Dear Sir,

RE: Southwood Project – Geotechnical & Hydrogeological Investigation

Please find attached our report on the geotechnical and hydrogeological assessment of the proposed Southwood project development at a site near the confluence of the Arve and Huon rivers.

Please feel free to contact the undersigned if you have any queries on this report.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD

BARRY MCDOWELL
HOBART OFFICE MANAGER
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1. INTRODUCTION

1.1 General

This report describes the geotechnical investigations and hydrogeological investigations carried out for John Holland Pty Ltd (JH) on the proposed project located at the Southwood site, Huon, Tasmania.

Mr. Trevor Webster of JH commissioned Coffey Geosciences Pty Ltd (Coffey) to carry out the geotechnical investigation works for this project following acceptance of Coffey’s proposal ref Ho154/1-AB of 1 August 2002, based on the brief supplied by John Holland Development Investment Pty Ltd (JHDI).

It is understood that the project comprises the construction of the following main features:

- Power Station;
- Mechanising Yard;
- Veneer Mill and Saw Mill;
- Wood fibre Mill and Fuel processing; and
- Stromwater Pond 1

Coffey has undertaken a preliminary geotechnical assessment for this site and the information is presented in the report referenced HO53/1-AB, dated 23 August 2000. The findings of that report have been addressed as part of the evaluation carried out in this report.

An A1 sized contour plan of the site and proposed layout was provided by Forestry Tasmania for field use. Preliminary earthworks site plans and sections produced by GHD, were provided by JHDI in PDF format to assist in planning the field work and provide a base for geotechnical plans. Recent air photos (24/2/02) were sourced from Services Tasmania.

The development is expected to cover some 40ha area. Preliminary earthworks sections for the merchandising yard (GHD drawings 3210596-04 to –07) indicate cuts and fills up to 9m high, but typically 2 to 4m high.

1.2 Scope of Work

The purpose of this investigation, as described in the JHDI brief are to:

- Meet the relevant conditions set out in the development approval (Geo1, Geo2, GW1, part GW3, and GW4);
- Provide information to enable the economic design of the various structures on site.

The scope of work was limited by JH due to time constraints and site access issues prior to construction commencing. The scope is, however consistent with a staged approach appropriate to investigation and development of such a large site where final decisions on the exact location and nature of development have yet to be finalised. The scope of work adopted was as follows:

- 1 borehole to assess foundation conditions for potential pile or large scale footings at the power station site. To be converted to a temporary groundwater monitoring well (destroyed during construction of the power station) to satisfy GW4 and GEO1 assessment;
- 1 ‘deep’ groundwater monitoring well (to standard environmental protocols) to assess and monitor
groundwater conditions before and during construction and operation. Location to be confirmed with GHD and MRT;

- 1 borehole completed as a groundwater monitoring well (replaces the original probe hole in JH brief) to be located immediately down gradient of the proposed stormwater storage dam (as shown on current drawings) to assess groundwater conditions on the up slope part of the site and allow monitoring down gradient of the storage dam during operations;

- 4 test pits across the proposed mill sites to assess foundation bearing capacities;

- 3 pits to obtain CBR samples from the sub grade depth (to be confirmed) for proposed hardstand areas (pavement design can be provided by Coffey if required);

- Clay borrow assessment by test pitting in areas identified by the walkover;

- Laboratory testing of clay borrow materials to assess suitability in terms of DPIWE guidelines and relevant national standards;

- Laboratory testing of subgrade samples to assess CBR characteristics;

- Development, permeability testing and sampling of groundwater monitoring wells;

- Reporting of geotechnical findings and recommendations for bearing capacities, cut and fill batter angles, foundation concepts, pond concepts and any further work required to achieve detailed design;

- Assessment of hydrogeological conditions on the site, development of a conceptual model for input to an impact risk assessment by GHD (water quality data will not be available in time to incorporate in a draft report).

2. FIELD WORK

2.1 General

The field work consisted of:

- Drilling three boreholes (SMB1, SMB2 and SMB3) using a truck-mounted drill rig at the locations shown on Figure 1, to a maximum depth of 31.5 metres (BH1). Locations were limited by the inability to access areas away from established roads and formed tracks. Logging of the materials penetrated was undertaken during drilling, followed by installation of groundwater monitoring wells in the three boreholes for water sampling. Development, purging, sampling and permeability testing of the monitoring wells was also conducted (see Section 2.2);

- Excavation of 13 test pits using a 20t excavator at the locations shown on Figure 1, to a maximum depth of 6.7 metres (TP1). Logging, soil sampling and observations of groundwater conditions were carried out during excavation. Some of these test pits were excavated to recover samples for CBR and associated testing (STP2, STP3 & STP13), while STP1, STP4, STP5, STP7 and STP8 are “foundation” pits for the assessment of the soils at the formation levels of proposed building. Test pits STP6, and STP9 to STP12 were excavated at the north western corner of the development site investigating the presence of clayey materials for construction of a dam, intended to be located in that vicinity.
Geological and geomorphological observations from site walkovers, and office based assessment of air photos.

The three boreholes were planned to intersect varying underlying geological conditions, due to proposed drill depths and location within the Southwood site. Unforeseen conditions present in SMB1 resulted in extension of the borehole some 20m beyond the proposed target depth to establish bedrock. Easy washbore drilling in silt, sand and clay layers, with only 2 recognised gravel/ cobble horizons, persisted to a depth of 27.2 metres, before any rock core was recoverable. The conditions encountered in this borehole extended the total drill metres for the project, and the total drilling program by 1.5 days.

The other two boreholes (SMB2 and SMB3) did not encounter hard rock that could deliver a core sample. SPT tests were carried out within clay layers in these boreholes.

The borehole drilling and excavation of the test pits were carried out in the period 12 to 15 August 2002. Site walkovers were undertaken on 8 August and 27 August 2002, with bore permeability testing conducted on 20 August 2002.

The engineering logs and photos of boreholes and test pits are presented in Appendix A, together with explanation sheets defining the terms and symbols used in their preparation. Monitoring well details and falling head permeability testing records are presented in Appendix B.

The test pits have been located by hand held GPS and map estimates. Forestry Tasmania personnel surveyed the locations of the boreholes.

### 2.2 Monitoring Well Installation

Three ground water monitoring wells were installed in boreholes drilled between the 12th and 15th August. The wells are designated SMB1, SMB2 and SMB3 (see Figure 1).

All wells were constructed using machine slotted 3m PVC screen at the base of the hole and screw-jointed PVC casing to surface. Graded sand was used to backfill the boreholes around each monitoring well, with 0.5m of bentonite and 0.5m concrete comprising the final 1m below surface. All wells were completed with 100mm PVC casing covers and caps, standing approximately 1m above ground surface.

Soil and rock types encountered during drilling of the wells were described in the field and logs of boreholes are provided in Appendix A.

#### 2.2.1 Well Development

Wells were developed on completion of each borehole. SMB1 failed to record a standing water level once installation was complete. Development of SMB2 and SMB3 continued until the bulk of drilling fines had been removed, or the water level was reduced to the base of the well.

A summary of conditions for each groundwater well is provided in Table 1.

#### 2.2.2 Bore Survey

The completed monitoring wells (SMB1, SMB2 and SMB3) were surveyed to establish their respective locations and elevation. Survey locations were conducted by Forestry Tasmania and are presented on the logs in Appendix B.
2.2.3 Groundwater Sampling

Groundwater sampling was conducted by a Coffey scientist on 15th August 2002. Samples were taken to establish baseline information for the long-term monitoring of water quality. Prior to sampling, the water level at each bore was recorded and then each well was purged to standard environmental protocols, i.e. between 3 and 5 bore volumes were removed and field water quality parameters (pH, EC and temperature) were measured prior to sampling.

Groundwater samples were recovered from two of the three wells SMB2 and SMB3; with samples retaining the borehole nomenclature. Samples were decanted immediately into appropriate sample containers, then placed in eskies with ice, and dispatched to the designated laboratory (WSL) using standard environmental sample handling and chain of custody protocols.

All work was conducted in general accordance with standard Coffey environmental protocols with respect to sampling procedures.

Table 1: Summary of Monitoring Bore

<table>
<thead>
<tr>
<th>Bore No.</th>
<th>Construction &amp; Monitoring Date</th>
<th>Drill Depth</th>
<th>Screen Interval</th>
<th>Geology of the screened interval</th>
<th>Measured depth from water to top of PVC</th>
<th>Stick up of PVC</th>
<th>RL of natural surface</th>
<th>pH</th>
<th>EC (dS/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMB1</td>
<td>14/08/02</td>
<td>31.5m</td>
<td>5.11-8.11m</td>
<td>Silty Sand</td>
<td>Dry well*</td>
<td>0.6m</td>
<td>103.55</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>SMB2</td>
<td>14/08/02</td>
<td>10.8m</td>
<td>6.85-9.85m</td>
<td>Silty Clay</td>
<td>3.42m</td>
<td>0.95m</td>
<td>93.68</td>
<td>3.89</td>
<td>0.08</td>
</tr>
<tr>
<td>SMB3</td>
<td>15/08/02</td>
<td>6.5m</td>
<td>3.7-6.7m</td>
<td>Sandy Clay</td>
<td>2.99m</td>
<td>0.55m</td>
<td>5.15</td>
<td>0.21</td>
<td></td>
</tr>
</tbody>
</table>

* Borehole water level measured at 16.5m when borehole depth at 31.5m. Well installed as temporary monitoring point to assess perched groundwater within influence of the development.

3. LABORATORY WORK

3.1 Geotechnical

For the test pits located at the footprints of the proposed structures, a set of CBR, Standard Compaction and Atterberg Limits testing was undertaken on three samples recovered from test pits STP2, STP3 and STP13, to assess the soil subgrade for design of pavements in the merchandising yard and access roads. In addition, two samples were selected from test pits STP6 and STP11 for laboratory permeability, Standard Compaction and Atterberg Limits testing to assess the properties of the soils and weathered rock for possible use as clay liner for proposed dams on the site.

Samples collected during previous fieldwork by GHD (Sample 1, MY1 and MY2) and tested by Coffey, are included in this report for completeness. The results of the laboratory testing are summarised in Table 2 and presented in Appendix C.
Table 2 Summary of Geotechnical Laboratory Test Results

<table>
<thead>
<tr>
<th>Test Pit Location</th>
<th>Sample Depth</th>
<th>Atterberg Limits</th>
<th>Std Compaction</th>
<th>CBR</th>
<th>Permeability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PI (%)</td>
<td>LL (%)</td>
<td>Linear Shrink (%)</td>
<td>Max Dry Density (t/m³)</td>
</tr>
<tr>
<td>STP2</td>
<td>2.0-2.5m</td>
<td>10</td>
<td>35</td>
<td>6.5</td>
<td>1.64</td>
</tr>
<tr>
<td>STP3</td>
<td>2.0-2.5m</td>
<td>18</td>
<td>36</td>
<td>7.5</td>
<td>1.90</td>
</tr>
<tr>
<td>STP13</td>
<td>1.0-1.5m</td>
<td>6</td>
<td>27</td>
<td>3</td>
<td>1.73</td>
</tr>
<tr>
<td>STP6</td>
<td>0.4-1.2m</td>
<td>26</td>
<td>55</td>
<td>10.5</td>
<td>1.44</td>
</tr>
<tr>
<td>STP11</td>
<td>0.4-1.2m</td>
<td>15</td>
<td>37</td>
<td>7.5</td>
<td>1.44</td>
</tr>
<tr>
<td>Sample#1 (existing gravel pit)</td>
<td>Surface</td>
<td>NP</td>
<td>NP</td>
<td>0</td>
<td>1.97</td>
</tr>
<tr>
<td>MPY1</td>
<td>0.5-1.0m</td>
<td>9</td>
<td>28</td>
<td>6</td>
<td>1.71</td>
</tr>
<tr>
<td>MPY2</td>
<td>&gt;0.5m</td>
<td>11</td>
<td>37</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

*compacted sample tested at MDD and OMC.

3.2 Water Quality

Water testing was undertaken on samples recovered from two of the three monitoring boreholes and sent to WSL laboratories in Melbourne, where the following tests were performed:

- Aromatic hydrocarbons (2 tests)
- TPH (2 tests)
- Total N (2 tests)
- Total P (2 tests)
- Anions content (Cl, PO4, SO4, CO3, HCO3) (2 tests)
- Cations content (Ca, Mg, Na, K, Al) (2 tests), and
- Faecal Coliforms & Streptococci (2 tests)

3.2.1 Groundwater Analytical Results

The analytical results are summarised in Table 3 and presented in Appendix D.
Table 3 Summary of Groundwater Analytical Results

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Monitoring Bore SMB2</th>
<th>Monitoring Bore SMB3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faecal Coliforms</td>
<td>Absent</td>
<td>Detected</td>
</tr>
<tr>
<td>Faecal Strep.</td>
<td>Low levels present</td>
<td>Low levels present</td>
</tr>
<tr>
<td>Total N (mg/L)</td>
<td>2.5</td>
<td>3.9</td>
</tr>
<tr>
<td>Total P (mg/L)</td>
<td>0.21</td>
<td>0.52</td>
</tr>
<tr>
<td>Aromatic Hydrocarbons (mg/L)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>TPH (mg/L)</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
</tbody>
</table>

Note: details of anions and cations are provided in the laboratory reports.

