Gerringong to Bomaderry
Princes Highway upgrade

ROUTE OPTIONS DEVELOPMENT
APPENDIX B - PRELIMINARY GEOTECHNICAL REPORT (PART B)
NOVEMBER 2007
Gerringong to Bomaderry
Princes Highway Upgrade

Preliminary Acid Sulphate Soil Assessment

The Roads and Traffic Authority NSW
August 2007
Quality Information

Document Preliminary Acid Sulphate Soil Assessment
Ref DEV06/04-GE-Co Prelim Acid Sulphate Assessment
Date 31 August 2007
Prepared by Manual Fernandez (Coffey)
Reviewed by Steven Andrew (Maunsell)

Revision history

<table>
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RTA acceptance

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<td>Project No.</td>
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<tr>
<td>Approving Manager</td>
<td>Jay Stricker</td>
</tr>
<tr>
<td>Reviewing Officer</td>
<td>Ron de Rooy</td>
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1.0 Background

Maunsell was engaged by the RTA in December 2006 to carry out an Options and Route Selection Study, Concept Development and Environmental Assessment (EA) for upgrading the Princes Highway between 42.6 km to 74.6 km south of Wollongong. Maunsell has engaged a number of prominent sub-consultants to contribute to the delivery of this project.

The work includes development of route options and concept development based on the identified preferred route, environmental assessment, public displays and handover period to allow for finalisation of all activities and reports following the announcement and display of the Preferred Route, the Environmental Assessment and the Conditions of Approval.

The project will provide a bypass of Berry. The northern extremity of the project is in the vicinity of the Mount Pleasant Lookout (north of Gerringong at the termination of the four lane configuration) and the southern extremity of the project is the intersection (roundabout) of the Princes Highway with Cambewarra and Moss Vale Roads at Bomaderry.

Community involvement is a key aspect of this project and will afford the broader community the opportunity to make a demonstrable input to the process and to ensure that the requirements and aspirations of the community will be adequately and appropriately addressed. This is particularly relevant to:

a) Any potential impacts on rural and residential areas within the study area;
b) Social and economic impacts;
c) Accessibility of the road network for local and through traffic;
d) Potential impacts on water quality;
e) Potential impacts on wetlands;
f) Potential impact on flooding;
g) Potential impacts on land uses;
h) Threatened flora and fauna species;
i) Indigenous and non-indigenous heritage;
j) Visual impact;
k) Noise; and
l) Air quality.

Several studies have been undertaken since the early 1990s to identify a preferred route to upgrade sections of the Princes Highway between Kiama and Nowra including a bypass around the town of Berry.

These studies include:

m) The 1991 Gerringong to Berry Route Study;
n) 1998 North Street Berry Bypass Corridor; and
o) 2004/05 Quantm Study from Kiama to Nowra.

Sections of the highway between Gerringong and Bomaderry have a poor accident record and limited safe overtaking opportunities.

Due to the significant changes in traffic, land use and population since 1991, the NSW state government, in March 2006 committed to investigating an area where it is likely a preferred route would be located to upgrade the Princes Highway between Mount Pleasant at Gerringong and Moss Vale/Cambewarra Road at Bomaderry to meet current road standards.
2.0 Objective of report

Coffey Geotechnics Pty Ltd (Coffey) was commissioned by Maunsell to carry out a Preliminary Acid Sulphate Soil (ASS) Assessment for study area for the upgrade of the Princes Highway from Gerringong to Bomaderry, NSW. This Preliminary ASS Assessment was carried out concurrently with a broader geotechnical investigation which is reported separately. This report should be read in conjunction with the Preliminary Geotechnical Report.

The objectives of the Preliminary ASS Assessment were to broadly assess the possible presence and occurrence of ASS within the study area and provide recommendation on the need for further investigations.
3.0 Scope of work

It is important to note that this preliminary assessment was limited to allow general comparison of results for different route options. Whilst the assessment was carried out with reference to the Acid Sulphate Soils Management Advisory Committee (ASSMAC 1998), Acid Sulphate Soils Manual, it does not intend to satisfy all requirements recommended such as sampling frequencies etc.

The following scope of work was carried out to meet the project objectives:

a) Review of ASS risk maps for the study area;
b) A site drive over to observe the general conditions of the study area;
c) Review of relevant information from the geotechnical investigation carried concurrently with this study including field mapping and borehole and test pit logs;
d) Acid sulphate soil sampling from selected boreholes and test pits in the generally low lying eastern parts of the route selection study area to check for the presence of potential acid sulphate soils.
e) Carrying out field screening tests on twenty five (25) soil samples for acid sulphate soils using hydrogen peroxide to assess the potential for acid sulphate soils to exist; and
f) Reporting the results of the assessment including, presenting and interpreting the results of the desk study, field screening and providing conclusions on the likely presence of ASS within the study area and the need for further investigations.
4.0 Site location and description

4.1 Site location

The study area extends from north of Gerringong to Bomaderry, NSW which is approximately 30 km in length and between 1 km to 5 km in width. The study area is shown in Figure 1.
4.2 Topography and drainage

The study area, extending from the Mount Pleasant lookout north of Gerringong to the intersection of Cambewarra and Moss Vale Roads at Bomaderry, involves two main regional topographic settings, first, the undulating hills and their associated foothills to the northwest of the railway, and, second, Shoalhaven lowland plain that extends southeast beyond Coolangatta towards Seven Mile Beach and the Shoalhaven Bight.

The elevated north western portion of the study area has been influenced by the Cambewarra Mountain range. This mountain range compared to the Illawarra range (north of Mount Pleasant at Kiama) is a narrow low range that runs roughly parallel with the coastline. The lower slopes of this range extend into the study area along the high points of Berry. Harley Hill and Toolijooa Hill lie disjointed from the Cambewarra towards the eastern part of the study area.

The prominent high points within the study area include Mount Pleasant (RL 200 m), Toolijooa Hill (RL 130 m), Harley Hill (RL 140 m) Foxground (RL 120 m) and Tomlins Hill (RL 136 m). A ridge of moderate elevation from Foxground to Toolijooa Hill and a flatter ridge to the southeast of Toolijooa Hill separates the Broughton Creek floodplain from the Crooked River floodplain.

Many high sinuosity secondary streams and creeks migrate from higher elevations within the Cambewarra range in a dendritic drainage pattern. These secondary creeks and streams generally flow to the southeast where they merge with either Crooked River in the north or Broughton Creek in the south.

The Shoalhaven lowland plain with a surface elevation generally less than RL 5 m includes the Crooked River floodplain and Broughton Creek floodplain.

Broughton Creek floodplain

The Broughton Creek floodplain and tributary valley floor areas occupy a large portion of the study area to the south and southeast of Berry (mainly floodplains) and tributary valleys to the north and northeast of Berry. Broughton Creek is the dominant watercourse in this area extending back to the escarpment slopes to the north and northeast in the areas of Broughton, Broughton Vale, Bundewallah, Jaspers Brush and Meroo Meadow areas to the south and southeast of Berry. Broughton Creek flows across a broad floodplain in a southerly direction, flowing into the Shoalhaven River about 5 km west of Shoalhaven Heads.

Crooked River floodplain

The Crooked River floodplain where it occurs within the study area includes the low lying areas to the southwest of Gerringong, generally between Toolijooa Road or the Prince Highway and the Illawarra railway. Crooked River originates in the Broughton Vale highlands and flows southeast across the Crooked River floodplain and into Crooked River coastal lagoon.

Omega Flat

Omega Flat is situated between Gerringong and Mount Pleasant ridge in the northern part of the study area described as a lowland marsh / floodplain that is regularly inundated during periods of high rainfall periods. Fluvial sediments originating from Ooaree Creek and general runoff from the Gerringong township, the Princes Highway and surrounding pavement areas is responsible for its accelerated rate of infilling.

The general topography south of Berry comprises undulating foot slopes of the coastal escarpment (Cambewarra range) which is mostly occurs to the west of the existing highway with the low lying coastal plain occurring mostly east of the existing highway. Some of the low ridges extend out into the plain in the areas of Jaspers Brush and Meroo Meadow.
North of Berry township there is a large area of near level land including some low lying areas near the watercourses, with slopes gradually increasing to the north and west. This near level is underlain by alluvial deposits. The existing highway initially follows a narrow ridge to the northeast of Berry then crosses hills and ridges of moderate elevation to Broughton Creek and Foxground Valley which comprises a large area of near level to gently sloping land over the valley floor. The highway passes through a valley and undulating slopes before crossing another high ridge near the southern side of Gerringong township.

### 4.3 General geology

The project specific geotechnical units delineated for the study are described below. Given the wide spacing between test holes and the complexity of floodplain depositional sequences and the bedrock stratigraphic units, it is anticipated that future investigations for a selected highway alignment will identify a more complex arrangement of geotechnical units.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Project specific geotechnical units delineated for the study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit symbol</strong></td>
<td><strong>Subsurface unit</strong></td>
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<tr>
<td>Topsoils and fill</td>
<td></td>
</tr>
<tr>
<td>FILL</td>
<td>Road embankments and hardstand areas</td>
</tr>
<tr>
<td>TOPSOIL</td>
<td></td>
</tr>
<tr>
<td>Seven Mile estuarine sediments and Shoalhaven fluvial sediments – quaternary soil units</td>
<td></td>
</tr>
<tr>
<td>Sm</td>
<td>Seven Mile estuarine deposits</td>
</tr>
<tr>
<td>Sf</td>
<td>Shoalhaven fluvial deposits</td>
</tr>
<tr>
<td>Coolongatta and Kiama erosional sediments – quaternary soil units</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>Coolangatta erosional deposits</td>
</tr>
<tr>
<td>ka</td>
<td>Kiama erosional deposits</td>
</tr>
<tr>
<td>Wattamolla Road depositional sediments</td>
<td></td>
</tr>
<tr>
<td>Wt</td>
<td>Wattamolla Road residual soils and extremely weathered rock</td>
</tr>
<tr>
<td>Shoalhaven group – Gerringong volcanics</td>
<td></td>
</tr>
<tr>
<td>Pgb</td>
<td>Broughton tuff</td>
</tr>
<tr>
<td>Pbk</td>
<td>Kiama tuff</td>
</tr>
<tr>
<td>Shoalhaven group – Berry formation</td>
<td></td>
</tr>
<tr>
<td>Psd</td>
<td>Budgong sandstone</td>
</tr>
<tr>
<td>Psb</td>
<td>Undifferentiated (also known as 'Berry siltstone')</td>
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</table>
4.4 Acid sulphate soil occurrence

ASS is a naturally occurring soil and sediment containing iron sulfides which when exposed to oxygen can generate sulfuric acid. ASS generally occur in marine or estuarine sediments of recent geological age (holocene), within soil horizons typically less than 5 m above Australian Height Datum (AHD).

ASS risk maps for the NSW coastline have been prepared by the Soil Conservation Service of NSW. The mapping was designed to provide information on ASS distribution and indicate land uses which are likely to create environmental risk by exposing ASS to air.

The majority of the study area is covered by three maps (Kiama, Burrier / Berry and Gerroa). A copy of these maps showing the study area is presented in Figure 2.

Reference to the Kiama 1:25,000 Acid Sulphate Soil Risk Map (1997) Edition 2, indicates that a section of the site where the Princes Highway intersects with Ooaree Creek (Rose Valley) is an area of high probability of ASS occurrence being described as low alluvial plains, estuarine sandplains, estuarine swamps, backswamp and supratidal flats, alluvial plains, alluvial swamps, alluvial levees and sandplains in estuarine reaches of catchments.

ASS, if present, are considered to be widespread or sporadic in occurrence and pose a severe environmental risk if disturbed. The map shows areas immediately to the east of this section of the study area as having a low to high probability of ASS occurrence.

Reference to the Burrier / Berry 1:25,000 Acid Sulphate Soil Risk Map (1997) Edition 2, indicates that land on the western side of the South Coast railway includes areas of low probability of ASS occurrence. These areas are described as elevated alluvial plains and levees dominated by fluvial sediments, plains and dunes dominated by aeolian sands, pleistocene plains and lacustrine and alluvium bottom sediment. ASS, if present, are considered to be sporadic and may be buried by alluvium and windblown sediments. Areas on the eastern side of the railway line that are encompassed by the study area are in areas of high probability of ASS occurrence being described as estuarine swamps, intertidal flats, supratidal flats, low alluvial plains, estuarine sandplains, estuarine swamps, backswamps, supratidal flats, alluvial plains, alluvial swamps, alluvial levees, sandplains, elevated levees and sandplains in occurrence and pose a severe environmental risk if disturbed.

Reference to the Gerroa 1:25,000 Acid Sulphate Soil Risk Map (1997) Edition 2, indicates that a section of the site between the southern side of the Princes Highway and the Crooked River is an area of high probability of ASS occurrence being described as low alluvial plains, estuarine sandplains, estuarine swamps, backswamp and supratidal flats, alluvial plains, alluvial swamps, alluvial levees, sandplains and elevated levees in estuarine reaches of catchments. ASS, if present, are considered to be widespread or sporadic in occurrence and pose a severe environmental risk if disturbed. The map shows land immediately to the west of this area at Toolijooa as having a low probability of ASS occurrence.
NTS TEST LOCATIONS WITH ACID SULPHATE SOILS RISK ZONES

PRINCES HIGHWAY UPGRADE, ROUTE SELECTION STUDY
PRELIMINARY ACID SULPHATE SOIL ASSESSMENT
GERRINGONG TO BOMADERRY, NSW

REF:
* Kiama 1:25,000 Acid Sulfate Soil Risk Map (1997) ed. 2 by the Soil Conservation Service of NSW
* Burnier/Berry 1:25,000 Acid Sulfate Soil Risk Map (1997) ed. 2 by the Soil Conservation Service of NSW
* Gerroa 1:25,000 Acid Sulfate Soil Risk Map (1997) ed. 2 by the Soil Conservation Service of NSW

LEGEND
● Approximate Location of Coffey Borehole
■ Approximate Location of Coffey Test Pit
▲ Approximate Location of Piezocone Test

MAUNSELL AECOM

MAUNSELL AECOM

A1

figure no: 2
5.0 Fieldwork and acid sulphate soil screening

5.1 Fieldwork

Fieldwork was carried out as part of the geotechnical investigation. The components of the geotechnical investigation that were relevant to this study included:

a) Field mapping; and
b) Logging of 30 test pits and 20 boreholes.

