shaw:urquhart
consulting
geotechnical +
environmental
services

AUSTRALIAN SOIL & CONCRETE TESTING PTY LTD

GEOTECHNICAL ASSESSMENT FOR DEVELOPMENT OF WEST BYRON/BELONGIL FIELDS

09531/1-E
10 June 2010

Suite 6, 633 Logan Road
GREENSLOPES
QLD 4120 Australia

PO Box 19
GREENSLOPES
QLD 4120 Australia

T: +61 7 3847 8751
F: +61 7 3847 7863

Shaw Urquhart Pty Ltd ACN 108 592 623

shaw:urquhart
consulting
geotechnical +
environmental
services

09531/1-E ps:PS
10 June 2010

Australian Soil & Concrete Testing Pty Ltd

PO Box 5120

BALLINA NSW 2478

Attention: Mr Brian Dick

RE: GEOTECHNICAL ASSESSMENT FOR DEVELOPMENT OF WEST BYRON/BELONGIL FIELDS

Please find attached our geotechnical report on the potential development of the West Byron/Belongil Fields area.

The report presents the results of field investigations carried out by Australian Soil & Concrete Testing Pty Ltd and provides a preliminary assessment of geotechnical constraints on development of the site.

If you have any questions or wish to discuss or clarify any of the issues raised in this report, please contact Philip Shaw at our Brisbane office.

For and on behalf of

SHAW URQUHART PTY LTD

Philip Shaw

PHILIP SHAW

Principal Geotechnical Engineer

Distribution: Original held by Shaw Urquhart Pty Ltd

1 electronic + 1 hard copy Australian Soil & Concrete Testing Pty Ltd

Suite 6, 633 Logan Road
GREENSLOPES
QLD 4120 Australia

PO Box 19
GREENSLOPES
QLD 4120 Australia

T: +61 7 3847 8751
F: +61 7 3847 7863

shaw:urquhart

TABLE OF CONTENTS

			Page
1.	INTRODUCTION		1
2.	FIELD WORK		1
3.	SITE CONDITIONS		1
	3.1	Surface Conditions	1
	3.2	Subsurface Conditions	2
	3.3	Groundwater	2
4.	REGIONAL GEOLOGY		3
5.	DISCUSSION AND RECOMMENDATIONS		3
	5.1	General	3
	5.2	Site Classification	3
	5.3	Bearing Capacity	4
	5.4	Site Preparation	4
	5.5	Excavatability and Use of Excavated Materials	5
	5.6	Stability	5

Understand the Limitations of Your Geotechnical Report

FIGURES

1 Location Plan
2 Regional Geology
3 Approximate Borehole Locations
4 Areas of Poor Traffickability at Time of Walk-Over Assessment

APPENDICES

A Engineering Logs of Boreholes and DCP Results Provided by Australian Soil & Concrete Testing Pty Ltd.
B Site Observation Notes

1. INTRODUCTION

This report describes geotechnical studies carried out by Shaw Urquhart Pty Ltd for Australian Soil & Concrete Testing Pty Ltd (ASCT) at West Byron/Belongil Fields.

2. FIELD WORK

The field work consisted of a walk-over assessment by a Geotechnical Engineer from Shaw:Urquhart and the drilling of twenty (20) boreholes by ASCT.

The boreholes were drilled using a truck mounted Yanmar 35 drilling rig to depths of between 1.5m and 3.0m below the existing ground surface at the approximate locations shown on Figure 3. Dynamic Cone Penetrometer (DCP) tests were carried out adjacent to each borehole.

The work was carried out in the full time presence of a Geotechnician from ASCT who was responsible for locating the boreholes, nominating and directing sampling and testing and providing field logs of the soil profiles encountered.

Engineering logs of the boreholes along with the DCP test results are presented in Appendix A.

A site plan and site observation notes from the walk-over assessment are presented in Appendix B.

3. SITE CONDITIONS

3.1 Surface Conditions

The site is located on Ewingsdale Road to the west of Byron Bay town centre. A site location plan is shown on Figure 1.

The study area is bounded to the east and south by Belongil Creek and associated wetland areas, to the north by Ewingsdale Road and to the west by the Sunnybrand Chickens abbatoir.

The site is about 100 hectares in area and is located on coastal lowlands. Aerial photographs show that the site is situated at the south-eastern end of a series of dunal ridges which are orientated in a north west – south easterly direction. The end of this dunal system is apparent in the topography in the south-eastern corner of the subject site. It is expected that the dunes have been flattened to form the current relatively level topography at an elevation of between about RL3m and RL4m.

As illustrated on Figure 2, the western, south-western and southern boundary of the site are located behind the dunal system and the existing alignment of Belongil Creek winds its way around the south-eastern extremity of the dunes. These lower lying areas coincide approximately with flood prone land identified on Map 15 of the "Byron Bay, Suffolk Park & Ewingsdale Local Environmental Study" published by Byron Shire Council and have reduced levels in the order of RL1m to RL1.5m.

