Douglas Partners
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ACID SULPHATE SOIL ASSESSMENT

PROPOSED TRINITY POINT MARINA AND TOURIST DEVELOPMENT
49 LAKEVIEW ROAD, MORISSET PARK

Prepared for
JOHNSON PROPERTY GROUP PTY LTD

Project 39823A
DECEMBER 2007

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ACID SULPHATE SOIL ASSESSMENT
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1. INTRODUCTION

This report presents the results of an acid sulphate soil assessment at the site of the proposed Trinity Point Marina and Tourist Development, located at 49 Lakeview Drive, Morisset Park (Lot 31, Part Lot 32 and Part Lot 33, DP 1117408). The work was carried out for Johnson Property Group Pty Ltd.

This acid sulphate assessment includes the lake bed sediments as well the on-land portions of the site.

The project is subject to other reports currently underway by Douglas Partners Pty Ltd (DP) which includes a geotechnical assessment and geochemical analysis within the proposed marina. A draft waste classification report was recently completed for the northern part of the site.

2. PROPOSED DEVELOPMENT

2.1 General

The Trinity Point Marina and Tourist Resort comprises a number of components, including the Marina, Marina Village and clusters of multi-storey accommodation buildings (Blocks A to G).

The Marina and Marina Village development will include an approximately 300 berth marina, along with an associated breakwater, boat maintenance facilities (travel lift, hardstand and workshop), and other related commercial infrastructure such as café, restaurant and function facilities.

Immediately south of the Marina Village is a cluster of multi storey buildings, up to six stories in height for short to medium term tourist accommodation. These areas are shown as Blocks A, B, C and D on the attached Drawing 2. These buildings will include under-croft car parking.

Another three clusters of multi-storey accommodation buildings are located further to the south (shown as Blocks E, F and G on attached Drawing 2). These three clusters comprise apartment style accommodation, in two to five storey buildings, associated car parking (underground parking), access roadways, footpaths, boardwalks, jetties and landscaping.

2.2 Proposed Marina Village Centre and Floating Marina Berths

The proposed marina and village centre will include a 308 berth marina consisting of up to four arms of floating pontoons, a floating helipad pontoon, marina administration offices, a breakwater, a travel lift with associated hardstand area for boat repairs and maintenance, and a workshop. It is understood that the marina has been configured to avoid any dredging.

The marina will comprise a system of floating walkways, and associated berths. The floating walkways would be located between vertical piles driven into the lake bed. It is understood that the preferred pile type is tubular steel piles.

The marina will incorporate a breakwater around the southern and eastern boundaries. The proposed breakwater will consist of two rows of parallel tubular steel piles driven in to the lake bed, with timber slats supported on outer side of each row of piles. The breakwater will also have a timber walkway, allowing access around the perimeter of the marina, and for access to the helipad.

The helipad will be an approximately 25 m by 25 m floating steel pontoon anchored to the lake bed, with an access gangway directly from the breakwater walkway. The current preference is that the anchors would be steel piles driven into the lake bed similar to piles for the breakwater and pontoons, however the piles would be cut off at the lake bed level.

In addition to the marina, there will be an associated on-shore village centre incorporating a café, restaurant, function centres, chandlery, general store and commercial offices.

2.3 Proposed Tourist/Accommodation Development

The southern portion of the site will incorporate apartment style accommodation (serviced tourist and permanent residential) with two to five storey buildings arranged in a series of three building clusters (Blocks E, F and G), with basement car parking proposed.

2.4 Pavements

Proposed pavement areas for the site include access roads and parking areas. It is understood that the majority of parking proposed for Blocks A to D will be offered via under-croft parking beneath the proposed multi-storey buildings. It is understood that the under-croft parking in this area of the site will be at about RL 1.2 (AHD).

The buildings within Blocks E, F and G will include basement car parking with preliminary basement floor levels ranging from 0.35 m to 4.85 m AHD.

2.5 Cut/Fill

Preliminary levels for under-croft car parking and basement car parking floor levels suggest approximate cut and fill depths could be in the order of the following:

Building Cluster	Approximate Ground Surface Level (AHD)	Preliminary Under-croft/Basement Floor Level (AHD)	Preliminary Approx Fill Depth (m)	Preliminary Approx Excavation Depth (m)
A	0.8	1.2	0.4	-
B	0.9	1.2	0.3	-
C	0.9	1.2	0.3	-
D	0.9 – 1.9	1.2	0.3	0.7
E	1.6 – 3.4	0.35	-	1.25 – 3.05
F	2.6 – 6.8	1.65 to 3.53	-	0.95 – 3.29
G	4.0 – 8.5	4.85	0.85	3.65

It is anticipated that excavations could also be required for installation of utilities, and also for swimming pool construction, although the final locations of these features are unknown at this time.

3. SITE DESCRIPTION AND REGIONAL GEOLOGY

The site is located to the north of, and on, Bluff Point on the Morisset Peninsula of the western shores of Lake Macquarie. The site is described as 49 Lakeview Road (Lot 31, Part Lot 32 and Part Lot 33, DP 1117408), Morisset Park. A plan showing the approximate location of the site is shown on Drawing 1, attached.

It is understood that the site used to contain several buildings, however these have been demolished. At the time of the investigation, the site was grassed with several stands of mature trees, particularly along the shoreline. Several stockpiles of building rubble and vegetation were located towards the southern part of the site.

Site elevations range from water level in the northern and eastern parts of the site up to about 8.5 m (AHD) at the southern end, which is known as Bluff Point. The site is relatively level in the northern part, where the marina is to be constructed, and slopes up to the high point at about 2º to 6º.

The following photographs show the general site area at the time of the investigation.

Photo 1 – set up on Bore 101, in the area of the proposed marina village

Photo 2 – view of site from the Lake

Photo 3 – looking south towards the crest of Bluff Point, from the area of the proposed tourist village

Reference to the 1:100,000 Newcastle Coalfield Geological series sheet indicates that the site is underlain the Narabeen Group of rocks. The Narabeen Group includes both the Terrigal Formation and the Clifton Subgroup. The Terrigal Formation typically includes sandstone and siltstone, while the Clifton Subgroup typically includes conglomerate, sandstone, siltstone and claystone.

4. FIELD WORK

4.1 Methods

The field work was undertaken on 3 October 2007, and comprised the backhoe excavation of ten test pits to depths of up to 3 m (Pits 301 to 310). In addition, seven on-land test bores (Bores 101 to 105, 101A and 102A), three over-water test bores (Bores 201 to 203) and collection of 15

samples of lake bed sediment (Samples SS1 to SS15) were undertaken during various other phases of the consultancy services for this project. The results from this other work have been included, where relevant.

The tests were set out by a geoenvironmental engineer from DP who also logged the subsurface profile in each pit and took regular samples for laboratory testing and identification purposes. Pocket penetrometer and dynamic cone penetrometer tests were performed at selected depths and locations.

All test locations were set out by measuring from existing site features. The pits were staked on completion and subsequently surveyed by project surveyors, SurDevel Pty Ltd. The locations of the pits are indicated on attached Drawing 2.

4.2 Results

The subsurface conditions encountered are presented in detail in the attached sample record sheet, borehole logs and test pit logs. These should be read in conjunction with the general notes preceding them, which explain the descriptive terms and classification methods used in the reports.

