BELL BAY PULP MILL PROJECT
PROPOSED PIPELINE
FOUR MILE BLUFF, GEORGETOWN

ONSHORE GEOTECHNICAL INVESTIGATION

For

Gunns Limited

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1.0 INTRODUCTION

At the request of Gunns Limited, BFP Consultants (BFP) has been commissioned to conduct an onshore geotechnical investigation for a proposed pipeline installation near Four Mile Bluff, Georgetown.

Pipeline Engineers for the shoreline crossing are Atteris Pty. Ltd.

1.1 Background

A scope of works and site plan with proposed borehole coordinates for the onshore geotechnical investigation, and a specification for the onshore core sampling and testing, were provided by Atteris.

2.0 STUDY METHODOLOGY

2.1 Objectives

This onshore geotechnical investigation has been conducted for the purposes of assessing the general subsurface conditions along the proposed pipeline alignment in order to determine the conditions for trenching and the feasibility for horizontal directional drilling (HDD) at the shoreline for an ocean outfall.

2.2 Scope of Work

The scope of work for the project involved the following:

- a desk study of relevant published and unpublished information,
- a walkover and visual examination of the site,
- a limited subsurface investigation comprising the drilling of 10 boreholes by use of a CMV Mk600 track mounted rig, a Scout rig mounted on a tracked Bombardier, and a Proline auger rig, and
- Laboratory testing of selected samples

3.0 DESK STUDY

3.2 Historical Review

A document search of the Mineral Resources Tasmania (MRT, formerly Tasmania Department of Mines) database revealed several studies pertaining to mineral sand, quarry and slope stability assessments within the vicinity of Georgetown Municipality. None of these studies were located within or in close proximity to the area being investigated.

Two other projects involving shore approaches utilising HDD have been undertaken in the area. These are the nearby Basslink electrical submarine supply cable and the Tasmanian Natural Gas Pipeline Project (TNGPP) at Five Mile Bluff further to the northeast. No details of the Basslink shore approach are available however a case study paper was published on the gas pipeline HDD landfall approach.

In brief, the TNGPP comprised the laying of a 355mm outside diameter pipeline between Victoria and Tasmania. The landfall approaches at both the Victorian and Tasmanian ends of the offshore pipeline were installed using HDD. On the nearby Tasmanian approach at Five Mile Bluff an 860 metre long 660 mm diameter hole was drilled. Difficulties were encountered during drilling, owing to the presence of highly fractured vesicular basalt rock and a gravel layer, inferred as a possible ancient river channel. The loss of drilling fluid circulation within the gravel layer caused the re-drilling of the original pilot hole at a greater depth, after several unsuccessful attempts at grouting the voids within the permeable gravels were made. The highly fractured vesicular basalt zones also required extensive grouting to fill the voids and re-establish drilling fluid returns.

4.0 FIELD INVESTIGATION

The field investigation was conducted on various days between 24 October and 22 November, 2005, and involved the drilling of 10 boreholes by CMV Mk600, Scout, and Proline auger rig. The boreholes were drilled to depths of between 1.3 and 31.1 metres. Standard Penetration Tests (SPT's) were conducted at regular intervals, with sampling of these soils being conducted for subsequent laboratory evaluation.

The results of the field tests are shown on the borehole logs presented in Appendix A, with the results of laboratory tests presented in Appendix B.

The borehole locations are shown in Figure 1. The coordinates of the boreholes were provided by the client and positioned on site by means of a hand held Global Positioning Satellite (GPS) receiver. Boreholes OP2 and OP3 were moved slightly due to drill rig and equipment access difficulties, and also to minimise disturbance of the coastal sand dune formations. The amended locations of the OP2 and OP3 are shown on Figure 1.

5.0 SITE CONDITIONS

5.1 Site Conditions - General

The proposed onshore pipeline alignment passes through rolling hills, coastal sand dunes and shoreline towards the southeast and east of Four Mile Bluff, Georgetown, as shown on figure 1.

The rolling hills are generally a series of ridge features aligned in a north south direction. The low-lying areas between the ridges become locally wet and waterlogged during and after periods of wet weather. A lagoon is located towards the south of the coastal sand dunes, between Boreholes OP3 and OP4. The coastal sand dunes are approximate 300 metres wide with a series of hollows that were observed to be waterlogged at the time of the investigation.

The fore dune along the beach has been eroded by wave action, forming a near vertical cliff face, as shown in Plate 1. Seepages through the sand dunes were observed along the beach.