The site is traversed by a number of open drains and shallow swales.

Slopes across the site are typically less than about 5% with locally steeper areas in the sides of open drains and localised areas of site filling.

With the exception of some localised areas of dense trees along Belongil Creek and the associated wetlands, the site is cleared and grassed. Lines of trees tend to be located along open drains and swales.

At the time of the field investigations, traffickabilty was poor in a number of areas due to poor surface drainage, the shallow groundwater table and low lying topography.

3.2 Subsurface Conditions

Subsurface conditions were relatively uniform across the site with a layer of 0.15m to 0.2m of dark grey black, silty sand, sand, clayey gravelly sand and silty gravelly sand topsoil.

With the exception of borehole 13, the topsoil was underlain by fine grained sand which extended to the limit of the investigations. At borehole 13, the topsoil was underlain by a thin layer of gravelly silty clay fill to 0.4m depth which was in turn underlain by fine grained sand.

The fine grained sand is inferred from the DCP test results to be mostly medium dense to dense.

Partially indurated layers were encountered at many of the locations investigated except for boreholes 7, 9, 11 and 13 to 18.

At borehole locations 1, 2, 5, 12, 15, 19 and 20 the DCP tests effectively refused in very dense sand.

3.3 Groundwater

Standing groundwater levels were measured in each of the boreholes and are summarised in Table 1.

TABLE 1: SUMMARY OF STANDING GROUNDWATER LEVELS

Location	Date	SWL Depth (m)	Location	Date	SWL Depth (m)
1	24/5/10	0.1	2	24/5/10	0.1
3	19/5/10	1.0	4	24/5/10	0.4
5	24/5/10	0.5	6	21/5/10	1.1
7	20/5/10	1.0	8	21/5/10	0.4
9	20/5/10	0.6	10	20/5/10	0.6

11	20/5/10	1.5	12	21/5/10	0.2
13	19/5/10	0.7	14	19/5/10	0.4
15	20/5/10	1.6	16	20/5/10	2.0
17	20/5/10	0.15	18	21/5/10	0.0
19	20/5/10	0.0	29	20/5/10	0.2

4. REGIONAL GEOLOGY

According to the 1:250,000 Geological Series Sheet SH56-3 "Tweed Heads", the site is underlain by Quarternary beach and dune sand, river gravels, alluvium,sand and clay.

The area of beach and dune sand on the geological map approximates the area identified on Figure 2.

5. DISCUSSION AND RECOMMENDATIONS

5.1 General

Subsurface investigations to date have been shallow but, on the basis of the available information both on the site and for surrounding areas, there are no major geotechnical constraints on development of the area.

There is potential for softer sediments to be encountered in the areas of the site identified on Figure 2 as being located behind the dunal system and along low lying areas to the west of Belongil Creek. It is possible that finer grained alluvial materials could have been deposited in these backwater areas during extreme flood events and later covered over by aeolin sand. The shallow investigations did not encounter any clayey materials in the upper 3.0m of the profile but, depending on the possible future development of these areas, it is recommended that several deep boreholes be drilling in this area at design stage to confirm that no soft soils present.

The areas of the site which are located within the dunal system are expected to be underlain by deep clean sands.

The following comments are based on the subsurface conditions encountered in the shallow boreholes drilled during the current investigations.

5.2 Site Classification

On the basis of the subsurface investigations to date, site classifications in accordance with AS2870-1996 "Residential Slabs and Footings" for structures founded in natural sandy soils are expected to range from Class A to Class S.

In areas of existing filling, the sites would be classified as Class P with the potential to revise the classification for footing design purposes after appropriate subsurface investigations and testing are carried out.

In areas of future filling, the site classification will depend on the site preparation, the type of fill materials used and the compaction employed in placing the fill.

5.3 Bearing Capacity

The estimated allowable bearing capacity for footings up to 1.0m wide at 0.6m depth ranges from 100kPa to 200kPa for natural medium dense to dense sand respectively. Founding conditions are therefore expected to be adequate for residential housing and small to medium size commercial buildings or units.

Larger structures above say three to four storeys in height will require site specific investigations.

The walk over assessment identified area of possible localised filling. The construction history of this filling is not known and for the purpose of planning existing fill should be considered to be uncontrolled. For developments proposed in areas of existing filling, the fill could be removed and re-compacted as engineered fill in accordance with AS3798-2007 "Guidelines on Earthworks for Commercial and Residential Developments" or the structures could be supported on piers taken through the fill into the underlying natural soils.

5.3 Site Preparation

At the time of the investigation, portions of the site were boggy with poor surface traffickability as identified approximately on Figure 4. It is expected that after prolonged rain periods other areas of the site may also be temporarily inaccessible.