In general, the lake bed sediments comprised a mixture of sand, silt and clay in varying proportions. The over-water bores (Bores 201 to 203) encountered soft lake sediment which ranged in thickness from about 1.7 m to 3.0 m. The underlying soils generally comprised clay, gravelly clay and clayey sand, which was in turn underlain by bedrock at depths which ranged from 5.8 m to 7.9 m below the lake bed.

Bores 101/A and 102/A, and Pits 301 to 306 generally encountered sandy soils with variable proportions of clay, silt and gravel to depths of about 5 m. In the bores, the sandy soils were underlain by clay, sandy clay and gravelly clay. Rock was encountered in the bores at depths of 12.8 m and 11.4 m respectively.

Bores 103 to 105, and Pits 307 to 310 generally encountered filling (with the exception of Pit 309) to depths of up to 1.15 m over generally sandy and clayey soils. The clay in Pit 309

graded to clayey sand/extremely weathered sandstone below about 1.0 m, and backhoe refusal was encountered at 1.8 m depth. Rock was also encountered in Bores 104 and 105, with pebbly sandstone encountered below 4.2 m in Bore 104, and residual clay grading to an extremely low strength conglomerate below 4 m in Bore 105.

In addition, a sulphurous odour was observed during excavation of two of the test pits. This can be an indicator of acid sulphate conditions.

Groundwater seepage was encountered in seven of the 10 test pits during field work. It should be noted that the pits were only open for a relatively short period of time, and hence the groundwater observations in the pits are not necessarily representative of static water levels. Monitoring wells were installed in the seven on-land test bores, allowing additional groundwater measurements.

The following table summarises the groundwater observations made during field work.

Table 1 – Summary of Groundwater Observations

Location	Approximate Surface Level (AHD)	Depth to Groundwater Seepage During Field Work (m)
301	0.96	1.5
302	0.97	1.3
303	1.21	1.4
304	1.16	1.0
305	1.15	1.0
306	1.12	1.1
307	1.78	1.5
308	2.6	Not encountered
309	3.0	Not encountered
310	4.4	Not encountered

Other field work undertaken on the site during the same period, including measurements in groundwater monitoring wells, indicated groundwater levels in the ranges shown in Table 2, below. Groundwater pH and EC were also measured in the wells, with the results summarised in Table 3:

Table 2 – Summary of Groundwater Measurements in Bores

Bore	Approximate Surface Level (AHD)	Range of Groundwater Levels Observed (AHD)
101	1.27	0.07
101A	1.27	0.05 to 0.12
102	0.89	0.0 to 0.23
102A	0.89	-0.1 to 0.1
103	2.47	0.84 to 0.96
104	3.82	0.9 to 1.0
105	6.62	Dry

Table 3 – Summary of Groundwater pH and EC Ranges in Bores

Bore	Observed pH Ranges	Observed EC Ranges (mS/cm)
101	7.1 to 7.3	1.7 to 3.8
101A	7.2 to 7.7	0.6 to 0.8
102	6.8 to 7.3	8.7 to 2.1
102A	7.4 to 7.7	1.2 to 2.1
103	5.0	0.6
104	4.1 to 4.2	5.6 to 6.8
105	Bore dry	Bore dry

It should be noted that groundwater levels are affected by factors such as climatic conditions and soil permeability and will therefore vary with time.

5. ACID SULPHATE SOIL ASSESSMENT

5.1 Methods

An acid sulphate soil assessment was undertaken with reference to the ASSMAC “Acid Sulphate Soils Manual” (Ref 1) and QASSIT “Soil Management Guidelines” (Ref 2), and comprised the following:

- review of available acid sulphate risk maps;
- 57 screening tests on selected soil samples from the on-land test pits for pH in water (pH_F) and pH in hydrogen peroxide (pH_{FOX});
- 25 screening tests on selected samples of lake bed sediment, and soil from the over water bores for pH in water (pH_F) and pH in peroxide (pH_{FOX});
- 12 samples tested for more detailed acid sulphate testing, comprising either full chromium suite or POCAS testing to assess acid sulphate potential.

Samples collected for the assessment of acid sulphate soil conditions were wrapped in plastic wrap and plastic bags to exclude air, and stored and transported on ice. Samples were then refrigerated in the DP laboratory.

5.2 Published Data

Reference to the DLWC Acid Sulphate Soil Risk Maps for Swansea and Catherine Hill Bay indicate that the northern part of the site lies in area with a high probability of acid sulphate soil conditions within 1 m of the ground surface. The southern part of the site is located in an area mapped as having no known occurrence of acid sulphate soils.

In addition, there is a high probability of the occurrence of acid sulphate soils within the lake bed sediments of the adjoining portions of Lake Macquarie.

5.3 Laboratory Testing

Laboratory testing comprised 79 acid sulphate screening tests on samples collected from the test pits (57) and also lake bed sediments (22) collected during earlier field work. The results of the screening tests are presented in Tables 4 and 5, below.

Table 4 – Results of Acid Sulphate Soil Screening Tests – On-land Soils

Pit	Sample Depth[a] (m)	Approx Sample RL (m AHD)	Sample Description	Screening Test Results		
				pH_F	pH_{FOX}	$pH_F - pH_{FOX}$
301	0.1	0.86	Silty sand	5.8	4.0	**1.8**
	0.5	0.46	Sand	6.2	5.6	0.6
	1.0	-0.04	Clayey sand	6.5	**2.4**	**4.1**
	1.5	-0.54	Clayey sand	6.5	**2.2**	**4.3**
	2.0	-1.04	Clayey sand	6.8	**2.3**	**4.5**
	2.5	-1.54	Gravelly sand	7.2	3.9	**3.3**
302	0.1	0.87	Silty sand	7.1	4.0	**3.1**
	0.5	0.47	Sand	7.1	5.7	**1.4**
	1.0	-0.03	Clayey sand	7.2	6.3	0.9
	1.5	-0.53	Clayey sand	7.3	**2.2**	**5.1**
	2.0	-1.03	Clayey sand	7.2	**2.1**	**5.1**
	2.5	-1.53	Clayey sand	7.2	**2.2**	**5.0**
303	0.1	1.11	Silty sand	5.8	4.6	**1.2**
	0.5	0.71	Sand	6.0	5.4	0.6
	1.0	0.21	Clayey sand	6.2	5.9	0.3
	1.5	-0.29	Clayey sand	6.4	**2.1**	**4.3**
	2.0	-0.79	Gravelly sand	6.0	**2.7**	**3.3**
	2.5	-1.29	Gravelly sand	5.7	**2.6**	**3.1**
304	0.1	1.06	Silty sand	6.0	3.6	**2.4**
	0.5	0.66	Sand	6.0	5.7	0.3
	1.0	0.16	Sandy gravel	5.9	4.5	**1.4**
	1.5	-0.34	Gravelly clayey sand	4.2	**2.3**	**1.9**
	2.0	-0.84	Sandy gravel	4.6	**2.3**	**2.3**
305	0.1	1.05	Silty sand	5.2	4.7	0.5
	0.5	0.65	Gravelly sand	5.8	5.2	0.6
	1.0	0.15	Gravelly sand	6.0	5.3	0.7
	1.5	-0.35	Gravelly sand	5.5	**2.4**	**3.1**
	2.0	-0.85	Sand	4.7	**2.1**	**2.6**