4. SITE CONDITIONS

4.1 Location & Existing Developments

The proposed development site occupies an area of about 40ha and is situated on a broad ridge, trending roughly north-south, bordered on 3 sides (west, south, east) by an incised meander of the Huon River, where the Arve River flows into the Huon.

Existing site development consists of the recently constructed Geeveston/Judbury Road, bridge over the Huon River, forestry tracks, as well as other excavated flat areas.

4.2 Geology

The Geological Atlas 1:250,000 digital series Geology of Southeast Tasmania produced by Mineral Resources Tasmania (1999 edition) indicates that the proposed development site is underlain by Permian Age siltstone and sandstone deposits.

Further geology and geomorphology information can be found in the report titled “Geomorphic Values Survey: Barnbuback Block, Huon Forest District prepared by Mr. C Sharples for Forestry Tasmania (Huon Forest District).” This report indicates that the area is underlain by Permian marine siltstone and sandstone bedrock, with an erosion remnant of Quaternary glacio-fluvial material forming a ‘cap’ on the top of the high level terrace at the site.

Observations for this study include the following:

- Bedrock comprising Permian siltstone, mudstone and some sandstone beds exposed in road cuttings (see Figure 2) and sub crop around the site. Highly weathered, low to medium strength, bedding dip approximately 5° towards the SW (with potential for minor variations), sub vertical joint sets striking NWSE and NE-SW, and sub vertical shear/fault zones (containing altered and weathered material) striking approximately N-S;

- Quaternary glacio-fluvial alluvium, exposed in road cuts across the site, comprising Silty Sand,
Sandy Clay and Silt with varying proportions of generally matrix supported, rounded gravel and cobbles (10 to 40%), and some Sandy Gravel lenses (clast supported). Sand and silt are generally fine grained, with low to medium plasticity clay and silt.

4.3 Geomorphology

4.3.1 General

The site is located on the crest and side slopes of a broad ridge with gentle upper slopes of approximately 5 to 10°, side slopes in the range of 10 to 20°, and locally 25 to 30° at the toe beside the Huon River (see Figure 2). The morphology is that of a remnant alluvial aggradation terrace at approximately RL100 to 106m that has been dissected by erosion of the Huon River (current approximate RL 40m) to produce lower degradation terraces and isolated remnants of alluvium (see Figures 2 to 4). Gullies and stream courses dissect the side slopes of the ridge, with head slopes in the region of 30°; discharge to the relatively narrow (<20m) modern floodplain of the Huon River. The Weld Plains to the west of the site represent a lower level (approximately RL 50m) alluvial terrace system that has also been mapped further downstream of this location.

Active natural erosion was not evident on any of the side slopes, which are blanketed with thick vegetation comprising button grass and heath on the terrace remnants and eucalypt forest on the slopes. The vegetation distribution reflects surface soil development, with a generally poorly drained peat sward occurring on the terrace remnants, and clay/silt colluvial soils developed over bedrock on side slopes.

Specific zones of groundwater seepage on side slopes were not observed during site walkovers due to the masking effects of persistent wet weather in recent months. However seepage is indicated towards the base of the alluvial terrace remnants and on the steeper lower bedrock slopes above the Weld Plains and the recent Huon River flood plain.

4.3.2 Landslides and Slope Stability

The previous work undertaken by Coffey (report ref HO53/1-AB, dated August 2000) had described a possible ancient landslide in bedrock on the side slopes at the SW end of the site (below the proposed power station and water pond). The geomorphology of this feature and 2 other possible large landslide features were confirmed by an overview of topographic maps and air photos for this study. The 3 possible landslide features are marked A, B and C on Figure 2.

A site walkover of the features has not revealed any field evidence to support the existence of landslides. If these features are landslides they are ancient failures that occurred in bedrock at a critical point in the down cutting of the Huon River, possibly several thousand years ago during rapid climate change at the end of the last glacial period.

Due to the age of features A, B and C, the degree of erosion and degradation, the absence of any evidence for recent or ongoing instability and the proposed location of development at least 50 to 100m from the crest of these features it is assessed that they do not pose a threat to site development.

Evidence of small scale recent and active slope instability, including in the heads of gullies, is absent. Soil creep is occurring on the bedrock and colluvium slopes along the Huon River, and there is potential for undercutting and local failures on these slopes. It is assessed that such failures would be very unlikely to undercut or other wise affect the main upper terrace area.
### 4.4 Sub Surface Conditions

The information on sub surface conditions inferred from the test pits, boreholes and mapping observations that are to be encountered in the 2 main development areas is summarised in Tables 4 and 5 below. Natural scale cross sections presented in Figures 3 and 4 depict the main geological units, observed groundwater levels and extrapolated indicative bedrock structure.

**Table 4: Southern Area, Main High terrace, Power station, Fuel storage, Merchandising Yard**

<table>
<thead>
<tr>
<th>Geotechnical Unit</th>
<th>Thickness, m</th>
<th>Typical depth, m</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topsoil – Peat sward</td>
<td>0.2-0.5</td>
<td>0.3</td>
<td>Root zone &amp; peat, generally wet, restricted drainage due to underlying coffee rock layer.</td>
</tr>
<tr>
<td>White Sand/Silt, or</td>
<td>0.3-0.4</td>
<td>0.6</td>
<td>STP1, STP3 &amp; STP13; typically non-plastic silts and in a very loose state</td>
</tr>
<tr>
<td>Natural Clays</td>
<td>0.3-0.5</td>
<td>0.5</td>
<td>Occurs occasionally on the high level terrace in place of the white sand and coffee rock (e.g. STP1), typical pocket penetrometer tests range 170-300 kPa</td>
</tr>
<tr>
<td>Organic/Fe layer, partially cemented (‘coffee rock’)</td>
<td>0.05-0.2</td>
<td>0.7</td>
<td>Underlying the white sand silt layer (e.g. STP3 &amp; STP13)</td>
</tr>
<tr>
<td>Alluvium (Glacio-fluvial)</td>
<td>5 to 25</td>
<td>6 to 26</td>
<td>Approx base RL 80m in the east to 90-100m in the west</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sand, silt and clay, fine grained, low to medium plasticity, with some gravel to gravelly. Some zones or lenses of sandy gravel (e.g. gravel pit in the NE of the terrace), medium dense to dense; soil matrix generally returned pocket penetrometer values of 300 to 600 kPa. Excavated in all test pits on the main terrace, except TP10 which encountered bedrock at 1m depth on the terrace margin.</td>
</tr>
<tr>
<td>Residual soils</td>
<td>0.5 to 2</td>
<td>6 to 28</td>
<td>1.5m of black high plasticity clay intercepted in SMB1, possible weathered carbonaceous mudstone or organic soil at the base of the alluvium?</td>
</tr>
<tr>
<td>Bedrock</td>
<td></td>
<td></td>
<td>Siltstone, mudstone and sandstone, extremely to highly weathered and very low to low strength for in the upper 1 to 5m (depending on lithology and presence of steep shear zones). The 50% core recovery from 27.2 to 31.5m in SMB1 was extremely weathered, and fractured.</td>
</tr>
</tbody>
</table>
Table 5 North West Area, Bedrock Slopes, Veneer Mill, Saw Mill, Woodfibre Mill & Dry Mill

<table>
<thead>
<tr>
<th>Ground Unit</th>
<th>Thickness, m</th>
<th>Typical depth, m</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topsoil</td>
<td>0.05-0.5</td>
<td>0.3</td>
<td>Silt/Clay soil with root zone &amp; peat, generally wet</td>
</tr>
<tr>
<td></td>
<td>0.4-0.7</td>
<td>0.9</td>
<td>Typically clayey silts and sandy silts (uncovered at STP4 to STP12 inclusive). The residual cohesive soils were typically stiff, but occasionally firm, while the non plastic soils ranged from loose to dense</td>
</tr>
<tr>
<td>Residual soils</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedrock</td>
<td>Extremely weathered approx 0.5-2</td>
<td>Extremely weathered 2-3</td>
<td>Siltstone and sandstone, extremely to highly weathered, very low to low strength (rock ripper used from 0.5m depth at STP4, 2.2m at STP5 &amp; from 2.6m at STP7). Steeply joints dipping to wards the west noted in some test pits.</td>
</tr>
</tbody>
</table>

4.5 Groundwater

Surface water and saturated topsoil conditions were prevalent at the time of the field work for this study. Ponded water in the soils on the main terrace and other remnants suggest that the drainage of the soil is impeded by the development of a thin partly cemented 'coffee rock' layer at about 1m depth.

The test pits generally did not encounter ground water, with the exception of the north-western corner of the site were some seepage was encountered in three of the test pits, as follows: STP6 (seepage from the southern side at 1.8m depth), STP10 (seepage at the northern corner at 0.9m depth), and STP12 (seepage at the southern side at 1.6m depth). This is the location of the proposed stormwater dam.

Standing water levels within two monitoring wells SMB2 and SMB3 were measured at 2.43m and 2.44m below ground level respectively. These water levels represent shallow groundwater within sandy aquifers overlying clayey alluvium. The monitoring well SMB1 is dry indicating that there is no perched aquifer at this location beneath the topsoil on the main terrace. The standing water level measured in the borehole before installing the well was 16.5m(with the hole collapsed back to 25m from 31m), suggesting that the silty sand and sandy clay materials are vertically well drained.

The results of hydraulic tests conducted in the monitoring wells (presented in Appendix B) indicate permeabilities in the order of $10^1$ to $10^2$ m/day for the perched sandy aquifers and approximately $10^3$ m/day for the unsaturated silty sand materials in SMB1.

A conceptual model for the groundwater system based on site observations and investigations is presented in Figure 5. This model is considered appropriate for developing a groundwater impact risk assessment and using as the basis for establishing a long term groundwater monitoring network at the site, once development locations are finalised and access is available to suitable monitoring sites.
The major groundwater implication for development is that site earthworks that strip the upper layers of alluvium will be exposing the deeper alluvial aquifer to direct infiltration from site activities.

5. DISCUSSION AND RECOMMENDATIONS

5.1 Slope Stability

Natural slope stability is not considered to be a significant risk to the development provided standoffs of 100m from the potential ancient landslide features (Figure 2) and the crests of side slopes steeper than 20° are maintained. Any structures that are required inside the stand off zone will need a specific investigation to assess local subsurface conditions and risk of slope instability.

5.2 Earthworks for the Merchandising Yard

Site development will involve cuts up to 8 metres (as shown on Drawing 3210596-04, CH 100 at the location of the power station), and fills of up to about 7 metres (see CH 200 through the Fuel processing unit).

Excavation using ordinary earthworks machinery should be capable of excavating to the required foundation level, although ripping may be required on the western limit of the yard if siltstone and sandstone bedrock is encountered (will depend on final subgrade levels). The excavated materials should be suitable for usage to build up the formation levels for the foundations of the structures.

The general procedure recommended for engineered fill under roads and structures are as follows:

- Strip all existing fill, topsoil to spoil or stockpile for re-use as landscaping material only.
- Compact the exposed surface (upper 150mm) to a dry density ratio of 98% Standard Compaction (AS1289 54.1-1993). In any area where the above level of compaction cannot be achieved, excavate to a depth of 0.3 meters and fill with clean granular fill and compact as specified above.
- Place and compact clean fill in 150mm thick (compacted) layers to 95% Standard under roads and to 98% Standard under buildings and hard stand areas.
- The upper 150mm beneath road pavements should be compacted to 98% Standard Compaction.

Clay fill should be placed within +/- 2% of Standard Optimum Moisture Content. Where fill consists of clean sand and gravel, then it shall be compacted to a minimum 80% Density Index (AS1289 56.1-1993).

Where fill is placed on slopes in excess of 1V:8H (7°), a prepared surface should be bench/stepped into the natural slope. Proper sub-surface drainage should be provided beneath the new fill, as appropriate.

Based on the laboratory test results a subgrade CBR of 10 is recommended for the merchandising yard area.

5.3 Cut and Fill Batter Stability

Excavated slopes, not exceeding 8 metres height in natural ground areas should be constructed no steeper than the following:

- 1V: 2H in alluvium, colluvium and residual soil;
- 1V:1.5H in extremely weathered rock;
- 1V:0.5H in highly weathered to fresh, sub-horizontally bedded rock.

Fill slopes constructed under engineering control should not be steeper than 1V:2H.
For all slopes:

- slope drainage should consist of catch drains
- erosion protection should be provided.

