Urban Geological Mapping Project Report 2

Ulverstone Engineering Geology Project





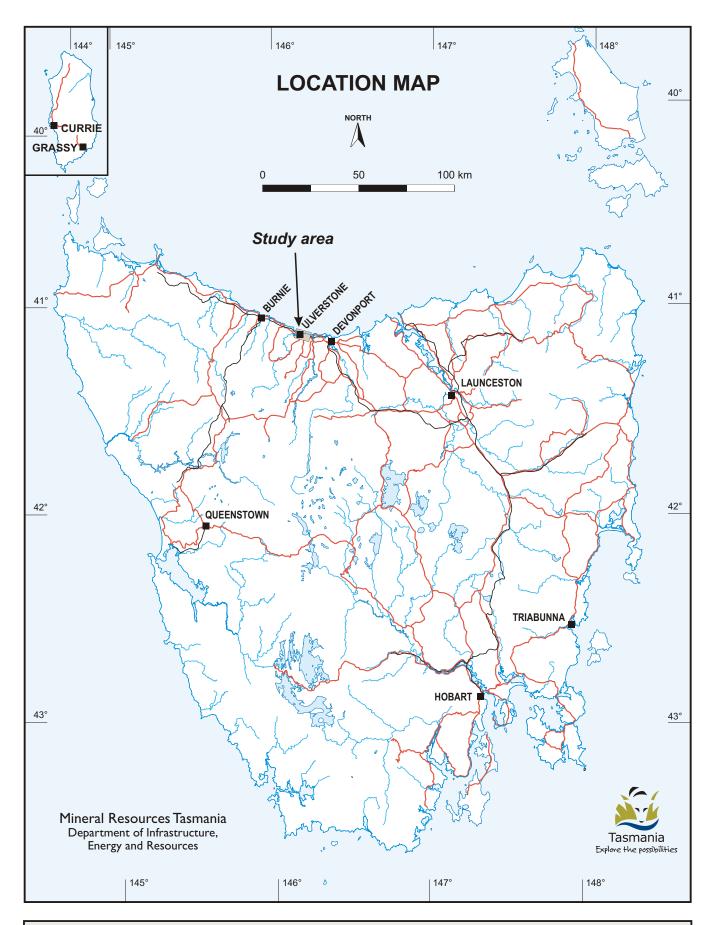
URBAN GEOLOGICAL MAPPING PROJECT REPORT 2

Ulverstone Engineering Geology Project

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Introduction

The Ulverstone Engineering Geology Project was jointly funded by the Tasmanian Government and the Ulverstone Municipal Council. The study was undertaken as a special project supervised by the then Division of Mines and Mineral Resources over a period of eighteen weeks from the end of August to the end of December 1990.

The objective of the project was to produce an engineering geology map of the area, with an accompanying report, for development planning purposes. The 1:10 000 scale map (Urban Engineering Geology Series Map 3 — Engineering Geology Ulverstone) and the three 1:25 000 scale maps were published in 1991 but further work on the report was delayed until 1994. This report, issued in 2014, is a compilation of the material that was prepared for publication in 1994 but not finalised at the time.

Study area

Ulverstone is located on the North West Coast of Tasmania (fig. 1). The $40~\text{km}^2$ project area forms a coastal strip extending from the $146^{\circ}\,08'$ longitude in the west to the River Forth in the east. The $41^{\circ}11'31''$ latitude marks the southern limit of the area, with Bass Strait forming the northern boundary.

The data presented in this report were derived as part of a regional-scale study and as such should not be used for site-specific design purposes. The data should serve to provide an indication of the different types of material which occur in the Ulverstone area and some of their properties, and give basic information for areas where development is being considered.

Terminology and standards

The procedures for soil descriptions and classifications (weathering, soil and rock strengths) as compiled by Moon (1980) are used in this report.

The soils are classified according to the Unified Soils Classification system (fig. 7).

Use of the maps

The maps associated with this project include:

- 1. An engineering geology map (the main map for the project) at a scale of 1:10 000.
- 2. A map of the geology of the area at 1:25 000 scale (fig. 2).
- 3. A map of the physiography of the area at 1:25 000 scale (fig. 3).
- 4. A slope class map at 1:25 000 scale (fig. 4) showing zones of $0-10^{\circ}$ and zones of greater than 10° .

The engineering geology map shows the distribution of various soils and rocks with the legend describing their properties and associated potential hazards. The survey only deals with broad-scale features and soil properties on a regional scale to provide general information. The map should not be used to replace site-specific investigations for particular projects.

The geological hazards associated with the various materials shown on the maps should alert planners and designers of projects of possible problems that should be investigated. For example the engineering geology map shows old landslide areas as well as recently active landslides. Old landslide areas are marked as discrete zones, but it should not be assumed that it is only these zones and the active landslide areas where problems can occur. Around the contour from these zones are often areas with similar or greater slope angle and underlain by the same or similar material. Such areas should also be treated with caution. Alteration of drainage patterns, oversteepening of slopes by excavation and removal of trees could also alter the current apparent stability of these areas.

The slope classification map (fig. 4) will aid in determining zones where investigations may be warranted.

The shear strength measurements (residual factors) show that quite low values have been measured on some of the soil types and development on slopes of greater than 10° where these materials are present should be treated with extreme caution. Occasionally soils on slopes of less than 10° may also require some investigation.

Investigation method

The study of the area was undertaken using established procedures and techniques. These included collation and interpretation of available data, aerial photograph interpretation, mapping, drilling and laboratory soil testing.

Field mapping was undertaken on 1:5000 scale orthophoto maps and data points were also plotted at this scale. Information was later transferred to a 1:10 000 scale base map provided by the Ulverstone Municipal Council, and the final map was drawn from this base.

Grid references provided in this report were taken from the 1:5000 scale orthophoto maps which cover the area. All grid references are AGD66 datum and are MGA co-ordinates in Zone 55.

A total of 54 holes were drilled for sampling purposes and to provide an indication of overburden thickness. Drilling was undertaken using a trailer-mounted powered auger with a maximum practical depth capability of seven metres. Although this was beyond the expected depth of influence for most development activities, the drill was used to gather as much information as possible, especially within sloping and landslide-affected areas.

The distribution of sampling (auger hole) sites was made with two objectives:

- □ to obtain representative samples of the various types of material in the area;
- □ to collect more data on sloping and landslide-affected areas by adopting a closer spacing between sites selected for drilling.

The achievement of these objectives was governed by site accessibility and time constraints.

Disturbed samples were bagged for laboratory soil testing at each auger hole site . Undisturbed samples were taken with cylindrical, thin-wall steel tubes (63 mm diameter, 450 mm

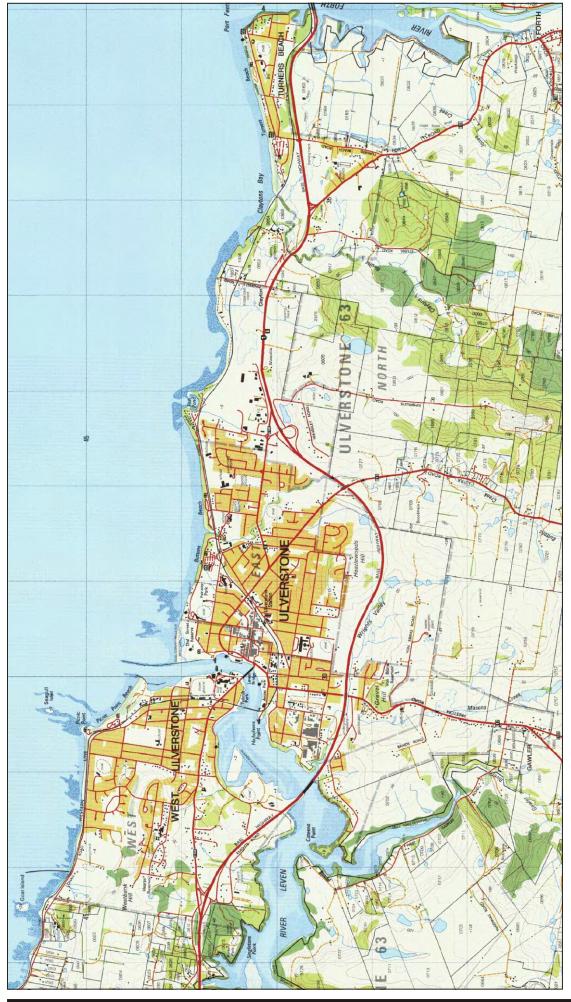


Figure 1. Location of study area.

long) and square, thin-wall steel samplers (inside dimensions 70 70 mm, length 300 mm) pushed hydraulically into the ground. The undisturbed samples were trimmed and sealed at both ends and later extruded for laboratory soil testing. The square steel samplers were used specifically to obtain samples for the determination of shear strength parameters using a shear box.

Soils were logged in the field for engineering classification, moisture content and strength. *In situ* strength determinations were made using a shear vane and pocket penetrometer. An estimate of the degree of compactness in cohesionless material was made by the relative rate of drilling penetration.

The classifications used for various soil properties determined in the field are presented in Figure 7. The auger hole logs (data points I to 54) are presented in Appendix I. Profiles on two existing cuttings and a trench (data points 55 to 57) were also logged in a similar manner to the auger holes. These logs are also given in Appendix I.

In areas where the groundwater table was reached during drilling, the water level was recorded and the specific conductance of the water measured. Specific conductance and water level measurements were also carried out in some of the existing boreholes, a well and seepages.

Surface grab samples (data points 58 to 65) were also collected (Appendix I). Laboratory test results on samples from data points I to 65 are presented in Appendix 2.

Results of investigations previously undertaken by the then Division of Mines and Mineral Resources, Department of Main Roads and Ulverstone Municipal Council (data points 66 to 157) have been incorporated into this report and are presented in Appendix 3. Water bore logs (data points 159 to 200) are presented in Appendix 5.

The locations of the data points (incorporating previous work and those undertaken for this project) are shown on the accompanying 1:10 000 scale engineering geology map of Ulverstone.

Laboratory soil testing

Laboratory testing of soils was undertaken for classification purposes, under the Unified Soil Classification System, and for providing an indication of the adverse properties of materials in the area with regard to some development related activities.

A total of 104 samples was collected for testing and reference purposes (Appendix 2). The location of the samples are given in the logs (Appendix I) and on the 1:10 000 scale engineering geology map of Ulverstone. The samples took the form of auger bit cuttings, thin-wall tube samples and surface grab samples. Tests performed on the samples included moisture content, liquid limit, plastic limit, linear shrinkage, soil particle density, particle size distribution, dispersion (Emmerson class number), bulk wet density, X-ray diffraction, and shear strength parameters.

X-ray diffraction analyses for mineralogical composition determination and shear strength parameters determination (using a shear box) were conducted according to the standard procedures of the Division of Mines and Mineral

Resources. Results of X-ray diffraction analyses are presented in Appendix 4.

The remainder of the tests were carried out in accordance with AS1289 (SAA, 1977) using the following standard procedures:

- □ AS1289 B1.1: Determination of the moisture content of a soil oven drying method (standard method);
- □ AS1289 C1.1: Determination of the liquid limit of soil oven drying method (standard method);
- ☐ AS1289 C2.1: Determination of the plastic limit of a soil;
- ☐ AS1289 C3.1: Calculation of the plasticity index of a soil;
- ☐ AS1289 C4.1: Determination of the linear shrinkage of a soil:
- □ AS1289 C5.1: Determination of the soil particle density of a soil;
- ☐ AS1289 C6.1: Determination of the particle size distribution of a soil standard method of analysis by sieving;
- □ AS1289 C8.1: Determination of the Emmerson class number of a soil;
- □ AS1289 E3.3: Determination of the field dry density of soil core cutter method for fine-grained soils (modified using thin wall sample tube).

These tests were selected as they were considered to be the most relevant for engineering classification purposes and some of the parameters determined from the tests could be used to derive or infer other properties. Brief descriptions of the tests with some implications are given below.

Moisture Content (MC)

This is the ratio of the weight of water to the dry weight of the soil. The moisture content of a soil can vary for considerable depths below the surface as a result of seasonal changes (often 1–2 metres and sometimes greater). Below this zone the moisture content remains relatively constant. The behaviour of a soil (whether it behaves as a solid, a plastic or a liquid) is largely dependent on its moisture (or water) content. Changes in moisture content are particularly relevant in areas of reactive (expansive) soil.

Liquid Limit (LL)

The liquid limit is defined as the moisture content at which the soil just starts to become fluid under a series of standard shocks (Bureau of Reclamation, 1974). The property is measured using a liquid limit machine and the moisture content at which 25 blows of the machine closes a standard groove cut in the soil pat is arbitrarily defined as the liquid limit.

The Liquid Limit is used with the plasticity index to classify cohesive soils according to degree of plasticity.

Plastic Limit (PL)

This is the moisture content at which the soil ceases to be plastic. It is determined by measuring the moisture content at which a thread of soil rolled to a diameter of 3 mm will just crumble.

Plasticity Index (PI)

The plasticity index is the difference between liquid limit and plastic limit. Chen (1975) has established the relationship between the swelling potential of clays and plasticity index.

Table IRelationship between the swelling potential of clays and plasticity index

Swelling Potential	Plasticity Index
Low	0–15
Medium	10–35
High	20–55
Very High	55 and above

Linear Shrinkage (LS)

This is the decrease in length expressed as a percentage of the original length when a sample of soil is oven dried from a moisture content of about the liquid limit (AS1726; SAA:1975).

The linear shrinkage is generally used as an indication of the swell potential of a soil.

Soil Particle Density (SPD)

This parameter is defined as the mass of soil particles after drying to constant mass per unit volume of dry material excluding voids.

Particle Size Distribution (PSD)

This test is used for classification purposes and to give an indication of the origin of soils.

Emmerson Class Number

This test gives an indication of the dispersive potential of a soil which is determined by classifying the reaction of soil crumbs in water. It is an important indicator of the erodibility of a soil.

Bulk Density

Bulk density is defined as the weight of the material per unit volume. The determination of the parameter was made to provide an indication of values, as this is one of the factors used in slope stability analysis.

Physiography

The area is dissected by the valleys of the Leven, Gawler and Forth rivers, Masons and Buttons creeks, and Clayton Rivulet. The rivers have well developed alluvial flats towards their mouths whilst the creeks have narrow, discontinuous alluvial flats along their lengths.

The drainage systems are basically dendritic, with local drainage densities being much greater within areas underlain by Cambrian and Precambrian basement rocks compared to areas underlain by Tertiary basalt. Relatively higher infiltration rates within the basalt areas, compared to areas underlain by basement rocks, would explain the difference in drainage densities. The presence of springs within basalt areas is evidence of higher infiltration and storage capabilities.

The major drainage systems occur within basement rocks. This suggests that basalt flows caused lateral displacement of the drainage systems resulting in the formation of

post-basaltic drainage along the contacts of basalt and basement rocks. The presence of sub-basaltic sediments (sand and gravel) on ridges between the present drainage valleys is evidence of lateral displacement of drainage systems.

The sub-basaltic sediments represent deposits of major pre-basaltic drainage systems.

The area can be divided into three main physiographic units (fig. 3):

- □ coastal and alluvial plains;
- □ coastal escarpment and steep slopes;
- □ higher flat to gently sloping surface.

These units correspond to Burns' (1964) coastal marine platform; coastal escarpment and dissected surfaces; and lower coastal surface respectively.

Coastal and alluvial surface

Although these two landforms have different characteristics with respect to material composition and topographic location, they have been combined into one unit in this study. The two surfaces merge where the rivers enter the coastal plain and the boundary between the two is often difficult to determine. Similarities between the landforms include low-lying flat to gently sloping surfaces and the occasional presence of swampy areas. The unit includes recent beach deposits.

The Forth and Leven rivers have well developed alluvial plains. Burns (1964) recognised the presence of an older alluvial surface at a higher elevation than the present system and indicated that this older surface corresponds well with a higher strand line representing the limit of inland coastline migration. The surfaces (higher alluvial surfaces and strandline) are easily identifiable on old aerial photographs of the area.

In the study area, alluvial plain development by the creeks is limited to narrow discontinuous stretches along their lengths.

The coastal plain is a major landform in the area and represents a former marine platform exposed as a result of a relative fall in sea level and the northward migration of the coastline. Burns (1964) suggests that the relative fall in sea level probably occurred during the Pleistocene.

The present beach is more of a depositional site fed by sediments from the Leven and Forth rivers. The beach profiles are gently sloping, with wide intertidal flats indicating low energy environments. The presence of berms containing coarse gravel to medium-sized boulders indicates occasional high energy environments resulting from storm activity.

The coastal plain is continuous from east to west but narrows towards the western limit of the study area. The inland limit of the coastal plain generally approximates the 25 m contour. Except for parts of the eastern portion, which is still used for grazing, the coastal plain is being gradually covered by urban development. The Ulverstone urban area is centred along the banks of the River Leven.

Coastal escarpment and steep slopes

These two landforms are combined into one unit because of similarities in slopes and topographic locations.

The coastal escarpment is an area of steep landform which is continuous along the inland fringe of the coastal plain, interrupted only by the valleys of the major drainage systems. The other areas of steep slopes occur along valley sides.

The steepness of slopes within these landforms generally reflect the composition and weathering susceptibilities of the underlying basalt and basement rocks, or the degree of compactness for sub-basaltic sediments, which are generally loosely compacted. The steepest slopes occur in areas underlain by basement rocks, while areas underlain by sub-basaltic sediments (sand and gravel) have the lowest slope angles.

The basalt is more susceptible to weathering and it is rare to find anything other than highly weathered exposures along slopes, these areas being composed mainly of transported soils. As these soils are relatively low-strength materials they cannot support very steep slopes, resulting in lower slope angles compared to areas underlain by basement rocks. Sloping areas underlain by these rocks have thinner overburden and more rock exposure, resulting in relatively steeper slopes.

Urban development within the coastal escarpment and steep slopes unit is limited to areas of more gentle slopes, with grazing being the dominant land use. The steepening of slopes due to mass movements (landslide and soil creep) has occurred and continues to occur in a few sites.

Higher flat to gently sloping surface

This surface is composed mainly of basalt except for small areas in the west and to the south which are underlain by basement rocks and sub-basaltic sediments respectively.

The thickest development of overburden as a result of weathering occurs within this unit and this surface is extensively cultivated, except for areas on the fringe of the urban centre which have accommodated urban sprawl.

Burns (1964) suggested that the surface is erosional, probably developed during the Pliocene.

General geology

The following summary of the geology of the Ulverstone area is based on Burns (1964) and work undertaken during this project.

The basement rocks consist of folded and regionally metamorphosed Precambrian and Cambrian rocks. Sand and gravel of Tertiary age overlie the basement in some areas. Tertiary basalt flows and intra-basaltic sediments overlie the above units. Rocks between the Cambrian and Tertiary are not exposed in the area. Unconsolidated Quaternary sediments cover the alluvial and coastal plains and colluvium occurs on some of the slopes.

The geology of the area is shown in Figure 2.

Precambrian

Burns (1964) subdivided the Precambrian into two divisions on the basis of structure and degree of metamorphism. The Forth Metamorphics and Ulverstone Metamorphics belong to the 'Lower Division' and the Rocky Cape Group to the 'Upper Division', with the boundary between the divisions being a thrust fault. The Rocky Cape Group occurs west of the thrust with the metamorphic assemblages occurring to the east of the thrust.

The Forth Metamorphics underlie the Ulverstone Metamorphics. The Forth Metamorphics consist of schist and quartzite, with outcrop occurring along and east of Buttons Creek. The Ulverstone Metamorphics consist of quartzite with interlayered schist and subordinate conglomerate. The boundary between the two metamorphic units is defined by the first appearance of garnet in the schist and the last appearance of conglomerate in the Ulverstone Metamorphics.

The Rocky Cape Group is composed of alternations of mudstone and sandstone.

Cambrian

The Cambrian is represented by mudstone, volcanic rocks and serpentinite, with these rocks unconformably overlying the Precambrian. Serpentinite occurs at Clayton Rivulet within the Forth Metamorphics. Outcrops of the mudstone and volcanic rocks occur at Cateena Point and on the Bass Highway immediately west of the River Leven.

Tertiary

The Tertiary is represented by sub-basaltic sediments, basalt flows and intra-basaltic sediments.

The sub-basaltic sediments consist of quartz-rich sand and gravel, with silcrete occurring in some areas. The sediments represent pre-basaltic fluvial deposits. The main areas of outcrop are along parts of the River Leven bank (near the town centre), on the ridge between Buttons Creek and Clayton Rivulet, and along the northern parts of the ridge east of Clayton Rivulet.

The basalt flows occur mainly as ridges between the major drainage systems. Textures vary from fine grained to amygdaloidal. The unit is at least 85 m thick (see Appendix 6 — data point 158 for borehole log) and palynology work by Mineral Resources Tasmania indicates a middle Eocene age (Appendix 7).

The intra-basaltic sediments consist mainly of clay and sand with minor gravel of basement and basalt composition. The sediments are lenticular in form and their presence indicates that the basalt unit is composed of several flows. The thickest layer of intra-basaltic sediments found is about three metres.

Quaternary

The Quaternary is represented by alluvium on floodplains, by estuarine, beach, dune and glacial deposits on the coastal plains, and by slope deposits.

The alluvium deposits consist principally of clay and silt with minor sand. The sediments on the coastal plains are

composed dominantly of sand, with a low but variable proportion of clay and gravel.

The glacial sediments consist of mainly quartzite gravel and cobbles and occur in a thin coastal strip extending from just east of The Fish Pond to the River Forth. Work by Colhoun (1976) indicated that the lower Forth Valley was glaciated during the Late Quaternary and that ice crossed the present coastline of Bass Strait.

Slope deposits resulting from mass movement mantle most of the valley sides, especially below basalt ridges. The deposits consist mainly of clay and rock fragments in a clay matrix.

Soil descriptions and characteristics

In the following discussions, the soil characteristics presented for a particular unit are taken from the auger hole logs (Appendix I). In these logs, bedrock is defined as beginning where relict rock textures are preserved irrespective of strength properties. The auger hole data points are shown on the accompanying engineering geology map.

Results of the X-ray diffraction determinations are provided in Appendix 4.

Basement (Precambrian-Cambrian)

Soils derived from the *in situ* weathering of Precambrian and Cambrian rocks have been included into one unit because of similarities in characteristics and depth of soil development.

Most basement rocks encountered in auger holes were extremely to highly weathered and outcrops are generally highly weathered. The basement rocks have very low to low strengths when extremely weathered to highly weathered.

Rock strength in the basement unit is controlled by the rock type and the orientation of discontinuities. Low rock strengths would be expected if measurements were undertaken in the same direction as discontinuities, while higher strengths would be measured perpendicular to discontinuities. Quartzite and conglomerate would have higher strengths than schist and mudstone.