Table 4 – Results of Acid Sulphate Soil Screening Tests – On-land Soils (continued)

Pit	Sample Depth[a] (m)	Approx Sample RL (m AHD)	Sample Description	Screening Test Results		
				pH_F	pH_{FOX}	pH_F - pH_{FOX}
306	0.1	1.02	Silty sand	5.1	**3.4**	**1.7**
	0.5	0.62	Gravelly sand	5.5	5.3	0.2
	1.0	0.12	Gravelly sand	5.2	3.8	**1.4**
	1.5	-0.38	Gravelly sand	4.5	**2.7**	**1.8**
	2.0	-0.88	Gravelly sand	4.9	**2.3**	**2.6**
307	0.1	1.68	Filling – sandy silt	5.5	**3.3**	**2.2**
	0.5	1.28	Filling – sandy silt	5.4	3.9	**1.5**
	1.0	0.78	Clayey gravelly sand	4.9	4.4	0.5
	1.5	0.28	Clayey gravelly sand	5.8	4.3	**1.5**
	2.0	-0.22	Clayey sand	5.3	4.2	**1.1**
	2.5	-0.72	Silty clay	4.1	4.0	0.1
	3.0	-1.22	Silty clay	4.6	4.4	0.2
308	0.1	2.5	Filling – silty clayey sand	5.7	**3.0**	**2.7**
	0.5	2.1	Silty sand	5.2	4.4	0.8
	1.0	1.6	Sand	5.6	5.0	0.6
	1.5	1.1	Sandy clay	5.3	4.6	0.7
	2.0	0.6	Sandy clay	4.5	4.5	0.0
	2.5	0.1	Sandy clay	4.3	4.0	0.3
	3.0	-0.4	Silty clay	**3.9**	3.5	0.4
309	0.1	2.9	Silty sand	5.8	4.6	**1.2**
	0.5	2.5	Silty sand	5.9	5.4	0.5
	1.0	2.0	Silty sandy clay	5.4	5.0	0.4
	1.5	1.5	Silty sandy clay	5.3	4.8	0.5
310	0.1	4.3	Filling – sandy clay	5.3	4.2	**1.1**
	0.5	3.9	Filling – sandy clay	6.5	6.7	-0.2
	1.0	3.4	Sandy clay	7.1	6.3	0.8
	1.5	2.9	Sandy clay	5.0	4.5	0.5
	2.0	2.4	Sandy clay	4.8	4.8	0.0
	2.5	1.9	Sandy clay/clayey sand	4.7	4.5	0.2
ASSMAC and QASSIT Action Criteria				<4[b]	<3.5[c]	≥1.0[c]

Notes to Table 4:

a Depth below ground surface
b For actual acid sulphate soils (ASS)
c Indicative value only for Potential Acid Sulphate Soils (PASS)
Shaded and Bold results indicate an exceedence of ASSMAC and QASSIT criteria (Refs 1 and 2)
NA – Not applicable

Table 5 – Results of Acid Sulphate Soil Screening Tests – Lake Bed Sediment and Soil

Sample Location	Sample Depth[a] (m)	Approx Sample RL (m AHD)	Sample Description	Screening Test Results		
				pH_F	pH_{FOX}	pH_F - pH_{FOX}
SS1	0 – 0.3	Not measured	Silty clayey sand	7.2	4.9	**2.3**
SS2	0 – 0.3	Not measured	Silty clayey sand	7.5	5.0	**2.5**
SS3	0 – 0.3	Not measured	Silty sand / sandy silt	7.6	5.1	**2.5**
SS4	0 – 0.3	Not measured	Silty sand / sandy silt	7.6	6.3	**1.3**
SS5	0 – 0.3	Not measured	Silty sand / sandy silt	7.9	6.3	**1.6**
SS6	0 – 0.3	Not measured	Silty sand / sandy silt	8.0	6.0	**2.0**
SS7	0 – 0.3	Not measured	Sandy clayey silt	7.8	6.5	**1.3**
SS8	0 – 0.3	Not measured	Sandy clayey silt	7.7	6.5	**1.2**
SS9	0 – 0.3	Not measured	Sandy silty clay	7.7	6.4	**1.3**
SS10	0 – 0.3	Not measured	Sandy silty clay	7.7	6.5	**1.2**
SS11	0 – 0.3	Not measured	Sandy silty clay	7.8	6.3	**1.5**
SS12	0 – 0.3	Not measured	Sandy silty clay	8.0	6.5	**1.5**
SS13	0 – 0.3	Not measured	Sandy silty clay	7.8	6.8	**1.0**
SS14	0 – 0.3	Not measured	Sandy silty clay	7.8	6.9	0.9
SS15	0 – 0.3	Not measured	Sandy silty clay	7.8	6.5	**1.3**
201	1.0	-6.86	Sandy silt/silty sand	7.7	6.1	**1.6**
	2.4	-8.26	Silty clay	7.0	6.9	0.1
	3.9	-9.76	Silty clay	5.0	4.5	0.5
	5.5	-11.36	Sand	5.2	4.6	0.6
202	2.5	-7.65	Gravelly silty clay	7.4	7.1	0.6
203	4.5	-9.85	Clay	6.9	7.3	-0.4
	6.5	-11.85	Gravelly clay	5.1	4.5	0.6
ASSMAC and QASSIT Action Criteria				<4[b]	<3.5[c]	≥1.0[c]

Notes to Table 5:

a Depth below lake bed
b For actual acid sulphate soils (ASS)
c Indicative value only for Potential Acid Sulphate Soils (PASS)
Shaded and Bold results indicate an exceedence of ASSMAC and QASSIT criteria (Refs 1 and 2)
NA – Not applicable

The ASSMAC and QASSIT guidelines suggest that a soil pH_F<4 in water is an indicator of actual acid sulphate soils. The results of screening tests therefore indicate the absence of actual acid sulphate soils at the locations and depths tested, although one sample did return a pH_F of marginally less than 4 (Pit 308/3.0 m).

The ASSMAC and QASSIT guidelines also suggest that indicators of potential acid sulphate soils (PASS) include the following:

- soil pH <3.5 in H_2O_2 (ie. pH_{FOX}), but preferably less than 3.0;
- drop of 1 pH unit or more between pH_F and pH_{FOX}.

34 of the samples tested exhibited a pH drop of greater than one unit and of these, 18 samples also exhibited a soil pH following oxidation below 3.5.

It is noted that the above test method is a qualitative method only and gives an indication of the intensity of total acidification (pH). The ASSMAC guidelines indicate that peroxide may also oxidise organic matter (in addition to pyrite) to produce acids which are unlikely to form under natural conditions, thus giving a falsely high indication of acid sulphate potential.

Based on the results of the screening tests, 12 soil samples were selected for detailed laboratory testing, comprising either the Full Chromium Suite or POCAS testing in accordance with the ASSMAC and QASSIT guidelines (Refs 1, 2 and 3).

Detailed test results are contained in the attached laboratory report sheets, and are summarised in Table 6, below.