Support by retaining wall or specific investigation and design of slopes will be required if steeper slopes than those indicated above are required.

5.4 Foundations Of Structures

5.4.1 Shallow Foundations

Provided that the earthworks are undertaken in accordance with AS AS3798 "Guidelines on Earthworks for Commercial and Residential Developments", and the recommendations in Section 5.3, an allowable bearing capacity of 100 kPa should be available for the design of the foundations of new structures on fill.

Consideration should be given to the potential for differential settlement of foundations constructed partially on natural ground and partially on fill. Piled foundations for footings and slabs on fill may be appropriate for settlement sensitive structures.

Subject to inspection of all footings by a suitably qualified and experienced geotechnical engineer at the time of the foundation excavations, an allowable bearing capacity of 200 kPa should be available on alluvium and residual soils.

Shallow footings on weathered rock may have an allowable bearing capacity of 1000kPa, subject to inspection of all footings by a suitably qualified and experienced geotechnical engineer.

5.4.2 Deep Foundations

Piled foundations for heavily loaded structures on alluvium could include driven or bored piles. Preliminary estimates of allowable capacity are as follows:

- Driven or bored piles in very stiff clay, shaft resistance 20 to 25kPa;
- Driven piles in granular soils, shaft resistance 20kPa;
- Bored piles in granular soils, shaft resistance 10kPa;
- Driven piles end bearing capacity on extremely to highly weathered rock, 1000kPa;
- Bored piles end bearing capacity on extremely to highly weathered rock, 500kPa.

Note that large diameter bored piles may have advantages in terms of capacity achieved through large shaft surface area and stiffness of the pile for sensitive structures. Depending on the sensitivity of structures to settlement piles may have to be taken to rock. Further investigation will be required to assess site conditions sufficiently for detailed design and costing of foundations.

5.5 ‘Clay’ Liner for Dams

Samples collected from residual soil and weathered rock in the NW area of the site are considered suitable for use as low permeability liner materials. The low plasticity, observed field moisture contents and compacted permeability values of $1 \times 10^{-8}$ to $3 \times 10^{-9}$ m/s indicate that design requirements required in the development approval can be achieved. Borrow would involve stripping of approximately 0.3m of top soil followed by excavation of 1 to 2m of suitable material. Further assessment and testing will be required when a clay borrow
area is finalised to ensure that the overall (bulk) natural properties will be suitable.

5.6 Construction Monitoring of Merchandising Yard

Variations in ground conditions may occur between test locations. If conditions other than those described are encountered, further advice should be sought without delay.

During excavation, site visits should be made by a Geotechnical Engineer or Engineering Geologist to ensure that the uncovered ground conditions are as those anticipated during the site investigation stage.

During the field compaction of the fill materials, layer thickness and coverages by the compactor should be carefully controlled and density in places and compaction tests taken as required for the relevant level of fill construction.

5.7 Further Investigations

Additional investigations will be required at the location of all structures to assess specific footing and foundation conditions. This work should be conducted in conjunction with detailed design studies when the location of structures has been finalised. The power station site in particular will require investigation to establish the parameters for the design of piled foundations. We recommend that at least 3 boreholes will need to be drilled to rock, with Standard Penetration Tests undertaken at 1.5 metre intervals. Coring of the rock should be conducted for at least 3m in at least 2 of the boreholes.

Further investigation and laboratory testing is also recommended on the foundations of and the materials to be used for the dam construction.

Establishment of a long term groundwater monitoring well system will be required once the location of structures is finalised and access is available to suitable long term monitoring sites. The long term monitoring system will need to be designed to allow monitoring of the major aquifer systems and associated contamination pathways identified in the conceptual groundwater model. At this stage we would envisage an additional 3 or 4 wells.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD
APPENDIX A

Engineering Logs of Boreholes and Test Pits
APPENDIX B

Monitoring Bore Permeability Test Results
APPENDIX C

Laboratory Test Results – Soil
APPENDIX D

Laboratory Test Results – Groundwater
**Engineering Log - Borehole**

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Borehole Location:** See Figure 1, TBA

<table>
<thead>
<tr>
<th>method</th>
<th>penetration</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>material</th>
<th>consistency/density index</th>
<th>classification symbols and soil description</th>
<th>structural notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>auger screwing*</td>
<td>T timbering N nil</td>
<td>U&lt;sub&gt;u&lt;/sub&gt;- undisturbed sample</td>
<td>sand type: plasticity or particle characteristics, colour, secondary and minor components.</td>
<td>VS - very soft</td>
<td>based on unified classification system</td>
<td></td>
</tr>
<tr>
<td>AD</td>
<td>auger drilling*</td>
<td>C casing</td>
<td>D disturbed sample</td>
<td>NS - standard penetration test (SPT)</td>
<td>S - soft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>roller/tccone</td>
<td>N nil</td>
<td>N' - SPT - sample recovered</td>
<td>NC - SPT with solid cone</td>
<td>F - firm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>washbore</td>
<td>C casing</td>
<td>V - vane shear (kPa)</td>
<td>V - vane shear (kPa)</td>
<td>St - stiff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HA</td>
<td>hand auger</td>
<td>C casing</td>
<td>P - pressure meter</td>
<td>P - pressure meter</td>
<td>H - hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DT</td>
<td>diatube</td>
<td>C casing</td>
<td>Bs - bulk sample</td>
<td>Bs - bulk sample</td>
<td>Fb - friable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>V bit</td>
<td>C casing</td>
<td>R - refusal</td>
<td>R - refusal</td>
<td>VL - very loose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>V bit</td>
<td>C casing</td>
<td>M - moist</td>
<td>M - moist</td>
<td>L - loose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>TC bit</td>
<td>C casing</td>
<td>W - wet</td>
<td>W - wet</td>
<td>D - dense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>TC bit</td>
<td>C casing</td>
<td>Wp - plastic limit</td>
<td>Wp - plastic limit</td>
<td>D - dense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>TC bit</td>
<td>C casing</td>
<td>WI - liquid limit</td>
<td>WI - liquid limit</td>
<td>D - dense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>TC bit</td>
<td>C casing</td>
<td>MD - medium dense</td>
<td>MD - medium dense</td>
<td>VD - very dense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>TC bit</td>
<td>C casing</td>
<td>D - dense</td>
<td>D - dense</td>
<td>VD - very dense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>TC bit</td>
<td>C casing</td>
<td>VD - very dense</td>
<td>VD - very dense</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*bit shown by suffix e.g. ADT

**Soils:**
- CL: Silty clay, medium plasticity, some gravel and cobbles, rounded
- SILT CL: medium plasticity, some gravel and cobbles, rounded
- SANDY SILT: low plasticity, some clay, quartz chips
- SILTY SAND: quartz sand particles, white, some to trace gravel and cobbles

**Drilling Information:**
- Most fines washed out with bore water, minor sandy residue around collar, easy drill to 11.6m

**Additional Observations:**
- No resistance ranging to refusal

**Structure and Additional Observations:**
- Allochton

**Revision A**
**Engineering Log - Borehole**

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Borehole Location:** See Figure 1, TBA

**Borehole No.: SMB1**  
**Date started:** 12.8.2002  
**Date completed:** 14.8.2002  
**Logged by:** AGG  
**Checked by:** BMcD

**Drilling Information**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Notes, Samples, Tests</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td></td>
<td>SM SILTY SAND: quartz sand particles, white, some to trace gravel and cobbles (continued)</td>
</tr>
<tr>
<td>12</td>
<td>Core Borehole, Clay with some quartzite gravel and cobbles. Recovery &lt;20%</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>SANDY CLAY: medium plasticity, medium density, pink</td>
<td></td>
</tr>
</tbody>
</table>

**Material Substance**

- Soil type: plasticity or particle characteristics, colour, secondary and minor components.
- Consistency/density index:
  - S: soft
  - F: firm
  - St: stiff
  - H: hard
  - L: loose
  - M: moist
  - V: wet
  - Wp: plastic limit
  - WI: liquid limit
  - MD: medium dense
  - D: dense
  - VD: very dense

**Additional Observations**

- SPT - sample recovered
- SPT with solid cone
- Vane shear (kPa)
- Pressure meter
- Bulk sample
- Refusal

- Water inflow
- Water outflow

- No resistance
- No resistance ranging to refusal

**Graphic Log**

- Drill model and mounting:
  - Hole diameter: 100mm

**Revision A**

Additional drilling information and details are documented in the graphic log and tables, which provide a comprehensive overview of the borehole's characteristics and drilling progress.
### Engineering Log - Borehole

#### Client: John Holland Pty Ltd

#### Principal: John Holland Development & Investment Pty Ltd

#### Project: Southwood Project

#### Borehole Location: See Figure 1, TBA

#### Drilling Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Support</th>
<th>Notes, Samples, Tests</th>
<th>Material Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>N nil</td>
<td>undisturbed</td>
<td>SANDY CLAY: medium plasticity, medium density, pink (continued)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Silt</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Possible Gravelly Sand layer, CLAYEY SAND: fine, harder, some quartz cobbles</td>
</tr>
<tr>
<td></td>
<td>C casing</td>
<td></td>
<td>SANDY CLAY: medium plasticity, brown, quartz and some gravel/cobbles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SILTY SAND: fine, brown, with some clay, some gravel/cobble layers</td>
</tr>
</tbody>
</table>

#### Additional Observations

- Slope: -90°
- R.L. Surface: TBA m
- Datum: 0 m

#### Material Substance

- **Water Inflow:**
  - 10/98 water level on date shown
  - Water inflow

#### Method and Support

- **AS:** Auger Screwing
- **AD:** Auger Drilling
- **RR:** Roll/Tricone
- **W:** Washbore
- **HA:** Hand Auger
- **GT:** Cable Tool
- **B:** Blank Bit
- **V:** V Bit
- **T:** TC Bit
- **e.g.:** ADT

#### Notes, Samples, Tests

- **U:** Undisturbed Sample
- **D:** Disturbed Sample
- **S:** Standard Penetration Test (SPT)
- **V:** Vane Shear (kPa)
- **P:** Pressure Meter
- **B:** Bulk Sample
- **R:** Refusal

#### Classification Symbols and Soil Description

- **Moisture:**
  - D: Dry
  - M: Moist
  - W: Wet
- **Plasticity:**
  - V: Very Soft
  - S: Soft
  - F: Firm
  - St: Stiff
  - H: Hard
  - Fb: Frible
  - VL: Very Loose
  - L: Loose
- **Density:**
  - D: Dense
  - MD: Medium Dense
  - D: Dense
  - VD: Very Dense

#### Consistency/Density Index

- **VS:** Very Soft
- **S:** Soft
- **F:** Firm
- **St:** Stiff
- **H:** Hard
- **Fb:** Frible
- **VL:** Very Loose
- **L:** Loose
- **D:** Dense
- **MD:** Medium Dense
- **VD:** Very Dense

#### Drilling Information

- **Borehole No.:** SMB1
- **Date Started:** 12.8.2002
- **Date Completed:** 14.8.2002
- **Logged By:** AGG
- **Checked By:** BMcD

#### Revision A
### Engineering Log - Borehole

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project

**Borehole Location:** See Figure 1, TBA

<table>
<thead>
<tr>
<th>Drilling Information</th>
<th>Material Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>method</td>
<td>penetration</td>
</tr>
<tr>
<td>W</td>
<td>auger screwing*</td>
</tr>
<tr>
<td>AD</td>
<td>auger drilling*</td>
</tr>
<tr>
<td>RR</td>
<td>roller/tricone</td>
</tr>
<tr>
<td>W</td>
<td>washbore</td>
</tr>
<tr>
<td>HA</td>
<td>hand auger</td>
</tr>
<tr>
<td>DT</td>
<td>diatube</td>
</tr>
<tr>
<td>B</td>
<td>blank bit</td>
</tr>
<tr>
<td>V</td>
<td>V bit</td>
</tr>
<tr>
<td>T</td>
<td>TC bit</td>
</tr>
<tr>
<td>*bit shown by suffix</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**  
1. Water inflow  
2. Water outflow  
3. 10/1/98 water level on date shown  
4. 10/1/98 water level on date shown  

**Consistency/density index**  
- V5: very soft  
- S: soft  
- F: firm  
- St: stiff  
- VSB: very stiff  
- H: hard  
- Fb: friable  
- very loose  
- L: loose  
- MD: medium dense  
- D: dense  
- VD: very dense

**Material Substance:**  
- **Silty Sand:**  
  - Black, some clay  
- **Clay:**  
  - High plasticity, black, weathered carbonateous mudstone? or organic soil?