Soil development within the unit is relatively thin, and no soils thicker than one metre were encountered during drilling. The thickness of completely weathered material within some rock types can vary by up to about three metres (see data points 24 and 40).

The soil developed on these rocks consists of medium to high plasticity clay with some gravel (rock fragments). The major mineral constituents are kaolinite, illite, quartz and mica, except in soils developed on serpentinite where montmorillonite and serpentine are the major mineral components.

The presence of illite and montmorillonite, and plasticity index values of between 17 and 78, indicate medium to very high swelling potential (see table 1). The wide range in values reflects different parent rock material and indicates the need for site-specific investigations where development is to be undertaken.

The dispersion potential for clay in the unit is generally low. Anomalous areas of high dispersion potential occur (e.g. data point 40), indicating different parent material for the soils

developed. Identification of a sample from data point 40 (4.5 m depth) by MRT mineralogist/petrologist R. Bottrill showed that the material was an ultrabasic schist.

No landslides have been mapped within the unit, indicating low susceptibility to mass movement. However slope failure will occur if current regimes are altered with a resulting increase in moisture conditions and slope angles.

Excavations through rocks types in the unit are reasonably stable as shown by some road cuttings along the Bass Highway.

Sub-basaltic sediments (Tertiary)

These sediments were derived from the underlying basement rocks and are similar to basement in composition. The main mineral constituents are quartz, kaolinite and montmorillonite.

The sediments consist of quartz-rich sand and gravel, silcrete and clay, with exposed areas mainly composed of sand and gravel. The silcrete is extremely hard and has only been located in isolated spots near the junction of River Road and Hall Street at West Ulverstone and on the slopes behind this junction.

The sand deposits are generally loose but in some areas are weakly cemented. Clays are of high plasticity with high swell and dispersion potential.

Landslides have not been mapped in the unit, although the toes of some landslides on the lower parts of the escarpment are believed to involve sub-basaltic sediments. The absence of landslides wholly formed within the unit is probably due to its occurrence on land with a low slope angle and limited exposures of the dominantly clay material. Shear strength measurements of a clay sample from the unit provided values of $c_r' = 2$ and $c_r' = 8$. Excavations within the clay layers of this unit should be undertaken with care, as instability may be created by the formation of steep high cuts.

Basalt and intra-basaltic sediments (Tertiary)

Thick weathering profiles occur in the basalt, with areas covered by this unit being used extensively for farming. Where outcrop occurs the rocks are mainly extremely to highly weathered, with fresh to slightly weathered basalt being found only on the tops of some ridges and where the rock has been exposed by excavations. In its extremely weathered state the basalt has extremely low to very low strength.

Soils developed on the basalt consist of red-brown to orange-brown high plasticity clay. The main constituents of the soils are montmorillonite, halloysite and goethite, except in two samples (1 I – data point 6 and 82 – data point 44) where anomalous values of quartz were detected. The relatively high quartz content in these samples may indicate the presence of thin layers of intra-basaltic sediments.

Laboratory soil testing indicates that the basalt soils have a high swelling potential, with plasticity indices greater than 40. The soils have low dispersion potential, with Emmerson class numbers of 5 and 6. The consistency of the soils vary

from soft to very stiff, with consistency generally increasing towards the soil-rock boundary.

The intra-basaltic sediments consist mainly of clay and sand, with minor gravel composed of basalt and basement material. In some exposures the sand is weakly cemented. The clay and sandy clay are generally red-brown with grey mottling. Soft to firm consistency is common for the clay layers, with the sandy clay material being firm to stiff. The main mineral constituents are montmorillonite, halloysite and quartz.

When exposed the clay and sandy clay sediments generally develop a dry cracked crust (up to 150 mm deep), under which high moisture conditions exist. Gullies up to one metre deep have developed in some exposures.

Field observations and laboratory soil testing indicate that the clay zones in the intra-basaltic sediments have high shrink-swell and dispersion potential.

Ancient landslides occur on slopes composed of basalt and intra-basaltic material. Areas within the unit where slope angles are greater than 10° and where high moisture conditions (seepages, soggy/swampy ground, green vegetation) exist are likely to be highly susceptible to instability. The locations of areas subject to landslides are shown on the 1:10 000 scale engineering geology map of Ulverstone.

Quaternary

Slope deposits

These deposits contain clay and gravel (rock fragments) derived from basement rocks, basalt and Tertiary sediments (both sub-basalt and intra-basaltic) in a clay matrix. The clays are mainly light to dark brown in colour and in some cases contain light grey and/or orange mottling. The mottled clay was mainly encountered in auger holes within landslides and probably represents zones of lower permeability.

A shallow or perched water table is common in landslides within the unit. Water conductivity values of between 110–140 S/cm were recorded from auger holes where the water table was reached.

The main soil types developed on the unit are high plasticity clays and gravel (rock fragments) in a high plasticity clay matrix. Laboratory measurement of soil properties gave a wide range of results for the unit, reflecting the range of parent material from which the soils were derived. The major mineral constituents of the soils are montmorillonite, halloysite and quartz.

Soils derived from basalt and Tertiary sediments have higher plasticity indices, indicating high shrink-swell potential, compared to soils derived from basement rocks. Differences also occur with dispersion potential. Soils derived from basalt and basement rocks have low dispersion potential, whilst those derived from the Tertiary sediments (sub-basaltic and intra-basaltic clay) have very high dispersion potential.

The unit has high shrink-swell and dispersion potential and for planning purposes, the worst characteristics should be adopted unless site-specific investigations are undertaken.

Ancient and active landslides occur on slopes within the unit. Their locations are shown on the 1:10 000 scale engineering

geology map of Ulverstone. It should be noted that the landslide at Frombergs (near Westella, grid reference 433500 mE 5442700 mN) is still active although it is not shown as such on the map.

Sloping areas within the unit are highly susceptible to landslides and a large number of unstable areas have been mapped in the unit. Care should be exercised if development is undertaken in areas of slope deposits, as new landslides can be created and ancient ones re-activated by changes that will cause an increase in moisture conditions, steepening of slope, and loading of tops of slopes.

Alluvium

Deposits of alluvium occur adjacent to creeks and rivers. These deposits consist of unconsolidated sediments ranging from clay to gravel in grain size, reflecting the varying conditions of depositional environments. Gravel is more common adjacent to the upper reaches of the rivers and creeks while the finer-grained sediments predominate downstream.

A particle distribution chart of two non-cohesive sediments is given in Figure 5. This chart indicates the presence of well graded sands (SW) and sand/silt (SM) or sand/clay (SC) mixtures.

The cohesive sediments tested consisted of high plasticity clay and silt (CH, MH) with medium to very high swelling potential The major mineral constituents of the soils are halloysite, quartz montmorillonite and goethite. Of the four samples tested, three had low dispersion potential while the fourth showed high dispersion.

Shallow water table levels were encountered in the auger holes drilled on the alluvial plains. Depths to the water levels ranged from 0.5–5.92 m, with water conductivity being generally less than 500 S/cm.

Refusal depths also varied and suggest the presence of an uneven bedrock surface and coarse gravel layers.

Coastal plain deposits

The coastal plain is covered by mixtures of unconsolidated clay, silt, sand and gravel, with sand being the dominant grain size. The sand is generally poorly graded (SP) as a result of wave and/or wind sorting. The particle size distribution graphs for four sand samples are presented in Figures 5 and 6.

Clay was the major constituent in the samples of cohesive material collected. Laboratory soil testing indicated the presence of low to high plasticity clay types (CL, CH) with medium to high swelling potential. Dispersion potential for the cohesive soils is low to high. Quartz, montmorillonite, halloysite and kaolinite are the major mineral components of the soils.

Refusal depths in the coastal plain varied from 1.3 m to greater than seven metres. This indicates the presence of gravel layers and variable bedrock levels. Material sizes greater than coarse gravel would have halted auger penetration.

The variable bedrock levels are probably due to the presence of buried channels. These channels would have

been infilled during the last post-glacial sea level rise. The greatest thickness of sediments would occur in areas of buried channels and adjacent to existing channels.

The water table level on the coastal plain is shallow and generally occurs within two metres of the ground surface. Water conductivities of less than 1000 S/cm were recorded from the auger holes drilled on the coastal plain.

Geological hazards

Shrink-swell and dispersion potential

The shrink-swell and dispersion potential of the soils in the area has been discussed in the section on soil description and characteristics.

In general, basalt soils, cohesive layers in the Tertiary sediments (sub and intra-basalts), some soils developed on the slope deposits, and alluvial clay and silt are highly susceptible to seasonal shrink-swell. Soils with high dispersion potential include cohesive material within the Tertiary sediments, some soils developed on the slope deposits, and some alluvial clay and silt. These materials must be regarded as being particularly erodible when compared to some of the other soil types (e.g. basalt).

Landslides

Sloping areas underlain by basalt with slope angles greater than 10°, and slopes composed of colluvium (slope deposits), are most susceptible to landslides. Risks within the other units can be increased by development methods which result in the steepening of slopes, loading of the tops of slopes, and the increase in moisture conditions.

Buried channels

The variable depth to bedrock in the alluvial and coastal plain areas suggests the presence of buried channels. These channels would have been filled during the last post-glacial sea level rise.

The locations of the channels and the nature of infill material should be investigated in areas where developments are proposed. Channel infill can contain material susceptible to settlement and depths to bedrock will be greater in areas of buried channels and near existing channels.

Faults

Geological faults occur in the Ulverstone area; their locations are shown on the I:10 000 scale engineering geology map of Ulverstone. The degree of fracturing and weathering is expected to be greater and bedrock strengths lower along the faults relative to the surrounding area. There is no evidence to suggest recent movement along the faults.

Earthquakes

Tasmania, as with the rest of Australia, is in a low earthquake risk area compared to the major earthquake belts in the world. Ulverstone is located within the Western Tasmanian earthquake source zone of Michael-Leiba and Gaull (1989). This area has a 10% probability that peak ground motion will not exceed 0.55 m/s⁻² during a 50 year period. Gaull et al.

(1990) consider areas of greatest risk to be those where peak ground acceleration of 1.0 m/s⁻² or greater will be exceeded with 10% probability in a 50 year period.

Since European settlement the larger earthquakes that have been felt have been centred off the far northwest coast of Tasmania.

Floods

Damage due to inundation, silting and undermining of the foundations of structures by strong currents created during floods are the main hazards related to flooding. Development of flood-prone areas should always be undertaken with these factors in mind.

Coastal processes

For proper coastal management, a study of coastal processes occurring in the area, and the expected effects of proposed structures or developments on these processes, should be considered. Interference to the natural coastal processes can lead to the erosion or silting of prime areas.

Acknowledgements

During the course of the project, assistance was received from the Ulverstone Municipal Council's Engineering Section through the provision of plans, reports and access to some sites for sampling purposes. Landowners in the area also allowed ready access to their properties during fieldwork.

The drilling was carried out by B. Cox, while R. Woolley performed the laboratory testing of soils. R. Rallings and J. Giedl of the (then) Department of Main Roads provided access to geotechnical information gathered by their department during investigations for the construction of the Bass Highway and some buildings in the town area.

Advice and assistance received from staff of the Division of Mines and Mineral Resources is gratefully acknowledged.

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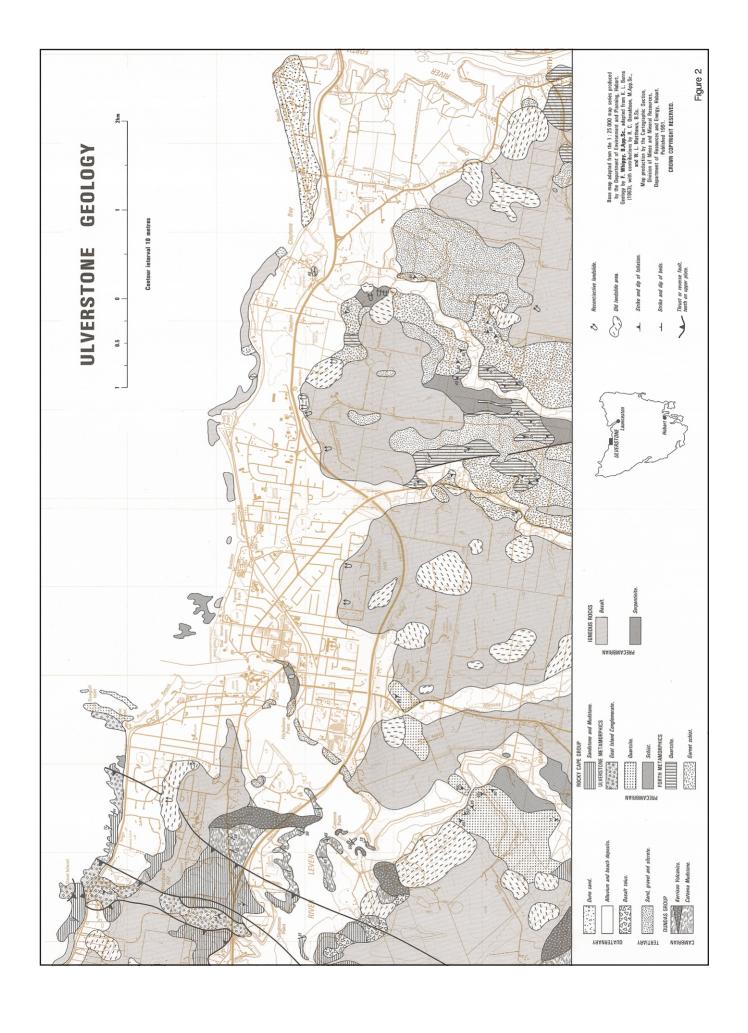
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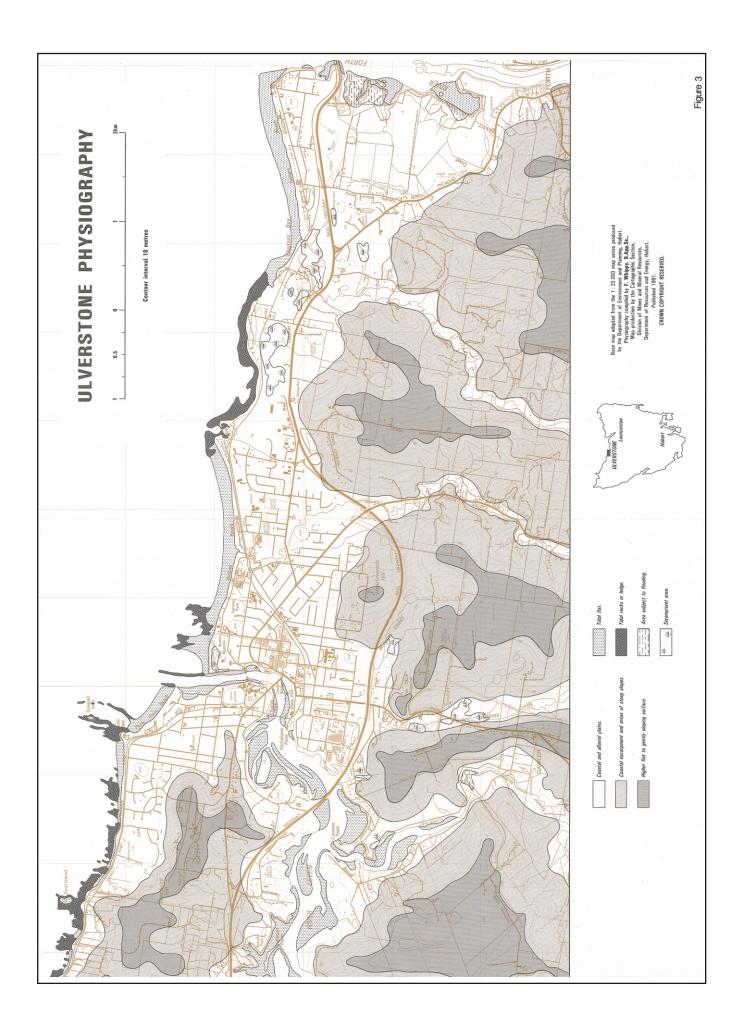
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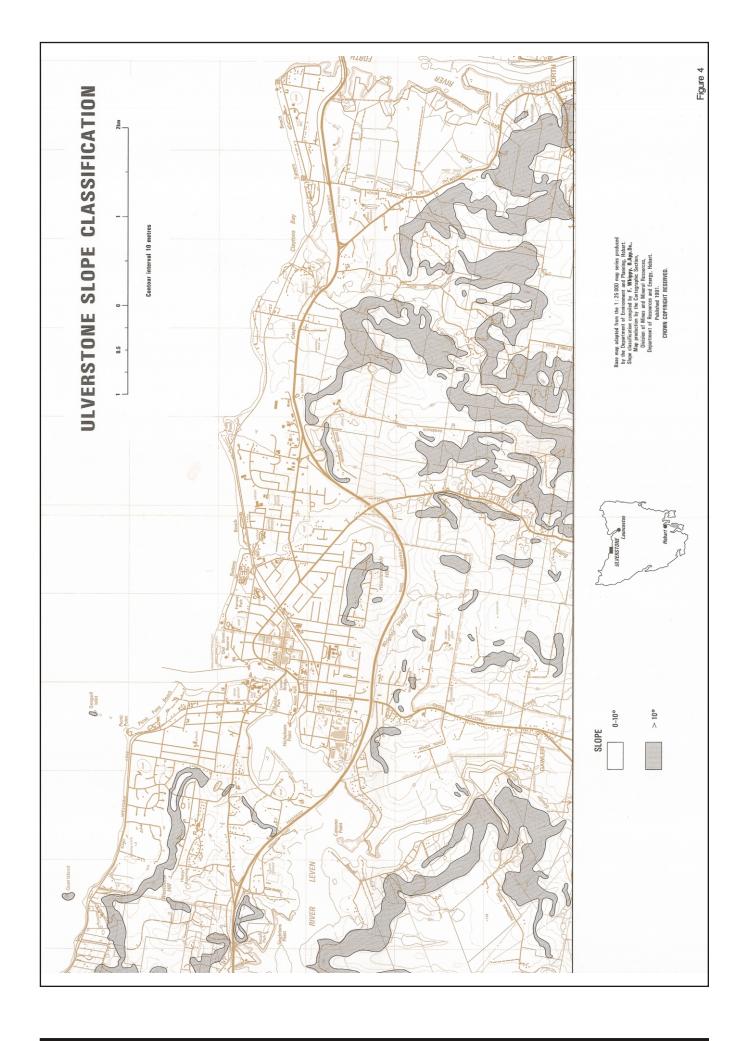
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PARTICLE SIZE DISTRIBUTION CHART

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Figure 5
Particle size distribution chart of a coastal plain sample and two alluvial plain samples.

PARTICLE SIZE DISTRIBUTION CHART

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Figure 6Particle size distribution chart of three samples of coastal plain sand.

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Information Required for Describing Soils	Give typical name; indicate approximate percentages of sand and gravel; max, size, angularity; surface condition and hardness of the coarse	grans. local or geological name and pertinent descriptive information: and symbol in parentheses. For undisturbed soils add information on stratification, degree of	compactness cementation and moisture conditions. Example:	"Silly said, gravelly, about 20% hard: angular gravel particles 12 mm max. size; rounded and subangular sand grants coarse to fine, about 15% nonplastic fines with low dry	strength; well compacted and moist in place; alluvial sand (SM).				e v		Give typical name, indicate degree and character of plasticity, amount and maximum size of coase grains; colour in whe condition odour if any	local or geological name: and other pertinent descriptive information and symbol in parentheses. For undistructed soils add information on error into extensions in	structure, strainteanon, consistency in undisturbed and remoulded states, and moisture condition. Example:	Clayey sill, brown, slightly plastic, small percentage of fine sand, numerous vertical root holes, firm and dry in place, loess (ML).			
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Field Identification Procedures (Excluding particles larger than 15 mm [3"] and basing fractions on estimated weights)	ge in grain sizes and substantial of all intermediate particle sizes.	antly one size or a range some intermediate sizes	Nonplastic fines or fines with low plasticity. (For identification procedures see ML below.)	Plastic fines. (For identification procedures see CL below.)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.	Predominantly one size or a range of sizes with some intermediate sizes missing.	Nonplastic fines or fines with low plasticity. (For identification procedures see ML below.)	Plastic fines. (For identification procedures see CL below.)	Identification Procedure on Fraction Smaller than 0.4 mm (BS No. 36 sieve) size.	Dilatancy (Reaction to shaking)	Quick to slow	None to very slow	Slow	Slow to none	None	None to very slow	Readily identified by colour, odour, spongy feel and frequently by fibrous texture.
Field Identif (Excluding p [3"] and bas weights)	Wide range amounts of	Predominant sizes with so missing.	Nonplastic f plasticity. (F procedures	Plastic fines procedures	Wide range substantial a intermediate	Predominan of sizes with sizes missin	Nonplastic f plasticity. (F procedures	Plastic fines procedures	Identificati Smaller than (Dry Strength (Crushing characteristics)	None to slight	Medium to high	Slight to medium	Slight to medium	High to very high	Medium to high	Readily ident spongy feel a fibrous textur
Typical Names	Well-graded gravels, gravel-sand mixtures, little or no fines.	Poorly graded gravels, gravel-sand mixtures, little or no fines.	Silty gravels, gravel-sand-silt mixtures.	Clayey gravels, gravel-sand-clay mixtures.	Well-graded sands, gravelly sands, little or no fines.	Poorly-graded sands, gravelly sands, little or no fines.	Silty sands, sand-silt mixtures.	Clayey sands, sand-clay mixtures.			Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty.	Organic silts and organic silty clays of low plasticity.	Inorganic silts, micaceous or diatom- aceous fine sandy or silty soils, elastic silts.	Inorganic clays of high plasticity, fat clays.	Organic clays of medium to high plasticity, organic sitts.	Peat and other highly organic soils.
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BOUNDARY CLASSIFICATIONS. So is possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well graded gravel-sand with clay binder.

LATERITIC SOLIS. These so its may be classified texturally in accordance with the above system, but their properties may be inconsistent with accepted usage because of their tendency to harden on exposure to atmospheric conditions.

Tilese procedures are to be performed on the minus 0.4 mm (BS-No. 36 Sieve) size particles FIELD IDENTIFICATION PROCEDURES FOR FINE GRAINED SOILS OR FRACTIONS DAY STRENGTH (Crushing characteristics) Mould a part of necessary Mould a part of soil to the Consistency of the a dring water if necessary is the controlled to the controlled by bown, sun or an drying and then test its strength as to select of the controlled by bown, sun or an drying and then test this strength as boseening and a drawing and then test feet grifty whereas typical sill tast fine smooth feet of flour.