Table 6 – Summary of Detailed Acid Sulphate Soil Testing

Location	Sample Depth[a] (m)	Approximate Sample RL (m AHD)	Sample Description	Laboratory Results						
				pH_{KCL}	s-TAA %S	s-TPA %S	s-TSA %S	Scr (%)	s-ANC_E %S	Net Acidity[b] %S
SS2	0 – 0.3	NM	Silty clayey sand	7.4	<0.01	-	-	0.23	0.32	0.01
SS3	0 – 0.3	NM	Silty sand / sandy silt	8.1	<0.01	-	-	0.64	1.9	<0.01
201	3.9	-9.76	Silty clay	4.7	0.03	0.02	<0.01	-	<0.01	0.03
203	6.5	-11.85	Gravelly clay	5.7	0.02	<0.01	<0.01	-	<0.01	0.02
301	0.5	0.46	Sand	5.9	<0.01	<0.01	<0.01	-	<0.01	<0.01
	1.0	-0.04	Clayey sand	5.6	0.01	0.65	0.64	-	<0.01	**0.72**
	1.5	-0.54	Clayey sand	5.8	<0.08	0.26	0.26	-	<0.01	**0.20**
302	2.0	-1.04	Clayey sand	8.2	<0.01	0.15	0.15	-	<0.01	**0.45**
306	2.0	-0.85	Gravelly sand	4.9	0.05	0.74	0.69	-	<0.01	**0.72**
307	2.5	-0.725	Silty clay	4.5	0.08	0.09	0.02	-	<0.01	**0.08**
308	0.1	2.5	Filling – silty clayey sand	5.3	0.02	<0.01	<0.01	-	<0.01	0.02
	3.0	-0.4	Silty clay	4.6	0.07	0.07	<0.01	-	<0.01	**0.07**
ASSMAC and QASSIT Action Criteria (Refs 1 and 2)				Coarse texture (sand)						0.03[c]/0.03[d]
				Medium texture – sandy loams						0.06[c]/0.03[d]
				Fine texture – medium to heavy clays						0.1/0.03[d]

Notes to Table 6:

a Depth below ground surface or lake bed, as appropriate
b Calculated from ABA equation in ASS Laboratory Methods Guidelines (Ref 3)
c Action criteria for less than 1000 tonnes of soil disturbed
d Action Criteria for more than 1000 tonnes disturbed
Shaded and bold results indicate an exceedence of ASSMAC and QASSIT criteria (Refs 1 and 2) for more than 1000 tonnes disturbed
NM – Not measured

6. COMMENTS

The results of detailed laboratory testing indicate the presence of actual and potential acid sulphate soils at the site.

Based on the results of this assessment, the proposed development will need to consider the presence of acid sulphate soils, particularly in the low-lying portions of the on-land marina development.

Of the on-land soil samples tested, four of the eight samples exceed the action criteria for the situation where less than 1000 tonnes of soil is excavated. If however the results are compared to the criteria for when more than 1000 tonnes of soil is excavated, then the number of samples exceeding the action criteria increases to six of the eight samples.

Therefore, all excavations within the low lying portions of the site covering the Marina, Marina Village and Blocks A, B, C and D have the potential to disturb acid sulphate soils. Excavations in these areas should be undertaken with specific reference to an Acid Sulphate Soil Management Plan. Treatment typically includes neutralising the soil by mixing with lime.

It is understood that dredging is not proposed in the marina area, and that driven piles will be utilised. Therefore, the current project proposal does not indicate that lake bed sediments will be exposed to oxidising conditions during construction.

Dewatering of excavations, if required, also has the potential to oxidise acid sulphate soils, and will also need to be undertaken with reference to an Acid Sulphate Management Plan.

It is considered possible that excavations within some of the other areas of the site could also encounter acid sulphate soils, eg. the basement excavation to RL 0.15 for Block E. The risk is likely to diminish as surface elevations increase to the south. However, it is recommended that additional targeted acid sulphate soil investigations be undertaken during the design stage of the project to further delineate the presence of acid sulphate soils.

7. LIMITATIONS

Conditions on site different to those identified during this assessment may exist. Therefore Douglas Partners Pty Ltd (DP) cannot provide unqualified warranties nor does DP assume any liability for site conditions not recorded in the data available for this assessment.

This report and associated documentation and the information herein have been prepared solely for the use of Johnson Property Group Pty Ltd. Any reliance on this report assumed by other parties shall be at such party's own risk. Any ensuing liability resulting from use of the report by other parties cannot be transferred to DP.

DOUGLAS PARTNERS PTY LTD

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Associate

John Harvey
Principal

REFERENCES

1. New South Wales Acid Sulphate Soil Management Advisory Committee "Acid Sulphate Soil Manual", August 1998.

2. Dear SE, Moore NG, Dobos SK, Watling KM and Ahern CR "Soil Management Guidelines" in "Queensland Acid Sulphate Soil Technical Manual", Department of Natural Resources and Mines, November 2002.

3. Ahern CR, Sullivan LA, McElnea AE "Acid Sulphate Soils Laboratory Methods Guidelines" in "Queensland Acid Sulphate Soil Technical Manual", Department of Natural Resources and Mines, June 2004.

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NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Test Pits — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descent into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water

table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling — the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling — similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling — a continuous core sample is obtained using a diamond-tipped core barrel, usually 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" — Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7

  as 4, 6, 7
  N = 13

- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm

  as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- Cone resistance — the actual end bearing force divided by the cross sectional area of the cone — expressed in MPa.
- Sleeve friction — the frictional force on the sleeve divided by the surface area — expressed in kPa.
- Friction ratio — the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:—

q_c (MPa) = (0.4 to 0.6) N (blows per 300 mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:—

q_c = (12 to 18) c_u

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. Normally, there is a depth limitation of 1.2 m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section

is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

AN ENGINEERING CLASSIFICATION OF SEDIMENTARY ROCKS IN THE SYDNEY AREA

This classification system provides a standardized terminology for the engineering description of the sandstone and shales in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

Under this system rocks are classified by Rock Type, Degree of Weathering, Strength, Stratification Spacing, and Degree of Fracturing. These terms do not cover the full range of engineering properties. Descriptions of rock may also need to refer to other properties (e.g. durability, abrasiveness, etc.) where these are relevant.

ROCK TYPE DEFINITIONS

Rock Type	Definition
Conglomerate:	More than 50% of the rock consists of gravel sized (greater than 2mm) fragments
Sandstone:	More than 50% of the rock consists of sand sized (.06 to 2mm) fragments
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06mm) granular particles and the rock is not laminated
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated
Shale:	More than 50% of the rock consists of silt or clay sized particles and the rock is laminated

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, e.g. clayey sandstone, sandy shale.

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh	Fs	Rock substance unaffected by weathering, limonite staining along joints.
Fresh	Fr	Rock substance unaffected by weathering.

STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly laminated	<6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	>2 m

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Society of Rock Mechanics (Reference).

Strength Term	Is(50) MPa	Field Guide	Approx. qu MPa*
Extremely Low:	0.03	Easily remoulded by hand to a material with soil properties	0.7
Very Low:	0.1	May be crumbled in the hand. Sandstone is “sugary” and friable.	2.4
Low:	0.3	A piece of core 150 mm long x 50 mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.	7
Medium:	1	A piece of core 150 mm long x 50 mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.	24
High:	3	A piece of core 150 mm long x 50 mm dia. cannot be broken by unaided hands, can be slightly scratched or scored with knife.	70
Very High:	10	A piece of core 150 mm long x 50 mm dia. may be broken readily with hand held hammer. Cannot be scratched with pen knife.	240
Extremely High:		A piece of core 150 mm long x 50 mm dia. is difficult to break with hand held hammer. Rings when struck with a hammer.	