The fieldwork was carried out between the 12 and 23 March 2007 in the full time presence of an experienced Coffey scientists, engineers and geologists.

Soil samples were generally collected from selected test pit and borehole locations in lower lying areas where there may have been potential for ASS to be present, based on field mapping and information presented on the ASS risk maps. Also, some additional samples from other areas were also collected for screening purposes.

The approximate borehole and test pit locations are shown in Figure 2. The test pit and borehole logs are contained within the geotechnical investigation report. We have included copies of relevant logs from which soil samples were selected for ASS screening purposes in Appendix A.

Soil samples were collected with a new pair of latex gloves from the test pit walls after removal of the smeared surface or from soil in the centre of the excavator bucket, which had not come into contact with the bucket. Samples from borehole locations were collected using an SPT tube sampler.

Soil samples collected for the purposes of acid sulphate soil screening and analysis were wrapped tightly in low-density polyethylene plastic film to expel air and were subsequently placed into labelled plastic bags.

Each plastic bag was then placed immediately into an ice-cooled chest for transport to Coffey’s Unanderra laboratory. Once at Coffey’s Unanderra laboratory, the soil samples were placed into a refrigerator.

5.2 Acid sulphate soil screening

Twenty-five (25) soil samples were screened at Coffey’s Unanderra Laboratory on 19 and 27 March 2007 using the field pH and peroxide test, generally as described in the Acid Sulphate Soil Management Advisory Committee (ASSMAC, 1998) Acid Sulphate Soils Manual and the QLD Department of Natural Resources, Mines and Energy (2004) Acid Sulphate Soils – Laboratory Methods Guidelines. Initially the pH of the soil was tested in an approximate 1:5 solution of distilled water and then also tested following reaction with 30% hydrogen peroxide.
6.0 Results

6.1 Acid sulphate soil screening results

The results of the acid sulphate soil screening tests are presented in Appendix B.

A field pH below 4 can indicate that actual acid sulphate soils are present (i.e. soils in which oxidation of iron sulfides has occurred and have produced acid). Generally a pH drop below 3 following oxidation with hydrogen peroxide indicates the probable presence of unoxidised sulfides in the samples, and for the purposes of the screening test, is taken as an indication of the probable presence of potential acid sulphate soils.

The screening results indicated the following:

a) One soil sample (CBH5/1.5m) recorded a field pH value less than 4, with a value of 3.56; and
b) Five soil samples (CBH5/1.5m, CBH8/2.8-2.9m, CTP21/0.3-0.4m, CTP30/1.5m and CTP30/3.0m) recorded pH values less than 3, following oxidation with hydrogen peroxide, where sample CTP30/3.0m recorded the lowest pH value of 0.89;
7.0 Conclusions and recommendations

Based on the results of the desk studies and fieldwork portions of the study area are likely to be affected by ASS. The field mapping and logging correlated well with the information presented in the ASS risk maps.

Soils showing typical characteristics normally associated with ASS and located in lower lying parts of the study area (less than about 10 m AHD) were identified at locations CBH5, CBH8, CTP30 and CBH3. These soils were typically limited to the upper parts of the soil profile in the upper 1.5 m to 3 m, except for CTP30 where estuarine soils extended below the base of the test pit.

In general, field screening results confirmed the field observations and correlated well with the ASS risk map. One soil sample from location CTP21 at a depth of 0.3 m-0.4 m reacted with the hydrogen peroxide in the field screening test with a low pH of 1.66 after oxidation. This test pit location is mapped as being in an area of ‘no known ASS occurrence’ on the risk map. This area is approximately 400 m west of an area mapped as having a ‘low probability of occurrence’. It is possible that ASS could extend further west than indicated on the risk map in this area. However, this would need to be checked by further sampling and laboratory testing.

Lower lying areas in the eastern parts of the study area have a high likelihood of being ASS, particularly within the alluvial and estuarine units. Other geotechnical units in the study area generally have a low likelihood of potential acid sulphate occurrence.

One section of the study area (about 1.5 km in length) at Ooaree Creek (Rose Valley) within the northern part of the study area is likely to be affected by ASS, based on the ASS risk map.

Appropriate identification of potential high hazard and high risk ASS zones should be carried out along the preferred route at the planning and design stage. Activities such as creek culverts, drainage works, and stormwater basins become a high risk if they are likely to intersect zones with a high ASS hazard rating. Proper planning may avoid placing these high risk activities in areas of high ASS hazard.

Some examples of planning include, but should not be limited to:

a) Where piles are required to extend into the acid sulphate soils (such as the floodplain soils), driven piles or screw piles are preferred to bored piles, where practicable;

b) Design of wider shallow drainage or high level pipes should be preferred, rather than deep drains that extend into the acid sulphate soils;

c) Excavations below the groundwater table should be avoided. If excavation below the groundwater table is unavoidable, cut off walls or possibly groundwater reinjection may need to be considered to reduce the risk of lowering the groundwater table during construction; and

d) Where acid sulphate soils are disturbed and excavated, the excavated soils should be either returned immediately to below the water table, placed in temporary stockpiles or transported directly to a specially prepared treatment pad for liming. Following successful neutralisation with lime, the soils may be used as general fill subject to geotechnical, environmental and other relevant requirements.

An ASS assessment would be required along the selected route to check for the presence of ASS and assess management strategies. An ASS management Plan would need to be prepared to outline methods of assessment, management and monitoring of ASS for areas where ASS is likely to be disturbed.
8.0 Limitations

The findings contained in this report are the result of discrete / specific methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general conditions of the site in the areas tested. Under no circumstances can it be considered that these findings represent the actual state of the site at all points.
Appendix A  Engineering logs of selected boreholes and test pits
Soil Description Explanation Sheet (1 of 2)

DEFINITION:
In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME
Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

PARTICLE SIZE DESCRIPTIVE TERMS

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<th>SUBDIVISION</th>
<th>SIZE</th>
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<td>Boulders</td>
<td></td>
<td>&gt;200 mm</td>
</tr>
<tr>
<td>Cobble</td>
<td></td>
<td>63 mm to 200 mm</td>
</tr>
<tr>
<td>Gravel</td>
<td>coarse</td>
<td>20 mm to 63 mm</td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td>6 mm to 20 mm</td>
</tr>
<tr>
<td></td>
<td>fine</td>
<td>2.36 mm to 6 mm</td>
</tr>
<tr>
<td>Sand</td>
<td>coarse</td>
<td>600 μm to 2.36 mm</td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td>200 μm to 600 μm</td>
</tr>
<tr>
<td></td>
<td>fine</td>
<td>75 μm to 200 μm</td>
</tr>
</tbody>
</table>

MOISTURE CONDITION
Dry    Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.
Moist   Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet     As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

<table>
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<tr>
<th>TERM</th>
<th>UNDRAINED STRENGTH f'φ (kPa)</th>
<th>FIELD GUIDE</th>
</tr>
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<tr>
<td>Very Soft</td>
<td>&lt;12</td>
<td>A finger can be pushed well into the soil with little effort.</td>
</tr>
<tr>
<td>Soft</td>
<td>12 - 25</td>
<td>A finger can be pushed into the soil to about 25mm depth.</td>
</tr>
<tr>
<td>Firm</td>
<td>25 - 50</td>
<td>The soil can be indented about 5mm with the thumb, but not penetrated.</td>
</tr>
<tr>
<td>Stiff</td>
<td>50 - 100</td>
<td>The surface of the soil can be indented with the thumb, but not penetrated.</td>
</tr>
<tr>
<td>Very Stiff</td>
<td>100 - 200</td>
<td>The surface of the soil can be marked, but not indented with thumb pressure.</td>
</tr>
<tr>
<td>Hard</td>
<td>&gt;200</td>
<td>The surface of the soil can be marked only with the thumb.</td>
</tr>
<tr>
<td>Friable</td>
<td></td>
<td>Crumbles or powders when scraped by thumbnail.</td>
</tr>
</tbody>
</table>

DENSITY OF GRANULAR SOILS

<table>
<thead>
<tr>
<th>TERM</th>
<th>DENSITY INDEX (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very loose</td>
<td>Less than 15</td>
</tr>
<tr>
<td>Loose</td>
<td>15 - 35</td>
</tr>
<tr>
<td>Medium Dense</td>
<td>35 - 65</td>
</tr>
<tr>
<td>Dense</td>
<td>65 - 85</td>
</tr>
<tr>
<td>Very Dense</td>
<td>Greater than 85</td>
</tr>
</tbody>
</table>

MINOR COMPONENTS

<table>
<thead>
<tr>
<th>TERM</th>
<th>ASSESSMENT GUIDE</th>
<th>PROPORTION OF MINOR COMPONENT IN:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace of</td>
<td>Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.</td>
<td>Coarse grained soils: &lt;2% Fine grained soils: &lt;10%</td>
</tr>
<tr>
<td>With some</td>
<td>Presence easily detected by feel or eye, soil properties little different to general properties of primary component.</td>
<td>Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%</td>
</tr>
</tbody>
</table>

SOIL STRUCTURE

<table>
<thead>
<tr>
<th>ZONING</th>
<th>CEMENTING</th>
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</thead>
<tbody>
<tr>
<td>Layers</td>
<td>Continuous across exposure or sample.</td>
</tr>
<tr>
<td>Lenses</td>
<td>Discontinuous layers of lenticular shape.</td>
</tr>
<tr>
<td>Pockets</td>
<td>Irregular inclusions of different material.</td>
</tr>
</tbody>
</table>

GEOLOGICAL ORIGIN
WEATHERED IN PLACE SOILS
Extremely weathered material
Residual soil
Structure and fabric of parent rock visible.
Structure and fabric of parent rock not visible.

TRANSPORTED SOILS

| Aeolian soil  | Deposited by wind. |
| Alluvial soil | Deposited by streams and rivers. |
| Collouvial soil | Deposited on slopes (transported downslope by gravity). |
| Fill          | Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils. |
| Lacustrine soil | Deposited by lakes. |
| Marine soil   | Deposited in ocean basins, bays, beaches and estuaries. |
### Soil Description Explanation Sheet (2 of 2)

#### Soil Classification Including Identification and Description

<table>
<thead>
<tr>
<th>FIELD IDENTIFICATION PROCEDURES</th>
<th>USC</th>
<th>PRIMARY NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide range in grain size and substantial amounts of all intermediate particle sizes.</td>
<td>GW</td>
<td>GRAVEL</td>
</tr>
<tr>
<td>Predominantly one size or a range of sizes with more intermediate sizes missing.</td>
<td>GP</td>
<td>GRAVEL</td>
</tr>
<tr>
<td>Non-plastic fines (for identification procedures see ML below)</td>
<td>GM</td>
<td>SILTY GRAVEL</td>
</tr>
<tr>
<td>Plastic fines (for identification procedures see CL below)</td>
<td>GC</td>
<td>CLAYEY GRAVEL</td>
</tr>
<tr>
<td>Wide range in grain sizes and substantial amounts of all intermediate sizes missing.</td>
<td>SW</td>
<td>SAND</td>
</tr>
<tr>
<td>Predominantly one size or a range of sizes with some intermediate sizes missing.</td>
<td>SP</td>
<td>SAND</td>
</tr>
<tr>
<td>Non-plastic fines (for identification procedures see ML below)</td>
<td>SM</td>
<td>SILTY SAND</td>
</tr>
<tr>
<td>Plastic fines (for identification procedures see CL below)</td>
<td>SC</td>
<td>CLAYEY SAND</td>
</tr>
</tbody>
</table>

#### Identification Procedures on Fractions < 0.2 mm.

<table>
<thead>
<tr>
<th>DRY STRENGTH</th>
<th>DILATANCY</th>
<th>TOUGHNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>None to Low</td>
<td>Quick to slow</td>
<td>None</td>
</tr>
<tr>
<td>Medium to High</td>
<td>None</td>
<td>Medium</td>
</tr>
<tr>
<td>Low to medium</td>
<td>Slow to very slow</td>
<td>Low</td>
</tr>
<tr>
<td>Low to medium</td>
<td>Slow to very slow</td>
<td>Low to medium</td>
</tr>
<tr>
<td>High</td>
<td>None</td>
<td>High</td>
</tr>
<tr>
<td>Medium to High</td>
<td>None</td>
<td>Low to medium</td>
</tr>
</tbody>
</table>

#### Highly Organic Soils

- Readily identified by colour, odour, spongy feel and frequently by fibrous texture.
- *Low plasticity – Liquid Limit W_L less than 35%.
- *Medium plasticity – W_L between 35% and 50%.

#### Common Defects in Soil

<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION</th>
<th>DIAGRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARTING</td>
<td>A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.</td>
<td></td>
</tr>
<tr>
<td>JOINT</td>
<td>A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term ‘fissure’ may be used for irregular joints &lt;0.2 m in length.</td>
<td></td>
</tr>
<tr>
<td>SHEARED ZONE</td>
<td>Zone in clayey soil with roughly parallel or curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.</td>
<td></td>
</tr>
<tr>
<td>SHEARED SURFACE</td>
<td>A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION</th>
<th>DIAGRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOFTENED ZONE</td>
<td>A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.</td>
<td></td>
</tr>
<tr>
<td>TUBE</td>
<td>Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by dense packing of grains. May contain organic matter.</td>
<td></td>
</tr>
<tr>
<td>TUBE CAST</td>
<td>Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.</td>
<td></td>
</tr>
<tr>
<td>INFILLED SEAM</td>
<td>Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.</td>
<td></td>
</tr>
</tbody>
</table>
**Rock Description**

Examination Sheet (1 of 2)

The descriptive terms used by Coffey are given below. They are broadly consistent with Australian Standard AS1726-1993.