TOUGHNESS (Consistency near pleastic limit)
A specimen of soil about (7 min* in sets is moulded to the consistency of putty. If too dry, water must be added and if stick, the specimen should be spread out in a thin layer and smowed to loses some monsture by expandant. Then the specimen is other outly hand on a move to loses some monsture by expandant into a thread about 3 min identer. The thread is then folded and if explicitly and the paths into a thread about 3 min identer. The thread is gradually reduced and the specimen stiffent may may be abscribe; and cumbles when the plastic limit is reached. After the thread crumbles, the places should be lumped together and as slight kneader gation continued until the timp cumbles.

The toughtness of the thread near the plastic limit and the stiffness of the lump when it finally crumbles is indicative of the clay content of the soil.

Figure 7. Unified Soil Classification System (from SAA Code of Practice for Site Investigation). DILATANCY (Reaction to shaking)

Prepare a paid moists otion with a volume of about 10 mm⁻⁾ Add enough water, if necessary, to make the soil soft but not sticky. Place the pair in the open paim of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consistency and becomes glossy. When the sample is gueteze to there the integers, the passis of the page and becomes the integers, the passis of the page and becomes the integers, the passis of the page of the pa

APPENDIX I

Logs for data points I to 65

Geological symbols for logs

F Fill
A Topsoil
Qa Alluvium

Qm Coastal plain deposits

Sd Slope deposit (transported soils)

Tbw Residual soil — basalt parent rock

Tsi Intra-basaltic sediments

Tbr Basalt bedrock

Ts Sub-basaltic sediments

Cw Residual soil — Cambrian parent rock

Cr Cambrian bedrock

PEw Residual soil — Precambrian parent rock

PEr Precambrian bedrock

r includes extremely weathered material (original rock fabric preserved)

Data point numbers:

I to 54 auger holes 55 trench

56 and 57 existing excavations58 to 65 surface grab sample sites

DATA POINT NO 1

BOREHOLE LOG

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penetration	ЕТНОГ	NOTAN METTER	GEOLOGICAL DESCRIPTION soil Type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NOMBER	CLASSIFICATION	3	Residual (MA) 22	Penetrometer (KB)	consistency density index	moisture condition	SPD (3/cm3)	BNO (g/cm3)	%	S;//	\$ 6%	limi.	Plasticity Index &	Shrinkage	Free Swell %	Emerson Class No	Stre	neters (bap) 'd	NMC %	water level
	AS	, -	CLAY, medium to high plasticity, red-blown, trace fine sand and fine to medium gravel (subangular basalt fragments)	-1						F to St	M < PL						Andreas - Control - Contro								1111111111
	TST	2	colour change to dark brown, increase in moisture content & consistency	S _d	1/2 * 3	CH	ŀ	35 20	175 220	VSĆ	M ≥ PL	237	1-77				80	49	17		3	4	32	50 54 44	
	AS	3-	increase in gravel (HW -SW basall) content to 20%.								M > PL	-													8-10-90
		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	End of hole : 4.3m (refusal)																						
 	Remarks	· Site · wate	on mid slopes of basalt escarpmer r level: 3-52m; conductivity: 2 radvancing holi EXPLANATION	290 _м	S (,	4. <i>9.</i> 01.06	ical	e symr ext	OL #	a able	(an	ds	h de	clos	e) VGII	NEE	1/9	NG	GEG	da OLO	л G Y	?)		
7	: thin	wall tub	wing (d: 100mm). NMC: Natural Moistur Content: (d;:63 mm). BWD: Bulk Wet Dens.	ity.	·/.	(Sec	= 7	ext,	,			Drill	er	B	Co	×			40	 199e			90		

SPD: Soil Particle Density

* : Mineral composition determined by XRD.

8.10.90

Water level on
date shows (70×70mm). Plant Triefus Drawn F. Whippy Started, 8 · 10 · 90 Water level on date shown. Finished 8 . 10 . 90

BOREHOLE LOG	DA	TA POINT	NO 2
PROJECT ULVERSTONE ENGINEERING GEOLOGY	0 %	BYATEM	AMG
FEATURE Auger hole	OR T		429355
LOCATION Moore Street reserve, towards Josephine Street end - W. Ulverstone	03	N N	5444395
CASING/HOLE COMPLETION	CED	DATUM	AHD (Tasmania)
. No support used . End of hole: 5.05m (refusal)	AEDUCE LEVE	COLLAR	≈ 4m

				. Find of hole: 5.05m (rej	fusa	/)												LIE.	_	ORO	AAJJ INUC ZALI	 D	≈ 4	m	•••••
c penetration	METHOD OF ADVANCING HOLE	Metre:	DEPTH	GEOLOGICAL DESCRIPTION soil type: plasticity or particle characteristics, colour, secondary and miner companents.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION	~ 15	Residual (KPa)	Penetrometer (KA)	consistency density index	moisture condition	SPD (8/cm³)	BWO (5/cm3)	% %	2 %	%		nkage 7, a	%	Emerson Class No	She Street Rame	ar ngth peleis	NMC %	water leve!
			=	SAND; fine to medium grained, black, organic rich (* 20-30%).	A						VL	D													:
		,	arrel 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	SAND; fine to medium grained, light brown, quartz; trace silf + clay.	Q _m	4	SF				L	M			6	94									9.10.90
	AS	3	**********	BASALT; extremely weathered, extremely low to very low Strength; pockets of clay- high plasticity.	7 6 _r																				
			111111111111111111111111111111111111111	CLAY/5/LT; low to medium plasticity, blue-grey, trace fine gravel (quartz-ongular). End of hole: 5.05m (refusal)	7 s		CL				St to VSt	M >PL													
Α	•marks	·Si	te.	on coastal plain level: 0.74m; conductivity:	670																				
1e ·	0//00	MITHO	0 01	Nevel: 0:74m; conductivity: ADVANCING HOLI EXPLANATION ing (d:100mm). NMC: Natural Mois			OLOGIC		symm text			1	''''''			EN			CTIC		orc	GY			
,,	1096	, 50,		Content. BWD: Bulk Wet Den			100		~!	,			Drill	er	3. C	×							Vhip	_	
				SPD: Soil Particle L	•	fy							Plan	 t.:	riet	45							hip.		
				9.10.90 Water level	l on								Star Finis	red	9.7	10.9	0				ived		ol .	/	

PROJECT ULVERSTONE ENGINEERING GEOLOGY	OS	SYSTEM	AMG
FEATURE Auger hole	ATE		429020
LOCATION Upper Maud Street reserve, towards Clara Street end - N. Ulverstone	88	N	5444215
CASING/HOLE COMPLETION	ED	DATUM	AHD (Tasmania
. No support used	O E		
· End of hole: 2.89m (refusal)	EB	GROUND	≈ / m
	Tr.	LOVIMACE	1

			End of hole : 2.89m (refuse	1/)													REDU	<u> </u>	ILVI	2A1	نان	∻ /	<u></u>	
penetration	METHOD OF ADVANCING HOLE	Wettes DEPTH	GEOLDGICAL DESCHIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	Peak (4/R) 575	in.	Consistency	moisture candition	SPO (g/cm³)	BNO (5/cm²)	%	7	30 6	$\dashv _{i}$	ty Index %	akage % =	Free Swell % =	Emerson Class Ne		ar ng# neders (680)	NMC %	water
	AS	1-	CLAY; high plasticity, dark brown, some organics and some coarse sand to fine gravel (HW-SW basaH fragmen -ts)	S _d	5*6	СН	70 3	5 7	F	M ≥ PL	2.26	1-80	70	6	14	116	86	24					44	
	AS ST	2	colour change to light brown with grey mottling, increase in moisture content + consistency Colour change to wange - brown and decrease in moisture content (decomposed basalt?)		7*		60 3	7	50	PL							71		0	1	5	15	45	dry
4		3-	BASALT; EW-HW; VL strength End of hole: 2.89m (refusal).	T b _r .			\parallel	+	-	-	-		H	+	+	+	+	H					-	-
	Remati	Site :	3 up basalt escarpment within le	ndeli	de 7	be a								general track (IV)										
• · · · ·	· · · · · · · · · · · · · · · · · · ·	. Вава МІТНОВ	ige present 20m east of auger hole (H (HW-SW) apparently encountered 5:0 DI ADVANCING HOLE EXPLANATION	2m a6	G	rast ologic (see	AL SY	ORA		g fou	ndar	ion	exc	va	FINC	IN	SE!	IIN	GG	<i>f Δ</i> ο EOL	Hom	of s	slope	
7	: thin	wall to	rewing (d: 100mm). NMC: Natural Note (d; : 63mm). Content. soss section BWD: Bulk Well 10mm). SPD: Soil Parti Density * : Mineral co	t Dens. c.k	ity .						Pla Sta	nt !	B Ir.	e fa	10	90			Date Drou		9.1 F. h	Whi 10-90 Ihipf	9 29	

State of Able: 7.3m (required dypth) Lituspical asserting and intercomposition of the control o		CASI	TUR ATIC	E	Auger hole. Auger hole. 2 300m west of Amy Street; LE COMPLETION . No support used. . End of hole: 7:3m (require	on u	nstab (epth)	le si	ope.	F.	(Fr D					 	LABO	RATO		DA CO GR	N. N. TUM	4 5 A	≈ 4	45 447	
Some time grave (New-Sun bassalf) Change in colour to red - brown (three engular quartz in graver) Change in colour to orange -brown; some sand (coarse grained - quartz and basalf fragmen(s). Change in consistency to seff - \$d St Total Transfer in consistency - stiff to very stiff. AS Change in consistency - stiff to very stiff. CLAY; high plasticity, grey- Gravelly CLAY; medium to high plasticity, light grey-green; gravel - fine to medium sub- angular, quartz.	penetration	METHOD OF ADVANCING HOLE		res	soil type: plasticity or particle characteristics,	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	(k/k)			consistency density index	maisture condition	SPD (8/cm3)	BNO (9/cm3)		,	timit.	Plasticity Index	Free Swell	C/ass	Param (WY)	(Sap)		water
Gravelly CLAY; medium to high plasticity, light grey-green; gravel-fine to medium sub- angular, quartz. To To		AS		3	some fine gravel (tiw-sw basalt). change in colour to red - brown (trace angular quartz in gravel). change in colour to orange - brown; some sand (coarse grained - quartz and basalt fragments). change in consistency to soft change in consistency - stiff to very stiff.			СН				St to vst	AM ≥ PZ								6				9.609
				•	Gravelly CLAY, medium to high plasticity, light grey-green; gravel-fine to medium subangular, quartz.	Ts						to		2:36				HZ	79	8	,	2	8	45	

BWD : Bulk Wet Density.

SPD: Soil Particle Density.

* Mineral composition determined by XRD.

10.90 Water level on

date shown.

Ulverstone 23

Plant: Triefus Started: 9.10.90 Finished: 9.10.90 Date: 9.10.90

Drawn : F. Whippy

PROJECT ULVERSTONE ENGINEERING GEOLOGY	o s	SYSTEM	AMG
FEATURE Auger hole	A P	•	427440
LOCATION East edge of western most reservoir enclosure - W. Ulverstone.	SZ	N	5444525
CASING/HOLE COMPLETION	۳. د ق	DATUM	AHD (Tasmania)
No support used	25	COLLAB	
End of hole: 7m (required depth).	REB	DANNORD	≈ 90m

			End of hole : 7m (required	depti	<u>5).</u>													RED.		ONO	IAU DAI		۶ 9	0m	
penetration	METHOD OF ADVANCING HOLE	METERNATION METERNATION	GEOLOGICAL DESCHIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NOMBER	CLASSIFICATION (USC metric)	(* R) 15	01	(k/k)	density index	moisture candition	SPO (g/cm²)	BWO (5/cm3)	%	Silt %	×2 %	imit % =	ty Index &	_	Free Swell %	Enerson Class Ne	She stre	ar ngth me/as	NMC %	water
		, ,	Sandy SILT; low to medium plasticity, dark grey, 50me organics; sand - fine grained (quartz, rock fragments)			ML				F	M 〈 PL														
		2	CLAY: low to medium plasticity, light brown; Some gravel - fine to medium quartz (primary) QUARTZITE: extremely to highly weathered, very low strength, cream; medium grained.	<i>y</i> • <i>n</i>																					-
	AS	3-																							dry
		5	SCHIST; extremely weathered, extremely low strength, some quartz veining. Remoulds to silty SAND; fine grained, trace fine gravel (quartz and rock fragments).	PEr																					-
		6																							-
		7-7-1	End of hole: Tm (required depth)																						
	Remarks													one	/	Neto	я то	cph	ics,)					
A	AS: auger screwing NMC: Natural Moisture (see fext)													TIC	ON										
	(d: 100mm). Content. BWD: Bulk Wet Density. SPD: Soil Particle Plant: Triefus													2	Date Draw	л	F. (NA 90 Whij	2						
	Density.													ved		of									

(see text)

EXPLANATION

MITHOD OF ADVANCING HOLE

AS: Quger screwing (d:100mm).

ST : square cross section

tube (70 × 70 mm).

NMC : Natural Moisture Logged : F. Whippy Driller : B. Cox T: thin wall tube (d : 63mm). Content. Date: 9.10.90 BWD: Bulk Wet Density. Drawn F. Whippy Plant : Triefus SPD: Soil Particle Started: 9.10.90 Density. * : Mineral composition determined by XRD. Approved Finished 9.10.90 Sheet /

						BO	RE	НΟ	LE	LOC	3			L					لنت
				ULVERSTONE Auger hole	ENGINEER	ING	GEO	10G	/				••••••	O.R.	, , , , , , ,	- 1	AM	•••••	
				On slopes betwe	en South Road	(4 Ba	ss H	ighwa	4-4	posite	: Hear	ps K	oad.	OO			544		
	ASI	NG/		LE COMPLETION										EDUCED FVFI	DATU	, m	AHD(T	asm	ania,
				. End of hole : To	(required	depth	.)							[2]	OROL		≈ 2	7m	
T		1	Z	***************************************				T	FIE	LD 7657.	5		LABO	BATORY	16616				
	F ADYANCHIG HOLE	ELEVATION	DEPT	GEOLDGICAL DESC	RIPTION	ICAL SYMBOL	NOMBER	IFICATION metric)	Spranty (AAA)	omerer (K/th.) Incr index	(0,003)	. 1 52 12	Pachanical Analyses	Limit % 1	hrinkage %=	C/ass N2	hear trength stameters	%	

T	>	3					T	T	T-	-[F	IELD	7£5	75					LABO	BATO	PAY	TE	£15	_				
METHOD OF ADVANCING HOLE	Metre:	C	GEOLDGIC lype: plastici llour, seconda		cla charact		GEOLOGICAL SYMBOL	SAMPLE NOMBER	CLASSIFICATION	MEINE)	l ā		consistency density index	maisture condition	SP0 (g/cm³)	BWD (5/cm²)	8 8	0/ 1/0	2 65	"imit %	Plasticity Index &	200	- -	rson Class Mi	-	efers (600)	NMC %	
			YD; fine vanics); s				7		SP				۷	D														
	1		ndy <u>SILT</u> sticity, ne grain		to medi brown	um . Sand	Qa		ML				S /	м < РL														
AS	2	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						14*												59	28	12		5			24	
	3																											,
7	4	w to	IDSTON eathered very los ne grains	d, ext w stre	remely ngth; s	low some	C,	15	мн			275 325	vst	M ≥ PL	-	1.60											24	
	5	7	emoulds ilt																									
AS	6	11111111111111																										
	7	End	of hole	: 7m (reg	guired d	depth)																						
Remark	Site	on slo	pes con	nposea	of of	Cambri	an C	afeer	10 F	310	 	Muo	ste	ne :		5 465		<u></u>			<u></u>							
: 01/06	MITHO	ou rovanc	ING HOLE	E	XPLAN : Natur	ATION		G	(50e	CAL	SYMB							E	NGI		EFII		GEO)LO	GY			
		iube (d;		BWD	Conte : Bulk : Soil h	ent. Wet De brlick									Plan		B . Tr/e	fu	 5			A	ate.	/	5./6	Nhip O 9 Ihip	0	
Density. * Mineral composition determined by XRD Started: 10.10.90 Approved Sheet 1 of												<u> </u>	1															

DATA POINT NO 8

	FEA	ATION	Auger he West Uh OLE COMPL . No sup	verstone recreation g	roun		my s	••••			de	>						00	LEVEL INATES	DA CD ORG	MITIM L MUT MULLAR JALL	5 A	AN 28 44 HD()	950 486 asm	
penetration 23	METHOD OF ADVANCING HOLE	NOLL NO LE NATION	soil type: p colour, se	LDGICAL DESCRIPTION Ibsticity or particle characteristics, condary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)		71	Penetrometer (KA) 5	density index		SPD (8/cm³)	BNO (g/cm3)	%	Sond %	2 %	% 114	Plasticity Index %	9.6	Emerson Class No	Paran	ar ingth meters	NMC %	water
		1-	(organics	; fine grained, dark brown - oppreciable). ND; fine grained, poor of the sound in	A	16	SM					М			6	94						The second secon			10.10.90
	AS	2 -			Q _m		SP				<i>L</i>	W													
		3-	SCHIST: h	ighly weathered , very low ome quartz veining	PE,	17				1	-														-
	Remail		End of	hole: 3.2m (refusal).																					
· · · · ·		· waf	er level: 0.	52 m; conductivity: 900			OLDGIC/	AL SY	MBG				······			E ?	/GI	NEE	HIN	G G	ord	OGY		·····	
AS	: auge		ing (d: 100mm		ue ty. ensit		(see				****		Plan Star	t i !	7/1e	. Co	· x	S		Logg Date Draw Appro	ed: : /! n:/	F. 10	Whip O . 9 Thip	o py	

W MERCHANE BUSINESS			
PROJECT ULVERSTONE ENGINEERING GEOLOGY	00	AVATEM	AMG
FFATURE Auger hole	167		43/205
LOCATION Ampol Service Station backyard - junction Eastland Drive and Main Street.	02.5	М.	5443045
CASING/HOLE COMPLETION			AHD (Tasmania)
. No support used	25		
· End of hole: 7m (required depth).	[8]	GROUND	≈ /5m
7	LEC	TOVILLACE.	

			· End of hole : 7m (required	dep	<i>(</i> 6)					•••••								E FOI	9		AJJ WO ALL		≈ /	5m	
nenetration 11	METHOD OF ADVANCING HOLE	NOILVI HELENATION METERS	GEOLOGICAL DESCHIPTION soil type: plasticity or particle characteristics. colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NOMBER	CLASSIFICATION (USC metric)		ne er ngih	Penetrometer (KB)		moisture condition	SP0 (g/cm³)	BWO (g/cm³)	1	%	%	2	1,4	1	Swell %	00 Class W	Auro Paro	1	10	water
		1	Silty <u>SAND</u> ; fine to medium grained, black (organics).	A		зм					D to M														
		, 1111111	SAND; fine to medium grained, dark brown; thin (5mm) dense lagers.	-	/8						м			4		96									10.10.50
		2				0.5				_															.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
		3-	change in colour to dark grey	Q _m		SP					w														
	AS	4																							1:1:11:11
		5 -	Sandy CLAY; low to medium plasticity, light grey with																		-				111111111
		611111111111111111111111111111111111111	dark grey pockets; trace fine to medium grained gravel (subround to angular quartz and rock fragments); nica rich. (PHYLLITE - weathered in-situ?)	PEw	* 19	CL ML				S fo F	M > PL										5				
		7-1	End of hole: "Im (required depth).								-														11111111
Rampiles Sife on coastal plain . Water level: 1-08; conductivity: /90 MS MITHOD OF ADVANCING HOLE EXPLANATION GEOLOGICAL SYMBOL ENGINEERING GEOLOGY													 												
A5:	AS: auger Screwing (d:100mm). NMC: Natural Moisture (see text) Content. BWD: Bulk Wet Density SPD: Soil Particle Density Plant: Trefus proun: F. Whippy																								
			* : Mineral composi 10.10.90 Water level of date shown	tion a	letermi	ned i	ьу <i>-</i>	×.R	D			Star Finis						 2		Appr Shee			, ol	1	

				ВС	RE	НО	L	E	L	0	G									- π		W.I.			
	PRO	JECT	ULVERSTONE ENGINEERING	G	EOLO	GY												10					AM	G	
	FEA	TURE	Auger hole															ORD	E I		TEM	1	32	•••••	5
			Nature strip at eastern e	nd e	4 4	eight	an	ds	A	ven	ue	- 4	£. 6	110	er.	to	œ.	0.00	X			1	44:		
	CAS	ING/H	DLE COMPLETION															CED	- -	541	r.				ania
			. No support used															Ü	E .					.3=7	
			· End of hole : 3.2m (refusa	/)														REDU	-1	ONC	LAR	0 .	≈ 6	m	
Г	T	7		T	T	Т	7-	· F	IELD	TES	75					us	ORA	TORY		1113]
	METHOD OF ADVANCING HOLE	ELEWATION		709		3	1 51	101	(£8)			5	_	-	400 h	nical 111	$\frac{1}{2}$	200	60	96	42	She	19%	%	
tigo	ANCM	\$13		GEOLOGICAL SYMBOL	SAMPLE NOMBER	CLASSIFICATION (USC MEINC)		3		<u> </u>		(g/cm3)	(s/cm3)	%	%	30 g	١٧.) ê	1990		C/ass		neters		
penetration	OF 40		GEOLDGICAL DESCRIPTION	61CAL	V 33	3/F/	(4.12)	Residual (xPa)	Penetrometer	consistency density index	2.5		3			,		100	1.2	Free Swell		(k.R.)	(263)		
٩	THOD		soil type: plasticity or particle characteristics, colour, secondary and minor components.	£070	AMP	243	Peak	Scon	ener	sonsis Jensit	moisture condition	500	BWD	Clay	#15	Sand	orav.	Diasticity	near	99	Emerson	١, ر	, d	NMC	wafer
12	¥ E	metres			<u> </u>	<u></u>	100	8				0,	Ø,	0	2	7	1	4 9	7	Q.	E	U	<u> </u>	V	_
			Silfy SAND; fine grained, cark brown	A		SM	-			,	,														,
И		:	SAND; fine to medium grained, brown - grey, quartz			SP				1	D														-
ħ			Sandy CLAY: high plasficity, grey		*				/25		М				1										
\mathcal{A}		1 -	with orange mottling; sand - fine to medium grained + occur in leases.	1.0	20	CH	60	15	150	St	>	2.43					6	2 45	16		5			25	-
1								\dashv			PL	_					-	+-	\vdash		-				(O-10-9)
1		-	Clayey <u>SAND</u> ; fine to medium grai- ned, light grey; Clay-high plasti - city			Sc				۷	M to					-									-
$ \mathbf{l} $	AS	-	- city	\boldsymbol{Q}_m						_	W														
		2 -	CLAY; high plasticity, olive -green,			СН				5+	M ŽL														-
		1	trace fine gravel (basalt).				1			_	PL														:
Я		SAND; fine to medium grained (?) (NO RETURN) GRAYEL; fine to medium grained, angular to subangular; trace clay. GP																							-
A																									
	N .	3-	angular to subangular; trace clay.			GP																			
		End of hole: 3.2m (refusal)																							
																									:
		-																							-
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	Remark	Site	on coastal plain					••••									••••								
	· · · · · · · · · · · · · · · · · · ·	·wat	er level: 1.41m; conductivity	. 960	2 بر					· · · · · · · · · · · · · · · · · · ·	······		·····	·····											
		MITHOD	DI ADVANCING HOLE EXPLANATION			oraeic										NG	IN		INC	G G E	OLO	OGY			
AS	: aug	er scre		ture		(500	te.	x+)						·							F. 1	Nhij	וזמס	
i	(0:1	00mm)	. Content.								-	Drill	er :	.0	ч	×			4	-0996	90 :	.f.:.!		.19	

BWD : Bulk Wet Density .