The boggy conditions are a combination of poor surface drainage and the presence of a shallow groundwater table. In areas of indurated sand it is likely that the water table is perched on the relatively low permeability indurated layers.

If boggy areas are to be filled, it is recommended that topsoil is stripped from the surface and a number of temporary shallow drains are excavated to allow the upper soil profile to be locally drained to facilitate the placement of engineered fill.

Where additional filling is not proposed, it may be necessary to carry out further investigations to better understand the cause of the high groundwater table and enable a localised subsurface drainage system to be installed.

Road pavements will require subsoil drainage and may also require localised subgrade replacement to facilitate pavement construction.

5.4 Excavatability and Use of Excavated Materials

It is expected that footing and trench excavations will generally be feasible using a 15t to 20t excavator. Some localised difficulties may be experienced depending on the degree of induration of the sand. Bulk excavations should be feasible using 15 to 20 tonne excavators or D6-D7 size tractors.

In many of the lower lying parts of the site, subsurface excavations will encounter the standing groundwater table at or close to the natural ground surface. Generally in the dunal areas, the standing groundwater was at depths of between 0.6m and 2.0m below the surface.

With the exception of organic rich topsoils, the excavated material types are considered to be suitable for use as engineered fill but the materials as excavated will require significant moisture conditioning to make then suitable for compaction. Due to the shallow groundwater table, the materials will be saturated and will need to be dried back to close to optimum moisture content prior to use as fill.

5.4 Stability

5.4.1 Slope Stability

The site is relatively level and is not susceptible to slope instability or subsidence due to slope instability.

5.4.2 Excavation Stability

Due to the presence of shallow groundwater and the sandy nature of the subsurface soils, excavations are likely to be unstable unless dewatering measures are implemented.

As a general guideline, temporary batters excavated in very loose to loose sand may be formed no steeper than 26° (1V:2H) for a vertical height no greater than 2.0m, provided that the sand has been effectively de-watered with no visible surface seepage. Temporary batters in medium dense sand may be formed no steeper than 33°(1V:1.5H) for a vertical height no greater than 2.0m, or no steeper than 26° (1V:2H) for a vertical height no greater than 3.0m, provided that the sand has been effectively de-watered with no visible surface seepage. If the excavated batters are to be subject to significant surcharge loads, site-specific geotechnical advice will be required.

5.4.3 Embankment Stability

There are no significant stability constraints on embankment filling due to the good foundation conditions.

As indicated in Section 5.1, several deep boreholes are recommended at design stage to confirm that there are no soft soils within the alluvial profile. In particular these boreholes should be targeted in low lying areas west of Belongil Creek and in the areas behind the dunal system. Special consideration should be given to the transition

between the aeolian dunal system and the alluvial sands where interfingering of materials may have occurred during successive flood depositions.

For and on behalf of

SHAW URQUHART PTY LTD

Philip Shaw

UNDERSTAND THE LIMITATIONS OF YOUR GEOTECHNICAL REPORT

shaw:urquhart

This report has been based on project details as provided to us at the time of the commission. It therefore applies only to the site investigated and to a specific set of project requirements as understood by Shaw:Urquhart.

If there are changes to the project, you need to advise us in order that the effect of the changes on the report recommendations can be adequately assessed. Shaw:Urquhart cannot take responsibility for problems that may occur due to project changes if they are not consulted.

It is important to remember that the subsurface conditions described in the report represent the state of the site at the time of investigation. Natural processes and the activities of man can result in changes to site conditions. For example, ground water levels can change or fill can be placed on a site after the investigation is completed. If there is a possibility that conditions may have changed with time, Shaw:Urquhart should be consulted to assess the impact on the recommendations of the report.

The site investigation only identifies the actual subsurface conditions at the location and time when the samples were taken. Geologists and engineers then extrapolate between the investigation points to provide an assumed three-dimensional picture of the site conditions. The report is based on the assumption that the site conditions as identified at the investigation locations are representative of the actual conditions throughout an area. This may not be the case and actual conditions may differ from those inferred to exist. This will not be known until construction has commenced. Your geotechnical report and the recommendations contained within it can therefore only be regarded as preliminary.

In the event that conditions encountered during construction are different to those described in the report, Shaw:Urquhart should be consulted immediately. Nothing can be done to change the actual site conditions which exist but steps can be taken to reduce the impact of unexpected conditions. For this reason, the services of Shaw:Urquhart should be retained through the development stage of a project.

Problems can occur when other design professionals misinterpret a report. To help avoid this, Shaw:Urquhart should be retained to work with other design professionals to explain the implications of the report.

This report should be retained as a complete document and should not be copied in part, divided or altered in any way.

It is recommended that Shaw:Urquhart is retained during the construction phase to confirm that conditions encountered are consistent with design assumptions. For example, this may involve assessment of bearing capacity for footings, stability of natural slopes or excavations or advice on temporary construction conditions.

This document has been produced to help all parties involved recognise their individual responsibilities.