**Definitions:**
- **Rock Substance**: In engineering terms rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.
- **Defect**: Discontinuity or break in the continuity of a substance or substances. It can consist of two or more substances without defects, or one or more substances with one or more defects.
- **Mass**: Any body of material which is not effectively homogenous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

**Substance Descriptive Terms:**

<table>
<thead>
<tr>
<th>ROCK NAME</th>
<th>Term</th>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse</td>
<td>Grain size terms for sandstone are: Mainly 0.06mm to 2mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>Mainly 0.2mm to 0.6mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fine</td>
<td>Mainly 0.06mm (just visible) to 0.2mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FABRIC</td>
<td>Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Massive</td>
<td>No layering or penetrative fabric.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indistinct</td>
<td>Layering or fabric just visible. Little effect on properties.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distinct</td>
<td>Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Classification of Weathering Products**

<table>
<thead>
<tr>
<th>Term</th>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual Soil</td>
<td>RS</td>
<td>Soil derived from the weathering of rock; the mass and structure of the fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.</td>
</tr>
<tr>
<td>Extremely Weathered Material</td>
<td>XW</td>
<td>Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or can be remoulded in water. Original rock fabric still visible.</td>
</tr>
<tr>
<td>Highly Weathered Rock</td>
<td>HW</td>
<td>Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching. The extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.</td>
</tr>
<tr>
<td>Moderately Weathered Rock</td>
<td>MW</td>
<td>The whole of the rock substance is discoloured, usually by iron staining or bleaching, to the extent that the colour of the fresh rock is no longer recognisable.</td>
</tr>
<tr>
<td>Slightly Weathered Rock</td>
<td>SW</td>
<td>Rock substance affected by weathering to the extent that partial staining or partial discoloration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.</td>
</tr>
<tr>
<td>Fresh Rock</td>
<td>FR</td>
<td>Rock substance unaffected by weathering.</td>
</tr>
</tbody>
</table>

**Rock Substrate Strength Terms**

<table>
<thead>
<tr>
<th>Term</th>
<th>Abbreviation</th>
<th>Load Index, Ig50 (MPa)</th>
<th>Field Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low</td>
<td>VL</td>
<td>Less than 0.1</td>
<td>Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.</td>
</tr>
<tr>
<td>Low</td>
<td>L</td>
<td>0.1 to 0.3</td>
<td>Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.</td>
</tr>
<tr>
<td>Medium</td>
<td>M</td>
<td>0.3 to 1.0</td>
<td>Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.</td>
</tr>
<tr>
<td>High</td>
<td>H</td>
<td>1 to 3</td>
<td>A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.</td>
</tr>
<tr>
<td>Very High</td>
<td>VH</td>
<td>3 to 10</td>
<td>Hand specimen breaks after more than one blow of a pick; rock rings under hammer.</td>
</tr>
<tr>
<td>Extremely High</td>
<td>EH</td>
<td>More than 10</td>
<td>Specimen requires many blows with geological pick to break rock rings under hammer.</td>
</tr>
</tbody>
</table>

**Notes on Rock Substrate Strength:**

1. In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy.
2. The term "extremely low" is not used as a rock substrate strength term. While the term is used in AS1726-1985, the field guide therein makes it clear that material in that strength range are soft in engineering terms.
3. The unfaulted compressive strength for isotropic rocks (and purely isotropic rocks which fall across the planar anisotropy) is typically 10 to 25 times the point load index, b4. The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.
# Rock Description Explanation Sheet (2 of 2)

<table>
<thead>
<tr>
<th>COMMON DEFECTS IN ROCK MASSES</th>
<th>Diagram</th>
<th>Map Symbol</th>
<th>Graphic Log (Note 1)</th>
<th>DEFECT SHAPE</th>
<th>TERMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
<td></td>
<td></td>
<td></td>
<td>Planar</td>
<td></td>
</tr>
<tr>
<td>Parting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A surface or crack across which the rock has little or no tensile strength. Parallel or sub parallel to layering (eg bedding) or a planar anisotropy in the rock substance (eg, cleavage). May be open or closed.</td>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="Bedding" /> <img src="image" alt="Cleavage" /></td>
<td><img src="image" alt="Note 2" /></td>
<td>Curved</td>
<td>The defect does not vary in orientation</td>
</tr>
<tr>
<td>Joint</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.</td>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="60°" /></td>
<td><img src="image" alt="Note 2" /></td>
<td>Undulating</td>
<td>The defect has a gradual change in orientation</td>
</tr>
<tr>
<td>Sheared Zone (Note 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.</td>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="35°" /></td>
<td><img src="image" alt="Note 2" /></td>
<td>Stepped</td>
<td>The defect has one or more well defined steps</td>
</tr>
<tr>
<td>Sheared Surface (Note 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A near planar, curved or undulating surface which is usually smooth, polished or slickensided.</td>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="40°" /></td>
<td><img src="image" alt="Note 2" /></td>
<td>Irregular</td>
<td>The defect has many sharp changes of orientation</td>
</tr>
<tr>
<td>Crushed Seam (Note 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties.</td>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="50°" /></td>
<td><img src="image" alt="Note 2" /></td>
<td>Very Rough</td>
<td>Many large surface irregularities (amplitude generally more than 1mm). Feels like coarse sand paper.</td>
</tr>
<tr>
<td>Infilled Seam</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface.</td>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="65°" /></td>
<td><img src="image" alt="Note 2" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extremely Weathered Seam</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seam of soil substance, often with gradational boundaries. Formed by weathering of the rock substance in place.</td>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="32°" /></td>
<td><img src="image" alt="Note 2" /></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes on Defects:**
1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip.
2. Partings and joints are not usually shown on the graphic log unless considered significant.
3. Sheared zones, sheared surfaces and crushed seams are faults in geological terms.

**ROUGHNESS TERMS**
- Slickensided: Grooved or striated surface, usually polished.
- Polished: Shiny smooth surface.
- Smooth: Smooth to touch. Few or no surface irregularities.
- Rough: Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
- Very Rough: Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.

**COATING TERMS**
- Clean: No visible coating.
- Stained: No visible coating but surfaces are discoloured.
- Veneer: A visible coating of soil or mineral, too thin to measure; may be patchy.
- Coating: A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein.

**BLOCK SHAPE TERMS**
- Blocky: Approximately equidimensional.
- Tabular: Thickness much less than length or width.
- Columnar: Height much greater than cross section.
### Engineering Log - Borehole

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERY, PRINCES HWY UPGRADE  
**Logged by:** CA  
**Borehole Location:** SWAMP ROAD, JASPERS BRUSH (REFER SITE PLAN)

#### Drilling Information

<table>
<thead>
<tr>
<th>Drilling Method</th>
<th>Support</th>
<th>Notes, Samples, Tests</th>
<th>Material</th>
<th>Structure and Additional Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADT</td>
<td>C</td>
<td></td>
<td>PEA: low to medium plasticity, black</td>
<td>Organic layer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Silty CLAY: high plasticity, light black and grey</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Silty SAND: fine grained, pale orange, yellow and grey</td>
<td>Extremely weathered, residual soil with iron staining</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CLAY: high plasticity, pale blue and grey</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Silty Sandy CLAY: high plasticity, pale blue and grey with trace fine angular gravel</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Claysay SAND: fine grained, pale green</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CLAY: low plasticity, orange, brown and grey with trace medium angular gravel</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Silty Clayey SAND: fine grained, pale green and grey with some trace angular gravel</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CLAY: low plasticity, orange</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Clayey GRAVEL: fine to coarse grained, angular with underbedded clay bands and shale bands</td>
<td>V bit and TC bit refusal, SPT bouncing @ 4.65m (25, - , -)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SPT bouncing @ 6.72m (23, 25/70mm, -)</td>
</tr>
</tbody>
</table>

---

**Classification Symbols and Soil Description**

- **Moisture:** D dry, M moist, W wet
- **Wp:** plastic limit
- **Wl:** liquid limit
- **Classification Symbols:** vS very soft, s soft, F firm, St stiff, VSr very stiff, H hard, Sh shaley, WL very loose, L loose, MD medium dense, D dense, VD very dense

---

**Notes:**

- **ADT:** auger surveying
- **AD:** auger drilling
- **RR:** roller/tonne
- **CT:** cable tool
- **HA:** hand auger
- **DT:** disturbed
- **N:** refusal
- **V:** water intake
- **T:** water outflow
- **10/198 water level on date shown**

---

**Location Details:**

- **Easting:** 286506.88
- **Northing:** 614544.04
- **R.T. Surface:** 0.82

---

**References:**

- **BOREHOLE GL0290-00 LOGS GPS COFFET 13.4.07**
**Engineering Log - Borehole**

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Borehole Location:** SWAMP ROAD, JASPER S BRUSH (REFER SITE PLAN)

<table>
<thead>
<tr>
<th>drill model and mounting:</th>
<th>FOX UB40 TRUCK</th>
<th>Easting: 286506.88</th>
<th>slope: -90°</th>
<th>R1 Surface: R1K</th>
</tr>
</thead>
<tbody>
<tr>
<td>hole diameter:</td>
<td>100 mm</td>
<td>Northing: 614544.04</td>
<td>bearing:</td>
<td>datum:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>drill method</th>
<th>support</th>
<th>notes, samples, tests, etc</th>
<th>Rl depth metres</th>
<th>graphic log classification symbol</th>
<th>material</th>
<th>moisture condition</th>
<th>consistency/density index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>soil type: plasticity or particle characteristics, colour, secondary and minor components.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Borehole CBH5 continued as cored hole.
Engineering Log - Cored Borehole

Client: MAUNSELL AECOM
Principal: RTA
Project: GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE
Borehole Location: SWAMP ROAD, JASPERS BRUSH (REFER SITE PLAN)

Borehole No: CBH5
Sheet: 3 of 3
Project No: GEOTUNAN02580-AA
Date started: 21.3.2007
Date completed: 21.3.2007
Logged by: CA
Checked by:

Drill model & mounting: FOX UB40 TRUCK
Hole diameter: 100 mm
Drilling fluid: Northing: 6145441.04
Northing: 286506.88
Easting: 286506.88
Slope: -90°
RI Surface: 0.00
Datum: 0

Drilling Information:

<table>
<thead>
<tr>
<th>method</th>
<th>core-lift</th>
<th>RL</th>
<th>depth</th>
<th>graphic log/core recovery</th>
<th>material</th>
<th>rock mass defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM/C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ALLUVIUM: cobbles gravel and clay, cobbles and gravel rounded to sub rounded, brown to grey, clay pale grey and orange brown</td>
<td>DW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NO CORE: 9.1m to 9.3m</td>
<td>D 7.546.75</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ALLUVIUM: cobbles gravel and clay, cobbles and gravel rounded to sub rounded, brown to grey, clay pale grey and orange brown</td>
<td>D 7.545.71</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CBH5 terminated at 12m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D 7.545.33</td>
</tr>
</tbody>
</table>

Core-lift: casing used
Bailers withdrawn

Graphic log/core recovery:
- Core recovered
- Graphic symbols indicate material
- No core recovered

Water:
- 10/100 water level
- Water inflow
- Partial drill fluid loss
- Complete drill fluid loss

Water pressure test result:
- (lugeon) for depth interval shown

Weathering:
- Fresh
- Slightly weathered
- Moderately weathered
- Highly weathered
- Extremely weathered
- Distinctly weathered

Strength:
- Very low
- Low
- Medium
- High
- Very high
- Extremely high

Defect Type:
- Joint
- Planar
- Curved
- Undulating
- Stippled
- Irregular

Coating:
- CN clean
- SN stained
- VN venetian
- CO uveing

Roughness:
- VR very rough
- RD rough
- SO smooth
- SL slickensided

Planarity:
- PL planar
- UN undulating
- ST stippled
- IR irregular

Crown:
- VR very rough
- RD rough
- SO smooth
- SL slickensided

Softness:
- VN very hard
- VV very very hard
- EH extremely hard

Crown:
- VR very rough
- RD rough
- SO smooth
- SL slickensided
# Engineering Log - Piezometer

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Borehole Location:** SWAMP ROAD, JASPERS BRUSH (REFER SITE PLAN)  
**Borehole No.:** CBH5  
**Sheet:** 1 of 2  
**Project No.:** GEOTUNAN02580-AA  
**Date started:** 21.3.2007  
**Date completed:** 21.3.2007  
**Logged by:** CA  
**Checked by:**  

<table>
<thead>
<tr>
<th>drilling information</th>
<th>material substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>method</td>
<td>support</td>
</tr>
<tr>
<td>ADT</td>
<td>260/290</td>
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<td>RE</td>
<td>25.8</td>
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</tr>
</tbody>
</table>

**Notes:**  
- **Support:** C: casing N: nil  
- **Method:**  
  - AS: auger screwing  
  - AD: auger drilling  
  - RR: roll erator  
  - W: washbore  
  - CT: cable tool  
  - DT: disturbance  
  - B: blank bit  
  - V: V bit  
  - T: TC bit  
  - TBX: Tuex  
- **Notes, samples, tests:**  
  - 10/1/06 water level on date shown  
  - Water inflow and water outflow  
- **Classification symbols and soil description:**  
  - Moisture: D: dry, M: moist, W: wet  
  - S: soft, S: stiff  
  - F: firm, F: fragile  
  - V: very soft, V: very stiff  
  - F: firm, F: fragile  
  - VL: very loose, VL: very firm  
  - L: loose, L: dense  
  - MD: medium dense, MD: dense  
  - D: dense  
- **Consistency/density index:**  
  - VS: very soft, S: soft  
  - F: firm, F: fragile  
  - V: very soft, V: very stiff  
  - F: firm, F: fragile  
  - VL: very loose, VL: very firm  
  - L: loose, L: dense  
  - MD: medium dense, MD: dense  
  - D: dense  
  - VD: very dense
## Engineering Log - Piezometer

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Borehole Location:** SWAMP ROAD, JASPERS BRUSH (REFER SITE PLAN)

**Drill model & mounting:** FOX UB40 TRUCK  
**Casing:** 200C50.00  
**slope:** -8°  
**R.L. Surface:** 0.82

<table>
<thead>
<tr>
<th>method</th>
<th>support</th>
<th>notes, samples, tests, etc</th>
<th>well details</th>
<th>material</th>
<th>classification symbol</th>
<th>soil type: plasticity or particle characteristics, colour, secondary and minor components.</th>
<th>moisture condition</th>
<th>consistency/density index</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

**material**  
ALLUVIUM: cobbles gravel and clay, cobbles and gravel rounded to sub rounded, brown to grey, clay pale grey and orange brown

**material**  
ALLUVIUM: cobbles gravel and clay, cobbles and gravel rounded to sub rounded, brown to grey, clay pale grey and orange brown

**Datum:**

- **Borehole terminated at 12m**
### Engineering Log - Borehole

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Borehole Location:** COOLANGATTA ROAD, BERRY (REFER SITE PLAN)