* The approximate unconfined compressive strength (qu) shownin the table is based on an assumed ratio to the point load index of 24:1. This ratio may vary widely.

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks

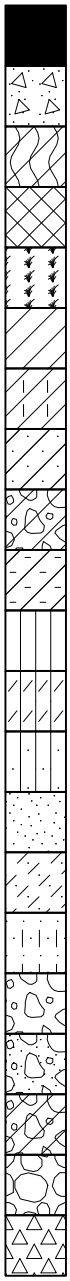
Term	Description
Fragmented:	The core is comprised primarily of fragments of length less than 20 mm, and mostly of width less than the core diameter.
Highly Fractured:	Core lengths are generally less than 20 mm - 40 mm with occasional fragments.
Fractured:	Core lengths are mainly 30 mm - 100 mm with occasional shorter and longer sections.
Slightly Fractured:	Core lengths are generally 300 mm - 1000 mm with occasional longer sections and occasional sections of 100 mm - 300 mm.
Unbroken:	The core does not contain any fracture.

REFERENCE

International Society of Rock Mechanics, Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1 Final Draft October 1972

GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



BITUMINOUS CONCRETE

CONCRETE

TOPSOIL

FILLING

PEAT

CLAY

SILTY CLAY

SANDY CLAY

GRAVELLY CLAY

SHALY CLAY

SILT

CLAYEY SILT

SANDY SILT

SAND

CLAYEY SAND

SILTY SAND

GRAVEL

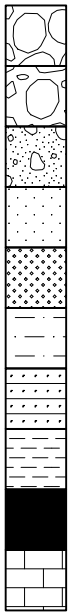
SANDY GRAVEL

CLAYEY GRAVEL

COBBLES/BOULDERS

TALUS

SEDIMENTARY ROCK



BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

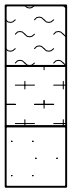
LAMINITE

MUDSTONE, CLAYSTONE, SHALE

COAL

LIMESTONE

METAMORPHIC ROCK

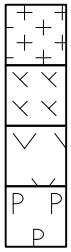


SLATE, PHYLITTE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

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CLIENT: Johnson Property Group Pty Ltd **DATE:** 25.9.07

PROJECT: Proposed Trinity Point Marina **PROJECT NO:** 39823A

LOCATION: Morisset Park, Lake Macquarie

Sample No	Container Type	Sample/Material Description	PID Reading (ppm)	Depth of Water at Time of Sampling (m)
SS1	2 jars and 1L bag and snap lock	Dark grey silty clayey sand, trace shell	1.1	1.8
SS2	2 jars and 1L bag and snap lock	Dark grey fine to medium grained silty clayey sand	0.8	3.3
SS3	2 jars and 1L bag and snap lock 2L water	Dark grey low plasticity silty sand/sandy silt, some clay	1.1	3.3
SS4	2 jars, 1L bag and snap lock and 2L water	Dark grey low plasticity silty sand/sandy silt, some clay	0.9	4.1
SS5/QA1	2 jars, 1L bag and snap lock and 2L water	Dark grey low plasticity silty sand/sandy silt, some clay	1.1	4.8
SS6	2 jars, 1L bag and snap lock and 2L water	Dark grey low plasticity silty sand/sandy silt, some clay	1.1	4.2
SS7	2 jars, 1L bag and snap lock and 2L water	Dark grey sandy clayey silt with trace shells	1.7	5.1
SS8	2 jars, 1L bag and snap lock and 2L water	Dark grey sandy clayey silt with trace shells	1.2	5.2
SS9	2 jars, 1L bag and snap lock and 2L water	Dark grey low plasticity sandy silty clay, trace shells	0.8	5.3
SS10	2 jars, 1L bag and snap lock and 2L water	Dark grey low plasticity sandy silty clay, trace shells	1.2	5.4
SS11	2 jars, 1L bag and snap lock and 2L water	Dark grey low plasticity sandy silty clay, trace shells	0.9	5.1
SS12	2 jars, 1L bag and snap lock and 2L water	Dark grey low plasticity sandy silty clay, trace shells	1.3	5.2
SS13	2 jars, 1L bag and snap lock and 2L water	Dark grey low plasticity sandy silty clay, trace shells	1.2	5.3
SS14	2 jars, 1L bag and snap lock and 2L water	Dark grey low plasticity sandy silty clay, trace shells	1.2	5.3
SS15	2 jars, 1L bag and snap lock and 2L water	Dark grey low plasticity sandy silty clay, trace shells	0.8	5.4

BOREHOLE LOG

CLIENT: Johnson Property Group
PROJECT: Trinity Point Marina & Tourist Development
LOCATION: 49 Lakeview Road, Morisset Park

SURFACE LEVEL: 1.27 AHD
EASTING: 363834
NORTHING: 6334174
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 39823
DATE: 26/9/07
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
1	0.35	FILLING: Generally comprising brown fine to coarse grained gravelly silty sand, humid							A			
0	1	GRAVELLY SAND: Very loose to loose grey-brown fine to coarse grained gravelly sand, with trace silt and clay, damp From 0.6m, moist to wet From 1.0m, saturated				▼			A S			1,0,1 N = 1
-1	1.7	GRAVELLY CLAYEY SAND: Very loose to loose grey-brown fine to coarse grained gravelly sand, with some silt, shell fragments, saturated							S			1,0,0 N = 0
-2	3.0	GRAVEL: Loose grey and brown fine to medium sized gravel, with some sand and shells and trace silt, saturated										
-3	4.05	GRAVELLY SAND: Loose grey fine to medium grained silty gravelly sand, with some shells, saturated							S			5,2,2 N = 4
-4	5.5	GRAVELLY CLAY: Very stiff to hard grey-brown and brown gravelly clay, with some sand, M~Wp							S			5,14,16 N = 30
-5	6.3	GRAVELLY SANDY CLAY: Very stiff light grey-brown gravelly sandy clay, M~Wp										
-6	7.0	SILTY CLAY: Very stiff grey-brown and red-brown silty clay, M~Wp							S			3,7,12 N = 19
-7	7.8	SANDY SILTY CLAY: Firm to stiff grey-brown sandy silty clay, with some gravel, M~Wp From 8.55m to 8.8m, soft to firm							pp pp S pp			30-50 kPa 30-50 kPa 1,0,4 N = 4 80-100 kPa
-8	9											

RIG: Scout 2 **DRILLER:** Ground Test (Driver) **LOGGED:** Reid **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (tc-bit) to 2.5m, then wash boring to 5.5m; then rotary with mud to 13.25m; then NMLC coring to 19.9m

WATER OBSERVATIONS: Free groundwater observed at 1.0m during drilling

REMARKS: Coordinates are MGA. 50mm diameter Class 18 PVC piezometer installed to 4m; screened from 1.0m to 4.0m; 5mm gravel filter from 0.4m to 4.0m; bentonite plug from surface to 0.4m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Johnson Property Group
PROJECT: Trinity Point Marina & Tourist Development
LOCATION: 49 Lakeview Road, Morisset Park