**Additional Observations:**  
- Residual EW rock

**Borehole SMB1 continued as cored hole**

---

**Revision A**
<table>
<thead>
<tr>
<th>Material</th>
<th>Estimated Strength</th>
<th>Rock Mass Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>SILTSTONE</em>: medium to high, black, highly weathered, moderately fractured &lt;50mm core pieces</td>
<td><strong>27.8-29.4m</strong></td>
<td>Core Loss 27.8-29.4m</td>
</tr>
<tr>
<td><em>SILTSTONE</em>: extremely weathered, intense fracturing &lt;50mm core pieces, clay along structures</td>
<td><strong>30.5-31.5m</strong></td>
<td>Core Loss 30.5-31.5m</td>
</tr>
</tbody>
</table>

**SMB1 terminated at 31.5m**
### Engineering Log - Borehole

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Borehole Location:** See Figure 1, TBA

<table>
<thead>
<tr>
<th>method</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>material</th>
<th>borehole diameter</th>
<th>structure and additional observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>timbering</td>
<td>1 2 3</td>
<td>SW</td>
<td>100mm</td>
<td>Drill stalling on cobbles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50mm</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**SPT**  
SPT 1,2,2  
N*=4

**SILTY CLAY:** high plasticity, white

**Consistency/density index**

- **moisture**  
  - D dry  
  - M moist  
  - W wet

- **classification symbols and soil description**
  - based on unified classification system
  - consistency/density index

- **notes, samples, tests**
  - U<sub>n</sub> undisturbed sample
  - D disturbed sample
  - N standard penetration test (SPT)
  - N<sub>c</sub> SPT - sample recovered
  - N<sub>c</sub> SPT with solid cone
  - V vane shear (kPa)
  - P pressure meter
  - B<sub>s</sub> bulk sample
  - R refusal

- **consistency/density index**
  - VS very soft
  - V very stiff
  - N hard
  - F brittle
  - S stiff
  - V<sub>f</sub> very loose
  - L very loose
  - M medium dense
  - D dense
  - VD very dense

**Revision A**
**Engineering Log - Borehole**

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project

Borehole Location: See Figure 1, TBA

<table>
<thead>
<tr>
<th>drill model and mounting</th>
<th>drilling information</th>
<th>material substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>hole diameter: 100mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>drilling method</td>
<td>notes, samples, tests, etc</td>
<td>material</td>
</tr>
<tr>
<td>method</td>
<td>support</td>
<td>soil type: plasticity or particle characteristics, colour, secondary and minor components.</td>
</tr>
<tr>
<td>AS</td>
<td>auger screwing*</td>
<td></td>
</tr>
<tr>
<td>AD</td>
<td>auger drilling*</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>roller/drill</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>washbore</td>
<td></td>
</tr>
<tr>
<td>CT</td>
<td>cable tool</td>
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</tr>
<tr>
<td>HA</td>
<td>hand auger</td>
<td></td>
</tr>
<tr>
<td>DT</td>
<td>diatube</td>
<td></td>
</tr>
<tr>
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</tr>
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<td>TC bit</td>
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<td>&quot;bit shown by suffix e.g.&quot;</td>
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<tr>
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</tr>
<tr>
<td>Borehole SMB2 terminated at 10.2m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Soil description based on unified classification system:

- **Consistency/density index**
  - VS: very soft
  - S: soft
  - F: firm
  - St: stiff
  - VH: very stiff
  - H: hard
  - Pb: friable
  - VL: very loose
  - L: loose
  - MD: medium dense
  - D: dense
  - VD: very dense

- **Moisture**
  - D: dry
  - M: moist
  - W: wet

- **Plasticity**
  - Wp: plastic limit
  - WI: liquid limit

- **Physical**
  - Vf: void fraction

- **Chemical**
  - P: pH

- **Engineering**
  - G: modulus of elasticity

- **Behavior/Property**
  - L: load

- **Grading/Texture**
  - S: sand
  - G: gravel
  - L: clay
  - M: mud

- **Classification symbols and**
  - U: unconfined compressive strength (MPa)
  - C: compressive strength (MPa)
  - K: resonant frequency (Hz)
  - R: relative density
  - L: liquidity index
  - P: plasticity index
  - D: dry density (g/cm³)
  - M: moisture content (%)
## Engineering Log - Borehole

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Borehole Location:** See Figure 1, TBA

### Drilling Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Penetration</th>
<th>Support</th>
<th>Water</th>
<th>Notes, Samples, Tests</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT</td>
<td>4, 4, 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N* = 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Road surface, siltstone and dolerite cobbles, with brown silt/clay
- SILTY SAND with some clay, fine, light brown
- SANDY CLAY: medium plasticity, white, some silt

### Material Substance

- Borehole SMB3 terminated at 6.55m

### Additional Observations

- Old log at 2.3m

### Notes

- Low water return to surface, water is moving thru road at ~500
### Engineering log - Excavation

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Test pit location:** Approximate GPS: 484840.00mE 5233285.00mN  
**Date started:** 14.8.2002  
**Date completed:** 14.8.2002  
**Logged by:** ASAZ  
**Checked by:** BMcD

**Equipment type and model:** Excavator 20t, 0.75m bucket  
**Pit Orientation:**  
**RL Surface:** See plan for approximation  
**Datum:**

### Excavation Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Penetration</th>
<th>Support</th>
<th>Notes, Samples, Tests</th>
<th>Water Level</th>
<th>Water Inflow</th>
<th>Water Outflow</th>
<th>Notes, Samples, Tests</th>
<th>Water Inflow</th>
<th>Water Outflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
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</table>

### Material Substance

<table>
<thead>
<tr>
<th>Material</th>
<th>Soil Type</th>
<th>Plasticity or Particle Characteristics, Colour, Secondary and Minor Components.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOPSOIL</td>
<td>Peat sward</td>
<td></td>
</tr>
<tr>
<td>ML</td>
<td>SANDY SILT: pale grey</td>
<td></td>
</tr>
<tr>
<td>CL</td>
<td>ORGANIC SILT</td>
<td></td>
</tr>
<tr>
<td>CL</td>
<td>SILTY CLAY: medium plasticity, light orange</td>
<td></td>
</tr>
<tr>
<td>ML</td>
<td>SANDY CLAYEY SILT: low to medium plasticity, light brown-light orange, ~10% to 15% subrounded gravels, gravels increase with depth up to 200mm</td>
<td></td>
</tr>
</tbody>
</table>

**Sketch**

**Method**

- N: natural exposure
- X: existing excavation
- BH: backhoe bucket
- B: bulldozer blade
- R: ripper
- E: excavator
- HA: hand auger
- DT: diatube

**Support**

- T: timbering
- N: nil

**Notes, Samples, Tests**

- U_s: undisturbed sample
- D: disturbed sample
- V: vane shear (kPa)
- B_s: bulk sample
- R: refusal

**Classification Symbols and Soil Description**

Based on unified classification system

- **Moisture**
  - D: dry
  - M: moist
  - W: wet

- **Plasticity Limit**
  - WI: liquid limit
  - Wp: plastic limit

**Consistency/Density Index**

- VS: very soft
- S: soft
- F: firm
- St: stiff
- VSt: very stiff
- H: hard
- Fb: friable
- VL: very loose
- MD: medium dense
- D: dense
- VD: very dense

---

**Revision A**
## Engineering log - Excavation

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Test pit location:** Approximate GPS: 484840.00mE 5233285.00mN

### Test pit STP1

- **Test pit:** STP1  
- **Date started:** 14.8.2002  
- **Date completed:** 14.8.2002  
- **Logged by:** ASAZ  
- **Checked by:** BMcD  

### Equipment and model:

- Excavator 20t, 0.75m bucket

### Excavation dimensions:

- m long  
- m wide

### Excavation information

<table>
<thead>
<tr>
<th>method</th>
<th>penetration</th>
<th>support</th>
<th>notes samples, tests, etc</th>
<th>RL</th>
<th>depth metres</th>
<th>material</th>
<th>consistency/density index</th>
<th>structure and additional observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SANDY CLAYEY SILT: low to medium plasticity, light brown-light orange, ~10% to 15% subrounded gravels, gravels increase with depth up to 200mm (continued)</td>
<td>M</td>
<td>H/D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td>Test pit STP1 terminated at 6.7m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Sketch

---

**Notes:**  
- Soil type: plasticity or particle characteristics, colour, secondary and minor components.  
- Notes, samples, tests  
- Classification symbols and soil description based on unified classification system

---

**Revision A**
### Engineering log - Excavation

**Client:** John Holland Pty Ltd

**Principal:** John Holland Development & Investment Pty Ltd

**Project:** Southwood Project

**Test pit location:** See Figure 1

<table>
<thead>
<tr>
<th>equipment type and model:</th>
<th>Excavator 20t, 0.75m bucket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pit Orientation:</td>
<td>R.L. Surface: See plan for approximation</td>
</tr>
<tr>
<td>excavation dimensions:</td>
<td>m long  m wide</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>excavation information</th>
<th>material substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>method</td>
<td>penetration</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 2 3</td>
</tr>
<tr>
<td>W</td>
<td>N</td>
</tr>
</tbody>
</table>

**Test pit STP2 terminated at 2.5m**

No refusal, groundwater not encountered during excavation

---

**Sketch**

---

**notes, samples, tests**

<table>
<thead>
<tr>
<th>U&lt;sub&gt;50&lt;/sub&gt;</th>
<th>50mm diameter</th>
<th>V</th>
<th>vane shear (kPa)</th>
<th>Bls</th>
<th>bulk sample</th>
<th>R</th>
<th>refusal</th>
<th></th>
</tr>
</thead>
</table>

**classification symbols and soil description**

- based on unified classification system
- moisture: D dry, M moist, W wet
- plastic limit: Wp
- liquid limit: WI

---

**Method and equipment**

- Excavator 20t, 0.75m bucket
- BH: backhoe bucket, E: excavator, HO154/1

---

**Support and penetration**

- T: timbering, N: nil

---

**Sketch and additional observations**

- See Figure 1

---

**Revision A**
**Engineering log - Excavation**

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Test pit location:** Approximate GPS: 484720.00mE 523312.00mN

<table>
<thead>
<tr>
<th>Test pit No.</th>
<th>STP3</th>
</tr>
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<tbody>
<tr>
<td>Sheet</td>
<td>1 of 1</td>
</tr>
<tr>
<td>Office Job No.:</td>
<td>HO154/1</td>
</tr>
<tr>
<td>Date started:</td>
<td>14.8.2002</td>
</tr>
<tr>
<td>Date completed:</td>
<td>14.8.2002</td>
</tr>
<tr>
<td>Logged by:</td>
<td>ASAZ</td>
</tr>
<tr>
<td>Checked by:</td>
<td>BMcD</td>
</tr>
</tbody>
</table>

**Topsoil**
- Sand, fine grained, pale grey
- Clayey gravelly silt, fine to medium grained, pale orange, with some clay
- Silty sand with some clay, light orange, dense

**Test pit STP3 terminated at 2.6m**

<table>
<thead>
<tr>
<th>0.5</th>
<th>SP</th>
<th>TOPSOIL: peat sward</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>R</td>
<td>SAND: fine grained, pale grey</td>
</tr>
<tr>
<td>1.5</td>
<td>M</td>
<td>CLAYEY GRAVELLY SILT: fine to medium grained, pale orange, with some clay</td>
</tr>
<tr>
<td>2.0</td>
<td>SM</td>
<td>SILTY SAND with some clay, light orange, dense</td>
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<td>2.5</td>
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<tr>
<td>3.0</td>
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<td>3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- Test pit STP3 terminated at 2.6m
- No refusal; Groundwater not encountered during excavation

**Support:**
- Timbering
- N nil

**Penetration:**
- 0.5 SP
- 1.0 R
- 1.5 M
- 2.0 SM

**Material Substance:**
- Topsoil

**Additional observations:**
- Bulk sample for CBR testing

**Sketch**

**Testing:**
- Test pit location:
- Engineering log - Excavation
- Undisturbed sample
- Disturbed sample
- Vane shear (kPa)
- Bulk sample
- Refusal
- Water inflow
- Water outflow

**Classification symbols and soil description:**
- Based on unified classification system
- Moisture
- Vw very wet
- Wp plastic limit
- WI liquid limit

**Consistency/density index:**
- VS very soft
- S soft
- F firm
- St stiff
- VSb very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

**Equipment type and model:**
- Excavator 20t, 0.75m bucket

**Excavation dimensions:**
- Metric long
- Metric wide

**Sketch:**

**Revision A**
### Engineering log - Excavation

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Test pit location:** Approximate GPS: 484561.00mE, 5233418.00mN  
**Date started:** 14.8.2002  
**Date completed:** 14.8.2002

---

<table>
<thead>
<tr>
<th>equipment type and model:</th>
<th>Excavator 20t, 0.75m bucket</th>
<th>Pit Orientation:</th>
<th>R.L. Surface:</th>
</tr>
</thead>
<tbody>
<tr>
<td>excavation dimensions:</td>
<td>m long m wide</td>
<td>R.L. Surface:</td>
<td>See plan for approximation</td>
</tr>
</tbody>
</table>