#### Drilling Information

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Material Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>Gravely SAND: fine to coarse grained, brown, with fine to medium grained sand, subrounded to subangular with some silty clay, with a trace of rocks</td>
</tr>
<tr>
<td>1.0</td>
<td>Silty CLAY: medium plasticity, dark grey, with trace of fine to medium grained sand</td>
</tr>
<tr>
<td>2.3-2.5m</td>
<td>Silty CLAY: medium plasticity, pale brown, with a trace of fine to medium grained sand</td>
</tr>
<tr>
<td>3.0</td>
<td>Sandy CLAY: medium to high plasticity, pale grey/orange mottled, with fine to coarse grained sand, with a trace of 10% sandstone gravel fine to medium iron staining and rooflets</td>
</tr>
<tr>
<td>3.6-4.5m</td>
<td>Silty CLAY: medium high plasticity, grey/pale green</td>
</tr>
<tr>
<td>4.5-5.5m</td>
<td>Silty CLAY: medium to high plasticity, grey/pale grey, with a trace of fine to coarse sand and coarse gravel, subrounded to subangular, iron staining</td>
</tr>
<tr>
<td>5.5-6.6m</td>
<td>Gravels and possibly cobbles</td>
</tr>
<tr>
<td>6.6m</td>
<td>Borehole CBH8 terminated at 6.6m</td>
</tr>
</tbody>
</table>

#### Notes, Samples, Tests

- Undisturbed sample 50mm diameter
- Undisturbed sample 63mm diameter
- Disturbed sample
- Standard penetration test (SPT)
- SPT - sample recovered
- SPT with solid cone
- Vane shear (kPa)
- Bulk sample
- Environmental sample
- Refusal

#### Classification Symbols and Soil Description

- Based on unified classification system

<table>
<thead>
<tr>
<th>Moisture</th>
<th>Consistency/Density Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry</td>
<td>Very soft</td>
</tr>
<tr>
<td>Hard</td>
<td>Soft</td>
</tr>
<tr>
<td>Wet</td>
<td>Firm</td>
</tr>
<tr>
<td>Very loose</td>
<td>Stiff</td>
</tr>
<tr>
<td>Loose</td>
<td>Very stiff</td>
</tr>
<tr>
<td>Medium dense</td>
<td>Medium dense</td>
</tr>
<tr>
<td>Dense</td>
<td>Very dense</td>
</tr>
</tbody>
</table>

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**Date started:** 13.3.2007  
**Date completed:** 13.3.2007  
**Logged by:** DD  
**Checked by:**
**Engineering Log - Piezometer**

Client: MAUNSELL AECOM  
Principal: RTA  
Project: GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
Borehole Location: COOLANGATTA ROAD, BERRY (REFER SITE PLAN)

<table>
<thead>
<tr>
<th>method</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>classification symbols</th>
<th>material</th>
<th>moisture condition</th>
<th>structure and additional observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;Wp D</td>
<td>FILL</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT</td>
<td>2.02</td>
<td>N=2</td>
<td></td>
<td></td>
<td></td>
<td>1.0m to 1.1m: ASS Sample</td>
</tr>
<tr>
<td></td>
<td>4,5,6</td>
<td>N=11</td>
<td></td>
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<tr>
<td></td>
<td>3,7,9</td>
<td>N=16</td>
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**Drilling Information**

- **Well details**: 209214.94  
- **Shank**: -90°  
- **R.L. Surface**: 2.32  
- **Datum**: 614780.91  
- **Borehole terminated at 6.6m**  
- **SPT**: 2.02, 4.5, 6, 3.7, 9, 16  
- **N**: 2, 11, 16  
- **Gravely SAND: fine to coarse grained, brown, with fine to medium gravel, subrounded to subangular with some silt and clay, with a trace or two of gravel**  
- **Silty CLAY: medium plasticity, dark grey, with trace of fine to medium grained sand**  
- **2.3m to 2.4m: gravel lens**  
- **Silty CLAY: medium plasticity, pale brown, with a trace of fine to medium grained sand**  
- **Sandy CLAY: medium to high plasticity, pale grey / orange mottled, with fine to coarse grained sand, with a trace of XW sandstone gravel to fine to medium iron staining and rocklets**  
- **Silty CLAY: medium to high plasticity, grey / pale green**  
- **Silty CLAY: medium high plasticity, pale grey, with a trace of fine to coarse sand and coarse gravel, subrounded to subangular, iron staining**  
- **Gravels and possibly cobbles**  
- **Drill rig terminated augering, so not to damage augers**  

**Notes**

- UNDABRUPT termination at 6.6m  
- Borehole water inflow

**Consistency/density index**:  
- VS: very soft  
- S: soft  
- F: firm  
- St: stiff  
- VS: very stiff  
- H: hard  
- T: trace  
- V: very loose  
- L: loose  
- MD: medium dense  
- D: dense  
- VO: very dense
**Engineering Log - Borehole**

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Borehole Location:** BONG BONG ROAD, BROUGHTON (REFER SITE PLAN)

| drill model and mounting: | H-POWER SCOUT TRUCK  
|-------------------------|---------------------|
| hole diameter: | 100 mm  
| Northing: | 6151157.1  
| bearing: |  
| datum: |  
| slope: | -90°  
| R.L. Surface: | 26.86  

### Drilling Information

<table>
<thead>
<tr>
<th>method</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>classification and soil description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADV</td>
<td></td>
<td></td>
<td>soil type: plasticity or particle characteristics, colour, secondary and minor components.</td>
</tr>
<tr>
<td>ADT</td>
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<td>M M</td>
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</tbody>
</table>
|        |         |                         | 0.6m to 0.7m: ASS Sample  
|        |         |                         | 0.7m to 0.8m: SPT Sample  
|        |         |                         | 1.6m to 1.7m: ASS Sample  
|        |         |                         | 1.7m to 1.8m: SPT Sample  
|        |         |                         | 3.1m to 3.2m: ASS Sample  
|        |         |                         | 3.2m to 3.3m: SPT Sample  
|        |         |                         | 3.36m to 3.45m: SPT Sample  
|        |         |                         | 4.0m to 4.2m: Grab Sample  

### Material Substance

- **TOPSOIL:** Gravely Silty SAND: fine to coarse grained, brown, with fine to medium grained gravel, subangular
- Silty CLAY: medium plasticity, brown/green/red mottled, with a trace of fine sand, and fine to medium grained gravel from 0.15m to 0.6m
- Silty CLAY: low to medium plasticity, pale yellow/orange/white mottled, with a trace of fine to medium grained sand, fine grained gravel subrounded to subangular
- Silty CLAY: low plasticity, pale yellow/white, with some fine to medium grained gravel subrounded of ironstone and sandstone
- Sandly Silty CLAY: low plasticity, white, fine to medium sand, with a trace of fine gravel subrounded to subangular
- 3.7m to 4.2m: Crevela, sandstone, fine to medium grained, subrounded to rounded

Borehole CBH111 continued as cored hole.
# Engineering Log - Piezometer

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Borehole Location:** BONG BONG ROAD, BROUGHTON (REFER SITE PLAN)

**Borehole No.: CBH11**  
**Sheet:** 1 of 1  
**Project No.: GEOTUNAN02580-AA**  
**Date started:** 14.3.2007  
**Date completed:** 14.3.2007  
**Logged by:** DD  
**Checked by:** [Signature]

### Drilling Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Penetration</th>
<th>Support</th>
<th>Notes, Samples, Tests</th>
<th>Material Substance</th>
<th>Moisture Condition</th>
<th>Consistency/Density Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADV</td>
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<tr>
<td>SPT</td>
<td>3.4, 4 N=8</td>
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<td></td>
<td>TOPSOIL: Gravely Silty SAND: fine to coarse grained, brown, with fine to medium grained gravel, mottled. Silty CLAY: medium plasticity, brown/green/red mottled, with a trace of fine sand, and fine to medium grained gravel from 0.15m to 0.6m</td>
<td>M</td>
<td>FILL - TOPSOIL</td>
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<tr>
<td>ADT</td>
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<tr>
<td>SPT</td>
<td>5.8, 20 N=28</td>
<td></td>
<td></td>
<td>Silty CLAY: low to medium plasticity, pale yellow/orange/white, with a trace of fine to medium grained sand, fine to medium grained gravel subrounded to subangular</td>
<td>VST 0.6m to 0.7m: ASS Sample 0.7m to 0.8m: SPT Sample</td>
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**Drill Model & Mounting:** H POWER SCOUT TRUCK  
**Easting:** 200360.00  
**Slope:** 90°  
**Northing:** 6151157.1  
**Datum:** 20.05  
**Borehole Terminated at 4.2m**
## Engineering Log - Borehole

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Borehole Location:** GEMBROCK LANE, BROUGHTON (REFER SITE PLAN)

### Drilling Information

<table>
<thead>
<tr>
<th>Drilling Support</th>
<th>Water</th>
<th>Notes, Samples, Tests, etc.</th>
<th>RL Meters</th>
<th>Classification Symbol</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>10</td>
<td>Silty CLAY: medium plasticity, brown/orange, with a trace of fine to medium sand and fine to medium gravel, subrounded to subangular, well rounded, (inclined to horizontal)</td>
<td>&lt;=Wp</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>14</td>
<td>Silty CLAY: low to medium plasticity, brown/orange, with a trace of fine to medium sand</td>
<td>VSt</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>7,14,17</td>
<td>Sandy CLAY: low to medium plasticity, gray, with fine to medium sand, with some fine gravel, subrounded to subangular, well rounded, (inclined to horizontal)</td>
<td>&lt;=Wp</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>11</td>
<td>Silty CLAY: low to medium plasticity, gray, with a trace of fine sand</td>
<td>H</td>
</tr>
<tr>
<td>5</td>
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<td>10</td>
<td>Borehole CBH13 continued as cored hole</td>
<td>VSt</td>
</tr>
<tr>
<td>6</td>
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<td>9</td>
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<td>7</td>
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<tr>
<td>8</td>
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</tbody>
</table>

### Material Substance

- **soil type:** plasticity or particle characteristics, colour, secondary and minor components.

### Consistency/Density Index

- **Moisture:**
  - D: dry  
  - H: hard  
  - W: wet  
  - Wp: plastic limit  
  - WI: liquid limit

- **Consistency/Density Index:**
  - VS: very soft  
  - S: soft  
  - F: firm  
  - SI: stiff  
  - VL: very loose  
  - L: loose  
  - MD: medium dense  
  - D: dense  
  - VD: very dense
# Engineering Log - Cored Borehole

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Borehole Location:** GEMBROCK LANE, BROUGHTON (REFER SITE PLAN)

**Drilling Information**
- **Drill model & mounting:** H-POWER SCOUT TRUCK  
- **Hole diameter:** 100 mm  
- **Drilling fluid:** Not specified  
- **East:** 292004.2  
- **North:** 6150866.61  
- **Slope:** -90°  
- **Bearing:** Not specified  
- **Datum:** Not specified

**Rock Mass Defects**

<table>
<thead>
<tr>
<th>Method</th>
<th>Core-Lift</th>
<th>Material Substance</th>
<th>Rock Type</th>
<th>Grain Characteristics, Colour, Structure, Minor Components</th>
<th>Estimated Strength</th>
<th>Defect Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rock Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Silty SANDSTONE: fine grained, distinctly laminated @ 0 deg, grey / pale blue</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Silty SANDSTONE: fine grained, laminated @ 5 deg, pale grey/blue</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>CLAYSTONE: pale brown and grey</td>
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</tr>
</tbody>
</table>

**Defect Type**
- RT: joint  
- PT: parting  
- SM: seam  
- SL: slickensided  
- PL: planar  
- VN: vaneer  
- CD: coating  
- VR: very rough  
- RO: rough  
- SO: smooth  
- SN: stained  

**Weathering**
- Fresh  
- Slightly Weathered  
- Moderately Weathered  
- Highly Weathered  
- Extremely Weathered  
- Distinctly Weathered (covers MW and HW)  

**Strength**
- Very Low  
- Low  
- Medium  
- High  
- Very High  
- Extremely High  

**Planarity**
- Parallel  
- Curved  
- Unsturbed  
- Stopped  
- Irregular

**Defect Spacing**

**Defect Description**
- Type, inclination, planarity, roughness, coating, thickness

**Log: CBH13**  
**Logged by:** DD  
**Checked by:** [Signature]  
**Date started:** 12.3.2007  
**Date completed:** 13.3.2007  
**Project No.:** GEOTUNAN02580-AA
### Engineering Log - Cored Borehole

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Borehole Location:** GEMBROCK LANE, BROUGHTON (REFER SITE PLAN)

<table>
<thead>
<tr>
<th>Method</th>
<th>Core-Lift</th>
<th>Water</th>
<th>Rock Mass Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casing</td>
<td>Used</td>
<td>from 16 to 0 m</td>
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<tr>
<td>Barrel Withdrawn</td>
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</tr>
<tr>
<td>Graphic Log/core Recovery</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Core Recovered | - Graphic Symbols  
| Indicate Material |  
| No Zone Recovered |  
| Water | 10/1/09 Water level on date shown |  
| Water Inflow |  
| Partial Drill Fluid Loss |  
| Complete Drill Fluid Loss |  
| Water Pressure Test Result (loucens) for depth interval shown |  
| Weathering | Fresh |  
| SW | Slightly Weathered  
| MW | Moderately Weathered  
| HW | Highly Weathered  
| DWD | Distinctly Weathered  
| Strength | Very Low |  
| L | Low  
| M | Medium  
| H | High  
| VH | Very High  
| EH | Extremely High  
| Defect Type | Joint | Very Rough  
| PT | Parting  
| SM | Seam  
| S | Sheared  
| S3 | Sheared Surface  
| CS | Crushed Seam  
| Planarity | Plane | Very Rough  
| CU | Curved  
| UN | Undulating  
| ST | Stepped  
| IK | Irregular  

**Notes:**
- CBH13 terminated at 8.98m
- R.L. Surface: 15.56

**Additional Details:**
- Drill model & mounting: H-POWER SCOUT TRUCK
- Hole diameter: 100 mm
- Drilling fluid: Water
- Slope: -90°
- Datum: R.L.
### Engineering Log - Piezometer

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Borehole Location:** GEMBROCK LANE, BROUGHTON (REFER SITE PLAN)

**Borehole No:** CBH13  
**Sheet:** 1 of 2  
**Project No:** GEOTUNA02580-AA  
**Date started:** 12.3.2007  
**Date completed:** 13.3.2007  
**Logged by:** DD  
**Checked by:**