SPD: Soil Particle Density

* : Mineral composition determined by XRD
10:10:90
Water level on
clate shown

Ulverstone 29

Plant: Triefus
Started: 10.10.90
Finished: 10.10.90

Date: 10.10.90

Drawn : F. Whippy

Sheet / of /

	00	111	110	rr roo				
PROJECT ULVERSTONE ENGINEE	RING GEO	206Y				00	SYSTEM	AMG
FEATURE Auger hole						ATE	L.	430370
LOCATION John Wrights property - s	tope between	n Von	Bril	ras Road + Wrigh	bls Valley.	응호		5441720
CASING/HOLE COMPLETION						CED	DATUM	AHD (Tasmania
· End of hole: 7m (regun	red depth					REDU	GROUND DANNUB	≈ 47m
ATION DEPTH	708		*	FIELD TESTS Yant R		nder Ter	11111	Shear

				. No support used . End of hole : 7m (required a	dep ti	ه)												REDUC	C	AUON AUON AUON	D	≈ 4	+7m	?
untersation 3	METHOD OF ADVANCING HOLE	Contract of	metres	GEOLOGICAL DESCHIPTION soil type: plasticity or particle charecteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC METRIC)	Peak (4/R) Signal		consistency density index		SPO (g/cm³)	BWO (9/cm3)	% 6	1111	% /	Ind	a 1.	Shrinkage %	7	BAN CE		ţç.	water
				Silty CLAY; low plasticity, dark brown.	4		CL	65 20	250 350	F														
	AS		2 -	CLAY; high plasticity, red- brown; trace fine to medium Sand (basalt fragments).		21*	8		Applications with the contract of the contract		M < PL	2:57			and the first of the second se		97	51 2	20	6			38	
	д		3		S _d		СН			vs+														
			4	increase in moisture content.							M } PL													10.11
-	Τ		5	derease in consistency and increase in moisture content.		22		70 30	125	S†	M >		1.74										58 56	
,	AS		6	red-brown with orange — yellow mottling, increase in cosistency; relict rock texture discernible (BASALT - EW, EL-VL Strength)	7 b _r					VS+	PL													
				End of hole: 7m (required depth)																				
1 R	Remarks		. <i>N</i>	te towards head of landslide on ater level: 4.42m; canductivit oradvancing hore EXPLANATION	g	90 _A	S. OSOC	AL SYM				J			EN	GII			VG (GEOL	OG	Υ		
				ewing (d:100mm). NMC:Natural Mc bube (d;:63mm). Content. BWD: Bulk Wet D SPD: Soil Particle 10:70:90 Water leve date Sho	ensite Dens sition	·4·	(see)			Drilli Plan Stari	t	Trie	fus 10	9	0		Da Dro Apr	gged te.: nwn! proved	F.	Whip	o PPG	

to MEGATION TO THE STATE OF THE			
PROJECT ULVERSTONE ENGINEERING GEOLOGY	00	BYSTEM	AME
FEATURE Auger hole	A P		43/200
LOCATION Slopes behind dams, Mc Kennas property - end of Von Bribras Road.	양호	N.	5441485
CASING/HOLE COMPLETION	B .	DATUM	AHD (Tasmania
. No support used	12.0	DATOM	
· End of hole : 5.5m (required depth)	99	COLLAR	≈ 77m
	Loc	BUMBACE	

				:.	End of hole : 5.5m (require	<i>a a</i> e	pin													L C		LUV	ило	<u></u>	≈ 7	7m	
penetration	METHOD OF ADVANCING HOLE	> ELEVATION	netres	DEPTH	GEOLOGICAL DESCRIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NOMBER	CLASSIFICATION	3.00	Residual (A.P.)	Penetrometer (KB.)	consistency density index		SPO (g/cm³)	BWO (g/cm²)	%	A-11	% A	9%	% 11	1	\$ 96	on Class	Para	neters	NMC %	water
	AS		2		CLAY; medium to high plasticity, black (organics); some silt. Colour change to dark brown. Colour change to red-brown, grey mottling; some fine to medium sand, trace fine gravel (basall fragments). Colour change to dark red-brown and decrease in moisture content: mavelly CLAY; freed HW basalt frags. red-brown, orange mottling, fr. gravel. trace fine sand. Colour change to yellow—	A S _d	23 24 25 26 27	СН		0 20	400 325 375		M Y PL MY PL MY PL				the state of the s									50 52 52 53	
	7		5	.	brown; some medium to coarse sand (limonite nodules and rock fragments). End of hole: 5.5m (required depth).		28*		4	10 15	500 150 200	Ftost	M > PL	2.50	1.64					48 /	25 25	9	6			74	11.10.90
F	Remarks		Sit	" Literatura Characteria Contraction of the Contrac	in the middle of landslide displa	nced /	mass	- <i>bo</i>	150	a/f	s/c	pes															
	_	M	Wa 11HOI SCF	te. o oi ew	Property of the property of th	ture sity- pensing omposi	0) <u>i</u> g. 61 (3	cono ocosio iee f	AI e×	symi +)	i.ty.	; /	50	Drill Plan Star	er :	Tr: !	.c.	us O.	90	81		Logg Date Draw App	ged.	// · //	Whi _l 0 · 9i Vhi _l	2	

and the second s			
PROJECT ULVERSTONE ENGINEERING GEOLOGY	OS	BYSTEM	AMG
FEATURE Auger hole	S I		430270
LOCATION Slope east of Preston Road above dams - John Wrights property: C. Ulverstone	O X	н.	5440870
CASING/HOLE COMPLETION	8	DATUM	AHD (Tasmania)
· No support used	SE	DATOM	
· End of hole: 4.9m (refusal).	EB	GROUND	2 67m
	l mr	BUILLACE	2 0 .,,,

9	18	DEPTH			İ	1	-		1840	725	75	-		7-77		LABO	T.			818		64		τ	1
METHOD OF ADVANCING HOLE	ELEVATION.	netres	GEOLOGICAL DESCRIPTION softlype: plasticity or particlo characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	(A.R.) "	1 8		consistency density index	moisture	SPD (g/cm³)	8NO (5/cm3)		%	Sand % ==	20 11007	ity Index &	Linear Shrinkoge &	Free Swell %	Emerson Class Ne	She Street (AA)	ngth neters (·680)	10	
			CLAY, medium to high plasticity, black (organics); trace fine to medium sand	A					250	F	M < PL														
AS		2	colour change to dark brown; some fine to coarse sand, trace fine gravel (basalt fragments).			СН	80	30	250	VS†	M ≥ PL											***************************************			
		3	colour Change to red-brown; trace coarse sand to fine gravel (basalt fragments).	S _{o'}	30*				175 200									72			6			38 39	12
ST		1	colour change to grey with orange mottling.		32*		55	20		64	М	2.68						30			3	5	21	43	
As		4-	colour change to dark brown.	4						St	» PL				-										*
		1	Some fine to medium gravel (basalt)						150 175																L
		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	End of hole: 4.9m (refusal).																						
Aemerks		Site	af The head of a landslide levels: 4:16m (11:10:90), 3m (12:	(0.00	5					400	uS.														
		11100 0	ADVANCING HOLF EXPLANATION		61	OLOGIC.	AL S	YMR	οι	7.7.9	<u></u>				E	NGI		ERI			olo	GY			-
square	e		g (d:100mm). NMC: Natural Moistura section Content. mm). BWD: Bulk Wet Dens SPD: Soil Particle L ** Mineral compos. 11:10:90 Water level	ity Vensin		(see						Drill Plan Star		Tri	ef	ús.			. 0	ogge ate	i(. 1.i)	1.19	Whi p. 90 Vhip	?	,

					ВС	RE	НО	L	E	L	0	G								DA	TA	7-	'0/N		NO	14			
	PRO	JECT	r	ULVERSTONE ENGINEERI							_													AM					
				Auger hole					•••••						· · · · · · · · · · · · · · · · · · ·				ORG	TES	8 Y I	TEN	٠	306	••••	 ວ			
	LOC	ATIO	N	Top of ridge above dams	- Jo	hn h	right	`۲	pr	ope	rtg	: (c . 4	lve.	15	on	e		Ö	INAT		L		44					
				LE COMPLETION	••••••					.,									03			N	1			ania			
				No support used	· · · · · · · · · · · · · · · · · · ·														10	w		TUM	-		a sm	37714			
				End of hole: 7.2m (require	d a	epth.).												EDU	릴	ORG	UNI	0 3	≈ 6	7m				
	T	7-	3		Γ	1	1	Т-		IELD	TES	75	1					ORA	1081		EFIF	IAC	<u> </u>			<u> </u>			
	METHOD OF ADVANCING HOLE	ELEVATION	DEPTH		7807	, ex	3	5	heer	(88)			5			Anely	100	- 1-	0 0	0 00	96	1/2	She	ar ngth meters	%	ĺ			
Tiga	ANCW	ELE			8	CMB.	C2 7,	(4/4)	[2	نغ			(g/cm²)	(g/cm ³)	%	%	96	2		ege X		C/ass	_						
penetration	or Ap			GEOLOGICAL DESCRIPTION	61CAL	1 3	13/15	3	2	rome.	sinde	e 5		۳			ĺ		1/1	10.75	Swell	8	(A.A.)	(600)					
-	THOO	1		soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC Metric)	Peak	Residual (4.2a)	Penetrometer	consistency density index	maisture	800	BWO	lay	Silt	and	Gravel	חוסבנות דו	Linear Shrinkage	Free Swell	Emerson			NMC	wafe			
1 2 3	3W	metre	_					d	8		<u> </u>	<u> </u>	10,	8	0	3	"	,	10	13	Q.	E	١,٢	,e,	*				
			7	CLAY; high plasticity, black, trace f-m sand.	A	1				275	F	KPL	1				1									1			
M			-	colour change to red-brown						2/3	1															-			
Ш			=	with yellow/grey mottling				-			VS+						1									-			
$ \mathbf{H} $	1	1	4																							1			
ИI			7					-	-	-	_	-														1			
M			=	colour change to yellow-brown; trace fine gravel (basalt).				60	25	100													- 1			-			
11			1			<u></u>		-	├-										1							3			
H		2	? -			T																				-			
M			=			*							\vdash		Н	Ħ	1	H	+	t	†		\vdash			-			
			4	colour change to dark		33*]						2.56		78	19	3	14	Ø98	3 28		6	5	18	64	-			
]	brown; some coarse sand		1							\vdash		_	1	\exists	T	†	T	1					-			
Ш		3	5 =	(HW basalt fragments and		34	ļ				F						١									-			
M			3	vesicle infillings).	- ,	1	СН				to	м						1								-			
	AS		=		7 6 _w	11					Sf	5				- 1		1								-			
			=	2					İ			PL														27			
Ш		4	4			1																							
H			†	colour change to red-brown		-	1]			
			7																							3			
\mathcal{U}		5	Ė,			136													1										
H)			4	colour change to dark																									
			3	brown; some medium sand																						-			
			=	to fine gravel (vesicle								ļ														:			
		6	; =	infillings).																						-			
ומ			=													1	-									-			
			=																							-			
H			=																										
	7	7	Ή.	light brown with yellow orange mottling; relict texture (EW basalt).		35		20	10	22.5 27.5	vs+			1.56											66 82	-			
			-	End of hole : 7.2m (required depth).															T							1			
			=																							-			
			1																										
	Remark		do	on basalt ridge																					•••••				
				on basait riage ole 34 is for interval between 1.8-	4.3/	n .										·····							·····						
		MITHO	00 00	ADVANCING HOLE EXPLANATION		G	OLDGIC.									1	NC					OL	OGY						
	_			ng (d: 100mm). NMC: Natural Moisture			(see	tex	(+))						_			3 L	CTI			F	C Milian					
7:	T: thin wall tube (d: 63mm). Content.																F. Whippy 1.10.90												
				BWD: Bulk Wet Densin	g.									•••••										Vhip					
				SPD: Soil Particle									Plan												ry.				
				Density.									Star	ted.	÷!	/ . /	2.5	10			4 ppro	ved							

* : Mineral composition determined by XRD

Finished : 11 - 10 - 90

PROJECT ULVERSTONE ENGINEERING GEOLOGY	0		AMG
	ES	SYSTEM	
FEATURE Auger hole	A-C	t.	4297/0
LOCATION Beside creek crossing -side road to Mc Kennas homestead: C-Ulverstone.	응폭	N.	5440580
CASING/HOLE COMPLETION	0 .	DATUM	AHD (Tasmania)
. No support used	2 4	DATOM	
· End of hole: 2.9m (refusal).	50	COLLAR	≈ 33m
. Und of More . 2.7m (refusar).	T	DVIIIACL	~ 33m

		:	End of hole: 2.9m (refusal	<u>'</u>													[E F	OR DV	NUO NUO 2A.U		≈ 3.	30	·
penetration	METHOD OF ADVANCING HOLE	WELEVATION WELEVATION	GEDLOGICAL DESCRIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	G E 0 10 6 17 5 7 7 8 0 L	SAMPLE NOMBER	CLASSIFICATION (USC metric)	(k/k) 5 "	7a/ (x/a)	(k.A)	consistency density index		SPD (3/cm²)	BWO (g/cm³)	8	Site %	9 6%	Limit % =	000	Free Swell %	433 N2	Paran	neters	NMC %	wafer
			CLAY; medium to high plasticity, dark bown (organics); some fine sand (rock fragments).	A						F														1:177
		1 -	same as above with grey— orange mottling.		36*		40	25	/50 /20 //0		M >	2-53					105	8/ 2	27	5	4	/8	32	1
	AS	2	colour change to blue-grey with orange motiling.	Q _a		СН	90	25	200 210	5†	PL													11030
			Sandy CLAY; medium to high plasticity, olive green; some fine gravel; sand-medium to coarse; quartz, rock fragments.		37						M < LL													
	Apmerk		End of hole: 2.9m (refusal)																					
		. Wa	e on alluvial flat fer level: l'8m; conductivity: 50 pradvancing holi EXPLANATION (C. 100-10) NMC: Notice (001)	V	G	hole IDLOGI (See	CAL	SYMI	ot	(cr	eek) <u></u>			E	NG			NG (.og	······································		
AS:	auge		ing (d:100mm). NMC: Natural Mois Content. BWD: Bulk Wet De SPD: Soil Particle * Mineral compos 11.10.90 Water level date Show	ensity. Densi Sition o on								Pla. Sta	nt	Tr	.ce ef	1.S 0 · 9			Dai Dra	wn:	· F ·	Whi O · 90 Whip	י פאלי	

PROJ	ECT ULVERSTO	NE ENGINEERIN	G GEO	106Y				Os	BYSTEM	AMG	
	URE Auger hol							A ST		430880	,
LOCA	TION Slopes beta	seen Hazelwoods Hil	1 and	Bass	His	shway		Ö.Ž		544217	15
CASII	NG/HOLE COMPLE . No suppo				•••••			CED	DATUM	AHD(Tasm	ania)
		hole: 2.8m (requi	red o	lepth)			LEV LEV	COLLAR	≈ 67m	
k	TOTA		7,	T	T	FIELD TESTS	LABORA'	DAY	TESTS	hear	-
8	¥ 4		100	œ	18	Sheet of		10000	₹ s	trength 10	.1

		7	· End of hole: 2.0m Crequire												LABO	<u> </u>	E	TEST	MA	בנו].	≈ 6	m	
nontration penetration	METHOD OF ADIANCHIS HOLE	MELLES WELLES	GEOLOGICAL DESCRIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NOMBER	CLASSIFICATION (USC metric)	Peak (kR) Sangak	Penetrometer (KA)	consistency density index	maisture condition	SPO (g/cm3)	BWO (g/cm²)	%	chans 01/11	2 6%	mil % 11mm	0.0	Shrankage %=	e \$	3		رد	wafer
		-	Silty CLAY, high plasticity, black; trace f sand.	A				100	F	< PL	_		1			Н	H	+	-	-			
		1	CLAY, medium to high plasticity, olive green; some fine to medium sand	S _d	.38 *	СН	75 25	/50		м	2-3/					/29	98.2	24	1			46	
1	AS	2	BASALT; extremely to highly weathered, very low strength, light brown. Remoulds (in parts) to sandy and gravelly CLAY; high plasticity.	T b _r					S†	> PL													dry
		1	Colour change to dark brown																				_
		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	End of hale: 2.8 m (required depth).																				
			in the middle of a small slump.																······		· · · · · · · · · · · · · · · · · · ·		
AS:	auner	MI 1HOD 0	ing (o: 100mm). NMC: Natural Moist	terre		See								EA	VGI			1G C	1036	OG	′		
д.	-uyer	ou en	Content. BWD: Bulk Wet Den SPD: Soil Particle Density.			(356		,			Drille Plant Stari	 ¢.ż.,	7/	e fa	s			Dal Dra	'e шп:	/2 . / F. J	Whip	py	

* : Mineral composition determined by XRD

Ulverstone 35

								ВС	RE	HC	1	E	L	0	G						L					, VO		
	P	RO.	JECT.		ULVERSTONE	ENGINEER	RING G	FOLO	GY												Г	<u> </u>	Γ		\top	AMO		
					Auger hole																	CO-ORD	871	MITEM	`	430	•••••	•
					Slopes betwee	n' Hazelwood	s Hill	and	Bass	Hig	16	wac	······		•••••	•••••						- X		Ł		544		
					LE COMPLETI		•••••						•									0		N	1	HD (70		
					No support		************															걸선		TUM		10.00		arro. j
					End of hole		ired d	eph)														REDUCED	OAG	LLAR	pl.	× 6	3m	•••••
_			1.					1	T	T	7		IELD	755	75	1				Abo			TESTS	2A.1	<u></u>			
		HOL	ELE VA TION	DEPTH				200		3		Vene	T 😭	Γ	Ī	1			echani instru	al .	T			42	She	ar		
9		WCWG	373					SYM	mig E,	27.4	5	<u> [3</u>	1 3			(g/cm²)	(g/cm³)	%	% %	1 3%	1%			C/453	Bran	neters	%	
Denetration		7. A.			GEDFOCIO	CAL DESCRIPTION		7831	W 9	(USC METCIC)	(4.8.)		omen	index	0 E	3	ণ		-	1	Tim'	10 11	Swell	Ü	(A.A.)	(069)		
6		METHOD OF ADMANCHS HOLE				city or particle charac lary and minor compo		GFOLOGICAL SYMBOL	SAMPLE NOMBER	CLASSIFICATION	1 4	Residual (KPs)	Penetrometer	consistency density index	morsture	820	BWD	Clay	Sand	Gravel	Liguid	Plasticity Index	Free	Emerson			NMC	wafer
1 2	3	MEZ	metres	1	Colour, Silcono	ary and minor compo	noma,	6	<u> </u>	0	d	Res	_	0.0	E 0	S	B	O)	_δ	6	7	à l	1 12	ξw	١,٢	,ør	8	3
1				-	SILT; high p	lasticity, black	k (orga-	A						F	M ≥													-
1	11.	5		1	nics); trace th	ine gravel (basa	/+ frags.)	, ·						_	≱ PL							\perp	1					-
\mathbb{H}	11 ~	orange - Grey mothling; derease in So 39 MH 25 M																	168	129 2.	5	3			63	- 1		
1	_		1	1	consistency	il calous as	4	30			25	5 20		5	11				+	-	-	+	-			12	<i>c</i> 1:	1
1	S	ST CLAY, high plasticity, colour as above. 40 CH 25 20 LL 225 91 6 BASALT; extremely to highly														6 3	1	773	136 2	4	3	6	12	64	3			
1		- 1		=	BASALT : ex	tremely to his	phly																					,
И				1		very low str	ength,			GC			75	F to	М													47.5
1	A	5	2	7	light brown	7.	437	T_{b_r}		СН			100	5+	>				1									-
1				=	Remoulds	to gravelly CL	AT:				1			,	PL													-
H]	medium gi	icity, gravel- rained (basalt	frags.)										- 1											-
1		_		1							+	\perp					\dashv	-	+	\vdash		+	-				\dashv	
				٦.	End of hole:	2.9m (required o	tepth).										1											-
				=																								-
		-		=																								=
		ı		7																								=
				7																								-
П				1																								
				7																								-
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	1			-															1									-
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	1		-	7																								-
Ш				=																1								1
	1			=					1																			-
				1	2																							3
_	Aerr	norks	. Si+		in the middle	of a small	slumb													••••	• • • • •							
• • • •				••••			<i></i>	········									·····											
					ADVANCING HOLE	EXPLAN				orogic		SYMA	αL						EN	GII		RIN	GGI	ore	OGY			
		_			ng (d:100mm).	NMC: Natural		re	(see	≠e	x+)			}			2	<u></u>						F	Whi	,	
57					section	Conten		.:/								Drille	·/		X							10.9	_	
	7	ube	(70 × 7	101	nm).	BWD : Bulk V		iry.								Plant		7-								Vhip		
						SPD : Soil Pa	article									riant		///	7.00				uraw	n		/	ry	

Started: 12 · 10 · 90
Finished: 12 · 10 · 90

Density. ** : Mineral composition determined by XRD

PROJECT ULVERSTONE ENGINEERING GEOLOGY	Ov		AMG
FEATURE Auger hole	ORI	BYSTEM	430985
LOCATION Slopes between Hazelwoods Hill and Bass Highway	NA		5442625
CASING/HOLE COMPLETION	ED	N	AHD (Tasmania)
. No support used	UCE	DATUM	
· End of hole : 4.3m (refusal)	EDI	COLLAR	≈ 65m
	<u> </u>	PAINVET	

