strength			
				0.40								
			0.5						TEST TERMINATED AT 0.40 m Refusal			
			1.0									
			1.5									
			2.0									
			2.5									
			3.0									

Sketch & Other Observations

Comments

Checked SRF

Date 28/10/20

TEST PIT: TP4

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Project	Geotechnical Investigation	East	336491.0 m		
Site	69 - 73 Murphy Murphy Street	North	8176825.0 m MGA94 55	Sheet	1 OF 1
Location	Port Douglas	Surface RL	10.00 m AHD		
Position	Refer to Site Plan	Contractor	Geo Investigate	Date	17/10/20
Job No.	20039AA-D	Machine	>6t Excavator	Logged	SRF
Client	Gurner	Bucket Size	450mm Bucket		

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L	Not Encountered	0.0	10.00				GC	FILL CLAYEY SANDY GRAVEL: brown, fine to coarse gravel, fine to coarse grained sand, low plasticity clay, with cobbles	M	L to MD	
			0.5									
				0.90								
			1.0	9.10				CL	SANDY CLAY: orange-brown, low plasticity, fine to coarse grained sand		VSt to H	
			1.5	*1.60*								
	L-M			8.40					GREYWACKE: orange-brown, fine grained; extremely weathered to distinctly weathered, extremely low to very low strength			
			2.0									
	H			*2.50*								
			2.5	7.50					GREYWACKE: brown, fine grained; extremely weathered to distinctly weathered, very low strength			
				2.90								
			3.0						TEST TERMINATED AT 2.90 m Refusal			

Sketch & Other Observations

Comments

Checked SRF

Date 28/10/20

GEO
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TEST PIT: TP5

Project	Geotechnical Investigation	East	336478.0 m		
Site	69 - 73 Murphy Murphy Street	North	8176835.0 m MGA94 55	Sheet	1 OF 1
Location	Port Douglas	Surface RL	10.40 m AHD		
Position	Refer to Site Plan	Contractor	Geo Investigate	Date	17/10/20
Job No.	20039AA-D	Machine	>6t Excavator	Logged	SRF
Client	Gurner	Bucket Size	450mm Bucket		

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L-M	Not Encountered	0.0	10.40				CL	SANDY CLAY: grey, low plasticity, fine to coarse grained sand	M	VSt	
				0.20								
	H		0.5	10.20					GREYWACKE: brown, fine grained; extremely weathered to distinctly weathered, very low strength			
				0.80								
			1.0						TEST TERMINATED AT 0.80 m Refusal			
			1.5									
			2.0									
			2.5									
			3.0									

Sketch & Other Observations

Comments

Checked SRF
Date 28/10/20

TEST PIT: TP6

GEO
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Project	Geotechnical Investigation	East	336502.0 m		
Site	69 - 73 Murphy Murphy Street	North	8176836.0 m MGA94 55	Sheet	1 OF 1
Location	Port Douglas	Surface RL	10.60 m AHD		
Position	Refer to Site Plan	Contractor	Geo Investigate		
Job No.	20039AA-D	Machine	>6t Excavator	Date	17/10/20
Client	Gurner	Bucket Size	450mm Bucket	Logged	SRF
			450mm Bucket		

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	H	Not Encountered	0.0	10.60					GREYWACKE: brown, fine grained; extremely weathered to distinctly weathered, very low strength			
				0.40								
			0.5						TEST TERMINATED AT 0.40 m Refusal			
			1.0									
			1.5									
			2.0									
			2.5									
			3.0									

Sketch & Other Observations

Comments

Checked SRF
Date 28/10/20

Appendix B

AGS 2007 Risk Matrix

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A - ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or **L** (5)
B - LIKELY	10^{-2}	VH	VH	H	M	**L**
C - POSSIBLE	10^{-3}	VH	H	M	M	**VL**
D - UNLIKELY	10^{-4}	H	M	**L**	**L**	**VL**
E - RARE	10^{-5}	M	**L**	**L**	**VL**	**VL**
F - BARELY CREDIBLE	10^{-6}	**L**	**VL**	**VL**	**VL**	**VL**

Notes: (5) For cell A5, may be subdivided such as that a consequence of less than 0.1% is Low risk

(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time

RISK LEVEL IMPLICATIONS

Risk Level		Example Implications (7)
VH	**VERY HIGH RISK**	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to low; may be too expensive and not practical. Work likely to cost more the value of the property.
H	**HIGH RISK**	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	**MODERATE RISK**	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce risk to Low. Treatment options to reduce to Low should be implemented as soon as practical.
L	**LOW RISK**	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	**VERY LOW RISK**	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.