<table>
<thead>
<tr>
<th>Drilling Information</th>
<th>Material Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Method</strong></td>
<td>Support</td>
</tr>
<tr>
<td>ADV</td>
<td>C casing N nil</td>
</tr>
<tr>
<td>AOT</td>
<td>ND</td>
</tr>
</tbody>
</table>

**Notes, Samples, Tests**
- **Uo:** undisturbed sample 50mm diameter, disturbed sample
- **SPT:** standard penetration test (SPT) sample recovered
- **P:** pressure meter
- **Bs:** bulk sample
- **R:** refusal
- **E:** environmental sample
- **ID:** PID measurement
- **WS:** water sample
- **PZ:** piezometer
- **ALT:** air lift test

**Classification Symbols and Soil Description**
- **Moisture:**
  - **D:** dry
  - **M:** moist
  - **W:** wet
- **Wp:** plastic limit
- **WL:** liquid limit
- **MD:** medium dense
- **D:** dense
- **VO:** very dense

**Consistency/Density Index**
- **VS:** very soft
- **S:** soft
- **F:** firm
- **St:** stiff
- **VT:** very stiff
- **H:** hard
- **Fb:** feasible
- **VL:** very loose
- **L:** loose
- **MD:** medium dense
- **D:** dense
- **VO:** very dense

**Material**
- **Silty CLAY:** medium plasticity, brownish-orange, with a trace of fine to medium grained sand and fine to medium grained gravel, subrounded to subangular, moderate...
- **Silty CLAY:** low to medium plasticity, brownish-orange, with a trace of fine to medium grained sand...
- **Silty CLAY:** medium to high plasticity, pale grey/orange, with a trace of fine grained sand...
- **Sandy CLAY:** low to medium plasticity, grey, with fine to medium grained sand, with some fine gravel, subrounded to subangular...
- **Silty SANDSTONE:** fine grained, distinctly laminated @ 0 deg, grey / pale blue
- **Silty SANDSTONE:** fine grained, laminated @ 5 deg, pale grey/blue

**Additional Observations**
- **<Wp:** VSST RESIDUAL / FILL? 0.0m to 0.05m: Grab Sample
- **<Wp:** VSST RESIDUAL
- **<Wp:** VSST HW SANDSTONE 2.5m to 2.85m: SPT Sample
- **>Wp:** infill at 4.7m
- **TC Bit Refusal**

**Drill model & mounting:** H-POWER SCOUT TRUCK  
**Easting:** 292004.2  
**Northing:** 6150886.61  
**R.L. Surface:** 16.66  
**Datum:**

**Method & Support**
- **Casing:** N nil
- **Tubex:** yes shown by suffix ADT

**Penetration**
- **No resistance:** ranging to refusal
- **Water:** 101/98 water level on date shown
- **Water inflow**
- **Water cut off**
# Engineering Log - Piezometer

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Borehole Location:** GEMBROCK LANE, BROUGHTON (REFER SITE PLAN)

<table>
<thead>
<tr>
<th>Method</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Support</th>
<th>Notes, Samples, Tests, etc.</th>
<th>Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NQ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Silty SANDSTONE: fine grained, laminated @ 5 deg, pale grey/blue (continued)</td>
</tr>
</tbody>
</table>

Borehole terminated at 8.96m
# Engineering Log - Borehole

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Logged by:**  
**Borehole Location:** KIMBERLEY PARK STUD, FOREXGROUND (REFER SITE PLAN)  
**Checked by:** DD  
**Date started:** 13.3.2007  
**Date completed:** 14.3.2007

<table>
<thead>
<tr>
<th>Drilling Information</th>
<th>Material Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>method</strong></td>
<td><strong>notes</strong></td>
</tr>
<tr>
<td>ADV</td>
<td></td>
</tr>
<tr>
<td>SPT</td>
<td></td>
</tr>
<tr>
<td>SPT</td>
<td></td>
</tr>
<tr>
<td>SPT</td>
<td></td>
</tr>
<tr>
<td>SPT</td>
<td></td>
</tr>
<tr>
<td>SPT</td>
<td></td>
</tr>
</tbody>
</table>

Borehole CBH17 continued as cored hole

**method support notes, samples, tests classification symbols and soil description based on unified classification system consistency/density index**

<table>
<thead>
<tr>
<th><strong>method</strong></th>
<th><strong>notes</strong></th>
<th><strong>RL (m)</strong></th>
<th><strong>classification</strong></th>
<th><strong>symbol</strong></th>
<th><strong>material</strong></th>
<th><strong>moisture</strong></th>
<th><strong>consolidation density index</strong></th>
<th><strong>drainage pressure (kPa)</strong></th>
<th><strong>structure and additional observations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADV</td>
<td></td>
<td>42</td>
<td>Silty CLAY: medium plasticity, brown, with some fine to coarse grained sand and fine gravel, subrounded to subangular</td>
<td>Wp</td>
<td>F/St</td>
<td>ALLUVIUM</td>
<td>1.0m to 1.1m: ASS Sample</td>
<td>1.25m to 1.35m: SPT Sample</td>
<td>2.1m Below Surface @ Completion</td>
</tr>
<tr>
<td>SPT</td>
<td></td>
<td>41</td>
<td>Silty CLAY: medium plasticity, green/red/orange mottled, with some fine to medium grained sand, with trace of fine to medium grained gravel (XW Sandstone)</td>
<td>VSt</td>
<td>X</td>
<td>ALLUVIUM</td>
<td>1.0m to 1.1m: ASS Sample</td>
<td>1.25m to 1.35m: SPT Sample</td>
<td>2.1m Below Surface @ Completion</td>
</tr>
<tr>
<td>SPT</td>
<td></td>
<td>40</td>
<td>Silty CLAY: medium plasticity, red/orange mottled, with fine to coarse grained sand and fine grained gravel (XW Sandstone) and iron staining</td>
<td>X</td>
<td>2.7m to 2.9m: SPT Sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT</td>
<td></td>
<td>39</td>
<td>Silty CLAY: low plasticity, pale grey</td>
<td>&lt;Wp</td>
<td>VSt</td>
<td>Intermittent gravel fine to medium grained subrounded, sandstone or iron stone</td>
<td>3.8m to 4.5m: Grab Sample</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT</td>
<td></td>
<td>38</td>
<td>Silty CLAY: low to medium plasticity, pale orange, with some fine to coarse grained sand becoming pale yellow with a trace of rootlets</td>
<td>&gt;Wp</td>
<td>S/F</td>
<td>RESIDUAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT</td>
<td></td>
<td>37</td>
<td>SANDSTONE: XW T/HW</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Borehole CBH17 continued as cored hole
## Engineering Log - Cored Borehole

### Client:
MAUNSELL AECOM

### Principal:
RTA

### Project:
GERRINGONG TO BOMADERY, PRINES HWY UPGRADE

### Borehole Location:
KIMBERLEY PARK STUD, FOXGROUND (REFER SITE PLAN)

### Drill model & mounting:
H-POWER SCOUT TRUCK

### Hole diameter:
100 mm

### Drilling fluid:
Northing: 6153406.06

### Flume:
Easting: 295092.08

### Slope:
-90°

### Datum:
R.L. Surface: 42.35

### Drilling Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Core-lift</th>
<th>Graphic Log/core recovery</th>
<th>Core recovered</th>
<th>Water</th>
<th>Weathering</th>
<th>Defect Type</th>
<th>Defect Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10/09</td>
<td>FRESH</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>Slightly weathered</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Moderately weathered</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Highly weathered</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Extremely weathered</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Distinctly weathered</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(covers MW and HW)</td>
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</tbody>
</table>

### Rock Mass Defects

<table>
<thead>
<tr>
<th>Defect Type</th>
<th>Defect Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT, PL, RO, VN</td>
<td>5 deg</td>
</tr>
<tr>
<td>PT, PL, RO, CN</td>
<td>30 deg</td>
</tr>
<tr>
<td>PT, IR, VR, CN</td>
<td>10 deg</td>
</tr>
</tbody>
</table>

### Core-lift

<table>
<thead>
<tr>
<th>RL</th>
<th>Core-lift</th>
<th>Material Substance</th>
<th>Estimated Strength</th>
<th>Weakening alteration</th>
<th>Rock mass defects</th>
<th>Defect Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>SILTSTONE: grey, indistinctly bedded at 0 deg</td>
<td>SW/FR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td></td>
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<td>40</td>
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<td>38</td>
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<td>37</td>
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<td>36</td>
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<td>35</td>
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<td>34</td>
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<td>33</td>
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<td>32</td>
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<td>31</td>
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<td>30</td>
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<tr>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes

- Full water level on date shown.
- Water inflow.
- Partial drill fluid loss.
- Complete drill fluid loss.

---

---
**Engineering Log - Piezometer**

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Borehole Location:** KIMBERLEY PARK STUD, FOXGROUND (REFER SITE PLAN)

<table>
<thead>
<tr>
<th>Drilling Information</th>
<th>Material Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Method</strong></td>
<td><strong>Notes, Samples, Tests</strong></td>
</tr>
<tr>
<td>ADV 10.6</td>
<td>Well details</td>
</tr>
<tr>
<td>ADV 20/05/2007</td>
<td>Well metres</td>
</tr>
<tr>
<td>ADT 10.6</td>
<td>RL</td>
</tr>
<tr>
<td>NQ 10.6</td>
<td>N=18</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Material Substances**

- **Silty CLAY:** medium plasticity, brown, with some fine to coarse grained sand and fine gravel, subrounded to subangular
- **Silty CLAY:** medium plasticity, green/red/orange mottled, with some fine to medium grained sand, with trace of fine to medium grained gravel (XW Sandstone)
- **Silty CLAY:** medium plasticity, red/orange mottled, with some fine to coarse grained sand and fine gravel, subrounded to subangular
- **Silty CLAY:** low plasticity, pale grey
- **Silty CLAY:** low to medium plasticity, pale orange, with some fine to coarse grained sand becoming pale yellow with a trace of rootlets
- **SANDSTONE:** XW7HW
- **SILTSTONE:** grey, indistinctly bedded at 0 deg

**Consistency/Density Index**

- **Wp**
- **FSf**
- **VST**
- **VSST**
- **H**
- **Sf**
- **Wp**
- **D**
- **Wp**
- **D**

**Soil Description**

- **D:** dry
- **M:** moist
- **W:** wet
- **Wp:** plastic limit
- **Vf:** liquid limit
# Engineering Log - Piezometer

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERY, PRINCES HWY UPGRADE  
**Borehole Location:** KIMBERLEY PARK STUD, FOXGROUND (REFER SITE PLAN)  
**Borehole No.:** CBH17  
**Date started:** 13.3.2007  
**Date completed:** 14.3.2007  
**Logged by:** DD

## Drilling Information

<table>
<thead>
<tr>
<th>No.</th>
<th>Method</th>
<th>Support</th>
<th>Water</th>
<th>Notes, Samples, Tests</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>auger drilling</td>
<td>C casing</td>
<td>N nil</td>
<td>water inflow</td>
<td>Tuffaceous SANDSTONE: medium grained, dark grey/blue, massive</td>
</tr>
<tr>
<td>2</td>
<td>auger drilling</td>
<td>C casing</td>
<td>N nil</td>
<td>water inflow</td>
<td>NO CORE: 8.40m to 8.57m</td>
</tr>
<tr>
<td>3</td>
<td>auger drilling</td>
<td>C casing</td>
<td>N nil</td>
<td>water inflow</td>
<td>Tuffaceous SANDSTONE: medium grained, dark grey/blue, massive</td>
</tr>
<tr>
<td>4</td>
<td>auger drilling</td>
<td>C casing</td>
<td>N nil</td>
<td>water inflow</td>
<td>NO CORE: 13.00m to 13.03m</td>
</tr>
<tr>
<td>5</td>
<td>auger drilling</td>
<td>C casing</td>
<td>N nil</td>
<td>water inflow</td>
<td>Tuffaceous SANDSTONE: medium grained, dark grey/blue, massive</td>
</tr>
<tr>
<td>6</td>
<td>auger drilling</td>
<td>C casing</td>
<td>N nil</td>
<td>water inflow</td>
<td>NO CORE: 13.81m to 13.96m</td>
</tr>
<tr>
<td>7</td>
<td>auger drilling</td>
<td>C casing</td>
<td>N nil</td>
<td>water inflow</td>
<td>Tuffaceous SANDSTONE: medium grained, dark grey/blue, massive</td>
</tr>
<tr>
<td>8</td>
<td>auger drilling</td>
<td>C casing</td>
<td>N nil</td>
<td>water inflow</td>
<td>NO CORE: 14.48m to 14.52m</td>
</tr>
<tr>
<td>9</td>
<td>auger drilling</td>
<td>C casing</td>
<td>N nil</td>
<td>water inflow</td>
<td>Tuffaceous SANDSTONE: medium grained, dark grey/blue, massive</td>
</tr>
<tr>
<td>10</td>
<td>auger drilling</td>
<td>C casing</td>
<td>N nil</td>
<td>water inflow</td>
<td>Borehole terminated at 14.71m</td>
</tr>
</tbody>
</table>

## CONSISTENCY/DENSITY INDEX

- VS: very soft
- S: soft
- F: firm
- St: stiff
- VS*: very stiff
- H: hard
- Fr: friable
- VL: very loose
- L: loose
- MD: medium dense
- D: dense
- VD: very dense
Engineering Log - Excavation

Client: MAUNSELL AECOM
Principal: RTA
Project: GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE
Test pit location: REFER SITE PLAN

Equipment type and model: BACKHOE 300mm BUCKET
Pit Orientation: Easting: 281453.11 m
R.L. Surface: 9.46
Northing: 6143413.46 m
datum: 