SURFACE LEVEL: 1.27 AHD
EASTING: 363834
NORTHING: 6334174
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 39823
DATE: 26/9/07
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-9	10.0	GRAVELLY SANDY CLAY: Stiff grey-brown gravelly sandy clay, M~Wp							S pp			120-140 kPa 5,4,6 N = 10
-10	11											
-11	12	From 11.9m, stiff to very stiff							S			7,4,11 N = 15
-12	12.8	CONGLOMERATE: Extremely low strength, extremely weathered orange-brown and light grey conglomerate							S			23,25/80mm
	13	From 13.25m, extremely low to very low strength, extremely to highly weathered						13.32m: P, 5°, ro, un 13.41m: P, 5°, ro, un 13.64m: J, 10°, ro, un	C	100	73	
-13	14	From 13.56m to 13.59, low strength From 13.7m, low to medium strength, highly to moderately weathered							C	100	94	PL(A) = 0.67MPa PL(D) = 0.26MPa
	15							14.85m: J, 45°, ro, un				
-14	15.25 15.3	CORE LOSS:						15.25m: CORE LOSS: 50mm				
	16	CONGLOMERATE: Medium strength, moderately weathered brown conglomerate						15.77m: J, 10°, sm, pl	C	98	98	PL(A) = 0.7MPa PL(D) = 0.35MPa
-15	17							16.7m: P, 5°, sm, pl, Fe				
-16	17.15	CLAYSTONE: Very low strength, moderately weathered brown conglomerate						17.15m: P, 10°, ro, pl, Fe	C	97	90	PL(A) = 0.07MPa PL(D) = 0.05MPa
	17.9 18 18.0 18.05	PEBBLY SANDSTONE: Low strength, moderately weathered light grey fine to coarse grained pebbly sandstone						17.9m: P, 5°, ro, pl 18m: CORE LOSS: 50mm From 18.05m to18.15m, highly Fg (1mm to 10mm)				
-17		CORE LOSS:										
-18	19	PEBBLY SANDSTONE: Extremely low strength, moderately weathered light grey fine to coarse grained pebbly sandstone From 18.45m, medium to high strength							C	100	100	PL(A) = 1.57MPa PL(D) = 1.06MPa
	19.9	Bore discontinued at 19.9m, limit of investigation										

RIG: Scout 2 **DRILLER:** Ground Test (Driver) **LOGGED:** Reid **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (tc-bit) to 2.5m, then wash boring to 5.5m; then rotary with mud to 13.25m; then NMLC coring to 19.9m

WATER OBSERVATIONS: Free groundwater observed at 1.0m during drilling

REMARKS: Coordinates are MGA. 50mm diameter Class 18 PVC piezometer installed to 4m; screened from 1.0m to 4.0m; 5mm gravel filter from 0.4m to 4.0m; bentonite plug from surface to 0.4m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Johnson Property Group
PROJECT: Trinity Point Marina & Tourist Development
LOCATION: Off Henry Street, Trinity Point

SURFACE LEVEL: 1.27
EASTING: 363834
NORTHING: 6334174
DIP/AZIMUTH: 90°/--

BORE No: 101A
PROJECT No: 39823
DATE: 16 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	FILLING: Generally comprising brown fine to medium grained gravelly silty sand, humid							From 0.05m to 0.4m, bentonite
		GRAVELLY SAND: Very loose to loose grey-brown fine to coarse grained sand, some silt and clay, damp From 0.65m, wet to saturated						▼	From 0.4m to 3.5m, 5mm gravel filter From 0.6m to 3.5m, screen
	1.7	GRAVELLY CLAYEY SAND: Very loose to loose grey-brown fine to coarse grained gravelly sand, with some silt, saturated							
	3.0	GRAVEL: Loose grey-brown fine to coarse gravel, with some sand and trace silt, saturated							
	3.5	Bore discontinued at 3.5m, limit of investigation							

RIG: Truck mounted rig **DRILLER:** Atkins **LOGGED:** Karpiel **CASING:** -

TYPE OF BORING: 150mm hollow flight auger

WATER OBSERVATIONS: Free groundwater observed at 1.15m below ground level during drilling

REMARKS: Endcap dislodged during removal of casing, screen backfilled inside well to 1.84m below ground level

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Johnson Property Group
PROJECT: Trinity Point Marina & Tourist Development
LOCATION: 49 Lakeview Road, Morisset Park

SURFACE LEVEL: 0.89 AHD
EASTING: 363828.6
NORTHING: 6334140.7
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 39823
DATE: 08 Oct 07
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.4	TOPSOIL: Generally comprising dark brown-black clayey sandy silt, with trace rootlets to 0.2m, damp							A			
	0.7	SILTY SAND: Dark brown fine to medium grained silty sand, damp										
	1	SAND: Very loose brown fine to medium grained sand, with trace silt, clay and shell fragments, moist							A			
	1.3	SILTY SAND: Very loose grey fine to medium grained silty sand, with trace clay and shell fragments, saturated				▼			S			1,0,0 N = 0
	2											
	3								S			0,0,0 N = 0 (weight of hammer)
	4											
	4.2	CLAYEY SAND/SANDY CLAY: Very soft grey-brown medium grained clayey sand/sandy clay, saturated							S			3,1,2 N = 3
	4.7	SILTY SANDY CLAY: Firm to stiff light brown sandy clay, with fine grained gravel, M>Wp										
	5											
	5.3	SILTY CLAY: Firm to very stiff light brown silty clay, with some sand, M<Wp							pp pp S pp			80 kPa 150 kPa 3,3,6 N = 9 320 kPa
	6											
	7											
	7.15	GRAVELLY SANDY CLAY: Very stiff to hard light brown gravelly sandy clay, M~Wp							S			3,8,25/130mm
	8											
	8.0	SILTY CLAY: Stiff light brown silty clay, with some fine grained sand, M>Wp							S pp			3,4,5 N = 9 170 kPa
	9											
		From 9.5m, very stiff to hard, slightly sandy										

RIG: Scout 2 **DRILLER:** Ground Test (Driver) **LOGGED:** Reid **CASING:** HW to 7.2m, HQ to 11.65m

TYPE OF BORING: 100mm diameter solid flight auger (tc-bit to 4.5m), then rotary wash boring to 11.65m, then NMLC coring to 17.75m

WATER OBSERVATIONS: Free groundwater observed at 1.3m during drilling

REMARKS: Coordinates are MGA. 50mm diameter Class 18 PVC piezometer installed to 4.0m depth on completion

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Johnson Property Group
PROJECT: Trinity Point Marina & Tourist Development
LOCATION: 49 Lakeview Road, Morisset Park