### excavation information

<table>
<thead>
<tr>
<th>method</th>
<th>penetration</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>RL</th>
<th>depth (m)</th>
<th>classification symbol</th>
<th>material</th>
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<tr>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>w</td>
<td></td>
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</tr>
<tr>
<td>1.0</td>
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<td></td>
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<tr>
<td>1.5</td>
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<td></td>
</tr>
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</tr>
<tr>
<td>2.5</td>
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<td></td>
</tr>
<tr>
<td>3.0</td>
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<tr>
<td>3.5</td>
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<td></td>
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<tr>
<td>4.0</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**  
Pipe ripper used from 3m

---

### material substance

| classification symbols and soil description based on unified classification system |
|--------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| moisture                 | dry             | wet             | plastic limit   | liquid limit    | consistency/density index |
| VFS                      | very soft       | soft            | very stiff      | stiff           | VS               |
| FD                       | firm            | very firm       | hard            | hard            | S               |
| F                        | friable         | very friable    | loose           | loose           | F               |
| W                        | very loose      | VL              | medium dense    | MD              | W               |
| Wp                       | plastic limit   | WL              | dense           | D               | Wp              |
| WI                       | liquid limit    | WLI             | very dense      | VD              | WI              |

---

**Test pit location:** Approximate GPS: 484561.00mE, 5233418.00mN  
**Excavator 20t, 0.75m bucket**

---

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Test pit location:** Approximate GPS: 484561.00mE, 5233418.00mN  
**Date started:** 14.8.2002  
**Date completed:** 14.8.2002

---

**Sketch**

---

**Notes:**  
1. **Topsoil:** organics  
2. **CLAYEY SILT:** medium plasticity, pale orange to pale brown with some rootlet inclusions  
3. **SILTSTONE:** fine grained, pale cream, low to medium strength, extremely weathered  
4. **CL**  
5. **EW**  
6. **St**  
7. **N**  
8. **nil**  
9. **bh**  
10. **B**  
11. **R**  
12. **HA**  
13. **DT**  
14. **water inflow**  
15. **water outflow**  
16. **water level on date shown**  
17. **water level**  
18. **water refusal**  
19. **penetration**  
20. **holes**  
21. **water refusal**

---

**Structure and additional observations:**  
1. Rock ripper used from 3m  
2. Rock, near vertical joints, iron stained, dipping westwards, <200mm spacing
**Engineering log - Excavation**

| Client: | John Holland Pty Ltd |
| Principal: | John Holland Development & Investment Pty Ltd |
| Project: | Southwood Project |
| Test pit location: | Approximate GPS: 484561.00mE 5233418.00mN |

**Test pit STP4**

- **Penetration**: 4.7m
- **Close to refusal**

**Test pit STP4 terminated at 4.7m**

- **Rock, near vertical joints, iron stained, dipping westwards, <200mm spacing**
- **Close to refusal**

**Sketch**

---

**Excavation information**

<table>
<thead>
<tr>
<th>method</th>
<th>penetration</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>RL</th>
<th>depth metres</th>
<th>soil type: plasticity or particle characteristics, colour, secondary and minor components.</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>N</td>
<td>N nil</td>
<td></td>
<td></td>
<td></td>
<td>SILTSTONE: fine grained, pale cream, low to medium strength, extremely weathered (continued)</td>
</tr>
</tbody>
</table>

**Material substance**

- **structure and additional observations**
  - Rock, near vertical joints, iron stained, dipping westwards, <200mm spacing
  - Close to refusal

---

**Test pit STP4 terminated at 4.7m**
### Engineering log - Excavation

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Test pit location:** Approximate GPS: 484550.00mE 5233698.00mN

<table>
<thead>
<tr>
<th>Test pit No.</th>
<th>STP5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheet</td>
<td>1 of 1</td>
</tr>
<tr>
<td>Office Job No.</td>
<td>HO154/1</td>
</tr>
</tbody>
</table>

**Equipment type and model:** Excavator 20t, 0.75m bucket

**Pit Orientation:**

- **RL. Surface:** See plan for approximation
- **datum:**

<table>
<thead>
<tr>
<th>excavation information</th>
<th>material substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>method</td>
<td>penetration</td>
</tr>
<tr>
<td>ul</td>
<td>N</td>
</tr>
<tr>
<td>CL</td>
<td>GLAYEY SILT: medium plasticity, pale brown, some rootlets</td>
</tr>
<tr>
<td></td>
<td>SILTSTONE: fine grained, cream, very low to low strength, extremely weathered</td>
</tr>
<tr>
<td></td>
<td>Test pit STP5 terminated at 3.3m</td>
</tr>
<tr>
<td></td>
<td>Rock joints dipping westwards, &lt;200mm spacing, rock ripper used from 2.2m, ripping became very difficult at 3m</td>
</tr>
<tr>
<td></td>
<td>Effective refusal: groundwater not encountered during excavation</td>
</tr>
</tbody>
</table>

**Sketch**

**Notes:**
- Support: Timbering Nil
- Penetration: 3
- Water level on date shown
- Water inflow
- Water outflow
- Undisturbed sample 50mm diameter
- Disturbed sample
- Vane shear (kPa)
- Bulk sample
- Refusal
- Soil type: plasticity or particle characteristics, colour, secondary and minor components.
- Classification symbols and soil description based on unified classification system
- Moisture: D dry, M moist, W wet
- Plastic limit: Wp
- Liquid limit: WI
- Consistency/density index: VS very soft, S soft, F firm, St stiff, VB very stiff, H hard, Fb friable, VL very loose, L loose, MD medium dense, D dense, VD very dense

**Approximate GPS:** 484550.00mE 5233698.00mN

**Date started:** 14.8.2002  
**Date completed:** 14.8.2002  
**Logged by:** ASAZ  
**Checked by:** BMcD

**Excavation information:**
- U: Undisturbed sample
- D: Disturbed sample
- V: Vane shear (kPa)
- B: Bulk sample
- R: Refusal
- VS: Very soft
- S: Soft
- F: Firm
- St: Stiff
- VB: Very stiff
- H: Hard
- Fb: Friable
- VL: Very loose
- L: Loose
- MD: Medium dense
- D: Dense
- VD: Very dense
### Engineering log - Excavation

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Test pit location:** Approximate GPS: 484406.00mE 5233768.00mN  
**Test pit No.:** STP6  
**Date started:** 14.8.2002  
**Date completed:** 14.8.2002  
**Logged by:** ASAZ  
**Checked by:** BMcD

<table>
<thead>
<tr>
<th>material substance</th>
<th>material</th>
<th>consistency/density index</th>
<th>classification symbols and soil description</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>penetration</th>
<th>equipment type and model</th>
<th>excavation information</th>
</tr>
</thead>
</table>
| TOPSOIL: organics, past | W | W | based on unified classification system  
undisturbed sample | natural exposure | | 1.0 | Excavator 20t, 0.75m bucket | excavation dimensions:  m long | 2.0 | Test pit STP6 terminated at 2m |
| SILT: slightly clayey, low to medium plasticity, orange stained cream | M | F/St | very soft | timbering | | 1.0 | | 1.5 | 2.0 | |
| SILT: medium to high plasticity, pale brown to pale orange | H | | soft | | | | | |
| Residual | | | very stiff | | | | | |
| Rock | | | hard | | | | | |
| Soft | | | | | | | | |

### Sketch

**Material substance:**  
- Topsoil: organics, past  
- Residual: medium to high plasticity, pale brown to pale orange, some roots  
- Rock: fine grained, cream, low strength, extremely weathered, highly fractured  
- Close to refusal: Test pit STP6 terminated at 2m

**Notes:**  
- **Equipment type and model:** Excavator 20t, 0.75m bucket  
- **Excavation information:** excavation dimensions:  m long | m wide  
- **Penetration:** 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0

---

**Revision A**
### Engineering log - Excavation

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Test pit location:** Approximate GPS: 484463.00mE 5233870.00mN  
**Date started:** 14.8.2002  
**Date completed:** 14.8.2002  
**Logged by:** ASAZ  
**Checked by:** BMcD

#### Excavation information

<table>
<thead>
<tr>
<th>method</th>
<th>penetration</th>
<th>support</th>
<th>notes samples, tests</th>
<th>material</th>
<th>moisture</th>
<th>classification symbols and soil description</th>
<th>consistency/density index</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>1 2 3</td>
<td>space</td>
<td></td>
<td></td>
<td></td>
<td>based on unified classification system</td>
<td></td>
</tr>
</tbody>
</table>

#### Material substance

- **TOPSOIL:** organics<br>
- **CLAYEY SILT:** medium plasticity, pale brown to pale orange<br>
- **SILTSTONE:** fine grained, cream, very low to low strength, highly weathered

**Groundwater not encountered during excavation**

**Ripper used from 2.6m**

---

**Sketch**

---

**Revision A**
## Engineering log - Excavation

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project

**Test pit location:** Approximate GPS: 484513.00mE 5233847.00mN

**Date started:** 15.8.2002  
**Date completed:** 15.8.2002

### Excavation Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Penetration</th>
<th>Support</th>
<th>Notes, Samples, Tests</th>
<th>R.L. (m)</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>STP8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TOPSOIL and organics</td>
</tr>
</tbody>
</table>

**Material Substance:**

- **TOPSOIL and organics**
- **SILTSTONE:** fine grained, cream, very low to low strength, extremely weathered

**Test pit STP8 terminated at 1.8m**

**Structure and Additional Observations:**

- Close to refusal; groundwater not encountered during excavation

### Sketch

**Equipment Type and Model:** Excavator 20t, 0.75m bucket
**Pit Orientation:**

**Notes, Samples, Tests,**

- U<sub>50</sub>: undisturbed sample
- V<sub>50</sub>: vane shear (kPa)
- B<sub>x</sub>: bulk sample
- R: refusal

**Consistency/Density Index**

- VS: very soft
- S: soft
- F: firm
- St: stiff
- V<sub>50</sub>: very stiff
- H: hard
- Fb: friable
- VL: very loose
- L: loose
- MD: medium dense
- D: dense
- VD: very dense
# Engineering log - Excavation

## Client:
John Holland Pty Ltd

## Principal:
John Holland Development & Investment Pty Ltd

## Project:
Southwood Project

## Test pit location:
Approximate GPS: 484389.00mE 5233900.00mN

## Equipment type and model:
Excavator 20t, 0.75m bucket

## Excavation information

<table>
<thead>
<tr>
<th>method</th>
<th>penetration</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>depth (m)</th>
<th>material</th>
<th>classification symbols and soil description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ul</td>
<td>N</td>
<td></td>
<td>TOPSOIL and organics</td>
<td></td>
<td>M</td>
<td>Topsod</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5</td>
<td>MH</td>
<td>Hamdcl</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D</td>
<td>SILTSTONE: fine grained, cream, very low to low strength, highly weathered</td>
<td>1.0</td>
<td>F/St</td>
<td>Rock</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Test pit STP9 terminated at 2m</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Sketch

**Material substance**

- **TOPSOIL and organics**
- **CLAYEY SILT: medium to high plasticity, pale brown/cream, friable, with some gravel**
- **SILTSTONE: fine grained, cream, very low to low strength, highly weathered**

## Additional observations
- No refusal; groundwater not encountered during excavation

## Notes
- Samples, tests, etc.
- Soil type: plasticity or particle characteristics, colour, secondary and minor components.
null
## Engineering log - Excavation

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Test pit location:** Approximate GPS: 484267.00mE 5233840.00mN

**Test pit No.: SPT11**  
**Date started:** 15.8.2002  
**Date completed:** 15.8.2002  
**Logged by:** ASAZ  
**Checked by:** BMcD

### equipment type and model:
- **Excavator** 20t, 0.75m bucket  
- **Pit Orientation:**
  - R.L. Surface: See plan for approximation
  - Datum:

### excavation information

<table>
<thead>
<tr>
<th>Penetration</th>
<th>Support</th>
<th>Notes, samples, tests</th>
<th>Water level</th>
<th>Water inflow</th>
<th>Water outflow</th>
<th>Material Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N</td>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
<td>TOPSOIL</td>
</tr>
<tr>
<td>2</td>
<td>D</td>
<td></td>
<td>1.0</td>
<td></td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td></td>
<td>1.5</td>
<td></td>
<td></td>
<td>S</td>
</tr>
<tr>
<td>4</td>
<td>MD</td>
<td></td>
<td>2.0</td>
<td></td>
<td></td>
<td>Test pit SPT11 terminated at 2.1m</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>3.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>4.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Sketch

**Revision A**

---

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Test pit location:** Approximate GPS: 484267.00mE 5233840.00mN  
**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Approximate GPS:** 484267.00mE 5233840.00mN  
**ACN:** 056 335 516
### Engineering log - Excavation