Excavation dimensions: 4m long, 0.4m wide

<table>
<thead>
<tr>
<th>method</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>classification symbol</th>
<th>material</th>
<th>moisture condition</th>
<th>consistency/density index</th>
<th>structure and additional observations</th>
</tr>
</thead>
</table>
| N      | natural exposure | 0 in | sample | TOPSOIL: Silty Clay: low plasticity, brown, roots and
gut fibres | M | S | TOPSOIL |
| X      | existing excavation | 9.0 | 0.5 | CLAY: high plasticity, dark brown | M | VST | ALLUVIAL |
| BH     | backhoe bucket | 8.5 | 1.0 | Silty CLAY: medium plasticity, grey, mottled orange
and brown | M | F | ARTIFICAL |
| R      | ripper | 8.0 | 1.5 | | | | |
| E      | excavator | 7.5 | 2.0 | | | | |
|        |          | 7.0 | 2.5 | | | | |
|        |          | 6.5 | 0.5 | | | | |
|        |          | 6.0 | 1.0 | | | | |
|        |          | 5.5 | 1.5 | | | | |
|        |          | 5.0 | 2.0 | | | | |
|        |          | 4.5 | 2.5 | | | | |
|        |          | 4.0 | 3.0 | | | | |
|        |          | 3.5 | 3.5 | | | | |
|        |          | 3.0 | 4.0 | | | | |
|        |          | 2.5 | 4.5 | | | | |
|        |          | 2.0 | 5.0 | | | | |
|        |          | 1.5 | 5.5 | | | | |
|        |          | 1.0 | 6.0 | | | | |
|        |          | 0.5 | 6.5 | | | | |
|        |          | 0.0 | 7.0 | | | | |

Sketch: Test pit CTP1 terminated at 2.5m

Traces of sedimentary rock fragments approx 2mm in diameter at 1.7m, black in colour

Walls collapsing

Consistency/density index:
- VS: very soft
- S: soft
- F: firm
- CI: stiff
- VST: very stiff
- H: hard
- P: plastic
- W: wet
- L: loose
- MD: medium dense
- D: dense
- VD: very dense

Soil description:
- Undisturbed samples 50mm diameter
- Undisturbed samples 63mm diameter
- Disturbed sample
- Vane shear (Vp)
- Bulk sample
- Environmental sample
- Refusal

Moisture:
- D: dry
- S: stiff
- M: medium
- W: wet
- V: very loose

Liquid limit (W):
- L: loose
# Engineering Log - Excavation

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Test pit location:** REFER SITE PLAN

<table>
<thead>
<tr>
<th>equipment type and model: BACKHOE 600mm BUCKET</th>
<th>Pit Orientation:</th>
<th>Excavation dimensions: 4m long 0.7m wide</th>
<th>Datum:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support:</td>
<td>Notes: samples, tests, etc</td>
<td>Graphic log symbol</td>
<td>Material</td>
</tr>
<tr>
<td>1 2 3 penetration</td>
<td>Support</td>
<td>Water</td>
<td>Depth (m)</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>17.0</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>17.0</td>
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<td>X</td>
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<td>17.0</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>17.0</td>
</tr>
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</table>

**Sketch:**

2.3m rock structure

---

**Consistency/Density Index**
- VS: very soft
- S: soft
- F: firm
- B: stiff
- VD: very stiff
- VH: very hard
- H: hard
- Fb: friable
- V: very loose
- L: loose
- Md: medium dense
- D: dense
- VD: very dense
# Engineering Log - Excavation

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERY, PRINCES HWY UPGRADE  
**Test pit location:** REFERENCE PLAN  
**Logged by:** KM  
**Checked by:**  

| equipment type and model | RACKHOF 600mm RUCKET  
|--------------------------|-------------------------|
| Pit Orientation: | Easting: 281931.62 m  
| R.L. Surface: | 20  
| Northing: | 6145476.17 m  
| Datum: |  

| excavation dimensions: | 4m long 0.7m wide  

| excavation information | material substance  
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<th></th>
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<tbody>
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<td>method</td>
<td>penetration</td>
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<tr>
<td>N</td>
<td>natural exposure</td>
</tr>
<tr>
<td>X</td>
<td>backhoe bucket</td>
</tr>
<tr>
<td>B</td>
<td>bulkhead blade</td>
</tr>
<tr>
<td>R</td>
<td>ripper</td>
</tr>
<tr>
<td>E</td>
<td>excavator</td>
</tr>
<tr>
<td></td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>S</td>
</tr>
<tr>
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<tr>
<td></td>
<td>S</td>
</tr>
<tr>
<td>notes, samples, tests</td>
<td>U&lt;sub&gt;soil&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>U&lt;sub&gt;disturbed&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>v</td>
</tr>
<tr>
<td></td>
<td>B&lt;sub&gt;s&lt;/sub&gt;</td>
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<tr>
<td></td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>R</td>
</tr>
<tr>
<td>classification symbols and soil description based on unified classification system</td>
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</tr>
<tr>
<td>moisture</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>W</td>
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<td>W&lt;sub&gt;p&lt;/sub&gt;</td>
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<td></td>
<td>W&lt;sub&gt;l&lt;/sub&gt;</td>
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<tr>
<td></td>
<td>very soft</td>
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<tr>
<td></td>
<td>dense</td>
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<tr>
<td></td>
<td>very dense</td>
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</table>

**Structure and additional observations:** Slow Progress  
Test pit CTP6 terminated at 2.66m
### Engineer Log - Excavation

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Test pit location:** REFER SITE PLAN  
**Logged by:** KM  
**Checked by:** 

**Excavation No.:** CTP8  
**Sheet:** 1 of 2  
**Project No.:** GEOTUNAN02580-AA  
**Date started:** 21.3.2007  
**Date completed:** 21.3.2007

#### Excavation Information
- **equipment type and model:** RACKHOF 600mm RUCKFT  
- **Pit Orientation:**  
- **Excavation dimensions:** 4m long, 0.7m wide  
- **Northing:** 6147782.88 m  
- **datum:**  

#### Material Substance

<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>classification symbol</th>
<th>material</th>
<th>moisture</th>
<th>consistency/density index</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>VS: very soft</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
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<td></td>
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<td>F: firm</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>St: stiff</td>
</tr>
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<td></td>
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<td>VS: very soft</td>
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<td></td>
<td>L: loose</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MD: medium dense</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<td>VD: very dense</td>
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<td></td>
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</tr>
</tbody>
</table>

#### Sketch

- **Sketch Description:**
  - TOPSOIL: Clay: low plasticity, dark brown, roots, root fines
  - FILL: Clayey gravel: fine to coarse grained, angular; some cobbles up to 150mm
  - Clayey Sandy GRAVEL: low plasticity, sand and gravel is fine to coarse grained; gravel is angular
  - CAY: high plasticity, dark grey, medium gravel sized charcoal fragments present, (faint orange mottle)

---

**Form BEQ 0.2 Issue A Rev 2**
# Engineering Log - Excavation

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERY, PRINCES HWY UPGRADE  
**Logged by:** KM  
**Test pit location:** REFER SITE PLAN

**Excavation No.:** CTP8  
**Sheet:** 2 of 2  
**Project No.:** GEOTUNAN02580-AA

---

**equipment type and model:** RACKHOF 800mm RUCKFT  
**Pit Orientation:**  
**Fading:** 297659.84 m  
**R.L. Surface:** 52  
**excavation dimensions:** 4m long, 0.7m wide  
**Northing:** 614782.98 m  
**datum:**

---

**material substance**  
**material**  
soil type: plasticity or particle characteristics, colour, secondary and minor components.

**structure and additional observations**

---

### Excavation information

<table>
<thead>
<tr>
<th>method</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>classification symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td></td>
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<tr>
<td>3</td>
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<th>depth</th>
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<td>Test pit CTP8 terminated at 2.6m</td>
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</tr>
<tr>
<td>5.0</td>
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</tbody>
</table>

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### Sketch

- **method**
  - N: natural exposure
  - X: existing excavation
  - BH: backhoe bucket
  - B: bulldozer blade
  - R: ripper
  - E: excavator

- **support**
  - S: shoring
  - N: nil

- **penetration**
  - 1: no resistance
  - 2: ranging to refusal

- **water**
  - water level
  - water inflow
  - water outflow

- **notes, samples, tests**
  - Undisturbed Sample 50mm diameter
  - Undisturbed Sample 63mm diameter
  - Disturbed sample
  - Vane shear (kPa)
  - Bulk sample
  - Environmental sample
  - Refusal

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

- **moisture**
  - Dry
  - Moist
  - Wet

- **water limit**
  - Plastic limit
  - Liquid limit

- **consistency/density index**
  - VS: very soft
  - S: soft
  - F: firm
  - Stiff
  - VSt: very stiff
  - H: hard
  - Fh: friable
  - VL: very loose
  - MD: medium dense
  - D: dense
  - VD: very dense
### Engineering Log - Excavation

**Client:** MAUNSELL AECOM

**Principal:** RTA

**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE

**Test pit location:** REFER SITE PLAN

**Equipment type:** BACKHOE 600mm BUCKET

**Excavation dimensions:** 4m long, 0.7m wide

**Datum:** 26.63

<table>
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<th>penetration</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>material</th>
<th>classification symbol</th>
<th>moisture condition</th>
<th>overburden kPa</th>
<th>structure and additional observations</th>
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<tbody>
<tr>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td>TOPSOIL: Silty Clay: low plasticity, black / brown, roots, root fibres</td>
<td>M</td>
<td>F</td>
<td>TOPSOIL</td>
<td>RESIDUAL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CLAY: medium to high plasticity, red and orange mottled, traces of fine to medium grained gravel, (break down to clay in water)</td>
<td>F/St</td>
<td></td>
<td>RESIDUAL</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>CLAY: medium plasticity, orange / red, some grey motting</td>
<td>H</td>
<td>X</td>
<td>RESIDUAL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CCAY: high plasticity, red and grey mottled</td>
<td></td>
<td></td>
<td>RESIDUAL</td>
<td></td>
</tr>
</tbody>
</table>

**Sketch**

**Classification symbols and soil description based on unified classification system**

- **moisture:**
  - D: dry
  - M: moist
  - W: wet
  - Wp: plastic limit
  - Wi: liquid limit
- **consistency/density index:**
  - V3: very soft
  - S: soft
  - F: firm
  - Gt: stiff
  - VSf: very stiff
  - H: hard
  - FB: friable
  - VL: very loose
  - L: loose
  - MD: medium dense
  - D: dense
  - VD: very dense

**Support:**

- N: natural exposure
- X: existing excavation
- BH: backhoe bucket
- R: ripper
- E: excavator

**Notes, samples, tests:**

- Uoo: undisturbed sample 50mm diameter
- U10: undisturbed sample 65mm diameter
- D: disturbed sample
- V: core shear (kPa)
- Bs: bulk sample
- E: environmental sample
- R: refusal

**Water levels:**

- Water level on date shown
- Water inflow
- Water outflow
Engineering Log - Excavation

Client: MAUNSELL AECOM
Principal: RTA
Project: GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE
Test pit location: REFER SITE PLAN

equipment type and model: RACKHOF 800mm RUCKPT
Pit Orientation: F: 24.91111111 0.4111
R1: Surface: 26.631
excavation dimensions: 4m long, 0.7m wide
Nothing: 6149953.41
Datum:

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<th>method</th>
<th>penetration</th>
<th>support</th>
<th>notes, samples, tests, etc</th>
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<th>classification</th>
<th>symbol</th>
<th>soil type: plasticity or particle characteristics, colour, secondary and major components.</th>
<th>moisture</th>
<th>consistency/density index</th>
<th>soil parameter</th>
<th>structure and additional observations</th>
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<td>1</td>
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<td></td>
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<td>CLAY: high plasticity, red, grey mottled (continued)</td>
<td>M</td>
<td>H</td>
<td>RESIDUAL</td>
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</tr>
</tbody>
</table>

Test pit CTP13 terminated at 2.6m

Sketch
**Engineering Log - Excavation**

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Test pit location:** REFER SITE PLAN  
**Excavation No.: CTP18**  
**Sheet:** 1 of 1  
**Project No.: GEOTUNAN02580-AA**  
**Date started:** 19.3.2007  
**Date completed:** 19.3.2007  
**Logged by:** KM  
**Checked by:**  

### Excavation Information

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<th>material</th>
<th>soil type: plasticity or particle characteristics, colour, secondary and minor components</th>
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<tbody>
<tr>
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<td>Gravelly Clay; low plasticity, brown, fine to coarse grained, angular</td>
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<tr>
<td>CLAY</td>
<td>low plasticity, brown, mottled grey/black/orange</td>
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<tr>
<td>CLAY</td>
<td>medium plasticity, orange/grey</td>
</tr>
<tr>
<td>CLAY</td>
<td>high plasticity, orange mottled grey/ black, with some gravel fine to coarse grained, angular, breaks down to clay in water</td>
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<td>ALLUVIAL</td>
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<td>RESIDUAL</td>
<td></td>
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<tr>
<td>RESIDUAL</td>
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### Support

- **N** natural exposure
- **X** existing excavation
- **BH** backhoe bucket
- **B** bulldozer blade
- **R** ripper
- **E** excavator

### Notes, Samples, Tests

- **U** undisturbed sample
- **D** disturbed sample
- **V** variably sheared (VSP)
- **B** bulk sample
- **E** environmental sample
- **R** refusal

### Classification Symbols and Soil Description

- **D** dry
- **M** moist
- **w** wet
- **L** plastic limit
- **W** liquid limit

### Consistency/Density Index

- **VS** very soft
- **V** soft
- **S** firm
- **F** stiff
- **VS** very stiff
- **H** hard
- **Fb** friable
- **L** loose
- **MD** medium dense
- **D** dense
- **VD** very dense

---

**Sketch**

Test pit CTP18 terminated at 2.4m

---

**Equipment type and model:** RACKHOF 300mm RICKERT  
**Pit Orientation:**  
**Excavation dimensions:** 4m long, 0.4m wide  
**Fasting:** 2956091.61 m  
**R.L. Surface:** 6.52  
**Northing:** 6150528.94 m  
**Datum:**  

---

**Notes:**

- **RI:** depth matrix
- **material:** classification symbol

---

**Method**

- **N** natural exposure
- **X** existing excavation
- **BH** backhoe bucket
- **B** bulldozer blade
- **R** ripper
- **E** excavator

---

**Support**

- **S** showing
- **N** nil
- **I** no resistance ranging to refusal

---

**Notes, Samples, Tests**

- **U** undisturbed sample
- **D** disturbed sample
- **V** variably sheared (VSP)
- **B** bulk sample
- **E** environmental sample
- **R** refusal

---

**Classification Symbols and Soil Description**

- **D** dry
- **M** moist
- **w** wet
- **L** plastic limit
- **W** liquid limit

---

**Consistency/Density Index**

- **VS** very soft
- **V** soft
- **S** firm
- **F** stiff
- **VS** very stiff
- **H** hard
- **Fb** friable
- **L** loose
- **MD** medium dense
- **D** dense
- **VD** very dense