SURFACE LEVEL: 0.89 AHD
EASTING: 363828.6
NORTHING: 6334140.7
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 39823
DATE: 08 Oct 07
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-10	10.0	SILTY CLAY: continued							S pp pp			340 kPa 5,9,13 N = 22 380-440 kPa
-10	11											
-11	11.4	PEBBLY SANDSTONE: Extremely low to very low strength, extremely to highly weathered light brown and orange-brown fine to medium grained pebbly sandstone							S			25/120mm PL(A) = 0.04MPa PL(D) = 0.05MPa
-11	12							12.1m: J, 70°, ro, un	C	100	100	
-12	12.45 12.57	CORE LOSS: 120mm						12.45m: CORE LOSS: 120mm				
-12	13 13.0	PEBBLY SANDSTONE: Very low strength, highly weathered light brown and orange-brown fine to medium grained pebbly sandstone							C	92	92	
-13	13.85	SANDSTONE: Extremely low to very low strength, highly weathered light brown fine to medium grained sandstone						13.63m: J, 10°, ro, pl				PL(A) = 0.01MPa PL(D) = 0MPa
-13	14	PEBBLY SANDSTONE: Very low to low strength, highly weathered light brown and orange-brown fine to medium grained pebbly sandstone										
-14	14.75	CONGLOMERATE: Very low strength, highly weathered light brown and orange-brown conglomerate						14.62m: P, 5°, ro, un 14.71m: P, 5°, ro, un 14.94m: P, 5°, ro, pl 15.07m: J, 40°, ro, pl	C	100	94	
-14	15	From 15.15m, low to medium strength						15.45m: P, 5°, ro, pl 15.47m: J, 20°, ro, un				PL(A) = 0.31MPa PL(D) = 0.22MPa
-15	16	From 15.95m, medium strength, moderately weathered										
-16	17	From 16.5m, medium to high strength, slightly weathered						16.4m: J, 30°, ro, un	C	100	99	PL(A) = 0.57MPa PL(D) = 0.5MPa
-17	17.75	Bore discontinued at 17.75m, limit of investigation										
-18	18											
-18	19											
-19												

RIG: Scout 2 **DRILLER:** Ground Test (Driver) **LOGGED:** Reid **CASING:** HW to 7.2m, HQ to 11.65m

TYPE OF BORING: 100mm diameter solid flight auger (tc-bit to 4.5m), then rotary wash boring to 11.65m, then NMLC coring to 17.75m

WATER OBSERVATIONS: Free groundwater observed at 1.3m during drilling

REMARKS: Coordinates are MGA. 50mm diameter Class 18 PVC piezometer installed to 4.0m depth on completion

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Johnson Property Group
PROJECT: Trinity Point Marina & Tourist Development
LOCATION: Off Henry Street, Trinity Point

SURFACE LEVEL: 0.89
EASTING: 363829
NORTHING: 6334141
DIP/AZIMUTH: 90°/--

BORE No: 102A
PROJECT No: 39823
DATE: 16 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.4	TOPSOIL: Generally comprising black clayey sandy silt, with trace rootlets to 0.2m							End cap; Stick up ~0.57m; From 0.1m to 0.45m, bentonite
	0.7	SILTY SAND: Dark brown silty sand medium grained, damp							
	1.3	SAND: (Very loose) fine to medium grained sand with trace silt, clay and shell, wet						▼	From 0.45m to 3.7m, 5mm gravel filter; From 0.7m to 3.7m, screen
	3.7	SILTY SAND: (Very loose) grey fine to medium grained silty sand, with trace clay, saturated							
		Bore discontinued at 3.7m, limit of investigation							

RIG: Truck mounted rig **DRILLER:** Atkins **LOGGED:** Karpiel **CASING:** -

TYPE OF BORING: 150mm hollow flight auger

WATER OBSERVATIONS: Free groundwater observed at 0.83m below ground level during drilling

REMARKS: Coordinates are MGA

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Johnson Property Group
PROJECT: Trinity Point Marina & Tourist Development
LOCATION: Off Henry Street, Trinity Point

SURFACE LEVEL: 2.487
EASTING: 363872
NORTHING: 6334034
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 39823
DATE: 28 Sep 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILLING - Generally comprising dark brown sandy silt with some organics, (bark, wood chips, rootlets), dry to moist							From surface to 0.4m, bentonite plug
	0.7	FILLING - Generally comprising dark brown-black fine to medium grained silty sand with trace sand, damp		A	0.5				
	1.15	FILLING - Generally comprising light brown and dark brown gravelly sandy clay with some silt, M>Wp			1.0				
		SILTY GRAVELLY SAND - Medium dense to dense, red and orange-brown silty gravelly sand, M~Wp		pp A,S	1.2 1.45		150-300 kPa 8,18,13 N = 31		
	2.2	SANDY CLAY - Very stiff, light grey-brown sandy clay, M~Wp			2.5				
	3.0	SILTY CLAY - Very stiff, light grey-brown and red-brown silty clay with some gravel, M>Wp		U_{50} pp	2.85		350-390 kPa		From 0.4m to 5.5m, 5mm gravel filter
					4.0			▼	From 2.5m to 5.5m, 50mm diameter Class 18 PVC screen
				S,pp	4.45		4,7,12 N = 19 300 kPa		
					5.5				
				S			7,13,16 N = 29		
	5.95	Bore discontinued at 5.95m, limit of investigation			5.95				

RIG: Scout 2 **DRILLER:** Ground Test (Driver) **LOGGED:** Reid **CASING:**

TYPE OF BORING: 100mm diameter solid flight auger (tc-bit)

WATER OBSERVATIONS: Free groundwater observed at 4.0m during drilling

REMARKS: Coordinates are MGA

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Johnson Property Group
PROJECT: Trinity Point Marina & Tourist Development
LOCATION: Off Henry Street, Trinity Point

SURFACE LEVEL: 3.82
EASTING: 363899
NORTHING: 6333964
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 39823
DATE: 28 Sep 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILLING -							From surface to 0.4m, bentonite plug
		FILLING - Generally comprising brown sandy silt, dry to humid from 0.6m, some gravel		A	0.5				
	1.05	SANDY SILTY CLAY - Very stiff, grey-brown, orange and red-brown sandy silty clay, M<Wp		A,S,pp	1.0 1.45		5,8,9 N = 17 400 kPa		
	1.8	SILTY CLAY - Very stiff, light grey-brown silty clay with some gravel, M<Wp							
				S,pp	2.5 2.95		3,8,8 N = 16 320-360 kPa		From 0.4m to 5.0m, 5mm gravel filter
		from 3.6m, (stiff) to very stiff						▼	From 2.0m to 5.0m, 50mm diameter Class 18 PVC screen
	4.2	PEBBLY SANDSTONE - Extremely low to very low strength, extremely to highly weathered, orange-brown fine to medium grained pebbly sandstone		S,pp	4.0 4.45		7,13,19 N = 32 150-250 kPa		
	5.0	Bore discontinued at 5.0m, limit of investigation							

RIG: Scout 2 **DRILLER:** Ground Test (Driver) **LOGGED:** Reid **CASING:**

TYPE OF BORING: 100mm diameter solid flight auger (tc-bit)

WATER OBSERVATIONS: Free groundwater observed at 3.6m during drilling

REMARKS: Coordinates are MGA

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Johnson Property Group
PROJECT: Trinity Point Marina & Tourist Development
LOCATION: Off Henry Street, Trinity Point