5.2 Geology

The Mineral Resources Tasmania Geological Atlas, Beaconsfield sheet (scale 1:63,360), shows the site to be primarily located on Quaternary aged beach and active dune sand with the lower lying areas being sand, silt and clay with occasional gravel probably derived from Tertiary deposits. The Quaternary deposits are

underlain by Tertiary aged vesicular basalt, which is exposed at both Four and Five Mile Bluffs.

The subsurface conditions encountered in the boreholes are consistent with the geological mapping of the area, and generally comprised silty sand on the higher elevated sand dunes and ridge features, grading to sandy clay/clayey sand within the low lying areas, which in turn were underlain by basalt rock.

Boreholes OP1 to OP3 and OP5 were drilled using wash boring techniques, making it difficult to determine the presence of groundwater. The remaining boreholes were drilled by auger rig, and within all of these, except OP10, groundwater was observed at depths of between 0.8 and 2.4 metres.

6.0 DISCUSSION

6.1 General

We understand that a one metre diameter pipeline is required as an ocean outfall for the proposed Bell Bay Pulp Mill Project. The pipeline will be trenched for most of its length and has to cross the existing buried Basslink power cable and coastal dunes to a discharge location approximately 2.5 kilometres offshore.

6.2 Trenching

The boreholes indicated at least 3.0 metres of soil along the alignment, except in Boreholes OP8 and OP10 where auger refusal occurred on inferred cemented sands and rock at depths of 2.9 and 1.3 metres, respectively. Use of larger excavators or rock breaking equipment may therefore be required within the vicinity of these areas.

Groundwater maybe encountered within the low-lying areas of the site, possibly requiring dewatering and shoring to prevent collapse.

6.3 Horizontal Directional Drilling

6.3.1 General

For HDD installation the size of the hole is nominally 1.5 times the product pipe diameter. Therefore, a one metre diameter pipe will require a drilled hole diameter of about 1500 mm. The risks associated with HDD operations increase significantly with increasing diameter, and large diameter holes are generally only feasible over short distances due to the higher risk of hole collapse especially through cobble, boulder and gravel layers, and highly weathered rock formations.

6.3.2 Rock Mass Qualities

The cored boreholes revealed basalt rock with highly fractured vesicular layers. The most critical depth where highly fractured rock layers were encountered is at the soil/rock interface, where Rock Quality Designation (RQD) ranged between 0 and 50 for the upper 1.5 to 7 metres of rock. Borehole OP2, below the initial 1.5 metres of rock encountered highly fractured zones greater than I metre thick at depths between 11 and 12.5 metres, 16.8 and 18.2 metres, 22 and 28 metres, and between 29.8 and the borehole termination depth of 31.1 metres. Highly fractured rock was also encountered in the upper 7 metres of Borehole OP3, with thinner 0.2 to 0.6 metre thick highly fractured zones at depths of 18, 20, 20.6, 22.4, 26 and 28.6 metres.

An increase in fracturing of the rock mass leads to higher risks of hole collapse, loss of circulation, and therefore the potential for drilling tools becoming jammed downhole, possibly losing the drilled hole. Fractured rock can also be damaging to tooling as the drilling action may become more erratic compared to the smoother drilling of a uniform rock mass.

6.3.3 Frac-outs

A ‘frac-out’ is a term given when drilling fluid escapes to the surface and is common when drilling close to the surface where there are voids and extensive rock fractures. It is considered that the highly fractured and vesicular nature of the rock overlain by permeable sand layers would be conducive to frac-out.

The high volume and pressure required to clean out such a large diameter hole will also increase the risk of frac-out.

6.3.4 Rock Boulders, Cobbles and Gravel

The ideal soil conditions for HDD are stiff clays and silts. The increased porosity of coarse sands and gravel present less than ideal conditions, due to the risk of drilling fluid loss and hole collapse. Cobbles and boulders also increase the risk of downhole tooling becoming obstructed or stuck.

The previous gas pipeline project experienced fluid loss circulation problems through a gravel filled ancient river channel, which resulted in abandoning the drill hole and the subsequent re-drilling along an alternative alignment.

7.0 CONCLUSION

Based on the large diameter installation and the expected length of drill hole required under the sand dunes to a suitable exit location offshore, the diameter to length ratio for such an installation is on or beyond the envelope for known HDD projects within hard rock. A previous, smaller diameter installation encountered difficulties through the highly fractured and vesicular rock. The risk of failure while attempting a larger installation through these same conditions would be very high, if at all feasible, given current technology and experience.

REFERENCES

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