---

**Form:** GEO0.6.2 Issue 3 Rev 2
EXCAVATION No. CTP19
Sheet 1 of 1
Project No. GEOTUN02580-AA

Engineering Log - Excavation

Client: MAUNSELL AECOM
Principal: RTA
Project: GERRINGONG TO BOMADERY, PRINCES HWY UPGRADE
Test pit location: REFER SITE PLAN

Excavation information

<table>
<thead>
<tr>
<th>depth (m)</th>
<th>notes, samples, tests</th>
<th>material</th>
<th>structural and additional observations</th>
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<tbody>
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<td>TOPSOIL</td>
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<td>CLAY: medium plasticity, dark brown, root fibres</td>
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<td>CLAY: high plasticity, grey mottled orange/brown, root fibres</td>
<td>VSH</td>
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<tr>
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<tr>
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</table>

Sketch
Test pit CTP19 terminated at 2.4m
# Engineering Log - Excavation

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERY, PRINCES HWY UPGRADE  
**Test pit location:** REFER SITE PLAN  
**Equipment type and model:** BACKHOE 600mm BUCKET  
**Pit Orientation:**  
**Easting:** 203697.76 m  
**Northing:** 6149367.44 m  
**Datum:**  
**Excavation dimensions:** 4m long, 0.7m wide  
**Date started:** 22.3.2007  
**Date completed:** 22.3.2007  
**Logged by:** KM  
**Checked by:**

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<th>Northing:</th>
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<tbody>
<tr>
<td>BACKHOE 600mm BUCKET</td>
<td></td>
<td>203697.76 m</td>
<td>6149367.44 m</td>
<td></td>
</tr>
</tbody>
</table>

| excavation dimensions | 4m long, 0.7m wide |

<table>
<thead>
<tr>
<th>excavation information</th>
<th>material substance</th>
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<tbody>
<tr>
<td>method</td>
<td>penetration</td>
</tr>
<tr>
<td>N</td>
<td>natural exposure</td>
</tr>
<tr>
<td>X</td>
<td>existing excavation</td>
</tr>
<tr>
<td>BH</td>
<td>backhoe bucket</td>
</tr>
<tr>
<td>R</td>
<td>ripper</td>
</tr>
<tr>
<td>E</td>
<td>excavator</td>
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</table>

<table>
<thead>
<tr>
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<th>material</th>
<th>moisture content (dry mass%)</th>
<th>density (kN/m³)</th>
<th>structure and additional observations</th>
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<tbody>
<tr>
<td>Uₜₚ</td>
<td>undisturbed sample 50mm diameter</td>
<td>Clayey SILT: low to medium plasticity, grey</td>
<td>M</td>
<td>ALLUVIAL</td>
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</tr>
<tr>
<td>U₉ₚ</td>
<td>undisturbed sample 63mm diameter</td>
<td>CLAY: high plasticity, grey / brown mottled orange/brown, medium gravel, chalky plaques present</td>
<td>M</td>
<td>ALLUVIAL</td>
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<tr>
<td>D</td>
<td>disturbed sample</td>
<td>Silty CLAY: high plasticity, grey, mottled orange and red</td>
<td>M</td>
<td>RESIDUAL?</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>vane shear (kPa)</td>
<td>Colour change: grey and orange brown mottled</td>
<td>M</td>
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<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
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<th>notes, samples, tests</th>
<th>classification symbols and soil description</th>
<th>consistency/density index</th>
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<tbody>
<tr>
<td>N</td>
<td>natural exposure</td>
<td>VS</td>
<td>very soft</td>
</tr>
<tr>
<td>X</td>
<td>existing excavation</td>
<td>S</td>
<td>soft</td>
</tr>
<tr>
<td>BH</td>
<td>backhoe bucket</td>
<td>F</td>
<td>firm</td>
</tr>
<tr>
<td>R</td>
<td>ripper</td>
<td>St</td>
<td>stiff</td>
</tr>
<tr>
<td>E</td>
<td>excavator</td>
<td>VS</td>
<td>very stiff</td>
</tr>
<tr>
<td>D</td>
<td>disturbed sample</td>
<td>H</td>
<td>hard</td>
</tr>
<tr>
<td>V</td>
<td>vane shear (kPa)</td>
<td>Fd</td>
<td>faille</td>
</tr>
<tr>
<td>Rs</td>
<td>bulk sample</td>
<td>Vs</td>
<td>very loose</td>
</tr>
<tr>
<td>E</td>
<td>environmental sample</td>
<td>L</td>
<td>loose</td>
</tr>
<tr>
<td>R</td>
<td>refusal</td>
<td>Md</td>
<td>medium dense</td>
</tr>
<tr>
<td>D</td>
<td>density</td>
<td>Vs</td>
<td>very dense</td>
</tr>
<tr>
<td>VD</td>
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**Sketch**

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<tr>
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<th>notes, samples, tests</th>
<th>classification symbols and soil description</th>
<th>consistency/density index</th>
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</thead>
<tbody>
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<td>natural exposure</td>
<td>VS</td>
<td>very soft</td>
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<tr>
<td>X</td>
<td>existing excavation</td>
<td>S</td>
<td>soft</td>
<td></td>
</tr>
<tr>
<td>BH</td>
<td>backhoe bucket</td>
<td>F</td>
<td>firm</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>ripper</td>
<td>St</td>
<td>stiff</td>
<td></td>
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<tr>
<td>E</td>
<td>excavator</td>
<td>VS</td>
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<td>D</td>
<td>disturbed sample</td>
<td>H</td>
<td>hard</td>
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<tr>
<td>V</td>
<td>vane shear (kPa)</td>
<td>Fd</td>
<td>faille</td>
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<tr>
<td>Rs</td>
<td>bulk sample</td>
<td>Vs</td>
<td>very loose</td>
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<tr>
<td>E</td>
<td>environmental sample</td>
<td>L</td>
<td>loose</td>
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</tr>
<tr>
<td>R</td>
<td>refusal</td>
<td>Md</td>
<td>medium dense</td>
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</tr>
<tr>
<td>D</td>
<td>density</td>
<td>Vs</td>
<td>very dense</td>
<td></td>
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---

نواعلاج لوج - خراج

**المشترِّث:** MAUNSELL AECOM  
**الخليفة:** RTA  
**الโปรجِكت:** GERRINGONG TO BOMADERY, PRINCES HWY UPGRADE  
**الموقع المثير للحيرة:** REFER SITE PLAN  
**نوع المعدّات والنموذج:** BACKHOE 600mm BUCKET  
**الاتجاه:**  
**الوادي:** 203697.76 m  
**النورثينغ:** 6149367.44 m  
**النظام:**  
**القياسات النهائية:** 4m طويل، 0.7m عريض  
**الإبتداء:** 22.3.2007  
**الانتهاء:** 22.3.2007  
**التسجيل:** KM  
**الاستعراض:**

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<th>نوع المعدّات والنموذج</th>
<th>الاتجاه</th>
<th>الوادي:</th>
<th>الـنورثينغ:</th>
<th>النظام:</th>
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<tr>
<td>BACKHOE 600mm BUCKET</td>
<td></td>
<td>203697.76 m</td>
<td>6149367.44 m</td>
<td></td>
</tr>
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</table>

| القياسات النهائية | 4m طويل، 0.7m عريض |

<table>
<thead>
<tr>
<th>الإخراج المثير للحيرة</th>
<th>المادّة</th>
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<tr>
<td>الملاحظات، العينات، الأدوات</td>
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<tr>
<td>Uₜₚ</td>
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</tr>
<tr>
<td>U₉ₚ</td>
<td>نمونة غير متحركة 63ملم في قطرها</td>
</tr>
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<td>D</td>
<td>نمونة متحركة</td>
</tr>
<tr>
<td>V</td>
<td>معدل رفع المشبوع (كيلوباس)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
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<th>الملاحظات، العينات، الأدوات</th>
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<th>المادة</th>
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<tbody>
<tr>
<td>N</td>
<td>عرض طبيعي</td>
<td>VS</td>
<td>مرن</td>
</tr>
<tr>
<td>X</td>
<td>عرض موجود</td>
<td>S</td>
<td>مرن</td>
</tr>
<tr>
<td>BH</td>
<td>حوض الخراجه</td>
<td>F</td>
<td>مرن</td>
</tr>
<tr>
<td>R</td>
<td>باقلًا</td>
<td>St</td>
<td>صلب</td>
</tr>
<tr>
<td>E</td>
<td>المدمرة</td>
<td>VS</td>
<td>مرن</td>
</tr>
<tr>
<td>D</td>
<td>نمونة متحركة</td>
<td>H</td>
<td>صلب</td>
</tr>
<tr>
<td>V</td>
<td>معدل رفع المشبوع (كيلوباس)</td>
<td>Fd</td>
<td>صلب</td>
</tr>
<tr>
<td>Rs</td>
<td>عينات</td>
<td>Vs</td>
<td>برهان</td>
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<td>E</td>
<td>عينات بيئية</td>
<td>L</td>
<td>مرن</td>
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<td>R</td>
<td>محتوى سائل</td>
<td>Md</td>
<td>مرن</td>
</tr>
<tr>
<td>D</td>
<td>جودة</td>
<td>Vs</td>
<td>مرن</td>
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الرسم

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<table>
<thead>
<tr>
<th>الملاحظات، العينات، الأدوات</th>
<th>العلامة التصنيفية</th>
<th>المادة</th>
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</thead>
<tbody>
<tr>
<td>Uₜₚ</td>
<td>نمونة غير متحركة 50ملم في قطرها</td>
<td>مادة سيراميك ماسية منخفضة إلى متوسطة، صفراء</td>
</tr>
<tr>
<td>U₉ₚ</td>
<td>نمونة غير متحركة 63ملم في قطرها</td>
<td>مادة سيراميك عالية الماسية، برتقال مع خليط صغير</td>
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<tr>
<td>D</td>
<td>نمونة متحركة</td>
<td>مادة سيراميك سيليسي مختلط بين الأحمر والبني</td>
</tr>
<tr>
<td>V</td>
<td>معدل رفع المشبوع (كيلوباس)</td>
<td>تغيير لون: أرجوحة و Osmanlı برتقالي ممطّر</td>
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</tbody>
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```
### Engineering Log - Excavation

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERLY, PRINCES HWY UPGRADE  
**Test pit location:** REFER SITE PLAN  

**Excavation No.:** CTP21  
**Sheet:** 2 of 2  
**Project No.:** GEOTUNA02580-AA  
**Date started:** 22.3.2007  
**Date completed:** 22.3.2007  
**Logged by:** KM  
**Checked by:**  

---

<table>
<thead>
<tr>
<th>method</th>
<th>penetration</th>
<th>support</th>
<th>water</th>
<th>notes, samples, tests</th>
<th>classification</th>
<th>material</th>
<th>moisture condition</th>
<th>consistency/density index</th>
<th>structure and additional observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- Test pit CTP21 terminated at 9.6m

---

**Sketch**

---

**Equipment:** BACKHOE 600mm BUCKET  
**Excavation dimensions:** 4m long, 0.7m wide  
**Datum:**
- Easting: 203907.76 m  
- Northing: 6149367.44 m  
- R.L. Surface: 8.24

---

**Notes, Samples, Tests:**
- \( U_{10} \): undisturbed sample 50mm diameter
- \( U_{60} \): undisturbed sample 63mm diameter
- D: disturbed sample
- V: vane shear (kPa)
- Bs: bulk sample
- E: environmental sample
- R: refuse

---

**Classification Symbols and Soil Description:**

- **Moisture:**
  - D: dry
  - M: moist
  - W: wet
  - Wp: plastic limit
  - \( W_l \): liquid limit

- **Consistency/Density Index:**
  - VS: very soft
  - S: soft
  - F: firm
  - Sft: soft
  - VS: very stiff
  - Vd: dense
  - VD: very dense

---

**Diagram:**
- Water level on date shown
- Water inflow
- Water outflow
# Engineering Log - Excavation

**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERY, PRINCES HWY UPGRADE  
**Logged by:** KM  
**Test pit location:** REFER SITE PLAN

---

**Equipment type and model:** BACKHOE 600mm BUCKET  
**Excavation dimensions:** 4m long, 0.7m wide  
**Easting:** 286411.42 m  
**Northing:** 6145335.47 m

---

**Notes:**
- **Pit Orientation:**
  - R.L. Surface: 1.68 m
  - Datum:  
  - SOIL: Silty Clay: low plasticity, black/brown
  - CLAY: high plasticity, brown and orange mottled
  - CLAY: high plasticity, blue grey and orange mottled

---

**Support:**
- **S ponson**
- **N nil**

---

**Penetration:**
- **water**

---

**Water level:**
- **on data shown**

---

**Water inflow out:**
- **wet, water inflow**

---

**Material Substance:**
- **TOPSOIL:**
  - Silty Clay: low plasticity, black/brown

---

**Moisture:**
- **F/S**

---

**Additional Observations:**
- **ALLUVIAL**

---

**Sketch:**

---

**Drawings:**
- **Sketch**

---

**Consistency/Density Index:**
- **VS:** very soft
- **S:** soft
- **F:** firm
- **G:** stiff
- **VSD:** very stiff
- **H:** hard
- **Fh:** firm
- **Moisture:**
  - **D:** dry
  - **M:** moist
  - **W:** wet
  - **WP:** plastic limit
  - **W_L:** liquid limit

---

**Classification Symbols and Soil Description:**
- **Based on Unified Classification System**
- **Moisture:**
  - **D:** dry
  - **M:** moist
  - **W:** wet
  - **WP:** plastic limit
  - **W_L:** liquid limit
- **Consistency/Density Index:**
  - **VS:** very soft
  - **S:** soft
  - **F:** firm
  - **G:** stiff
  - **VSD:** very stiff
Engineering Log - Excavation

Client: MAUNSELL AECOM
Principal: RTA
Project: GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE
Test pit location: REFER SITE PLAN

Equipment type and model: RACKHOF 800mm RICKFT
Pit Orientation: 1.68
Excavation dimensions: 4m long, 0.7m wide
Nothing: 6145335,47 m
Datum: 294411.47 m