_					· End of hole : 4.3m Crefusa	()	· · · · · · · · · · · · · · · · · · ·													. []		UNG BVII	NUC 2A1	D	≈ (65n	7
1 2	Upin Friday	METHOD OF ADVANCING HOLE	S ELEVATION	n Load utres	GEOLOGICAL DESCRIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	5110	ngth	(88)	consistency density index		SPO (8/cm3)	8WD (5/cm3)	%	%	96	%	Diagord Limit % 2	nyage 2	96	Emerson Class Ne	She Stre Para	neters (600)	NMC %	water
				:	Silty CLAY, high plasticity, black (organics). CLAY, high plasticity, dark	A	41*					F	>PL	2:50					1/2	35 10.	3 26		3			5/	
				/-	brown with grey mottling.			3	65	30	75 /25		< < <							+	-						-
		AS		2	colour change to light brown with orange & grey mottling; some fine to medium sand (rock fragments & vesicle infillings).	S _d		сн				5/ to VS1	M														9.
	Same as above with increa- 3 - Se in moisture content.																		dry								
		4 - BASALT; extremely to highly weath- ered, very low strength, light brown. Removids to sandy CLAY; fine-medium																									
					End of hole : 4·3m (refusal)														The state of the s								
••••	F	lamaik		Site	in The middle of a small slump	· · · · · · · · · · · · · · · · · · ·			1l. 	L																	
AS	: 0	uger			1 ADVANCING HOLL EXPLANATION 19 (0:100mm) NMC: Natural Moistu	re		see 7)L								IN	SE	CTI	DN		OGY			
					Content. BWD : Bulk Wet Dens SPD : Soil Particle										 دز.	Trie	fu	٦				Date Draw		/2./	vhip 0-9 Vhip	0	
				SPD: Soil Particle Density. **: Mineral composition determined by XRD. Plant: Triefus Started: 12:10:90 Finished:: 12:10:90																······		heet			o!	/	

TOCATION factock adjacent to North West Model Engineering Society compound — OUX St443330 CASING/HOLE COMPLETION			JECT			ENGIN	EE	R1NG	Ć	BE	02	0G	Υ					•••••	•••••	. [ES	871	ITEN	1.2	AM	G	,
CASINGHIOLE COMPLETION **No. SagPart used **First of hole : 2 Tm (refusal) **EIGLIGEAN DESCRIPTION **Internal internal in		FEA	TURE	Paddack a	ole	/. A/. edi 1860.		41 1			·····							·····	.		ATE		2				
No. support used First of hole: 2.7m (refusal) Solution in the production of the p					-	to North Wes	TIME	del E	ngine	eeri	<u>ng</u> .	50	cier	9	mp	N.	na Ulua	ret					N				
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ped	METHOD OF ADVANCING HOLE		soil type: plasticity	or particle characteristics.	GEOLOGICAL SYMBOL	SA.	CLASSIFICATION (USC METRIC)	1 15	Penetrometer	consistency density index	moisture condition	500	0	4	Sand	Grave	Plasficity	Linear Shrinkage	Free Swell	200		10	wafer
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		-	organic rich.	,	A		SP			7													1
VI.			SAND; fine to me some fine grav	dium, light grey;						-													=
	1	2																					3
	0.5 Clayey SAND; fine to medium, light brown with dark brown 4																						=
	light brown with clark brown 4]
W	as orange mottling; trace fine gravel (well rounded quartz).																						2
\mathbf{M}	AS gravel (well rounded quartz). (Clay - med to high plasticity. AB																		1				9
		1 Clay - med to high plasficity																					-
Yλ		Gravelly CLAY; high plasticity,																					-
111		light brown, trace fine to medium sand. Gravel - fine to medium, CH to >PL																					-
\mathcal{U}	X	sand. Gravel - fine to medium, 1.5 well rounded quartz.														+	\perp	\vdash	-	-	-	_	
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date shown.

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penetration 3	METHOD OF ADVANCING HOLE	western ELEVATION DEPTH	GEDLOGICAL DESCA soil type: plasticity or particl colour, secondary and mine CLAY; medium - high pla	e characteristics.	SAMPLE NUMBER	CLASSIFICATION (USC METRIC)	Peak (kh) zy		Penetrometer (KB.)	dex	maisture condition	SPD (3/cm³)	8)	%	chanica	% /		skage & a	Free Swell % ==	rson Class	She stree Bram	20%	NMC %	wafer
	AS CLAY; medium - high plasticity, dark brown; frace coarse sand to fine gravel (angular quartz and rock fragments). CHY; medium - high plasticity, dark brown; frace coarse sand to fine gravel (angular quartz and rock fragments). CHY St 48 CH St 4 Find of hole:4.2m (refusal)															6	4 2	9/6		6			27	استانتها
			End of hole:4·2m	(refusal)																				
7 :	MITHOD OF ADVANCING HOLE auger Screwing (d:100mm) thin wall tube (d; 63mm). Gontent SpD: Soil Particle Density tube (70x70mm). SpD: Soil Particle Density Water level on date Shown. EXPLANATION GLOLDGICAL SYMBOL ENGIN ENGIN ENGIN Driller: B. Cox Driller: B. Cox Starred: 30:10. Finished: 30:10.														90	EC	Log Dat Dra App	ged e: wn:	30 F.	Who	90 PPY			

PROJECT : ULVERSTONE ENGINEERING GEOLOGY	Os	BYSTEM	AMG
	-0F	1.	428565
LOCATION: Basalt slopes facing Gawler River - Braids property: Central Ulverstone	02 ₹	N.	544/875
CASING/HOLE COMPLETION	ΕD	DATUM	AHD(Tasmania)
· No support used	VE	COLLAR	
. End of hole : 1.5m (refusal)	윤피	DAUND	≈ 32m

		end of hole: 1.5m Crefusa			· · · · · · · · · · · · · · · · · · ·												-	ZALI	<u>L</u>	0 3		<u></u>
3	4710N Бертн		7	ER		Vent		7.57	5			n,	chenic	ABDR	Inde	. 1411		T or	She	ar ng#		
penetration of ADVANCWG HOLE	ELEVATION	GEOLOGICAL DESCRIPTION	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC METIC)	Peak (kk) = =	山さ	consistency density index	re on :	(g/cm²)	(g/cm³)	1	% %	% %	Limit %	Diasticity Index &	1	C/ass	Bran (PX)	neters (63)	%	
METHOD 0	metres	soil type: plasticity or particle characteristics, colour, secondary and minor components.	07039	75	(05(Peak	Pener	consist	moisture condition	800	8WD	Clay	Sand	Gravel	Diagi1	Diasticity	Free	Emerson	١, ٢	, ø,	NMC	water
П	-	CLAY; medium to high plasticity, dark brown	A					F								1	1		1			
AS	1-	CLAY; high plasticity, light brown with orange + light grey mottling; some medium sand to fine gravel (rock fragments).		49*	СН	40 14	75	1	M PL	2.49					85	5B 2	0	2			39	dry
		BASALT; highly weathered, 1 strength, brown	T_{b_r}			\sqcup	+	_					-			\dashv	+-	+	-		-	_
		End of hole : 1-5m (refusal)																				
		End of hole : 1-5m (refusal)																				
: thin T : 69u	MITHOG ger scre	OI ADVANCING HOLL Wing (d:100mm) NMC: Natural N We (d;:63mm) Confent S section BWD: Bulk We. SPD: Soil Partic ** Mineral 27890 Water le	loisture t Dens. cle Der compos	e ity sition	(see	tex	ct)	×RÌ	2.	Pla	arrec	Tr	E & Co. 30. 30. 30.	x 5	90	SEC	110 20	N 199ec 1/e	30 . F	7. W.	90	

	PRO.	TEC.	r	ULVERSTONE ENGINEER	MG	GEC	LOG	7											BO.	s	878	TEM	1.4	AMG		
	FEAT	ruri	i	Auger hole										······				·····	CO-08	ATE		Ł.		285	90	2
				Towards bottom of slope facili	ng 6	awer	Kive	.	- 4	span	ds	prof	261	<i>y</i>	Le	17	5/0		100	Z		_N.	-	441		
	CASI	NG/		LE COMPLETION No support used											4/		3,0		EDUCED	<u>ا</u> لا	DAT	UM	AA	ID(Tas	s/na/	ria)
				End of hole: The (required a	dept	ĸ).			•••••		•••••		•••••						EDO		CDL	LAR	,	≈ /c		
		7.	-					1		ve (0	7£57						LAP		TORY		BUN	ACI				·
	170H:	ELE VATION	DEPTH		802	HBER	*	V Si		(4.8)			_			erhe knely	netal	1	néss I	110	3.6	1/2	Shed	. 1	%	
tion	ANCWE	FILE			SYM BOL	E NU	METONETICA TICE	10	3	. 1	×		(8/50)	(B/cm ³)	%	%	% i	8	% × × × × × ×	age		C/ass		eters	•	
penetration	OF AD			GEOLOGICAL DESCRIPTION	616.44	SAMPLE NUMBER	CLASSIFICATION (USC metric)	(4/4)	2/ (%	Penetrometer	tency y inde	2 .5	٦	J				٠ ا	Cite ,	Shrin	Swell		(A.A.)	(660)		
	METHOD OF ADVANCING HOLF			soil type: plasticity or particle characteristics. colour, secondary and minor components.	6 F 0 L O 6 I CA L	(r)	C2.455/. (USC	Peak	Residual (xPa)	Pener	consistency density index	maisture condition	800	BWD	Clay	1115	Sand	Gravel	Diggio Li	Linear Shrinkage	Free	Emerson	١,٧	, pr	NMC	wafer
123	¥	metr	es	SAND; fine-medium, light grey; trace				a	2		4	_		-	_	4	+	+	+	17		4	픡	$\stackrel{\sim}{+}$	\dashv	=
			}	c/ay.			SP	-		-	1	М	-					-	+	-		\dashv		ŀ	\dashv	1
			=	SILT; medium to high plasticity, light brown some sand-		*				100	S+	М														-
			٤,	fine to medium (quartz and		50*	МН	60	25	125	"	PL	2.71					5	4 2	14		6			26	=
			']	rock fragments).						125									\perp	L						4
IJ۱			3	Clayey SAND; fine-medium, light brown with grey mottling.			SC				4	м														
\mathbb{R}			+					1		Ì							1									=
Иl			2 -	CLAY; medium to high plasticity, light grey brown; some fine							<i>S</i> †															. 1
/			7	to medium sand and trace							40 VSf															1
			7	medium gravel (quartz-subro- und)							~	- 1					-									=
1			3									1														-
\prod			=									М														1
	A5		4	colour change to light	Q_{α}							≥														-
411			=	brown							F	PL														-
		4	* -	<i>D</i> , <i>G</i> , <i>G</i> , <i>G</i> , <i>G</i> , <i>G</i> , <i>G</i> , <i>G</i> , <i>G</i>			CII				to								-							=
			1				СН				S+]
			=																-							
111			5 =																							-
			-	*											-											
411			=																							20 10 5
			=	4																						V .
		1	5								_															= :
411			=	colour change to dark							5	M >							l							:
			=	brown .							F	PL														
111		 - ;	<u>,</u>					H			-	1 -			\vdash		\vdash	+		+	<u> </u>	-		-	-	
			4	End of hole: Tm (required depth)																						
			4	depth)																						
			1						L										_L				<u></u>			<u> </u>
· • · • · ·	Remark	·	Site	within alluvium							 						 									• • • • • • • • • • • • • • • • • • • •
• • • •			wa	ter level: 5.92m; conductiv	ity.								·····					·····		DIN		E O !	OGY	······································		
15	aunn			ing (d: 100mm). NMC: Natural Mo.	isture		ologic (see)							ΕN	U11			ION		501			
				(d;:63mm). Content		,	, , , , ,	. ~	•	•			Drill	/er	£	. C	ох				2099	ieo':		Whi		
				section BWD: Bulk Wet	Densi	ty																e.i		. 10 . 9		
	_			mm). SPD: Soil Partick * Mineral com	Den	sity	ermin	ed	be	, XA	RD		Plan								Drac	on;	J.,	Whif	py.	
				27.8.90 Water leve		-,,			_				Sta								А ррі	roveo	<u> </u>			- 1
				= date show	wn.								Finis	shed	'.i	30		2 . 5	·O		Shee	t	/,,	ot		

						ВО	RE	HO	LE	Ξ	L	00	3							.,,			<u> </u>	<u> </u>	
	PBO	JECT	. :	ULVERSTONE	ENGINEE	RING	GEC	LOG	Y					 .	 .				٥،	٦.	. Y S T !		AN	16	$\overline{}$
	rra.	T110		Auger hole															ORD				42	8 77	0
	LOC	ATIO	N	Slope facing G	awler Rive	r - 8	raids	pro	per	ty	:	Cer	trai	1 4	vers	tor	e		000	٤		N		14/2	
			HOL	E COMPLETION							,								CED		DATU	ıM	AHD	(Tasma	enia)
				No custout used															200	. L	cou				
				End of hole: 2	8m (regu	ired	dep	16)	.:										REDU	ع اد	UNIC		<u> </u>	40	m
	1	>							L			7FS7	'5					BORAT	DRY	TE	212				
	METHOD OF ADVANCING HOLE	ELEVATION	DEPTH			1807	SAMPLE NUMBER	×0,		noth	(kA)			3	5		1,200	- 18	0 00	000	26	₹ 5	hear treng sames	* >	:
tion	ANCON	113				87.8	W 37	FICATIC Metric)			. 1	×		(8/cm3)	(g/cm³)	% %	%	%	l'idex	kage		2			
penetration	OF AD			GEDLOGICAL DESCHI	PTION	CICAL	AMP,	13/51 C M	ž	2/6	trome	tency ry ind	non					, e	city	540%			8 3 E	(660)	5
G.	1400			soil type: plasticity or particle colour, secondary and mino		SEOLOGICAL SYMBOL	Ŋ	CLASSIFICATION (USC METRIC)	Peak	Residual (KPa)	Penetrometer	consistency density index	moisture candition	800	BWO	Clay	Sand	Gravel	Plasticity	Linear Shrinkage	Free	Emerson	د ای	NAC	wafer
123	ME	mer							a	व्ह					7	-		+	+		4	4	<u> </u>	$\stackrel{\sim}{+}$	+=
1		1	=	Gravelly CLAY, low-m ty, red-brown; gravel-	edium plastic- fine to medium	PEW	51*	CL				F 10 51	M ÉL	2.65				4	3 17	9		6		15	1 =
14			+	19,720 0,000, 3,970, 0	////															П					1 =
\mathcal{U}			3	SCHIST . avtcamole	to highly																				1 =
14			1	SCHIST; extremely																					=
11	45	AS weathered, very low to low strength, light brown. PET 52																							=
\mathcal{H}	/,_	AS low strength, light brown PET 52 Remoulds to gravelly CLAY;																							2
\mathcal{H}		AS low strength, light brown. Remoulds to gravelly CLAY; PET 52																							[8]
И			2 -																						=
\mathcal{A}			4	Some quartz v	eining :																				1 3
			4	Grave! - fine to Guartz 4 rock fi	medium,																				1 1
4		+							+	H						_		\sqcap	T			1		1	13
		-	4	End of hole: 2.8m (reguired depth)							1							1			1			
			3		<i>49-111</i>).																1				1 3
			╡																			1			1 =
			3																					-	1 3
			4																						1 3
			3																			1			1 3
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									••••												• • • • • • • • • • • • • • • • • • • •				
		WI	HOD	DI ADVANCING HOLL E	XPLANATIO	N		10106	CAL	SYMI	POL.			T			E	NGI			G G	EOL	OGY		
AS	ave				1C: Natural M	loistur	e	(see	e te	ext)			-							10 N		of	W// .	
	-			e (d; :63mm)	Content									Dr	iller	: <i>B</i>	Cox	c						Whip	
				RM	ID: Bulk We	t Dens.	ity										,.				Date		T 1	0. 90 W.L.	
				omm). 5P	D : Soil Partie	le Dei	sity	tormin	ed	Би	XX	D		Ple	vit	Iri	etus							Whipp	y
				27.8	90 Water le	vel on	on de	recently	-	-5				St	a/teq					}	Appr	oved	<u> </u>		
i				and the second second										10.		,: £	0.	10.	90	- 1	i		/		/

Finished: 30 - 10 - 90

date shown.

	FEA	TURE ATION ING/HO	Auger hole Nose of rid LE COMPLETION	ge facing Wes	t Gai	oler			Cart	ers ,	prof	oerhy	; G	entra lvers	a/ fone	REDUCED CO-ORD	EVEL INAIES	AJTEY MUTAN MUTAN MUTAN ZAJIN	4 4 A	AMG +293 5440 HD(Ta	92. sman	o va)
penetration	METHOD OF ADVANCING NOLE	ELEVATION Gesting	GEDLOGICAL soil type: plasticity n	DESCRIPTION or particle characteristics, and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	Peak (4A) 275	16			(8/cm3)	(%/5)	S. H. S.	2 %	ATORT	skage & a	Class WR	Str	ear ength meters (500)	NMC %	water
	AS	0.5	Gravelly <u>CLAY</u> ty, olive g Gravel - fil grained b	race fine sand.		53	СН		/00 /00 /2.	,	M 4 PL					76 41	19	5			15	dry mathemateunitanian
End of hole: 1.5m (refusal).																						
	Rema		OI ADVANCING HOLE	EXPLANATION NMC: Natural M			:10LDG1		_		·······	T			ENG		RINC	GEC	100	; Y		
7	: thin : equ	wall tub	wing (d:100mm) e (d; :63mm) s section	Content BWD: Bulk Wet SPD: Soil Partic 27.890 Water let	Densi	ity	, ,			iy XR	rD	Plan	ed:	B Co	ıs -10-	90		Date :	30 . J	Who !	0	

					E ENGINEEN of gully sloping sed 2m (refu≤al						s/er srope	Re	ad 1 : '	'- Q	ar te	ers Uh		-		LEVEL INATE	MM	t. _X um	42 5 AH	1MG 293 440 1D(Ta	90 sman	ss va)
penetration	METHOD OF ADVANCING HOLE	WETTEN METTES		colour, secondary a	r particle characteristics, nd minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC Melric)	4. (2) 5 m	a/ (x/a) =	(kB.)	density index		SPD (g/cm³)	8	Clay %	6 % 6 %	%	Districte Index 9: 5	nkage % =	Free Swell %	rson Class Ms	\neg	19 (60)	NMC %	water
	AS	,	Transland	Gravelly CLAY.	licity, dark brown.	A S _o	54*	СН			75	5† F	M ∠PL ≥PL M						103 65	18		5			49	dry
12		2		to medium grav	ome medium sand el (Sw-Fr basalt) n (refusal)								PL													
7:	thin .	er sci wall t	rew ube	ing (d:100mm). (d;:63mm). section mm).	EXPLANATION NMC: Natural M Content BWD: Bulk Wer SPD: Soil Partic #: Mineral a 21.890 Water le	loistuid 1 Densi	e ity	(see	e f	ext)	(RD		P/a	ller :	Tri	Cos e fu	c		CT	Logg Date Drai	ned:	I. 30 F.	Whi	0	

PROJECT : ULVERSTONE ENGINEERING GEOLOGY	D vs	TYSTEM	AMG
FEATURE: Auger hole	OR ATE	I.	429150
LOCATION: Beside West Gawler Road in front of property with glasshouses.	BZ	н.	5440615
CASING/HOLE COMPLETION	ED	DATUM	AHD(Tasmania)
· No support used	UC VE	COLLAB	
. End of hole : 2.8m (refusal)	3ED LE	GROUND	2 14m

			End of Mole : 2.0m Cre		<							••••••		 	R.			أعما	<u> </u>		41	
	T.	> 3			×	Ī			7F5	75				BDBA		_	516				r—	
2 penetration	METHOD OF ADVANCING NOLE	ELEVATION PLEATION	GEDLOGICAL DESCRIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	Peak (4/2) 275	山ぐ		moisture candition	SPO (g/cm3)	BWO (9/cm3)	Clay %	%	Plasticity Index 2	000	Free Swell %	rson Clas	She Streeth Cary	eters (600) 6	ر	wafer
TTI		T -	Silty SAND; fine to medium, mid			SM	П	T	L	М				-								
	A5		grey CLAY; high plasticity, olive green with orange mottling; Some fine to medium sand		55 ³		65 3	75	1	м	2.54	/-84		9	73 6	7 2/		2			41 45	
		4 3		Q_{α}		1			+	l				Г								١.
	AS	2-	colour change to blue green with orange-brown mottling	4 a		СН		150	o fo	> PL												30.105
			End of hole: 2.8m (refusal)																			

١.	. water level: 2.3	5m; conductivity; 400,uS		
ľ	METHOD OF ADVANCING HOLE	EXPLANATION GIOLOGICAL SYMBOL //MC: Natural Moisture (see text)	ENGINEERIP SECT	NG GEOLOGY
	AS : auger screwing (d:100mm). T : thin wall tube (d;:63mm).	Content (See Text)		Logged: J Whippy
3	ST : equare cross section	BWD : Bulk Wet Density	Plant: Triefus	Date: 30.10.90 Drawn: F. Whippy
	tube (70x70mm).	5PD: Soil Particle Density * : Mineral composition determined by XRD. 27.8.90 Water level on	Started: 30.10.90	Approved:
		dada shawa	Finished 30 10 90	Sheet of

					ВС	RE	ΗO	LE	L	0	G						Ĺ				· · · ·				
סחיז	JE	CT	ULVERSTON	IE ENGINE	ERIN	1G (GEOL	OG									[٥،	1			TA	MG		
FEA.	ru	RE	: Auger hole															ORD.	<u>ה</u>	8 Y B 1		1	286	35	7
LOC	AΤ	ION	: Slope west of	f Gawler River	belou	o Beli	wick	_	Soc	eth	Ulv	ersi	tone	2				ġ.	2				440		
			DLE COMPLETION		,													0	-			4	ID (Tas		
			. No support a	ised														5	7	DAT					
			End of hole :		depi	%).												REDUCED	ا ت	COL	UND	2	~ ;	251	n
T	٦.		7		1	_	1	T-	FIELD	755	75				_	LAB	DRAI	_		111	ACL			_	
370H	ELE VATION	į			709	SAMPLE NUMBER	*	Yans Shep	(K.A.)	T		_		_ L	erke.	ocal	10	100	0%	%		Shed	1	%	
NCWG	61.61				SYM	NON	# 710	Sing				(g/cm³)	(g/cm3)	%	30	16 9	٠ ا	Kapur	36	- 1	C/ass	Bram	eters	0	
ADE			GEDLOGICAL	DESCRIPTION	1631	MPLE	(USC Metric)	(4/2)	ome	ncy index	a =	૭	ঙ				7		hrink	Swell		(k.k.)	(069)		
METHOD OF ADVANCING HOLE			soil type: plasticity or	particle characteristics,	GEOLOGICAL SYMBOL	l &	CLASSIFICATION (USC METTIC)	Peak (kR)	net	consistency density index	moisture	SPO	BWO	Clay	1115	Sand	Liourd	Diasticity	Linear Shrinkage	Free	Emerson	- 1		NMC	water
ME7.	1	netres	COIDUT, SECONDARY AF	nd minor components.	39	_	G	Peak	9	8-5	ES	S	8	٥ ا	6)	2	3	0	1,1	4	Εm	١٠'	,B,	₹	3
T	T		CLAY; low to me	dium plasticity.	1			II	T		М				T			Π							-
			dark brown	n, some fine to	A		CL				4														-
1			-	nd (rock frags)						F	PL					_	L	_	Ц	-	\dashv		ļ	4	= =
		,	SILT , med. plasti wn; clayey,	city, orange-bro		56*			50 75		>PL	2.61		35	48	7	45	31	12		5			24	=
		,	- with crayey,	<u>sana</u> y	1		1			T					\top		-	1	Н	1	\dashv		- 1		1
	Change in Consistency																								
	change in Consistency																								
	change in consistency																								
	Change in Consistency																								
	change in consistency																								
			3					11																	3
		3	Cia																						-
			trace fine																						-
AS			graver (ang	gular quartz)						St															=
]		S		ML)															616
		4	1																						-
			3								м														-
											>						-		-			.			-
]								PL														-
		5	_		4																				=
]											1											
			increase i																						-
			content (a	10%) - angular		-	-										-	+	+	-	\vdash	1		-	1
		6	guartz an	d rock tragminist); abundant	-	57											6	7 4	13		5			25	
			mica flai	ist); aoundant		-	-										-	+	+			1			1
																									-
			=																						
		- 7	End of hole : T	Im (required depti	0			\top							П	T		T							:
			7.00	7	7											-									-
																									:
]							_				_	\square			\perp	_					_	J:
Remail	٠.																								
		······									······	······											· · · · · · · ·		
			OF ADVANCING HOLE	EXPLANATIO			LOLOGI		_							EN	GIN		CTI		EOU	OGY			
			ewing (d: 100mm)	NMC: Natural N	1015tur	e	(see	†ex	()			_	//er	. 4	3 /	22						Ŧ.	Whi	bbu	,
			be (d, :63mm)	Content	/ N= - ·	; <i>1</i>						Dri	ner	5					- 1						
			s section	BWD : Bulk We	, νεης. - Δ	ng neidir							nt		ie+	นร	••••			Dm.	un	\mathcal{J}	Whip	bu	
tube	e (70 x	70 mm).	SPD : Soil Partie	omposi	tion a	letern	nineo	1 69	XR	D		nc vred				90				oved			19	
				Water le	vel or	7						5/0	ured.		3/					.,,,,					

date shown.