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project

**Test pit location:** Approximate GPS: 484290.00mE 5233752.00mN

**Equipment type and model:** Excavator 20t, 0.75m bucket  
**Pit Orientation:**  
**RL. Surface:** See plan for approximation

<table>
<thead>
<tr>
<th>depth (m)</th>
<th>method</th>
<th>penetration</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>material</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>N</td>
<td>N</td>
<td>D</td>
<td></td>
<td>CH: Topsoil and root zone</td>
</tr>
<tr>
<td>1.0</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td>ML: Clay: medium to high plasticity, orange stained, cream.</td>
</tr>
<tr>
<td>1.5</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td>SM: Silty Sand: with numerous quartzite rock pieces</td>
</tr>
<tr>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SILTSTONE: fine grained, pale grey, low to medium strength, extremely weathered, highly fractured</td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Test pit STP12 terminated at 1.8m</td>
</tr>
</tbody>
</table>

**Sketch**

---

**Notes:**  
- No refusal
- Residual
- Extensive roots
- Rock: seepage from southern end at ~1.6m depth

**Support**  
- Timbering
- Nil

**Penetration**  
- Water
- Ranging to 3-4

**Material Substance**

- **Classification symbols and soil description:**  
  - Based on unified classification system

- **Consistency/density index:**
  - VS: very soft
  - S: soft
  - F: firm
  - St: stiff
  - VS: very stiff
  - H: hard
  - Ph: friable
  - Vl: very loose
  - L: loose
  - MD: medium dense
  - D: dense
  - VD: very dense

---

**Revision A**
### Engineering log - Excavation

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Test pit location:** Approximate GPS: 484846.00mE 5233508.00mN

#### Excavation information

<table>
<thead>
<tr>
<th>equipment type and model:</th>
<th>Excavator 20t, 0.75m bucket</th>
<th>Pit Orientation:</th>
<th>R.L. Surface:</th>
</tr>
</thead>
<tbody>
<tr>
<td>excavation dimensions:</td>
<td>m long m wide</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Material substance

<table>
<thead>
<tr>
<th>method</th>
<th>penetration</th>
<th>support</th>
<th>notes</th>
<th>sample, tests, etc</th>
<th>RL</th>
<th>depth [m]</th>
<th>classification symbols and soil description</th>
</tr>
</thead>
<tbody>
<tr>
<td>u</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td>0.5</td>
<td></td>
<td>Topsil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0</td>
<td></td>
<td>Gravelly Silts: non plastic to low plasticity, pale grey, partly cemented</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.5</td>
<td></td>
<td>Organic Silts with some gravels</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.0</td>
<td></td>
<td>Silty Gravels: medium to coarse grained, pale orange/pale brown; sub-rounded quartzite gravels of low to medium strength</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit STP13 terminated at 1.5m

---

**Sketch**

**Method**

- N: natural exposure
- X: existing excavation
- BH: backhoe bucket
- L: ripper
- E: excavator
- HA: hand auger
- DT: diatube

**Support**

- T: timbering
- N: nil

**Notes, samples, tests**

- U<sub>u</sub>: undisturbed sample
- D: disturbed sample
- V: vane shear (kPa)
- B<sub>s</sub>: bulk sample
- R: refusal

**Classification symbols and soil description**

- Consistency/density index: VS: very soft, VL: very loose, MD: medium dense, D: dense, VD: very dense

---

**Revision A**
# Engineering Log - Piezometer

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Borehole Location:** See Figure 1, TBA

---

**Specifications and Methods:**

- **Drill Model and Mounting:**
  - U: Auger screwing
  - D: Auger drilling
  - N: Roller tricone
  - M: Drill from cable tool
  - V: Hand auger
  - B: Blank bit
  - TC: Diatube
- **Penetration:**
  - 1, 2, 3:
  - Water
  - Support
  - Notes, samples, Tests
  - Well details
  - Graphic Log
  - Classification symbol
  - Soil type: Plasticity or particle characteristics, colour, secondary and minor components.
  - Material: Consistency/density index
  - Moisture condition
  - Structure and additional observations

---

**Material Substances:**

- Soil type: Plasticity or particle characteristics, colour, secondary and minor components.
- Material: Consistency/density index.

---

**Logging Details:**

- **Borehole No.:** SMB1A
- **Date started:** 14.8.2002
- **Date completed:** 14.8.2002
- **Logged by:** AGG
- **Checked by:** BMcd
- **Office Job No.:** HO154/1

---

**Revision A**

---

**ACN 056 335 516**

---

**Engineering Log - Piezometer**
**Engineering Log - Piezometer**

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project

**Borehole Location:** See Figure 1, TBA

<table>
<thead>
<tr>
<th>Drilling Information</th>
<th>Material Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Support</td>
</tr>
<tr>
<td>AS</td>
<td>auger drilling*</td>
</tr>
<tr>
<td>RR</td>
<td>roller bit</td>
</tr>
<tr>
<td>W</td>
<td>wash boring</td>
</tr>
<tr>
<td>HA</td>
<td>hand auger</td>
</tr>
<tr>
<td>HA</td>
<td>hand auger</td>
</tr>
<tr>
<td>GT</td>
<td>cable tool</td>
</tr>
<tr>
<td>V</td>
<td>V bit</td>
</tr>
<tr>
<td>T</td>
<td>TC bit</td>
</tr>
<tr>
<td>blank bit</td>
<td>R</td>
</tr>
<tr>
<td>*bit shown by suffix</td>
<td>E</td>
</tr>
<tr>
<td>ADT</td>
<td>W</td>
</tr>
</tbody>
</table>

**Drilling Information:**
- **Method:** auger drilling*
- **Well Diameter:** 100mm
- **Support:** timbering
- **Notes, Samples, Tests:** undisturbed sample 50mm dia
- **Material:** undisturbed sample 50mm dia
- **Classification Symbols and Soil Description:** based on unified classification system
  - **Moisture:** dry, Moist, Wet
  - **Consistency/Density Index:** very soft, soft, firm, stiff, very stiff, hard, friable, very loose, loose, medium dense, dense, very dense

**Additional Observations:**
- Drill stalling on cobbles
- Harder drill area 3-3.5m, cobbles of quartzite

**Revision A**

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project

**Borehole Location:** See Figure 1, TBA
### Engineering Log - Piezometer

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project  
**Borehole Location:** See Figure 1, TBA

**Borehole No.:** SMB2  
**Sheet:** 2 of 2  
**Date started:** 14.8.2002  
**Date completed:** 14.8.2002  
**Logged by:** AGG  
**Checked by:** BMcd

**Notes:**
- **Material Substance:** SILTY CLAY: high plasticity, white (continued)
- **Drill Model and Mounting:**
  - U - 50\(^{\circ}\)
  - D - N
  - N - N*
  - Nc - V
  - P - BS
  - R - E
  - PID - WS
  - W - PZ

**Drilling Information:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Support</th>
<th>Notes, Samples, Tests</th>
<th>Well Details</th>
<th>Well Diameter</th>
<th>R.L. Surface</th>
<th>Datum</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>Timbering</td>
<td>N nil C casing</td>
<td>100mm</td>
<td>10.2m</td>
<td>TBA m</td>
<td></td>
</tr>
</tbody>
</table>

**Classification Symbols and Soil Description:**

- **Classification Symbols:**
  - GH: Silt clay, high plasticity, white

- **Soil Description:**
  - Undisturbed sample 50mm dia
  - Disturbed sample
  - Standard penetration test (SPT)
  - SPT - Sample recovered
  - SPT with solid cone
  - Vane shear (APa)
  - Pressure meter
  - Bulk sample
  - Refusal
  - Environmental sample
  - Moisture: D - dry, M - moist, W - wet
  - Plastic limit: Wp - plastic limit, WI - liquid limit
  - Moisture: V - very soft, S - soft, F - firm, St - stiff, VB - very stiff, H - hard, L - loose, MD - medium dense, D - dense, VD - very dense

**Additional Observations:**

- Borehole terminated at 10.2m
### Engineering Log - Piezometer

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project

**Borehole Location:** See Figure 1, TBA

**Date started:** 15.8.2002  
**Date completed:** 15.8.2002  
**Logged by:** AGG  
**Checked by:** BMcD

#### Drilling Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Support</th>
<th>Notes, Samples, Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>Timbering</td>
<td>N nil</td>
</tr>
<tr>
<td>AD</td>
<td>auger drilling</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>roller/screw</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>washbone</td>
<td></td>
</tr>
<tr>
<td>HA</td>
<td>hand auger</td>
<td></td>
</tr>
<tr>
<td>DT</td>
<td>diamond tool</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>blank bit</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>V bit</td>
<td></td>
</tr>
<tr>
<td>TC</td>
<td>TC bit</td>
<td></td>
</tr>
</tbody>
</table>

---

**Material Substance**

- **Road surface, siltstone and dolerite cobbles, with brown silt/clay**  
  - **Silty Sand** with some clay, fine, light brown  
  - **2.3-3m log backfill**

- **Silty Sand with some clay, fine, light brown**

- **2.3-3m log backfill**

- **Old log at 2.3m**

- **Sandy Clay:** medium plasticity, white, some silt

- **2:3:3m log backfill**

- **Sandy Clay:** medium plasticity, white, some silt

- **Borehole terminated at 6.55m**

---

**Soil Description**

- **Undisturbed sample 50mm dia**
- **Disturbed sample**
- **Standard Penetration Test (SPT)**
- **SPT - Sample recovered**
- **SPT with solid cone**
- **Vane shear (APa)**
- **Pressure meter**
- **Bulk sample**
- **Refusal**
- **Environmental sample**
- **Paimeter**
- **Water sample**
- **Pameter**

---

**Revision A**

---

**Engineering Log - Piezometer**

**Client:** John Holland Pty Ltd  
**Principal:** John Holland Development & Investment Pty Ltd  
**Project:** Southwood Project

**Borehole Location:** See Figure 1, TBA

**Date started:** 15.8.2002  
**Date completed:** 15.8.2002  
**Logged by:** AGG  
**Checked by:** BMcD

**Drill model and mounting:** auger drilling  
**Hole diameter:** 100mm  
**Slope:** -90°  
**RL Surface:** TBA m

---

**Classification Symbols and Soil Description**

- **Undisturbed sample 50mm dia**  
- **Disturbed sample**  
- **Standard Penetration Test (SPT)**

- **Support**
- **Notes, Samples, Tests**
- **Consistency/Density Index**

- **Moisture**
- **Swell**
- **Plastic Limit**
- **Liquid Limit**

---

**Revision A**
**FALLING HEAD TEST**

Hvorslev, 1951 - Well Point : Filter in Uniform Soil

<table>
<thead>
<tr>
<th>Fixed Parameters</th>
<th>Unit</th>
<th>Value</th>
<th>Elapsed Time (mins)</th>
<th>Depth to Water (mbGL)</th>
<th>Active Head (m)</th>
<th>Active Head/Initial Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWL = Standing Water Level</td>
<td>m bGL</td>
<td>8.71</td>
<td>0.00</td>
<td>8.71</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>D = diameter of test section or ID of casing</td>
<td>m</td>
<td>0.100</td>
<td>0.33</td>
<td>2.20</td>
<td>6.51</td>
<td>0.75</td>
</tr>
<tr>
<td>d = diameter of standpipe</td>
<td>m</td>
<td>0.057</td>
<td>0.50</td>
<td>3.55</td>
<td>5.16</td>
<td>0.59</td>
</tr>
<tr>
<td>L = length of test section</td>
<td>m</td>
<td>8.71</td>
<td>0.67</td>
<td>3.71</td>
<td>5.00</td>
<td>0.57</td>
</tr>
</tbody>
</table>

estimated \( k_{hv} \) ratio = 5.00

where \( k_v \) = vertical coefficient of permeability

\( k_h \) = horizontal coefficient of permeability

\( m = \frac{k_h}{k_v} \) ratio = 2.236

\( T = \text{basic time lag} = t \) when \( \frac{H_t}{H_0} = 0.37 \) mins

| Chosen time  \( t_1 \) | mins | 10.0 | 60.0 | 7.84 | 0.87 | 0.10 |
| Chosen time  \( t_2 \) | mins | 40.0 | 90.0 | 8.71 | 0.00 | 0.00 |

\( H_1 = \text{active Head at time} \ t_1 \) | m | 4.56 |
| \( H_2 = \text{active Head at time} \ t_2 \) | m | 2.60 |