SURFACE LEVEL: 6.62
EASTING: 363918
NORTHING: 6333881
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 39823
DATE: 28 Sep 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILLING -							From surface to 0.4m, bentonite plug
	1.05	FILLING - Generally comprising dark brown fine to medium grained silty sand with some fine grained sand, humid		A	0.5				
		SILTY SANDY CLAY - Very stiff to hard, orange and red-brown silty sandy clay with some fine grained gravel		A,S,pp	1.0		4,5,10 N = 15		
				pp	1.4 1.45		>450 kPa >450 kPa		
		from 2.1m, slightly gravelly							From 0.4m to 5.0m, 5mm gravel filter
				S,pp	2.5		6,10,13 N = 23		
					2.95		350->450 kPa		From 2.0m to 5.0m, 50mm diameter Class 18 PVC screen
		from 4m, hard, grading to extremely low strength conglomerate		S	4.0		4,14,18 N = 32		
	5.0				4.45				
		Bore discontinued at 5.0m, limit of investigation							

RIG: Scout 2 **DRILLER:** Ground Test (Driver) **LOGGED:** Reid **CASING:**

TYPE OF BORING: 100mm diameter solid flight auger (tc-bit)

WATER OBSERVATIONS: No free groundwater observed during drilling

REMARKS: Coordinates are MGA

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Johnson Property Group
PROJECT: Trinity Point Marina & Tourist Development
LOCATION: 49 Lakeview Road, Morisset Park

SURFACE LEVEL: -5.86 AHD
EASTING: 363920.9
NORTHING: 6334291.7
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 39823B
DATE: 03 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-6		SANDY SILT/SILTY SAND: Very loose/very soft grey-brown silty sand/sandy silt, with some shells, M>Wp							S			0,0,0 N = 0 (weight of rods)
-7	1								S			0,0,0 N = 0 (weight of rods)
	1.7	SILTY CLAY: Stiff to very stiff light grey-brown and grey-brown silty clay, M>Wp										
-8	2								pp S			350-390 kPa 3,5,8 N = 13
-9	3											
-10	4	From 4.25m, soft to firm							pp S pp			140-220 kPa 3,5,4 N = 9 20-60 kPa
-11	5											
	5.5	From 5.3m, some sand and coal fragments										
	5.8	SAND: Very loose to loose fine to coarse grained sand, with some silt and coal fragments, saturated							S			1,1,12 N = 13
-12	6	CONGLOMERATE: Extremely low to very low strength, extremely to highly weathered light grey-brown conglomerate										
-13	7	From 6.4m, (very low to low strength) higher resistance to drilling, brown From 7.45m, very low to low strength						From 7.0m to 7.3m, highly Fr 7.38m: J, 60°, ro, un 7.84m: J, 45°, ro, un 8.16m: J, 10°, ro, pl	C	100	100	PL(A) = 0.06MPa PL(D) = 0.05MPa PL(A) = 0.04MPa PL(D) = 0.04MPa
-14	8											
	8.5	Bore discontinued at 8.5m, bore abandoned due to strong winds										
-15	9											

RIG: Scout 2 on Modular Barge **DRILLER:** Ground Test (Driver) **LOGGED:** Reid **CASING:** HW to 2.2m

TYPE OF BORING: 100mm diameter rotary wash boring to 7.0m, then NMLC coring to 8.5m

WATER OBSERVATIONS: Depth of water 4.95m at start of bore

REMARKS: Coordinates are MGA

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Johnson Property Group
PROJECT: Trinity Point Marina & Tourist Development
LOCATION: 49 Lakeview Road, Morisset Park

SURFACE LEVEL: -5.15 AHD
EASTING: 363870.5
NORTHING: 6334479.2
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 39823B
DATE: 04 Oct 07
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-6	1	SANDY SILTY CLAY: Very soft dark grey-brown sandy silty clay, with some shells, M>Wp							S			0,0,0 N = 0 (weight of rods)
									S			0,0,0 N = 0 (weight of rods)
-7	2											
	2.2	GRAVELLY SILTY CLAY: Stiff light brown gravelly silty clay, with some sand, M>Wp										
-8	2.8	CLAYEY SAND: Stiff to very stiff light brown slightly gravelly clayey sand, M>Wp							pp S pp			160 kPa 3,5,7 N = 12 160 kPa
-9	3											
	4								pp S pp			100-150 kPa 4,8,12 N = 20 >450 kPa
-10	5											
-11	6								S pp			4,8,12 N = 20 300-360 kPa
-12	6.9	CONGLOMERATE: Extremely low strength, extremely weathered light brown and red-brown conglomerate							S			5,12,18 N = 30
	7											
-13	7.55	CORE LOSS: 950mm						7.55m: CORE LOSS: 950mm				
	8								C	46	31	
	8.5	CONGLOMERATE: Extremely low strength, extremely weathered light brown and red-brown conglomerate						From 8.5m to 8.72m, highly Fr				
-14	8.75	CLAYSTONE: Very low to low strength, extremely weathered light brown and red-brown claystone										PL(A) = 0.1MPa PL(D) = 0.12MPa
	9											
	9.3	CORE LOSS: 1700mm						9.3m: CORE LOSS: 700mm	C	33	33	
-15												

RIG: Scout 2 on Modular Barge **DRILLER:** Ground Test (Driver) **LOGGED:** Reid **CASING:** HW to 3.0m

TYPE OF BORING: 100mm diameter rotary wash boring to 7.5m, then NMLC coring to 14.55m

WATER OBSERVATIONS: Depth of water 5.25m at start of bore

REMARKS: Coordinates are MGA

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

Douglas Partners
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BOREHOLE LOG

CLIENT: Johnson Property Group
PROJECT: Trinity Point Marina & Tourist Development
LOCATION: 49 Lakeview Road, Morisset Park

SURFACE LEVEL: -5.15 AHD
EASTING: 363870.5
NORTHING: 6334479.2
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 39823B
DATE: 04 Oct 07
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-16	10.0	CORE LOSS: continued						10m: CORE LOSS: 1000mm				
-17	11 11.0	CONGLOMERATE: Extremely low to very low strength, extremely weathered light orange-brown conglomerate						11.55m: P, sh, ro, un, cy filled (20mm)	C	33	33	PL(A) = 0.03MPa PL(D) = 0.04MPa
	12 12.0	CORE LOSS: 50mm						12m: CORE LOSS: 50mm				
-18	12.05	CONGLOMERATE: Extremely low to very low strength, extremely to highly weathered orange-brown conglomerate						From 12.05m to 12.55m, high Fr 12.22m: P, sh, ro, un, cy filled (15mm)	C	95	78	PL(A) = 0.04MPa PL(D) = 0.02MPa
	13	From 12.15m, very low to low strength, highly to moderately weathered From 13.0m, moderately weathered light brown						13.35m: P, sh, ro, un				
-19	14	From 14.05m, low to medium strength							C	100	100	PL(A) = 0.11MPa PL(D) = 0.06MPa
	14.55	Bore discontinued at 14.55m, limit of investigation										
-20	15											
-21	16											
-22	17											
-23	18											
-24	19											
-25												

RIG: Scout 2 on Modular Barge **DRILLER:** Ground Test (Driver) **LOGGED:** Reid **CASING:** HW to 3.0m

TYPE OF BORING: 100mm diameter rotary wash boring to 7.5m, then NMLC coring to 14.55m

WATER OBSERVATIONS: Depth of water 5.25m at start of bore

REMARKS: Coordinates are MGA

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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