A5 1 ST

Started: 31.10.90 Finished: 31 - 10 - 90

PROJECT: ULVERSTONE ENGINEERING GEOLOGY	Os	MITEYE	AMG
FEATURE: Auger hole	ATE	t.	430355
LOCATION: Trevor Street reserve	양출	N.	544 2390
CASING/HOLE COMPLETION	ED	DATUM	AHD (Tasmania)
. No support used	U S	COLLAR	
. End of hole : 7m (required depth).	RED	GROUND	≈ 17m

			End of hole : 7m (required	d de	pth.).											U	HED U	TES	MUTA NON	ND 122		17n	1
METHOD OF ADVANCING HOLE	ELEVATION	H1d30	GFOLOGICAL DESCRIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)		a/ (4/a) = = =	Penetrometer (KR)	density index	moisture condition	SPD (g/cm3)	BWO (g/cm3)	C/ay %	2 6	2 %	Limit % 12	0.0	Shrinkage 7, =	e// %	\$ 8	hear trength ramete	S V	
	1	-	GRAVEL; fine to coarse angular, some sand Sandy SILT; low-med plasticity, dar-	۶		GW	-			MD F														
		1111	k brown; some gravel (rock frags).			ML	\vdash	H	100	-	< PL						_		+	-	+		-	
		1	CLAY; high plasticity, dark brown with grey and orange mottling; some fine sand.		58*	СН	1	35 30	125 160 150			2.38					136	105	28		5		43	
		2																						
		3	Sandy CLAY, high plasticity, light brown; sand-fine grained			CH SC				St to	M >													
AS		4	CLAY; high plasticity, dark	Q _m						VS+	PL													3/
	brown; some sand-fine to medium grained (zeolites and rock fragments); trace fine gravel (rock													-										
		6	fragments - basait).		59																			
		-7-	End of hole: Im (required depth)																					
Remark	•	. Sı	te within coastal plain attributes	: 84	50 u S																			
	м.	11100	OF ADVANCING HOLE EXPLANATION		(101061			POL			T				NG		E E R		G G E	OLC	GY		
thin 6	wa/ ve	l tub cros.	wing (d: 100mm) NMC: Natural Mo e (d: 63mm) Content s section BWD: Bulk Wet Omm) SPD: Soil Particle 278.90 Water law	Dens	ita	(see				χRi	Ď	Pla	nt.:	: B	e fi	5				Logge Date Draw	<u>: 3</u>	Э. И 1. 10 Э. W.	. 90	

					ВС	RE	HO	LE		LO	G						DA				700		
				E ENGINEE	RIN	G (SEOL	.OG	4								0 0		TEM	77	MG		
	FEA	TURE.	: Auger hol	le .										.			ORD	1		1	344	 495	-
	LOC	ATION	: Beside Wes	stella Drive,	iust	east	of CI	ayi	ons	, Ri	iulei						000 WAT			1	442		
			IOLE COMPLETIO	_													CED	-	TUM		ID (Tas		
			. No support														DUC	00	LLAR				
			. End of hole	: 2.8m (refu	(sal))											85	I GR	LALI) .	≈ 6	m	
	1		. 1		Т	1	T -	Т	FIE	D TES	75	1			u	BDRA		TESTE	ILAN			T	=
	METHOD OF ADVANCIVE HOLE	ELEVATION	DEPTH		708	SAMPLE NUMBER	*	She		ğ	T	10		Д.,	hin	1	0000	0 %		Shed	797	%	
ion	4NCAN	313			GEOLOGICAL SYMBOL	NO.	CLASSIFICATION (USC METRIC)	Sires	3			(s/cm3)	(g/cm³)	% %	36	64	Xě	age of	Class	Bram	eters		1
penetration	F ADK		GEOLOGICAL	L DESCRIPTION	1CA1	MPL	(USC METRIC)	3	<u> </u>	cansistancy density index	e E	3	ঙ				ity in	Free Swell		(k.R.)	(66)		.
a	100			or particle characteristics.	9070.	SA	(050	3	cova	Insisti	moisture	300	8110	C/4y	Sand	Grave/	Plasticity	Free S	Emerson			NMC	wafer
12:	MET	metres	1	and minor components.	39		73	Peak (4R) 3	RES	8-8	E S	S,	18	3	SS	9 3	1 4	1 12	Em	١٠,	8,	₹	3
\mathbf{I}			- SAND; fine to m	nedium; some clay	A	T		П	T	T	T					T	TT	T				Т	=
14					^	ļ	-													-			=
Ŋ			SAND; fine to	medium, brown;							D									1			-}
N		١,	frace fin	e gravel (rounded rock fragments).		60																	3
N																							=
$ \mathcal{A} $	colour change to fawn Qm SP M																						3
И		and trace fine to medi-																				34	10.90
		and trace fine to medi- um gravel (rounded																				-	▼ -
И		quartz and quartzite).																					-]
И																							=
B		End of hole: 2:8m (refusal)																				_	
П		End of hole: 2.8m (refusal)																					4
			1			1																	=
	£nd of hole: 2.8m (refusal)															4							
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	Remed		ite on coastal	plain																			
	· · · · · · · · · · · · · · · · · · ·		vater level: 1-97n	n; conductivity	: 180	μS				······	· · · · · · · · · · · · · · · · · · ·												
		мітно	D OF ADVANCING HOLE	EXPLANATIO	N	c	101001								EN	GIN	EERI	NG G		OGY			
			ewing (d:100mm).	NMC: Natural N	loisture	e	(see	tex	:t)			-					310			of	WE.		
			ibe (d; :63mm)	content								Dri	ller :	Β.	Cox		•••••				Whif		
57				BWD : Bulk We		_												Daf	e	9	ull.	4	
tube (70×70mm). SPD: Soil Particle Density Plant: Triefus prown: J. Whippy																							
				27.8.90 Water le	מח לפעי	,						Sta	rted.	: 3	1.70	90	·	App	roved	<u>:</u>			

Water level on

date shown.

Finished: 31 - 10 - 90

				ULVERSTON Auger hole	(E E	NGINE	ERIM	4 <i>G</i>	GEO	40	6)	.								ORO	INATES	1 Y 1			MG		
				Beside track	¢ 10 s	ewerage	por	d; 3	50,	٩	fr	en.	عو.	wer	35.e	<i>f</i> .	on	d.		ġ	MA		L.				
			101	E COMPLETION					•••••										.			DAT	UM	AA	D(Ta	smar	1/2)
				No support of										· · · · · · · · ·							2	COL					
			:	End of hole	e : 5	2m (n	efusi	<u> </u>													-	ORO	12A	L			<u> </u>
	T.,	×	DEPTH				Τ	×	1	L	F	ELD	TEST	rs				chan		RATOR		F2.18		C4 -		7	
	METHOD OF ADVANCING HOLE	ELE VA TION	DE				SYM BOL	SAMPLE NUMBER	NO/	511	ene heer enpth	(kA)			5	€	_^	11/11	+	%	6 00	3%	- 1	Shee Stree Bran	29th	%	
ation.	NANCE	13		eto, ocicii	Beec was		15 7	N 37.	CLASSIFICATION (USC METRIC)	(4/4)	400)		ex		(8/cm3)	(9/cm3	%	% %	10%	110	inde nkage	#1	C/433				
penetration	0F AL			GEOLOGICAL	DESCRIPTIO	N	DGICA.	SAMP	(USC A	ષ્ટ	10/6	Penetrometer	stency ty ind	iore				,	9	0, 1,10	5/75	Swell	205	(A.R.)	(deg.)		2
	THOO		1	soil type: plasticity or colour, secondary ar			7K31907039	0,	27.5	Peak	Residual (4Pa)	Pene	consistency density index	moisture condition	500	840	Clay	5000	Gravel	Ligura Limit	Linear Shrinkage	Free	Emerson	١,,	'a'	NMC	water
123	E	metre		SAND dia madin	- dade h			<u> </u>		a	9				_	$\dot{=}$	+	+	十	H	+		7	극	+	+	=
1			7	SAND; fine - medium colour chang				1						М													
			=				1	-																			V -
			Ė					61																			=
1		'	7	colour che	ange to	blue -			1																		=
1			=	grey; som gravel	e silt	, trace fine																			- 1		3
И			=	Occassiona	al thin	(100 ~ 200																					=
		١.	Ę.	mm) clay	to sand	dy clay																					3
		2	4	layers - A	high pla	sticity			SP				L														4
			4	with more	sture c	ontent >	Q_a		3,				_	w									-				3
И	AS		3	with mois plastic in - stiff to	veru st	ist.	"							,,													3
1		3	, ‡)	,,,						,]
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			E							1																	-
			. ‡																								=
A		9	. =				1						_	-	1												-
N			4	CLAY; high plass	ficity, b um sand	lue-grey; trace gravel	<u>/</u>		CH				VS+	>PL					İ]
ИI.			Ė	-fine to mediui	n (angulai	quartz +	/													1 1							
И			- =	SAND , dominantly		n grained;	Q_m		SP				1	W													-
1	<u> </u>			quartz rock fro	agments d	and bivalve		 	-	+	_		-	-	-	-	-	-	+	1-1		+	-	-		_	-
			3	(10-20 mm) she	lls; trace	5114.		100		1											İ						-
			=	End of hole : 5.2	m (refu	sal).																					:
Ш			=																								-
			=																								-
			3																								-
			=																								:
	1		=																								-
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Ш			=																			1					
			=																								-
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	• • • • • • • • • • • • • • • • • • • •			ite on Forth Riv ater level: 0.6				2 /00	s.	• • • • •	· · · · · ·							•••••									
				IT ADVANCING HOLE		ANATIO			101064	CAL	5 Y M	OL			1			E	NG				EOL	OGN	,		
45	: auge			ling (d: 100mm)	-	Natural M			(500													10 N		40	1		
	-			(d;:63mm)		Content									Dri	ller	: 3	Co	x						Who		
				section	BWD:	Bulk Wer	Densi	ity																	10.9		
				mm).	SPD:	Soil Partic	le Der	sity							Pla	nt.:	71	10/	45			Drai	on i	<i>.</i>	Whi	spy.	
					27.8.90	Water le	vel on								1	rtea						Арр	roved	/;			
					<u>_</u>	date sh									Fini	Shea	(i.i.)	3/ .	·	90		Shel	t	/	of	_/	
															i												

	FEAT	TURE ATION NG/HO	Auger hole Forth River of LE COMPLETION NO Support	ENGINEERI Alluvial plain	NG		LOG	Y	 							LEVEL INATES	DAT COL GRO BUR	.t. _N. UM	4 5 AH	MG 364 441 D(Tas	125 sman	5
penetration 1	METHOD OF ADVANCING WOLE	METTES METTES	GEOLDGICAL spil type: plasticity or colour, secondary ar	DESCRIPTION particle characteristics, nd minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC MET'E)	Peak (4/2) = 75	 consistency density index	moisture condition		SHU (9/cm²)	S:# % #!S	iral III	Limit %	Linear Strinkage 2	9.6	rson Class NS	1	eters (630)	NMC %	wafer
			CLAY, low -medic peaty, dark		(A)	62	CL		.S .	> <i>P</i> 2			30	70							3	₩. /o.90
	AS	3	Silty <u>SAND;</u> fine to blue gre rock fro odour ()	y; quartz, mica + igments; slight	Q_a		SM		۷	W												***************************************
		6 -	coarse gran	antly medium to ned; dark grey; rock fragments; to medium gravel.		63	SW		L MD	and the first charter and the abstract of strength of the first charter and the strength of th			3	52.	¥S.							
		7-	End of hole: Im	(required depth).																		
	Remai			n ; Conductivity.					 		T			FN	SINF	ERI	NG C	EOL	og	Y		
T	thin	er scre wall tul	oi AOVANCING HOLL Wing (d:100mm) Se (d;:63mm) Se Section TOmm)	EXPLANATION NMC: Natural Ma Content BWD: Bulk Wet SPD: Soil Partic 27.8.90 Water let date she	oistura Densi le Der vel on	ity nsity	(see	tex			Plan	t :	B (ox fus	. 90	SEC	Log Dai Dro	nged te: nwn: prove	J J	Wh	о. РРУ	

	FEA	rur	Ε		ULVERSTONE ENGINEER Auger hole Fork River alluwal pla															CO.080	LL I	1717	TEM L.	4	36 (
			/HC	L	E COMPLETION			· · · · · · · · · · · · · · · · · · ·												EDC	_ -	DAT	_N. UM	-	1D(Ta		
					No support used End of hole: 7m (require	ed c	depth	······································					· · · · · · · · · · · ·					••••		REDUCED	EVE	COL ORD		,	~	300	
	Τ.	>		7~	,	I						7£51						LABI	744(DRY	TI	5 U/III	12A				$\dot{\exists}$
penetration	METHOD OF ADVANCING NOLE	ELEVATION	tres		GEDLOGICAL DESCRIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC METRIC)		Residual (4.Pa)	Penetrometer (KA)	consistency density index		SPD (g/cm²)	BNO (9/cm3)	%		Sand %	100	Plasticity Index %	skoge %	Free Swell %	rson Class	i i	eters (600)	WMC %	water
			:	<u> </u>	LAY; low-medium plasticity, black; organics colour change to dark brown; medium -high plasticity; trace fine to medium sand.	A		CH	1			F	< PL >> PL								Ш						
					Sitty SAND; clominantly fine to		64						м						4	7	2					39	31.10.90
			2 -		nedium grained; blue grey with orange mottling fines content derease with depth.	Q a		SM					3										e propins de manda de distribuir de la companya de				
	AS		3 · · · · · · · · · · · · · · · · · · ·		SAND; dominantly medium grained; blue-grey; bivalve shells (10-20mm), quartz + rock fragments; some silt; slight odour. Occassional thin clay bands (100-200mm) - high plasticity with frim to stiff consistency.	Q _m		SP				L	W														
				- 4	End of hole: Im (required depth).					i									-					Account to the second to the s			
Ш	Remai			1		L	<u></u>		<u></u>		<u></u>		<u> </u>				<u>L</u>	Ш	<u></u>				<u></u>	<u></u>	<u></u>	<u></u>	
 		•••••	. 4	, q ,	ler level: 0.76m; conductivity		900 м	5					·······	1											······································		
45	: aug				ing (d: 100mm). NMC: Natural Mo		2	101001 (5 e 6	CAL P f	ext) HOL									51		101		.0G			
7	thin	was	11 +0	bе	(d; :63mm) Content	Done	et i							Dr.	iller.	: £	3.0	ox	••••	••••					Who. 9		·
o /	: 69U tub	are e (<i>cros</i> 70 x	55 70,	section BWD: Bulk Wet mm) SPD: Soil Partic		-							Pla	ut:	77	/e	fus							Whij		
					27.8.90 Water lev										artec vished								rove		<u></u>	ر	
					= date sho	wn.								1	ı/S∕hec	7.:						She	<u> </u>	, / , ,	of		

				ВС	RE	HO	LE	L	0(3					{							
	PRO	JECT	ULVERSTONE ENGINEER	ING	GE	0106	Υ	••••							[0,0	7	Y 8 T E	ı M	АМ	1G	
	FEAT	TURE 🦾	Auger hole												1	п. и	υl		t.	43	338.	55
	LOC	ATION	: Basalt ridge between Kim	ber ku	1s an	d 51	ubb	<u></u>	Ko	ads	:					0.00				54	42	160
	CASI		LE COMPLETION													EDUCED	ء ار	DATU	м	AHDI	(Tasm	ania.
			No support used			··········										200	ء ان	ow				
	• · · • · · • · ·		End of hole : 7m (requi	ec a	ep/	<i>າ).</i>									{	m.	10	VIII A		~	///n	7
	770	ATION DEPTH		1	SER		Vent	TELD	7£57	rs		\neg	Herk	an-cal	TARD	, ,	TEST	\neg	, s	hear	$\overline{}$	-
c	METHOD OF ADVANCING HOLE	ELEVATION DEPTH		SEOLOGKAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC METRIC)	Sheet	(K.A.)			(8/cm3)	J. 1	% %	÷0	10 01	2 0'\0' X	0/6 9		ID.	tre not ramete	×5	2
penetration	ADYAN		GEOLOGICAL DESCRIPTION	8 75	37d)	FICA TIC metric)	(4/R)	Penetrometer	consistency density index		8	(g/cm³)			13	y Index	Linear Shrinkage	• 1	Class	(4.6)	6	
Ded.	30 00		soil type: plasticity or particle characteristics.	19070	SAA	LA55/ (VSC	t dual	netro	nsister nsity	moisture	800	0	2 -	pu	Gravel	Plasticity	25 1	Si	3	-		water
123	MET!	metres	colour, secondary and minor components.	G.F.		3	Residual (A.P.)	do	8-8	Ĕ B	S	BWO	Sill	Sand	19	DIG	Tine	Free	19	9 5	NMC	×
П]	CLAY; high plasticity; red-brown	Ţ								T	T	П	T	П	T	\top	T	T	T	
			trace medium sand (basalt		*	1										\forall	\dashv	-	7			1
	AS	-	fragments).		65		4				2.44				94	56	19	6	5		51	
		1		1			30 15									Ш	_	_	4		-	4
		=																				
		1			66	-	45 20					.76									48	1
	trace fine gramed gravel (highly weathered to to																				45	4
4	trace fine grained 5																					
]	vesicular basalf).						F													
		=										Ì										
]										-										
		3 -								м		1							1			
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		=		1 OW	1					PL							П					7
1		[1												20				57	,
1	AS colour change to dark brown.															1						
	AS																	L	4		_	4
ħ		5-1 Prown.																				
V		5-1																				
U	5-]																					
7		1 1		1																		
			colour change to dark						St			1										1.11
		6-	brown with red																			
]	mottling.																			
И		=	3															1				
		7						125	1				\perp	\sqcup	\perp	1	Ц	_	\perp			-
		()	End of hole: Im (required depth).																			
		-	5 - , **																			
		-																				
П	Remail			L	l	<u> </u>		<u></u>		L						<u></u>	<u></u>			<u> </u>		J
		. n	later level: 6m; conductivity	. 39	ي بر ه																	
		MITHOD	OF ADVANCING HOLE EXPLANATION	J		LOLOGIC	AL SYM	POL	•••••		T			ΕN	GIN	EER	ING	GEC	DLO	G Y	*******	
5 :	auge		ling (d:100mm) NMC: Natural Me			(see		-									TIO	N				
			(d; :63mm). Content								Drill	e <i>r</i>	8.0	оx							hipp	<i>y</i>
			section BWD : Bulk Wet	Densi	ty												0	ate :		11.9	10	
	•	(70×70		le Den	sity	lotorm	ined	bu	X.R.I	٥.		ć.i?					0	rawn	<i>.</i>	·W	hippy	.
			27.8.90 Water les	mposii iel on	non a	C161 111.	,,,=0	-y '				red.					A	pprov	ed:			
			= date sho								Finis	hed.	!.:	//	90		51	heet	/	(ot	.