---

**Coffey Geosciences**

**John Holland Pty Ltd**

**Southwood Project**

**Hydrogeological Studies**

**FIGURE B1**

**Falling Head Test of Bore SMB#1**

---

**Holland Southwood Hydrogeological Studies (Hydrodesk) - Aug 1998**

---

**Coffey Geosciences**

**John Holland Pty Ltd**

**Southwood Project**

**Hydrogeological Studies**

**FIGURE B1**

**Falling Head Test of Bore SMB#1**
### FALLING HEAD TEST

Hvorslev, 1951 - Well Point : Filter in Uniform Soil

#### TEST DATA

<table>
<thead>
<tr>
<th>Elapsed Time (mins)</th>
<th>Depth of Water (mbGL)</th>
<th>Active Head (m)</th>
<th>Active Head/Initial Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.00</td>
<td>3.42</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**Fixed Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWL = Standing Water Level</td>
<td>mbGL</td>
<td>3.42</td>
</tr>
<tr>
<td>D = diameter of test section or ID of casing</td>
<td>m</td>
<td>0.100</td>
</tr>
<tr>
<td>d = diameter of standpipe</td>
<td>m</td>
<td>0.057</td>
</tr>
<tr>
<td>L = length of test section</td>
<td>m</td>
<td>10.80</td>
</tr>
</tbody>
</table>

**Variables and Calculations**

- $k_v$ = vertical coefficient of permeability
- $k_h$ = horizontal coefficient of permeability
- $m = \text{transformation ratio} = \frac{k_h}{k_v}$
- $T = \text{basic time lag} = t$ when $\left(\frac{H_t}{H_0}\right) = 0.37$

#### Elapsed Depth to Active Head

- $H_1$ = active Head at time $t_1$
- $H_2$ = active Head at time $t_2$

### Variable Head Determination

\[
k_v = d^2 \ln(2mL/D) - \ln(H_t/H_2)
\]

#### Basic Time Lag Determination

\[
k_h = d^2 \ln(2mL/D) / BLT
\]

### Hydrogeological Studies

**John Holland Pty Ltd**

**Southwood Project**

**Coffey Geosciences**

**Drawn - AGG**

**Approved -**

**Date - Aug 2002**

**Scale - Not to Scale**

**FIGURE B2**

Falling Head Test of Bore SMB#2
### BASIC TIME LAG SLUG OUT TEST

Hvorslev, 1951 - Well Point : Filter in Uniform Soil

#### TEST DATA

<table>
<thead>
<tr>
<th>Elapsed Time (mins)</th>
<th>Depth to Water (mbGL)</th>
<th>Active Head (m)</th>
<th>Active Head/ Initial Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>5.64</td>
<td>-2.65</td>
<td>1.00</td>
</tr>
<tr>
<td>0.17</td>
<td>5.41</td>
<td>-2.42</td>
<td>0.91</td>
</tr>
<tr>
<td>0.33</td>
<td>5.17</td>
<td>-2.18</td>
<td>0.82</td>
</tr>
<tr>
<td>0.50</td>
<td>4.94</td>
<td>-1.95</td>
<td>0.75</td>
</tr>
<tr>
<td>0.66</td>
<td>4.75</td>
<td>-1.76</td>
<td>0.66</td>
</tr>
<tr>
<td>0.83</td>
<td>4.59</td>
<td>-1.60</td>
<td>0.60</td>
</tr>
<tr>
<td>1.00</td>
<td>4.44</td>
<td>-1.45</td>
<td>0.55</td>
</tr>
<tr>
<td>1.03</td>
<td>4.33</td>
<td>-1.31</td>
<td>0.49</td>
</tr>
<tr>
<td>1.17</td>
<td>4.30</td>
<td>-1.31</td>
<td>0.49</td>
</tr>
<tr>
<td>1.33</td>
<td>4.18</td>
<td>-1.19</td>
<td>0.45</td>
</tr>
<tr>
<td>1.50</td>
<td>4.07</td>
<td>-1.08</td>
<td>0.41</td>
</tr>
<tr>
<td>1.66</td>
<td>3.98</td>
<td>-0.99</td>
<td>0.37</td>
</tr>
<tr>
<td>1.83</td>
<td>3.91</td>
<td>-0.92</td>
<td>0.35</td>
</tr>
<tr>
<td>2.00</td>
<td>3.85</td>
<td>-0.86</td>
<td>0.32</td>
</tr>
<tr>
<td>2.17</td>
<td>3.80</td>
<td>-0.81</td>
<td>0.31</td>
</tr>
<tr>
<td>2.33</td>
<td>3.75</td>
<td>-0.76</td>
<td>0.29</td>
</tr>
<tr>
<td>2.50</td>
<td>3.70</td>
<td>-0.71</td>
<td>0.27</td>
</tr>
<tr>
<td>3.00</td>
<td>3.60</td>
<td>-0.61</td>
<td>0.23</td>
</tr>
<tr>
<td>3.30</td>
<td>3.50</td>
<td>-0.51</td>
<td>0.19</td>
</tr>
<tr>
<td>4.00</td>
<td>3.43</td>
<td>-0.44</td>
<td>0.17</td>
</tr>
<tr>
<td>5.00</td>
<td>3.33</td>
<td>-0.34</td>
<td>0.13</td>
</tr>
<tr>
<td>6.00</td>
<td>3.24</td>
<td>-0.25</td>
<td>0.09</td>
</tr>
<tr>
<td>7.00</td>
<td>3.17</td>
<td>-0.18</td>
<td>0.07</td>
</tr>
<tr>
<td>8.00</td>
<td>3.14</td>
<td>-0.15</td>
<td>0.06</td>
</tr>
<tr>
<td>9.00</td>
<td>3.12</td>
<td>-0.13</td>
<td>0.05</td>
</tr>
<tr>
<td>10.00</td>
<td>3.11</td>
<td>-0.12</td>
<td>0.05</td>
</tr>
<tr>
<td>12.00</td>
<td>3.09</td>
<td>-0.10</td>
<td>0.04</td>
</tr>
<tr>
<td>15.00</td>
<td>3.07</td>
<td>-0.08</td>
<td>0.03</td>
</tr>
<tr>
<td>20.00</td>
<td>3.04</td>
<td>-0.05</td>
<td>0.02</td>
</tr>
<tr>
<td>25.00</td>
<td>3.02</td>
<td>-0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>30.00</td>
<td>3.00</td>
<td>-0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>35.00</td>
<td>2.99</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### Basic Time Lag Determination

\[
K = \frac{r^2 \ln(L/R)}{2LT_0}
\]

<table>
<thead>
<tr>
<th>K (m/s)</th>
<th>K (m/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5E-06</td>
<td>9.66E-02</td>
</tr>
</tbody>
</table>

---

Coffey Geosciences

Drawn - AGG
Approved -
Date - August 2002
Scale - Not to Scale

John Holland Pty Ltd
Southwood Project
Hydrogeological Studies
Rising Head Test - Bore SMB#3

FIGURE B3

job no. Ho154/1
# California Bearing Ratio Test Results

**Client:** JOHN HOLLAND CONSTRUCTIONS PTY LTD  
**Job No:** HO154/1  
**Laboratory:** MELBOURNE  
**Date:** 27/08/02  
**Test Report:** AA

**Test Procedure:** AS1289 6.1.1  
**Laboratory Compaction Method:** AS1289 5.1.1

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>TP 2</th>
<th>TP 3</th>
<th>TP 13</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Depth:</strong> m</td>
<td>2.0 - 2.5m</td>
<td>2.0 - 2.5m</td>
<td>1.0 - 1.5m</td>
</tr>
<tr>
<td><strong>Location:</strong></td>
<td>REFER TO FIGURE 1</td>
<td>REFER TO FIGURE 1</td>
<td>REFER TO FIGURE 1</td>
</tr>
<tr>
<td><strong>Date Sampled:</strong></td>
<td>N.A</td>
<td>N.A</td>
<td>N.A</td>
</tr>
<tr>
<td><strong>Date Tested:</strong></td>
<td>26-Aug-02</td>
<td>26-Aug-02</td>
<td>26-Aug-02</td>
</tr>
</tbody>
</table>

**Sample Description:**  
TP 2: GRAVELLY SILTY CLAY, medium plasticity, orange brown, fine to coarse gravel  
TP 3: SANDY CLAY / CLAYEY SAND, fine to coarse, orange brown, low plasticity, some gravel  
TP 13: clayey GRAVELLY SAND, orange brown, fine to coarse, gravel fine to coarse, low plasticity.

**Maximum Dry Density:** t/m³  
TP 2: 1.64  
TP 3: 1.90  
TP 13: 1.73

**Optimum Moisture Content:** %  
TP 2: 19.0  
TP 3: 13.0  
TP 13: 18.0

**Field Moisture Content:** %  
TP 2: 17.4  
TP 3: 13.0  
TP 13: 15.0

**% Retained on 19mm:**  
TP 2: 4.8  
TP 3: 0  
TP 13: 8.2

**C.B.R. Test:**

<table>
<thead>
<tr>
<th>Test</th>
<th>TP 2</th>
<th>TP 3</th>
<th>TP 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density t/m³</td>
<td>1.60</td>
<td>1.88</td>
<td>1.70</td>
</tr>
<tr>
<td>Density Ratio</td>
<td>98</td>
<td>98</td>
<td>98</td>
</tr>
<tr>
<td>Moisture Ratio</td>
<td>105</td>
<td>100</td>
<td>97</td>
</tr>
<tr>
<td>Number of Days Soaked</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Surcharge</td>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Moisture Content % Top 30mm</td>
<td>24.1</td>
<td>15.4</td>
<td>21.4</td>
</tr>
<tr>
<td>Moisture Content % Remaining Sample</td>
<td>23.4</td>
<td>13.9</td>
<td>18.1</td>
</tr>
<tr>
<td>Swell After Soaking</td>
<td>0.0</td>
<td>0.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Penetration</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>C.B.R. Value</td>
<td>13</td>
<td>11</td>
<td>20</td>
</tr>
</tbody>
</table>

**Remarks:**

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NATA No: 1040

Authorized Signature: [Signature]

Emila Gmelich
# Test Results

**Client:** JOHN HOLLAND CONSTRUCTIONS PTY LTD  
**Job No.:** H0154/1  
**Principal:**  
**Project:** SOUTHWOOD  
**Location:** TASMANIA  
**Date:** 28/08/02  
**Laboratory:** MELBOURNE  
**Test Report:** AB  
**Test Procedure:** AS1289 3.1.2 - 3.2.1 - 3.3.1 - 3.4.1  
**Preparation Method:** oven dried, dry sieved  
**Test Data:** various

<table>
<thead>
<tr>
<th>Location</th>
<th>TP 2</th>
<th>TP 3</th>
<th>TP 6</th>
<th>TP 11</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Liquid Limit</strong></td>
<td>WL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>36</td>
<td>55</td>
<td>37</td>
</tr>
<tr>
<td><strong>Plastic Limit</strong></td>
<td>Wp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>18</td>
<td>29</td>
<td>22</td>
</tr>
<tr>
<td><strong>Plasticity Index</strong></td>
<td>Ip</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>18</td>
<td>26</td>
<td>15</td>
</tr>
<tr>
<td><strong>Linear Shrinkage</strong></td>
<td>L.S.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.5</td>
<td>7.5</td>
<td>10.5</td>
<td>7.5</td>
</tr>
<tr>
<td><strong>Curling / Crumbling</strong></td>
<td>crumbling</td>
<td>neither</td>
<td>neither</td>
<td>crumbling</td>
</tr>
</tbody>
</table>

**Remarks:** 
1. Sampled by M. McDowall, tested "as received"  
2. Curling / crumbling refers to the condition of the linear shrinkage sample after constant drying

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**Authorised Signature:**

NATA No 431
**test results**

client: JOHN HOLLAND CONSTRUCTIONS PTY LTD  
principal:  
project: SOUTHWOOD  
location: TASMANIA  
job no: H0164/1  
laboratory: MELBOURNE  
date: 28/08/02  
test report: AC  
test procedure: AS1289 3.1.2 - 3.2.1 - 3.3.1 - 3.4.1  
Preparation method: oven dried, dry slaved  
test date: various

<table>
<thead>
<tr>
<th>Location</th>
<th>TP 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.0 - 1.5</td>
</tr>
</tbody>
</table>

- Liquid Limit WL 27
- Plastic Limit Wp 21
- Plasticity Index Ip 6
- Linear Shrinkage LS 3
- curling / crumpling crumpling

**remarks:**

1. sampled by B McDowell, tested “as received”
2. curling / crumpling refers to the condition of the linear shrinkage sample after constant drying

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Authorised Signature
NATA No 431
## Test Results

**Client:** JOHNNY HOLLAND CONSTRUCTIONS PTY LTD  
**Job No:** HO154/1  
**Principal:**  
**Project:** SOUTHWOOD  
**Location:** TASMANIA  
**Test Procedure:**  
- AS1289 6.7.3 (Triaxial Permeability)  
- AS1289 5.1.1  
**Test Date:** 22/08/02