<table>
<thead>
<tr>
<th>method</th>
<th>penetration</th>
<th>support</th>
<th>notes, samples, tests</th>
<th>material</th>
<th>classification symbol</th>
<th>structure and additional observations</th>
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<tr>
<td>1</td>
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<table>
<thead>
<tr>
<th>water</th>
<th>depth (m)</th>
<th>soil type: plasticity or particle characteristics, colour, secondary and minor components.</th>
<th>material</th>
<th>moisture condition</th>
<th>consistency/density index</th>
</tr>
</thead>
</table>

CLAY: high plasticity, blue grey and orange mottled (continued)

Test pit CTP26 terminated at 2.64m

Sketch

| classification symbols and soil description based on unified classification system |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| moisture                     | D                | dry             | M               | moist           | W               | wet             |
| Wp                            | plastic limit    |                 | Wl              | liquid limit    |                 |                 |                 |                 |                 |

Form GEO.5 Issue 3 Rev.2

EXCAVATION NO. CTP26

Sheet 2 of 2

Project No: GEOEVO02580-AA

Date started: 20.3.2007

Date completed: 20.3.2007

Logged by: KM

Checked by: 
# Engineering Log - Excavation

**Excavation No.:** CTP30  
**Client:** MAUNSELL AECOM  
**Principal:** RTA  
**Project:** GERRINGONG TO BOMADERRY, PRINCES HWY UPGRADE  
**Logged by:** KM  
**Checked by:**  

**Test Pit Location:** REFER SITE PLAN  
**Equipment Type and Model:** BACKHOE 600mm BUCKET  
**Pit Orientation:** Easting: 301030.3 m  
**Excavation Dimensions:** 4m long  
**Northing:** 8105324.42 m  
**Datum:** 2.54  

## Excavation Information

<table>
<thead>
<tr>
<th>Method</th>
<th>Support</th>
<th>Notes, Samples, Tests</th>
<th>Classification Symbol</th>
<th>Material</th>
<th>Moisture Condition</th>
<th>Consistency/Density Index</th>
<th>Soil Type: Plasticity or Particle Characteristics, Colour, Secondary, and Minor Components.</th>
<th>Structure and Additional Observations</th>
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</thead>
<tbody>
<tr>
<td>E</td>
<td>B</td>
<td></td>
<td>TOPSOIL: Clay: low plasticity, black/brown</td>
<td>M</td>
<td>F/St</td>
<td>T</td>
<td>TOPSOIL</td>
<td>ALLUVIAL</td>
</tr>
<tr>
<td>Bs</td>
<td>R</td>
<td></td>
<td>CLAY: high plasticity, black / brown</td>
<td>F/St</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
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<td>Clay: high plasticity, black / brown, mottled orange, red</td>
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<tr>
<td></td>
<td>ASS</td>
<td></td>
<td>Silty CLAY: medium plasticity, orange / black / red mottled, medium gravel sieved charcoal fragments</td>
<td>X</td>
<td>ALLUVIAL</td>
<td>X</td>
<td></td>
<td></td>
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</tbody>
</table>

## Sketch

**Notes, Samples, Tests:**
- Undisturbed sample 50mm diameter
- Undisturbed sample 63mm diameter
- S - sound
- N - nill
- B - backhoe bucket
- H - rubber bucket
- E - excavator
- D - disturbed sample
- V - very shour (kPa)
- S - saturated
- G - gallery
- R - refusal
- W - wate
- P - plastic limit
- L - liquid limit
- M - moist
- F - firm
- T - soft
- VSt - very stiff
- H - hard
- M - medium dense
- D - dense
- VD - very dense
Appendix B  Acid sulphate soil screening results
## Acid Sulfate Soil Screening Tests

**Client:** Maunsell Australia Pty Ltd  
**Principal:** Roads and Traffic Authority  
**Project:** Geotechnical Investigations  
**Location:** Princes Highway, Gerringong to Bomaderry

**Job no.:** GEOTUNAN02580-AA  
**Date:** 19/3/07  
**Tested by:** BMC

**pH meter serial number:** MC-81  
**Date of Calibration:** 19/3/07

| Hydrogen Peroxide pH Prior to Use (pH units): | 4.92 | Hydrogen Peroxide Temperature Prior to Use (°C): | 23.2 |
| Distilled Water pH Prior to Use: (pH units): | 6.02 | Distilled Water Temperature Prior to Use (°C): | 23.4 |

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Sample Depth (m)</th>
<th>Soil Description</th>
<th>pH in 1:5 Distilled Water</th>
<th>pH in H₂O₂</th>
<th>Temp (°C)</th>
<th>Test Duration (min)</th>
<th>Observed Reaction (See Note Below)</th>
<th>Additional Comments</th>
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<tbody>
<tr>
<td>CBH8</td>
<td>1.0-1.1</td>
<td>Silty Clay, medium plasticity, dark grey, very soft</td>
<td>5.73</td>
<td>3.89</td>
<td>24.2</td>
<td>60</td>
<td>1-2</td>
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<tr>
<td>CBH8</td>
<td>2.5-2.6</td>
<td>Silty Clay, medium plasticity, pale brown, very soft to soft</td>
<td>5.11</td>
<td>3.17</td>
<td>24.0</td>
<td>35</td>
<td>1-2</td>
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<tr>
<td>CBH8</td>
<td>2.8-2.9</td>
<td>Sandy Clay, medium to high plasticity, dark grey-orange mottled, stiff</td>
<td>4.55</td>
<td>2.92</td>
<td>25.0</td>
<td>20</td>
<td>2</td>
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<td>CBH8</td>
<td>4.6-4.7</td>
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<td>4.68</td>
<td>3.47</td>
<td>40.1</td>
<td>12</td>
<td>3</td>
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<tr>
<td>CBH13</td>
<td>0.65-0.75</td>
<td>Silty Clay, low to medium plasticity, brown-orange mottled, very stiff to hard</td>
<td>6.42</td>
<td>3.96</td>
<td>23.6</td>
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<td>CBH17</td>
<td>1.0-1.1</td>
<td>Silty Clay, medium plasticity, brown, firm to stiff</td>
<td>5.62</td>
<td>4.10</td>
<td>24.4</td>
<td>45</td>
<td>1-2</td>
<td></td>
</tr>
<tr>
<td>CBH17</td>
<td>1.35-1.45</td>
<td>Silty Clay, medium plasticity, grey-red-orange mottled, very stiff</td>
<td>5.54</td>
<td>4.07</td>
<td>23.7</td>
<td>45</td>
<td>1-2</td>
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</tr>
<tr>
<td>CBH17</td>
<td>2.5-2.6</td>
<td>Silty Clay, medium plasticity, red-orange mottled, very stiff</td>
<td>5.54</td>
<td>3.74</td>
<td>24.0</td>
<td>45</td>
<td>2</td>
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</tr>
</tbody>
</table>

**Notes:**
- Indicates a drop in pH to below 3 pH units, which generally indicates the presence of pyrite and the potential for acid to be produced.
- 1. No visible effervescence
- 2. Slight to moderate effervescence
- 3. Vigorous effervescent reaction
### Acid Sulfate Soil Screening Tests

**Client:** Maunsell Australia Pty Ltd  
**Principal:** Roads and Traffic Authority  
**Project:** Geotechnical Investigations  
**Location:** Princes Highway, Gerringong to Bomaderry  
**Job no.:** GEOTUNAN02580-AA  
**Date:** 19/3/07  
**Tested by:** BMC  
**Checked by:**  

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Sample Depth (m)</th>
<th>Soil Description</th>
<th>pH in 1:5 Distilled Water</th>
<th>pH in H₂O₂</th>
<th>Temp (°C)</th>
<th>Test Duration (min)</th>
<th>Observed Reaction (See Note Below)</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBH11</td>
<td>0.6-0.7</td>
<td>Silty Clay, medium plasticity, brown-orange-red mottled, firm to stiff</td>
<td>5.85</td>
<td>4.56</td>
<td>25.0</td>
<td>47</td>
<td>1-2</td>
<td></td>
</tr>
<tr>
<td>CBH11</td>
<td>1.6-1.7</td>
<td>Silty Clay, low to medium plasticity, pale yellow-orange-white mottled, very stiff</td>
<td>5.68</td>
<td>4.30</td>
<td>23.3</td>
<td>47</td>
<td>1</td>
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</tr>
<tr>
<td>CBH11</td>
<td>3.1-3.2</td>
<td>Silty Clay, low to medium plasticity, very stiff to hard</td>
<td>6.63</td>
<td>3.87</td>
<td>23.9</td>
<td>47</td>
<td>1-2</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**  
- Indicates a drop in pH to below 3 pH units, which generally indicates the presence of pyrite and the potential for acid to be produced.  
  1. No visible effervescence  
  2. Slight to moderate effervescence  
  3. Vigorous effervescence reaction
### Acid Sulfate Soil Screening Tests

**Client:** Maunsell Australia Pty Ltd  
**Principal:** Roads and Traffic Authority  
**Project:** Geotechnical Investigations  
**Location:** Princes Highway, Gerringong to Bomaderry  
**Job no.:** GEOTUNAN02580-AA  
**Date:** 27/3/07  
**Tested by:** DD  
**Checked by:**

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Sample Depth (m)</th>
<th>Soil Description</th>
<th>pH in 1:5 Distilled Water</th>
<th>pH in H₂O₂</th>
<th>Temp (°C)</th>
<th>Test Duration (min)</th>
<th>Observed Reaction (See Note Below)</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTP1</td>
<td>0.35-0.45</td>
<td>Clay, high plasticity, dark brown, very stiff</td>
<td>6.28</td>
<td>4.24</td>
<td>29.5</td>
<td>10</td>
<td>2</td>
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</tr>
<tr>
<td>CTP1</td>
<td>1.0-1.1</td>
<td>Silty Clay, medium plasticity, grey-orange mottled, firm</td>
<td>6.52</td>
<td>5.24</td>
<td>26.0</td>
<td>12</td>
<td>1-2</td>
<td></td>
</tr>
<tr>
<td>CTP6</td>
<td>1.1</td>
<td>Clay, high plasticity, grey-red mottled, stiff</td>
<td>5.65</td>
<td>3.34</td>
<td>24.4</td>
<td>13</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CTP8</td>
<td>2.4</td>
<td>Clay, high plasticity, grey-orange-brown mottled, very stiff</td>
<td>5.70</td>
<td>4.22</td>
<td>24.6</td>
<td>14</td>
<td>2</td>
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<tr>
<td>CTP13</td>
<td>0.8</td>
<td>Clay, medium to high plasticity, red-orange, very stiff</td>
<td>5.83</td>
<td>3.78</td>
<td>25.9</td>
<td>15</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CTP13</td>
<td>1.9</td>
<td>Clay, medium plasticity, orange-red, hard</td>
<td>5.72</td>
<td>3.19</td>
<td>38.5</td>
<td>0.25</td>
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<tr>
<td>CTP18</td>
<td>0.5-0.7</td>
<td>Clay, low plasticity, brown mottled grey-black</td>
<td>6.62</td>
<td>6.74</td>
<td>28.5</td>
<td>30</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CTP19</td>
<td>2.4</td>
<td>Clay, high plasticity, grey-orange-brown mottled, very stiff</td>
<td>5.65</td>
<td>3.86</td>
<td>27.8</td>
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<tr>
<td>CTP21</td>
<td>0.3-0.4</td>
<td>Clayey Silt, low to medium plasticity, grey</td>
<td>6.12</td>
<td>1.66</td>
<td>53.6</td>
<td>19</td>
<td>3</td>
<td>Green opaque liquid formed</td>
</tr>
</tbody>
</table>

**Notes:**

Indicates a drop in pH to below 3 pH units, which generally indicates the presence of pyrite and the potential for acid to be produced.

1. No visible effervescence
2. Slight to moderate effervescence
3. Vigorous effervescence reaction

**pH meter serial number:** MC-81  
**Date of Calibration:** 27/3/07  
**Hydrogen Peroxide pH Prior to Use (pH units):** 5.25  
**Hydrogen Peroxide Temperature Prior to Use (°C):** 22.5  
**Distilled Water pH Prior to Use: (pH units):** 6.41  
**Distilled Water Temperature Prior to Use (°C):** 22.5
## Acid Sulfate Soil Screening Tests

### Details

- **Client:** Maunsell Australia Pty Ltd
- **Principal:** Roads and Traffic Authority
- **Project:** Geotechnical Investigations
- **Location:** Princes Highway, Gerringong to Bomaderry
- **Job no.:** GEOTUNAN02580-AA
- **Date:** 27/3/07
- **Tested by:** DD
- **Checked by:**

### Test Conditions
- **pH meter serial number:** MC-81
- **Date of Calibration:** 2/3/07
- **Hydrogen Peroxide pH Prior to Use (pH units):** 5.20
- **Hydrogen Peroxide Temperature Prior to Use (°C):** 22.5
- **Distilled Water pH Prior to Use:** (pH units): 6.41
- **Distilled Water Temperature Prior to Use (°C):** 22.5

### Sample Results

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Sample Depth (m)</th>
<th>Soil Description</th>
<th>pH in 1:5 Distilled Water</th>
<th>pH in H₂O₂</th>
<th>Temp. (°C)</th>
<th>Test Duration (min)</th>
<th>Observed Reaction (See Note Below)</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTP26</td>
<td>1.9</td>
<td>Clay, high plasticity, pale grey-orange mottled</td>
<td>4.69</td>
<td>3.17</td>
<td>24.7</td>
<td>21</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CTP26</td>
<td>2.5</td>
<td>Clay, high plasticity, pale grey-orange mottled</td>
<td>6.15</td>
<td>4.38</td>
<td>24.2</td>
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<td>2</td>
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</tr>
<tr>
<td>CTP30</td>
<td>1.5</td>
<td>Silty Clay, medium plasticity, orange-brown-red mottled</td>
<td>4.36</td>
<td>2.60</td>
<td>25.0</td>
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<td>1</td>
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<tr>
<td>CTP30</td>
<td>3.0</td>
<td>Silt, low plasticity, grey, shell fragments, soft to firm</td>
<td>6.54</td>
<td>0.89</td>
<td>55.9</td>
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<td>3</td>
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<tr>
<td>CBH5</td>
<td>1.5</td>
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<td>3.56</td>
<td>2.23</td>
<td>23.3</td>
<td>22</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

### Notes:
- Indicates a drop in pH to below 3 pH units, which generally indicates the presence of pyrite and the potential for acid to be produced.
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