									•	LU	J							PROJECT : ULVERSTONE ENGINEERING GEOLOGY AMG												
	PRO.	JECT	ULVERSTON	E ENGINEER	NG	GEC	LOG	Υ									HO	s i	8 Y 8 T	ĮΜ	A	MG								
	FEAT	URE	Auger hole	<u>.</u>														ATE		t.	4	33	260	> \						
	LOCA	TION.	Slope east of	Castra Road &	past	end	of A	1eri	nde	a Dri	ve .	-80	000	P	ope	rty.	0.00	Z		N.	5	544	2/9	0						
		NG/HO	LE COMPLETION														10		DATE	JM	AH	D(7a	s/na/i	(a)						
			No support	used		·					· · · · · · · ·						15		coll	AR										
			End of hold	e: 2.4m (ref	usa!												REDUCE	ع اد	Ufil	DAL 12A	J	≈ <i>4</i>	Om							
	T	× #1				8				LD TES	rs			7/	U		ITORY		\$14	_	64-			-						
	OF ADVANCING HOLE	ELEYATION DEPTH			1804	SAMPLE NUMBER	30	She	pih C	(k/k)		2	£ -	An	1711)	7	% %		1	€	Shed Strei Bram	19%	%							
ation	rAwca	E			WXS :	LE N	FICATIO Metric)			. 1		(s/cm ³ ,	(g/cm ³)	% %	%	%	it	kage	"	n	$\overline{}$									
penetration			GEOLOGICAL	DESCRIPTION	GICA.	AMP	55/F	1	10/0	Consistency density index	ure		~			, e	city	Shrinkage			(A.A.)	(060)	-	ا ۱						
-	METHOD			or particle characteristics. and minor components.	5 £ 0 £ 0 £ 0 £ 0 € 1 € A £	0)	CLASSIFICATION (USC METIC)	Peak	Residual (*Pa)	Consistency density index	moisture condition	500	BNO	C/44	Sand	Gravel	Diasticity	Linear	Free	Emerson	رر	B	NMC	water						
123	E	metres						9	8	+		4	\dashv	+	Ľ	4	+	17	+	4	+	7	$\frac{1}{1}$	=						
ИΠ	AS			sticity, dark brown; to medium sand						S			1							1										
И		=	(zeolites	v rock fragments).	A					F			1																	
扣	7			sticity; light grey		68*					.	2.24	/.73	87 10	3		2/61	23	r	2	3		56 50	=						
И	<u> </u>	/-	with oran	ge mottling				90	30 7	75	/"						+	\forall	r	\dagger	1		~	\exists						
		=		<u> </u>	0		CH			F	>						_	Ш		4	_	_	\dashv	=						
		4	CLAY; high ple	asticity, dark	\mathbf{S}_{d}					to	PL											1		=						
	AS	=				69*				St						6	68 3i	17		/	4	27	40	=						
	brown; some fine to . medium sand (zeolifes and rock fragments). End of hole: 2.4 m (refusal)															11.90														
/								++	+	+		\vdash	-	+	+	H	+	H	-	+			-	Ħ						
			End of hole	: 2.4m (refusal)									1							-				3						
		1														1								4						
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															\perp	L														
	Ramark	•																												
	• • • • • • • • • • • • • • • • • • • •		water level : 2.3	6m; conductivity	, ; 22	Ous																								
			Of ADVANCING HOLF	EXPLANATION	J	G	10106		_)L					E	VGI		RIN	G GI	Oι	OGY	1								
			Wing (d: 100mm)	NMC: Natural Mo	osture	9	(500	tes	ct)						1-						7	Who	44	,						
			e (d; :63mm)	Content		. ,						Dri	//er_:	5	روي	Ċ	• • • • • •					90								
ST			s section	BWD : Bulk Wet		_								7.	~ _	,						Whij								
	tube	(70x7	Omm).	SPD : Soil Partice	le Der	sition	deter	min	ed	by X	PD		nt										צייןי							
				Water les	rel on	•						1	sted.						A ppr				<u></u>							
			Water level on and the shown. Finished: 1.11.90 Sheet																											

	FEAT	TURE	ULVESTONE ENGINEERING Auger hole Slope behind Brookvale, But LE COMPLETION NO support used End of hole: 5.2m Crey	alling	ess ,		er t	y .	- of	7 4	ast.	⁄a.	R) a c	 √		0	LEVEL INATES	DA	MJTI MJTI MUT. MAJJ MAJJ ZAJJ	A	AMG 431 544 HD(70	54.	s nia)
penetration penetration	METHOD OF ADVANCING HOLE	HLD3Q metres	GEDLOGICAL DESCHIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	GFOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION	(4.Pg.) 12 m	10/ (K.Pa.) 12: 2	(kB)		moisture condition	SP0 (3/cm3)	BNO (9/cm3)	%	Sitt %	9/ /	% pu	-	\$ 96	ion Class	ABrai	neters	NMC %	water
		1	CLAY; high plasticity, dark brown. CLAY; high plasticity; red-brown; Some fine-medium sand; trace fine gravel; zeolite and highly weathered to Slightly weathered basalt frags.	A	70*				/25 /50 200	F	<₽ <u>L</u>						146	104 2	8	6			52	بسيايينالسيين
	Colour change to dark brown, so the state of															dry								
	71 VSt PL 71 78 83 18 53 End of hole: 52m (refusal).																							
		111111111111111111111111111111111111111																			·			
	Remail		ite on basalt slope. DI ADVANCING MOLE EXPLANATION			torpe	1CA1	SYM	ROL			1—————————————————————————————————————				ENG				5 E O		Y		
T :	thin 69ua	wall tub	wing (d: 100mm) e (d; .63mm). s section Dmm). SPD: Soil Partic ## Mineral co. 278.90 Water let odate shi	Densi le Den mpositi vel on	ity sity lion de	(se				RD		Plas Sta		77	e,	us	00		Da Dro	gged fe: zwn: orove	J d:	Wh II 90 Wh	рру	

						ВО	RE	HO	L	E	L	0(G						1		//1	-5.	3//4 /			
	PR	OJ	ECT	ULVERSTONE	ENGINEE	RING	GE	040	GΥ	• 									.[0	ES	878	7 5 1.4	T ,	MG		
	cr.	A T1	10 E :	Auger hole															. 6	TE	•	1.		/3/	250	2
	LO	CA.	TION.	Basalt alope	behind dam,	Frenc	chs	orope	rty	.	off	6	asti	a	Ra	ad.			12	INATE		N_	4	44	06	10
			IG/HO	LE COMPLETION													••••		- G	LEVEL	DAT	UM	AA	D(Ta	smar.	ia)
			<u>:</u>	No support	used								· · · · · · · · ·							2	col	LAR				
				No support. End of hole	. 3.6m (refu	isal)) 													2	ORO BUB	LACI		≈ /	∞	и
	Τ,		. *			Τ.				-	IELD	7£57	75			U.,	L	LBDA		Tasts	1111		She			
	OF ADVANCING HOLE		ELE VATION DEPT			W BOL	SAMPLE NUMBER	NO!		ne ngth	(kA)			2	2		17711	\dashv		10 010	1 1	- 1	Stre	29%	%	
ation	DY ANG		3	GEOLOGICAL	DESCRIPTION	SEOLOGICAL SYMBOL	V 37,	CLASSIFICATION (USC METRIC)	(4/4)	Residual (4Pa)	efer	Jex Jex		(8/cm3)	(8/cm3)	% %	3/4	0	1,4	Plasticity Index	1/3	200	3			
penetration						0610	SAMI	55/7	હ	val (Penetrometer	consistency density index	moisture candition				ø	re/	17 01	Plasticity	Swell	Pos.	8	(663)		او
	METHOD				r particle characteristics, nd minor components.	GE01		275	eak	esca	Pen	dens	Cano	200	BWD	Clay	Sand	Gravel	Tigura'	Linea	Free	Emer	ر. ای	B	NMC	wafe,
12) <u>\$</u>	+	metres	CLAY; medium to his	oh plasticitu.dark	+		-	14	(V)		_				÷	+	H	\dashv	+	Н	7	7			==
7			=	brown, trace fin	ne to medium sand organ	ics						F	< PL						+	+		\dashv			-	=
			=	colour chan	ge to red-brown		72*				125		м						02	5721		6			42	=
U		1	-		,		~~				150		≽						^	"		١			~	=
H			1 -	70							150		PL													=
1			-								175								\perp							
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И			2	¥		"						V5†														2) =
W			=		ige ib orange-		*					,,,	М													g:
U			_	brown.			73						>						10/	64 21		6			54	-
1			-										PL						1							-
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H	-	+		F 1 1 1 1 1 2 1	(-6-6-1)	-	+	-	+	\vdash	-	-	-	+		\vdash	+	+	\vdash	+	\dagger					
			:	End of hole: 3.6	m (refusal).																					
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• • • •	••••	Remarks																								
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AS	a	ıgei		wing (d: 100mm).	NMC: Natural N		e	(see	e te	ext	()			-						SEC	TION		04	1217		
				be (d; :63mm)	Content									Dri	/er	: B	Co	.						Wh		
				s section	BWD : Bulk We	t Dens	ity														Daf	e	01	Who		
			(70x7		cle De	nsity	lotora		d	Бυ :	xR)	9	Pla	rt	Tri	e/	45	••••		1			MA	ppy		
					SPD: Soil Partin 27.8.90 Water le	evel or	nun 2 1	CIEIM	mec	,	-7 -		-	· i		:!						rove				
					= date si									Fini	shed	.i/.:	//:	90	•		5he	et	1	of	/	

date shown.

BOREHOLE LOG PROJECT: ULVERS TONE ENGINEERING GEOLOGY														L						ننث		لننت			
PRO	JECT :	ULVERSTON	E ENGINEERI	NG	GEO	LOG	/										[٥،				Τ,	4MG		
C F A -		Auger hole																ш. и	u i	111		1	34	90	
LOC	ATION	: Foot of slop	oe, G4L Turners	pro	pertu	, - 4	H	W	95/	e/16	а.	Dri	ve.					0-05	2		1.	1	44		
		LE COMPLETIO		/	······································												}	0			_N.		HD(Ta		
3		No support				•••••	• • • • • • • • • • • • • • • • • • • •											EDUCED	7	DAT		1			
		End of hole	: 1.3m (refus	a/)														<u> </u>	۳,	COL	UND	2	21	3m	
T	ı	·		1	·	····	T-	FIE	10	7£57	5					UB	DRATE	IFT		SIL	ייינט			7	
J70H	ELEVATION			80%	SAMPLE NUMBER	*	Ve.	7	(k/k)			~			Arely		100	0.0	00	96	×2	She	-4-	%	
NCWG	1979			SYM	NO.	(FICA TIC metric)	3111	3				(8/cm3)	(g/cm ³	%	1/2	% 6	익		960		455		eters		
F ADY		GEOLOGICAL	DESCRIPTION	7 <i>Y</i> 2/10	MPL	SIFIC	2	3	omer	inde	2 5	ુ	૭				7,007	ity h	hrink	Swell	5	(A.A.)	(069)		
METHOD OF ADVANCING HOLE			or particle characteristics.	GEOLOGICAL SYMBOL	ιδ	CLASSIFICATION (USC METRIC)	Peak (4R)	color	Penetrometer	density index	moisture candition	800	BWO	lay	21/1	and	Ligura Limit	Plasticity	Linear Shrinkage	Free Swell	Emerson Class	- 1		NMC	wafer
MET	metres	CDIOUF, SECONDARY	and minor components.	19		G	De	Res	2	8-8	E 5	S	8	Ú	S	3,	3 3	d	Li	N.	£.	١٠٠	,ø,	>	<u> </u>
		Silty SAND, fine	to medium , black ,	A		C11	П																		=
	:	trace fine	grave/.	~		SM				4	M														4
	Sandy SILT;																					=			
	0.5 - plasticity, grey-brown.																						. =		
	plasticity, grey-brown.																						;		
45	mica * rock fragments) ML 175 M														-	_	Ш		_				57		
	:	colour chan	ge to grey with			1112					PL														6 3
	/ -		ige mottling;		74*						_			21	28	50	36	19	5		1			17	1
			ium gravel (quartz veathered schist).		' 7				200																
	-						\vdash	+	-	\dashv		_	-	-		+	+	+	\vdash				-		一
		End of hole	1.3m (refusal)																						E
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		•••••																							· · · · · · · · ·
	МІТНОП	OF ADVANCING HOLE	EXPLANATION	J		101061	CAL S	YMR	o			T				EN	GIN	EEI	RIN	G G	EOI	OG	Υ		
: avo		wing (d: 100mm).	NMC: Natural Me			(500						_								ION				.	
_		be (d; : 63mm)	Content									Dri	ller	4	3.0	oχ							Wh		<i>'</i>
		s section	BWD : Bulk Wet	Densi	ity							ļ		• • • • •						Date	e.i	1	//: 90		• • • • • • • •
	(70x7		5PD : Soil Partice	le Der	sity	lakarı		1 6	, x	RD		1	nt.:						- 1				Whi	ppy	
			27.8.90 Water lev	mposi: iel na	non a	erermi	neo	שני	, ,,,			Sto	wrec	7	<i>.</i>	//:	90			App	rove	d:			
			- mares /es	-, 0.,											,		0 -		- 1						

date shown.

AS T ST

Finished 1.11.90

PROJECT : ULVERS TONE ENGINEERING GEOLOGY	OS	TYATEM	AMG
FEATURE: Auger hole	OR TE		434415
LOCATION: Beside Claytons Rivulet, Webbs property - off Stubbs Road.	O X	N.	544 2005
CASING/HOLE COMPLETION	r ED	DATUM	AHD(Tasmania)
. No support used	200	COLLAB	
. End of hole: 1.7m (refusal).	RED	UNOUND	≈ /2m

		······································	End of hole	sal	<u>)</u>													2 3	BUI	JAL JAL		~	12n	h	
5 penetration	METHOD OF ADVANCING HOLE	METICAL DEPTH		DESCRIPTION r particle characteristics, nd minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	53	ene men	Penetrometer (KB) 5		moisture condition	SP0 (g/cm²)	BWO (9/cm3)	%	Sand %	% 1	nii % 12	. 7	5 96	Emerson Class Ne	She Street Repair	\$ (600) 'd	NMC %	water
		1		edium plasticity, fine to medium ragments)			ML					M < PL													1 1 1 1 1 1
		0.5	dark brown	o high plasticity,; some medium to disub round quartz, artzite)							F to	м													
	AS	- 1	plasticity, n Gravel-fine	medium to high nid brown to medium schist & quartz)	Q a	* 75	сН				SŦ	£ PL						63	41 /	5	5			26	11190
		1.5	End of hole:	I·Im (refusal)																					-
																	Acceptance of the second of th								
		-																							
	Ramar		.wafer level :	1.56m ; Conduc	tivit	, 16	o _M S					• · · · • • • • • • • • • • • • • • • •		 											······
		МІТНОВ	OF ADVANCING HOLE	EXPLANATION			10100						T			E	NG			NG TIO		ιOG	Y		
45	: avg	er scre	wing (d:100mm)	oistur	e	(see	e f	ext)			-						520				WA	/AA	,	
			be (d; :63mm)	Content									Dr	iller	: 6	. (0	x								<i>f</i>
5 <i>T</i>			s section	BWD: Bulk Wer									D/.			~e	4s	 :					11.9 Wh		
	tub	e (70x7	10 mm).	5PD: Soil Partic * : Mineral co 27.890 Water le	ne vei	ion de	dermi	nea	1 6	y >	RD	1	1							1	prov			,,,,	
				Water le	vel on	7							ì			- 11						1	_	. ,	,

					во	RE	НΟ	LE	L	0	3					2	AT	A A	POIN	7	NO	40
	PRO.	JECT	ULVERSTONE	ENGINEER	NG	GEOL	-06Y									0	ES	878		A	MG	
	FEAT	URE	Auger hole	·····									······			10	_	•	L.	4	340	95-
	LOCA	ATION	: Slope west of	Claytons Rivule	t, we	illus p	rober	fy	-01	25	h166	s A	000	! ·			A M		N_	5	4418	75
	CASI		LE COMPLETION							• • • • • • • • • • • • • • • • • • • •						CED	EL	DAT	UM	AH	D(Tasn	nania)
		······	No support u. End of hole:	sect		•••••						•••••				\	LEVEL	COL	LAR UND			
			ENG OF More.	4.5M Crejus	31													UU	12A		= 45	m
	1701	ATION DEPTH			70.	BER		Van		7£5	75		Т	Herke Anali	necel		1000	%	22	Shea		- 1
ę	METHOD OF ADVANCING HOLE	ELEVATION DEPT			SYM BOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	Sum	西さ			(8/cm3)	(g/cm³)	5 %	% %	1961	J.		3 4	Brane	7e/5	श
penetration	ADYA		GEOLOGICAL E	NOITHIRD230	ICA1	MPLE	METRICATUR METRIC	(44)	Residual (xta.) Penetrometer	consistency density index	n =	9	૭			Timit	Linear Strinkage	Swell		(A.A.)	(663)	1.1
e.	HOD 04		soil type: plasticity or	particle characteristics,	GEOLOGICAL	ર્જ	4455, (USC	Peak	enert	ensity	moisture condition	300	8W0	, #	Sand	7.9010	Mear Shr	Free 5	52		, S	water
123	MET	metres	colour, secondary an	d minor components.			٥	g.	\$ 0	2.0	E 0	S	8	2	5	11	1 1	¥	E	'ç \	6, 5	3
4			SILT; low plasticity	, black; trace f. sand	A		ML	\prod	-	-	<pl< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1 =</td></pl<>											1 =
A			CLAY; medium to						125		м											1 =
1			dark brown;	some fine to med- rock fragments).	Pε		CH		175	+	>					H	\dagger		\exists	1	-	7 3
		1	, 5	76*					PL					110 7	8 21		2		4	8 -		
1]				77*						2.34				/28 8	7 22		/	3	11 5	7
\mathcal{I}]										H				H	+			+	+	- 3
И		, ;]]
И	AS SCHIST, completely to																			=		
\mathcal{A}		-	hiahlu v	veathered , very																		2
И		-	10w to	low strength	PE			11												- 1		10
N		3 -		O	,		1															
И	AS SCHIST; completely to highly weathered, very low to low strength PE,																	1		-		
		-																				=
	1																					
1		4 -	20																			
K)																						
H	1	<u> </u>	End of hole : 4.5%	n (refusal)	-	+	1	\dagger	+	1-	1	\Box			\sqcap		1	1				
			End of note: 4 3h	, (, 2, 4 304)																		
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			OF ADVANCING HOLE	EXPLANATION			HOLDGH								EN	SINE 5	ERIN			OGY		
			wing (d:100mm):	NMC: Natural M Content	0151410	9	(586	te)	(1)			Deil	ler '	BI	îox:					J.	Whip	bpy .
			be (d; :63mm)	BWD: Bulk Wer	Done	ita						1	· · · · · ·	. 				Date	e :	1.1	1.90	
51			s section	SDD . SAIL PART	וכנושע יבר פל	situ						Plan	rt.:	Tri	fu	\$		Drai	ωл	\mathcal{F}	Whip	by
	tub	e (70x7	Omm).	5PD: Soil Partice ** : Mineral 27.8.90 Water le	compo	sition	dete	rm)	ned	by >	RD		rred					1	roveo			
				vel on	,						57.20			7 · 9r	1				,		/	

Started: 1-11-90 Finished: 1.11.90

FEATURE: Auger hole LOCATION: Basalt ridge at top of Stubbs Road.	. 43	3900
	N 544	10505
	DATUM AHD	(Tasmania)
· No support used	COLLAR	
End of hole: 7.3m (required depth)	ONOUND ≈	125m

				No support used End of hole: 7.3m (reguin	red a	depth)										. [ORI BUI	MUT RALL INUC DALL		≈ /2	5N	
penetration	METHOD OF ADVANCING HOLE	CO EVA YOUN	HEDEL	GEOLOGICAL DESCRIPTION Soil Type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	(4.0) (4.0)	Penetrometer (KA)			SPO (3/cm3)	BWO (9/cm3)	Clay %	2 %	'	" ju	. 1	ত ১৫	Emerson Class No	Stree Street (By)	ar ng# neters (600) '&	NMC %	water
				GRAVEL; dominantly medium size; basalt, quartz, chert-road base.	F		GP			MD	D									_				
			/ !!!!!!!!	CLAY; high plasticity, red-brown; trace fine to coarse sand (rock fragments)		78*	Andrews of the Antidockite to manage the special of the state of the s		150 10 200		M < PL						/oų	65 1	3	6			4/	-
		Colour change to yellow- brown and increase in moisture content; some fine gravel (highly weathered basalt fragments). The The The The The The The Th															92	49 /	9	6	2	3/	51	
	AS	brown and increase in moisture content; some fine gravel (highly weathered basalt fragments). CH St to W5t M M																	-					dry
		basalt fragments). 4 Colour change to dark brown.																						
	T		7	BASALT, extremely weathered, very low strength; yellow-brown with red * blue-grey mottling. Remoulds to high plasticity clay.	T b _r	80							1.64				93	44	15				55 57	
			1	End of hole: 7:3m (required depth).																				
r :	thin wall tube (d; 63mm) NMC: Natural Moisture (see text) Content Sulf Wet Densitu														c		SEC	Da.	nged.	3	Y Who	0		
tube (70x70mm). SPD: Soil Particle Density * Mineral composition determined by XRD 27.890 Water level on date shown. Plant: Triefus Started: 2:11:9														AA	prove	1:	. ol							

PROJECT : ULVERSTONE ENGINEERING BEOLOGY																							
	PRO.	JECT	ULVERSTONE	ENGINEE	RING	GE	040	GΥ									0 2	,	YET	ıM	AN	16	
	FEAT	URE	Auger hole							,							ROF	<u>, </u>		ı.	43	3578	35
	LOCA	NOITA	Side of old	Bass Highway	east c	f 10	rner	s Ł	eac	4 1	Road	ď					0.00	2		N	54	4428	320
	CASI	NG/HO	LE COMPLETION.														ED	٦,	DATL	ıM	AHD	(Tasmo	nia)
			No support	used							. .						200) u	corr				
			End of hole	: 1.7m (refu	sal)) 											REDUCED	ء اد	NOL		<i>≈</i>	5m	
	T	× 7.	I		Г	· v	Γ.		FIEL	715	75					BORA	ORT	TES					
	METHOD OF ADMANCING HOLE	ELE VATION DE PTH			1 504	SAMPLE NUMBER	NO.	Sher				2	<u>ئ</u> .		17941	□ à	000	00	9%	5 5	hear	* 0	,
ation	PANCA	E			37/	TE N	CA T.	2	ارتوا يؤ			(8/cm3)	(g/cm³)	% %	%	%	Index	kage	- 1	2	ramen	_	
penetration	OF AD		QEDLOGICAL I	DESCRIPTION	GICA	AMP	35/50	ak (4.1)	Penetrometer	ty ind	ure					/o	City	Shrii			(g) (g)		
_	7H00		soil type: plasticity or colour, secondary an	particle characteristics, of minor components.	SEOLOGICAL SYMBOL	ŋ	CLASSIFICATION (USC METIC)	Peak	Penetrometer	consistency density index	moisture condition	300	BWO	5/4	Sand	Gravel	Plasticity	Linear Shimkage	Free	Emerson	ر کر	NAC	wafer
123	X X	metres						100	ž	\vdash			4	+	1	+	+	7	+	1	4	+	믬
]	SAND; fine-medium, w	hire; some organics			SP	11			M		1										
И		-	GRAVEL; fine to	coarse light																			=
И	AS				a		GW			1	D												[2]
K		1-	sand; quartz	medium to coarse * quartzites -	700		1/2																1 az
]	well rounded	to sub rounded.																			1 4
И								\sqcup		-				_		\perp	+	\sqcup		-	+	+	
]	End of hole:	17m (refusal)																			=
																					=		
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Ш	B.m.	ئــــا			<u> </u>	l	l <u>. </u>					<u></u>	1	ـــــــــــــــــــــــــــــــــــــــ		لمل	<u></u>	<u>ا</u> ۔۔۔۔	<u>ш</u>				
		•																					
				EXPLANATION	J				MAC			T			F 1	VGI	VEE	RING	GGE	OLC	GY		
45	. 01104		or ADVANCING HOLL Wing (d:100mm).	NMC: Natural M			(see		_									CTI	ON				
			e(d;:63mm).	Content			•		***			Dri	ller :	В	Cox	c			L099	9σ∷.	J. 1	Vhipp	sy
			s section	BWD : Bulk Wet	Densi	ty						\									2 . // .		
	tube	(70×7	Omm)	SPD : Soil Partic		-						Pla	nt:	Tri	e fu	s			Draw	n i	J. 1	hipp	<i>y</i>
	, 500	x/		27.8.90 Water le		-						Sta	vred.	: 2	!!	90			Appr	oved	:		
				date she								Fin	ished	. 2		.90			Sheel	/	/ <u>.</u>	ot	/.