<table>
<thead>
<tr>
<th>Identification</th>
<th>TP 8</th>
<th>TP 11</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Depth m</strong></td>
<td>0.4 - 1.2</td>
<td>0.4 - 1.2</td>
</tr>
<tr>
<td><strong>Maximum Dry Density</strong></td>
<td>1.44</td>
<td>1.60</td>
</tr>
<tr>
<td><strong>Optimum Moisture Content</strong></td>
<td>30.5</td>
<td>21.5</td>
</tr>
<tr>
<td><strong>Bulk Wet Density of Test Specimen</strong></td>
<td>1.839</td>
<td>1.908</td>
</tr>
<tr>
<td><strong>Natural Moisture Content</strong></td>
<td>32.4</td>
<td>22.6</td>
</tr>
<tr>
<td><strong>Dry Density of Test Specimen</strong></td>
<td>1.41</td>
<td>1.56</td>
</tr>
<tr>
<td><strong>Density Ratio</strong></td>
<td>98</td>
<td>98</td>
</tr>
<tr>
<td><strong>Moisture Ratio</strong></td>
<td>97</td>
<td>103</td>
</tr>
<tr>
<td><strong>Percentage Oversize</strong></td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Permeability (m/sec):**
- TP 8: $3.5 \times 10^{-9}$  
- TP 11: $1.2 \times 10^{-8}$

**Water Type:**
- TP 8: distilled  
- TP 11: distilled

**Description:**
- TP 8: SILTY CLAY, medium to high plasticity, mottled grey yellow brown  
- TP 11: SILTY CLAY, medium to high plasticity, mottled grey yellow brown

**Notes:**
The sample was remoulded in five layers at 98% SMDD @ OMC

**Remarks:**

---

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Authorized Signature: [Signature]

NATA No: 431

Emile Gmelich
# California Bearing Ratio Test Results

**Client:** GHD PTY LTD  
**Job No.:** H0142/1  
**Principal:**  
**Project:** SOUTHWOOD  
**Location:** TASMANIA

| Test Procedure: | AS1289 6.1.1  
| Laboratory Compaction Method: | AS1289 5.1.1 |

**Sample Number:** #1  
**Depth:** m  
**Location:** REFER TO FIGURE 1  
**Date Sampled:** 18-Apr-02  
**Date Tested:** 30-Apr-02  
**Sample Description:** SANDY GRAVEL, fine to coarse, light grey white, fine to coarse sand

| Maximum Dry Density: | 1.97 t/m³  
| Optimum Moisture Content: | 9.6%  
| Field Moisture Content: | 2.7%  
| % Retained on 10mm: | 34%  

**C.B.R. Test:**

<table>
<thead>
<tr>
<th>Dry Density t/m³</th>
<th>Before soaking</th>
<th>After soaking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.53</td>
<td>1.94</td>
</tr>
</tbody>
</table>

| Density Ratio: | 98%  
| Moisture Ratio: | 101%  
| Number of Days Soaked: | 4  
| Surcharge: | 9.0 kg  
| Moisture Content % Top 30mm: | 11.0%  
| Moisture Content % Remaining Sample: | 9.8%  
| Swell After Soaking: | 0.0%  
| Penetration: | 2.5 mm  
| C.B.R. Value: | 90%  

**Remarks:** Sampled by B Mc Dowell, tested "as received"
**test results**

**Client:** GHD PTY LTD  
**Job No:** H0142/1  
**Principal:**  
**Project:** SOUTHWOOD  
**Location:** TASMANIA  
**Laboratory:** MELBOURNE  
**Date:** 1/05/02  
**Test Report:** AC  
**Test Date:** 30/04/02

**Test Procedure:** AS1289 3.1.2 - 3.2.1 - 3.3.1 - 3.4.1  
**Preparation Method:** oven dried, dry sieved

<table>
<thead>
<tr>
<th>Sample Identification</th>
<th>Sample 1</th>
<th>MPY1</th>
<th>MPY2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid limit</td>
<td>WL</td>
<td>N.P</td>
<td>28</td>
</tr>
<tr>
<td>Plastic limit</td>
<td>Wp</td>
<td>N.P</td>
<td>19</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>Ip</td>
<td>N.P</td>
<td>9</td>
</tr>
<tr>
<td>Linear Shrinkage</td>
<td>L.S.</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Curling / Cracking</td>
<td>none</td>
<td>crumbling</td>
<td>crumbling</td>
</tr>
</tbody>
</table>

**Note:** N.P refers to non-plastic fines

**Remarks:**  
1. Sampled by B.M. McDowell, tested "as received"  
2. Curling / cracking refers to the condition of the linear shrinkage sample after constant drying

---

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[Signature]

NATA No: 431

Ernie Gmehling
# California Bearing Ratio Test Results

**Client:** GHD Pty Ltd  
**Job No.:** HG14271  
**Principal:**  
**Project:** Southwood  
**Location:** Tasmania  
**Laboratory:** Melbourne  
**Report Date:** 06 May 02  
**Test Report:** AF

## Test Procedure
AS 1289 6.1.1

## Laboratory Compaction Method
AS 1289 5.1.1

### Sample Number: MPY 1

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Location</th>
<th>Date Sampled</th>
<th>Date Tested</th>
<th>Sample Description</th>
</tr>
</thead>
</table>

### Maximum Dry Density (t/m³)
1.71

### Optimum Moisture Content (%)
19.5

### Field Moisture Content (%)
19.3

### % Retained on 1.18mm
5.2

### CBR Test

<table>
<thead>
<tr>
<th>Dry Density (t/m³)</th>
<th>Before Soaking</th>
<th>After Soaking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.68</td>
<td>1.70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Density Ratio</th>
<th>99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Ratio</td>
<td>98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Days Soaked</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surcharge (kg)</td>
<td>4.5</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>21.0</td>
</tr>
<tr>
<td>Swell After Soaking (%)</td>
<td>0.0</td>
</tr>
<tr>
<td>Penetration (mm)</td>
<td>5.0</td>
</tr>
</tbody>
</table>

### CBR Value (%)
20

### Remarks:
Sampled by B McDowell, tested "as received"
### MICROBIOLOGICAL RESULTS FORM Water (2002)

<table>
<thead>
<tr>
<th>Report No:</th>
<th>W484/02</th>
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<tbody>
<tr>
<td>Order No:</td>
<td>H0102</td>
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<tr>
<td>Page:</td>
<td>1 of 1</td>
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<tr>
<td>Submitted by:</td>
<td>B McDowell</td>
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<td>Date report issued:</td>
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**Coffey Geosciences**

ABN: 57 056 335 516  
289-291 Liverpool St  
Hobart TAS 7000  
Phone: (03) 6234 9955  
Fax: (03) 6234 9577

**National Association of Testing Authorities, Australia**

**NATA ENRORSED DOCUMENT**

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<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Lab. Number</th>
<th>Sample Description</th>
<th>Sample Site</th>
<th>Date Collected</th>
<th>Time Collected</th>
<th>Date Received</th>
<th>Date Tested</th>
<th>Tests Required *</th>
<th>FC /100mL</th>
<th>E.coli /100mL</th>
<th>FS /100mL</th>
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<tbody>
<tr>
<td>H0154/1 SMB#2</td>
<td>02/W8/243</td>
<td>Water</td>
<td>Southwood bore</td>
<td>15/08/02</td>
<td>nr</td>
<td>16/08/02</td>
<td>16/08/02</td>
<td>FC, E.coli, FS</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>20 (est)</td>
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<tr>
<td>H01541 SMB#3</td>
<td>02/W8/244</td>
<td>&quot;</td>
<td>Southwood bore</td>
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<td>10 (est)</td>
<td>10 (est)</td>
<td>10 (est)</td>
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*Tests were performed on samples as received  
est = estimate  
nr = not recorded

**Test Methods**  
FC (Faecal Coliforms), E.coli, AS4276.7-1995; FS (Faecal Streptococci), AS4276.9-1995.
<table>
<thead>
<tr>
<th>LAB NUM</th>
<th>Received</th>
<th>Sample</th>
<th>POTASSIUM</th>
<th>SODIUM</th>
<th>CALCIUM</th>
<th>MAGNESIUM</th>
<th>ALKALINITY as CaCO₃</th>
<th>DI-CARBONATE as CaCO₃</th>
<th>CARBONATE as CaCO₃</th>
<th>JIHYDROXIDE as CaCO₃</th>
<th>CHLORIDE</th>
<th>SULPHATE</th>
<th>AI</th>
<th>PHOSPHORUS</th>
<th>TOTAL NITROGEN</th>
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<tbody>
<tr>
<td>481486</td>
<td>19-Aug-2002</td>
<td>SMBP2</td>
<td>2.4</td>
<td>6.1</td>
<td>0.51</td>
<td>1.5</td>
<td>6</td>
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<td>13</td>
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<td>181487</td>
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<td>9.2</td>
<td>18</td>
<td>7.2</td>
<td>15</td>
<td>90</td>
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<td>&lt;2</td>
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<td>&lt;1</td>
<td>340</td>
<td>0.52</td>
<td>3.9</td>
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<td>LAB NUM</td>
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<td>Sample</td>
<td>TPH C6-C9</td>
<td>TPH C10-C14</td>
<td>TPH C15-C26</td>
<td>TPH C29-C36</td>
<td>BENZENE</td>
<td>TOLUENE</td>
<td>ETHYL BENZENE</td>
<td>XYLENES</td>
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<td>19-Aug-2002</td>
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A blank space indicates no test performed

Results expressed as mg/L.
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<thead>
<tr>
<th>LABNUM</th>
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<th>Sample</th>
<th>NAP</th>
<th>ACY</th>
<th>ACE</th>
<th>FLU</th>
<th>PRE</th>
<th>ANT</th>
<th>FLA</th>
<th>FVR</th>
<th>BAA</th>
<th>CHR</th>
<th>BGF</th>
<th>BKF</th>
<th>BAP</th>
<th>DBA</th>
<th>BOP</th>
<th>HPY</th>
<th>TOTAL* PAH</th>
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<tbody>
<tr>
<td>411185</td>
<td>19-Aug-2002</td>
<td>SMB42</td>
<td>&lt;0.001</td>
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<td>411187</td>
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*Total PAH's refer only to the sum of individual PAH's tested above.

A blank space indicates no test performed.

Results expressed as mg/L.
This note is an integral part of the plan.

BASE MAP FROM GHD. (DRAWING NO. 3210596-01)

~RL 80m
~RL 100m
~RL 105m
~RL 90m

LEGEND

17°
Slope Angle

Fault Zones in Bedrock

Degradational Element

Possible Ancient Landslide Geomorphology

Cutting in Siltstone

Alluvium

Fault Zones in Bedrock

Degradational Element

Possible Ancient Landslide Geomorphology

Cutting in Siltstone

~RL 80m
~RL 100m
~RL 105m
~RL 90m

Geeveston

5°
BEDDING IN MAIN CUTTING

Judbury

Eddy Road

WELD PLAINS

MAIN TERRACE

JOHN HOLLAND PTY LTD - SOUTHWOOD PROJECT

GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATIONS

SKETCH PLAN OF GEOLOGY AND GEOMORPHOLOGY
LEGEND

- Borehole with Groundwater level
- Quaternary Alluvium
- Permian Sedimentary Rocks (apparent dip in section)
- Shear Zone, Projection of mapped, others will be present

SMB1

Poor Rock In Borehole
possible Shear Zone

### REVISION

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Drawn</th>
<th>Approved</th>
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<td>0</td>
<td>Issued for Tender</td>
<td>SB</td>
<td>B McD</td>
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**Coffey Geosciences Pty Ltd**
ACN 096 335 516
Geotechnical | Resources | Environmental | Technical | Project Management

**JOHN HOLLAND PTY LTD - SOUTHWOOD PROJECT**
GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATIONS
cross-section C - C'

**DRAWING NO.**
Figure 4

**JOB NO.**
HO154/1AE
Variable aquifers in Sand/clay Colluvium/Residual Soils
Seepage at breaks in slope (seasonal?)

Perched Aquifer in Peat & Sand

Locally Perched Aquifers on Clay Lenses in Alluvium

LIMITED LOCAL FRACTURE PERMEABILITY IN SILTSTONE

Generally drained Alluvium

LEGEND

Seepage

Peat & Sand:
K=10^{-1}-10^{-3} m/day (horizontal)

Alluvium Sandy:
K=10^{-1}-10^{-3} m/day (horizontal & vertical?)

Aquifer

Alluvium Clayey:
K=10^{-4}-10^{-6} m/day (horizontal & vertical)

Colluvium/Residual:
K=10^{-4}-10^{-6} m/day (horizontal)

Siltstone/Sandstone:
K=10^{-4}-10^{-6} m/day
Local fracture zones 10^{-1}-10^{1} m/day

Main Groundwater flow

Minor Groundwater Flow

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**JOHN HOLLAND PTY LTD - SOUTHWOOD PROJECT**
GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATIONS
CONCEPTUAL GROUNDWATER MODEL

Drawing No.: FIGURE 5
Job No.: HO154/1AE