					HE						J													
			ULVERSTONE ENGINE	ERI	NG	66	04	-0	GY	.	• • • • • • • • • • • • • • • • • • • •							ES	111	TEM	1	AMG		
	FEAT	TURE	Auger hole								•••••						5	INATE		t.	1.5	£28	60	0
	LOC/	ATION	: Western abutment of	Leve	?n . L	Sride	90			.						••••				N_	-	44		
	CASI	NG/HO	LE COMPLETION			• • • • • • • • • • • • • • • • • • • •												ועונ	DAT	UM	A/	4D(74	\$ma/	1/a)
			No support used			····					•••••				••••		. 5	들		LAR	_			
			End of hole: 7m (regi	urea	def	D/h)	:										[BUIL	14U	الــــــــــــــــــــــــــــــــــــ	≈ 5	3	
	370	ATION DEPTH		76	35.8		V.	nt I	2	TEST	rs	-	_	μ,	ikanie sigia	ABDE	1-4-	Laste	1811	, ou	She	ar	\dashv	
c	ADYANCWG HOLE	ELE VATION DEPT		GEOLOGICAL SYMBOL	SAMPLE NUMBER	7.00	She	PID!	(k)			(8/643)	(g/cm ³)	30 8		1	%	× × ×		- 1	Bran	eters	%	
penetration	ADYAN		GEOLOGICAL DESCHIPTION	8 78	37/41	CLASSIFICATION (USC metric)	(48)	Residual (MPa)	Penetrometer	consistency density index			8)				imit	Diasticity Inde	Swell	C/ass	(k.A.)	(060)		
lad la	30 Oc		soil type: plasticity or particle characteristics.	1907	SAA	. 453, (USC		dual	reto	isisten Isity i	moisture condition	0	0	5	,00	Gravel	Ligard 1	Plasticity	. 5,	Emerson			ی	wafer
123	METHOD	metres	colour, secondary and minor components.	GFC		73	Peak	Resi	9	i e	E 53	500	BNO	Clay	Sand	0	6/7	Line Pla	Free	Ems	١,٢	Br	NMC	ž
77	†		Clayey GRAVEL; fine to coarse;				\Box	T	T					T	T	Т		T						
$\prime\prime$			light brown; in a low plasticity	F		6C					D													=
//]	light brown; in a low plasticity clay matrix. Gravel consist of angular quartzite, sitrete frags.			ĺ																		-
KΓ		E, 1	•				1			L														=
Y)			Sitty SAND; fine to medium grained; dark brown;																					=
I]	Plant fragments			SM					М													4
A			Francis programmes																					=
															4									
/ 1 CEAT; high plasticity; grey-															20.11.9									
green with orange mottling,															Ť									
		1	some fine to medium sand -											-										-
		3 -	quartz & rock fragments.			1																		1
	5 ome fine to medium sand - quartz & rock fragments.															=								
Ŋ١	AS	-		Qa		-																		=
III										F														-
		4-								to	М													:
И		-	· ·			CH				5†.	>													
И											PL													-
И		5	colour change to khaki brown	-																				-
N		1																						
1/																								-
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I_{λ}																								-
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\mathcal{L}		-				-																		
H		7-	End of hole: Im (required depth)	1	-	-	+					T		$\dagger \dagger$	+	1	T	H	T	1	1			
		. 3																						
	1	-																						
							\perp				<u> </u>			Ш							<u></u>	<u></u>		
	Remark	· Wa	ter level: 2.5m; conductivity	: 44	40 MS	;											· · · · · ·				. 			
												1						r b		E 0 :	0.0			
			OI ADVANCING HOLE EXPLANATION Wing (d:100mm) NMC: Natural M			nococio see									Ε	NG		ERIA ECT			. OG			
	_			U1574/6	=	(566	76.		/			Dei	/er	В	Co	x			400	ged:	3	Whi	ppu	,
T			e (0, . 0 3 min 1	Done	ita									~.		:			Date	e :	20	11.	70	
5,												Plan	nt :	Tri	efu	s						Whij		
	tube	(70×70	27.8.90 Water le		-									: 2						rove				
1			Water le	10/ 00								1												

						ВО	REI	HO	L	E	L	00	3						01	7//					
	PRC	JE	от <i>:</i>	ULVERSTON	E ENGINEE	RIN	G	GEO	2	6	<u> </u>								D Y	7	BTEN		AMG (1:25	000)
	T.T.A	T111		Auger															HO.	1			27	,	
	roc	ΑΤΙ	ON.	Top of basal	4 ridge , John	sons	place	e -	of	£	We	5 ₹	Gau	s/e/		Roa	1		0.00	2		ي ا	544	14 2	2
			/H0	LE COMPLETION									,						CED	ام اد	LTUN	A/	HD(Ta	sman	10)
				No support u	sed'					••••							••••		200	n c	LLAF				
				End of hole	: 3.4m Crequir	ed a	lepth ,)					· · · · · · ·						REDU	101	NUO DA 1/I	<u>.</u>	≈ /	20 n	لـــــ
	T	*				T .			T		ELD	7£57	5			п.,	LAI	OFF		7657	$\overline{}$	She	ar	-	
	METHOD OF ADVANCING HOLI	ELE VA TION	DEPTH			70 B W.	SAMPLE NUMBER	×0/	51	ene heer eepth	(k/k)			(6"	5		2 60	٦,	000	9/0	100	Stre		%	
ation	PYANCE	13		GEDLOGICAL	DESCRIPTION	\S 71	V 37c	FICA TIC	(4.1)	(g)	efer	y dex		(g/cm3)	(g/cm²)				ty Index	inkog.	1 %	(A.A.)	(660)		1
penetration	1 A					SEOLOGICAL SYMBOL	SAMI	CLASSIFICATION	, [-	Residual (4Pa)	etron	consistency density index	maisture condition	0			0	Gravel	Diasticity	Linear Shrinkage	Emerson Class	8	0	J	wafer
	10HL3			colour, secondary as	r particle characteristics, nd minor components.	049		770	Peak	lesia	Pen	den	COU	800	BWO	Clay	Sand	3	Plastici	Linear	Eme	1,7	'a'	NMC	W
123	Σ	1/2	etres	CLAY: high plastic	ity, dark brown.	A			Ť				. 01	_		+	$\forall \forall$	十	\dagger	\vdash	1	\Box	\Box	寸	=
4			-		ify, dark brown, sand (basall + zeolile)	^							<pl< td=""><td></td><td></td><td></td><td></td><td>+</td><td>+</td><td>H</td><td>-</td><td>1</td><td></td><td>\dashv</td><td>=</td></pl<>					+	+	H	-	1		\dashv	=
			-		icity, orange-brown,						50														=
	AS		. =	trace mediu	um to coarse sand gments & zeolites	T_{b_w}	81				10							٤	8 69	25				46	3
al			/-	- 2013411 /14	gillenis F Zeon -s				80	25	/00	_													1
H			-					Сн				to	м						\pm			1			4
	7	1	-	BASALT; extre			82*					St	>		1.76			8	10 4	18	6	-		39 40	₫
N			2 -	extremely w	eathered, fine t texture preserved)								PL					+	+	H	-	+			21-11-90
И		Remoulds to CLAY, high plasticity, dark red - brown,													8	4 44	17	6			38				
И																		L				=			
ИI	AS	50me medium to coarse sand- nock fragments.																					, ‡		
	ĺ															1]		
															4	+	\vdash	+	+	_	\vdash				
		T	-	End of hale: 3.4	m (required depth).																				=
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	Reme		, 434	afer level : 2·3m	: conductivitu	. 94	uS						•••••												•••••
	• • • • • • • •		. H	igh water table	probably due to	c/03	e pro	x/m	114	07	ري ک	le .	10	da	m ·										
			MI 1 HOC	OF ADVANCING HOLE	EXPLANATIO	N		61010	gical ee t	SYN	JOA						E	1G1		RING		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
				ewing (d: 100mm)	NMC: Natural M Content	015141	e .	(56	ee 1	ex i	/			D.	iller	: B	Cox	2		1	099e0	y: 5	T. Wh	ippe	/
				be (d; :63mm)	BWD: Bulk We.	+ Dona	ita								•					2	ate :	2,	1.11.5	90	
5/		Gourse cross section BWD: Bulk Wet Density 5PD: Soil Particle Density Plant: Triefus														<i>r</i> αω <i>n</i>	: F	Wh	ppy						
	* : Mineral composition determined by XRD Stocked: 21.11.90											2		pprov											
					Water le	vel or	?							1	,		21. 11								,

Finished 21. 11. 90

		ULVERSTONE ENGINEE		. G											D. C.	ģ.	8 Y 8 '	TEM		MG ((1:25	5,000)
		Auger hole Slope fåcing Gawler River, Jo.		·······							ler.	Ro			0.00	4		L.	1	427		
		LE COMPLETION	MJOM.	<i>pro</i> ,	والتعظيم	·	7. 7	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,							ED C	7		N.		1D (Tas		
		cuttont used			••••••				• • • • • • • • • • • • • • • • • • •						DUCE	7	DAT		100	D(143		
	. E,	nd of hole: 5.8m (refusa	/)			•••••									85	- 1 '		UND		≈ 5	31	2
7	ATION DEPTH		Ι	8	<u> </u>	Vans	-	7FS	rs			ш	(A)	DRAT			111		She		\exists	
METHOD OF ADYANCWE HOLE	wetter DE DT	GEOLOGICAL DESCRIPTION Soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC Metric)	Peak (kk)		consistency density index	moisture condition	SPO (8/cm3)	8WD (9,cm3)	- 1	%	٦,	ty Index %	Se se	Free Swell %	rson Class NS	Stre. Bram (24)	eters (630)	WMC %	wafer
		CLAY; high plasticity, dark brown; some medium to coa- rse sand and fine to medium gravel - basalt fragments		84				F to 51	M ∠ PL													الممدلائيدالسب
The state of the s	same as above except for colour change to light brown. Solution S_d Solution S_d Solution S_d Solution S_d CH															22					47	بلينييني
AS	CLAY; high plasticity, dark brown; some medium to coarse sand and fine to															2/		5	4	29	50	2).11.90
A THE TAXABLE PROPERTY OF TAXABLE PROPERTY OF TAXABLE PROP	5 _	medium gravel; trace coarse gravel — zeolite and basall fragments.							PL													
	End of hole: 5.8m (refusal)																					
Remer	. wa	fer level: 3.8m; conductivity	1101	 ک																		
	. sif	e towards head of landslide.								T			F			2112	G G	EO!	OGY	······································		
: פנוס		DIADVANCING HOLL EXPLANATION Wing (d: 100mm) NMC: Natural M			totosio See	text				L			ĿΝ	۱۸ ق		CTI	ON					
		e(d; :63mm) Content								Dri	//er	8	Cox			- 1				Whi	ppy	
: 6qu	are cross	s section BWD : Bulk We:																	7	Whip	564	
tub	e (70x70	Omm). SPD: Soil Partion * Mineral of 278.90 Water le	le Den	isity tion (detern	ined	64	XRL	>	1		Trie						on: ovea		1.17.19f	yy.	
		₩ater le					~					. 2				-	-			of		

AS T ST

				ВО	RE	HO	L	Ŀ.	L() (ì						,								
	FEAT	TURE ATION NG/HO	: ULVERSTONE ENGINEER! Auger hole : Beside railway track, Hill LE COMPLETION															CED CO.ORD	INATE		TEM L. N.	5	4MG 429 44.	2 99	ي
		·············	No support used End of hole: 7m (required	1 def	574).										:			REDUCED			AAJ JAU			0m	
penetration 2.3	METHOD OF ADVANCING HOLE	wester beautiful DEPTH	GEOLOGICAL DESCRIPTION soil type: plasticity or particle characteristics. colour, secondary and minor components.	GE0106/CAL SYMB0L	SAMPLE NUMBER	CLASSIFICATION (USC METRIC)	5100	Residual (MPa) = 2	(kB)	density index	ıre ion	SPO (g/cm³)	BWD (g/cm³)	%		200	- -	to Index %	nkage % =	Free Swell % ==	Emerson Class No	She Stre Bran	ng#	NMC %	water
		1-	SAND; fire to medium; quartz & organics colour change to while; quartz Colour change to dark brown Colour change to light brown	\mathbf{Q}_m		SP					D													4	21-11-94
	AS	SAND; nedium to coarse;																							
		5	blue - grey ; quartz * rock fragments.	Q_m		SP																			
		6	CLAY; high plasticity; blue- grey to light grey. (decomposed basalt?)	7 5 _w	** 87	CH		Colonia de la co	100 10 175	F +0 S+	M > PL		A CONTRACTOR OF THE CONTRACTOR				V	348	9 26		5			62	
		7.	End of hole: Im (required depth).	•																					
	Remark	. wa	iter level: 1.32m; conductivity: 95,	<u>,,,5</u>																					
45	: aun		OI ADVANCING HOLI EXPLANATION NING (d:100mm) NMC: Natural Mo			(500	CA1	symp))							EN	GIN			ION		LOG			
T	thin	wall tub	e(d;:63mm). Content		,	September 1						Dri	//er	: <i>E</i>	3 . C	ох						. F.		ppy	
۱ ن		re cross e (70 x 70		le Den	sily tion	detern	ine	ed	<i>ь</i> у)	KRD	1		nt :				9^			Drai	wn:	\mathcal{F}	Who	opy.	
			Water lev	ve, on									ishea									/	of	/	

BOREHOLE LOG : ULVERSTONE ENGINEERING GEOLOGY

	FEAT LOCA	TURE MOITA DH\DNI	: Auger hole : Beside railway track — DLE COMPLETION No support used - End of hole : 7m (reguin	Wa	ter		e f											REDUCED CO-ORD	77.77	DAT		S A	4M6 3/2 443 4D(Ta	560 5/11a/	,5 7/a)
penetration	METHOD OF ADYANCING HOLE	METTES METTES	GEDLOGICAL DESCRIPTION Soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	51	Residual (KPa) = = =	Penetrometer (K.A.)	consistency density index	moisture condition	SPO (g/cm²)	BWO (9/cm3)	%	S:# %	201	imit %	0.0	Shrinkage %	e// %	erson Class N	She Street Bran	eters (bap)	NMC %	wafer
			Sandy CLAY, low plasticity, dark brown; sand - fine grained SAND; fine to medium, light grey. Colour change to light brown.	A	88	CL					O M			J	3 9	5 1									1 to the tent
	AS	3	SAND; medium to coarse, mid brown, some fine to madium gravel. Colour change to grey, grain size dominantly medium.	Q_m	89	SP				۷	W				2 9	2 9									24.97.5
		7	Gravelly CLAY; high plasticity, blue-grey; gravel dominantly fine to medium with trace coarse—rock fragments and quartz End of hole: Im (required depth).			СН				F	M > PL														
7 :	thin s	MITHOD OF F SCREW	Tr level: 1.6m; conductivity: 81 DI ADVANCING HOLL VING (d:100mm) EXPLANATION NMC: Natural Mo Content S section BWD: Bulk Wet SPD: Soil Partice 27890 Water level date sho	Densi Densi Densi Densi Densi Densi Densi	ty	(see						Drill Plan Star Finis	t	Tr.	.Co	x.) <i>o</i>		Z D	ogge late trawn	n :	T. I 11	Whip 90 Whip	ру.	

						ВΟ	RE	HO	L	E	L	O(3						L.	_						
	D D O	IECT	: 6	ILVERSTONE EN	GINEERING	; 6	SEOLO	GY											5	$\overline{}$				4MG	-	
				Auger hole									•••••							ES	8 Y 8	TIM				
	FEAT	TURE	••••	Ho and Par	/ //		٠	z	····		604					•••••				INAT		L	1	3/8		
	rocy	ATION		Haywoods Reser	ve - crivers	איזסחפ	DIST	100		202	BQ//		(ue)		•••••							ĸ		44		
	CASI	NG/H		E COMPLETION				• • • • • • • • • • • • • • • • • • • •												اري	DA	ı um	AA	4D(Ta	s/na/	(2)
			. :	No support use	d					.										LEVE	col	LAR				
				No support use End of hole :	5m (refer	sal,	<u>)</u>	,.,												2	GRO			≈ /	15m	.
	1	1				Τ	1		_		IELD	7£5	75	Γ			_	LABOI			E 5 1 8				=	
	1704	NOT	DEPTH			8	SAMPLE NUMBER	>	1 .	a ne	3					H.	chen	raf r	Inde	11111	. %	42	She			
_	CWB	ELE VA 710A				Уж	NOM	7.0	51	TO:	- (k.B.			(g/cm3)	(g/cm²)	%	% %	6 %	96	¥ 8	(Bran		%	
penetration	WAN			GEDLOGICAL DESCR	IPTION	8 7	PLE	FICATIC metric)	(44)	84	se(e)	dex			9				110	inka i	//a/	C/ass	(A.A.)	(060)		
pene	8					0610	SAM	L 455/,	1	100	Penetrometer	ity in	tigue					re	7 0	3 3	Swell	200	8		.	\$
	METHOD OF ADVANCING HOLE			soil type: plasticity or particl colour, secondary and mine		GEOLOGICAL SYMBOL	"	CLASSIFICATION (USC METRIC)	Peak	Residual (KPa)	Pen	consistency density index	maisture	SPD	BWO	Clay	5.11	Grav	Figurd .	Plasticity Index Linear Strinkage	Free	Emerson	C,	'a'	NMC	wafer
123	ME	metres							d	8					_	4	1	+		17	<u> </u>	7		_	-	
ИH			=	CLAY; low to medium pla brown - organics.	sticity, dark	A		CL				F														3
וג׳			+	Sandy CLAY; high plo	acticity light				1										П		1			Ī		=
			3	brown; sand domin			*																			
			7	grained.	anny paic	_	90							2.61					68	49 16	-	5			33	V
Л		1	7			Q_a				1							1								I	=
			1	6			-												H	+	1					1
/			1	red - brown mottling	y, grey with																					3
Π	to medium sand and fine gravel - mica flakes and subrounded quartz. 5 M																						4			
1																							4			
Л	AS CLAY, high plasticity, dark																	1					3			
И		brown with light grey and light brown mottling; some medium to coarse sand and fine to medium gravel - zeolite *																						-		
ИU																	1						. 1			
И																									3	
N	1																							-		
Z			=						ł																	-
И			7	basalt rock fragn	nents.																				-	_
ľИ		4	7			1			İ	1																:
ИN			3														ı									-
И			-																							-
И			=						1					1												
Λ	ļ	_ 5	4			-		-	+	-	-	+	-	+-	\vdash	\vdash	+	+	+-	\vdash	+	+	-	-	\vdash	<u> </u>
			=	End of hole 5m (re	fusal).					1									ĺ							:
			7																							-
			3						1																	
			3																					1		
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			7																		1					-
			3																İ					1		
		1	1						-																	
	Remail	<u>ا</u>																								
				water level : Im																						•
														T					INF	F D 13	VC C	EO	00	Υ		
	MITHOD OF ADVANCING HOLE AS: auger screwing (d: 100mm) NMC: Natural Moisture (see text) T: thin wall tube (d; 63mm) Content ST: equare cross section BWD: Bulk Wet Density SPD: Soil Particle Density Plant: Triefus Drawn: J. Whippy																									
																	. 9	W6	inn	,						
T																										
	T: Square cross section BWD: Bulk Wet Density													Dat	e	04										
	<i>}</i> ≠,,£.	e (70x	70	mm). SP	D : Soil Partic	le Del	sity							Pla	nt.	7,	ef	15			Dra	wn:	<i>J</i> .	Mhy	opy	
	100	= (/UX	,,	27.8	90 Mineral c	omposi	tion o	deteri	חומ	ed	Бу	XR	D	Sta	vteo	γ.: .	21.	//-5	90		APA	rove	d:			
				270	Water le	ve/ or	7										21.									

date shown.

Started: 21.11.90 Finished 21.11.90

	FEA	TURE .:	OLVERSTONE E. Auger hole				£040				······································					·····		INATES	EY.	TEM	,	AMG 435	40	20
		ING/HC	: Slope behind forth LE COMPLETION NO support used	Koool - be	tween) Vone	s (re	rek	tr	but	arie:	s]	9		X. TUM	A.	5 44 4D(Ta		
			End of hole: 7,	n Crequire	d o	lepth))										[LEVEL	ORC	AAJJ JAUC JAL	0	≏ :	52,	n
t a penetration	METHOD OF ADVANCEM HOLE	eteVATION DEPTH	GEOLDGICAL DESCRIPT soil type: plasticity or particle o colour, secondary and minor o	haracteristics.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	GLASSIFICATION (USC METRIC)	Peak (kh) gr				SP0 (g/cm²)	<i>(</i> 8)	%	rhen:	% /6	Limit %	Diasticity Index & _ 3	1 80	on Clas	She Stre Bram	ng# eters (600)	NMC %	wafer
加	Ī	-	GLAY, medium plasticity dark b		A		CL	Ì	Ť	F	< PL	\Box			Ť	T		T						=
	AS		Clayey SAND; fine to med, gray - brown; some fine grave! - quarts and rock can be rolled into Three Sandy CLAY, high plastic	to mediam fragments.		91	sc			4	м													
		'-	grey - brown with red - c ng; sand-fine to mediu coarse gravel - quart fragments.	range mottli- m trace	T s,																			1
	7	2	· Sand content derease · Slickensides on some ; surfaces .			92*				F			/ ·9/				65	45 /3		6			40 25	1111111
	As CLAY; high plasticity, dark red brown; trace fine sand— zeolites. Relict planes Mn oxide shipped and some shippensided 93* CH 269 1:55 10467 19 6 44															111111								
	T zeolites. Relict planes Mn oxide stained and some slickensided. 93* CH 93* CH N 269/35 10467/9 6 41]								
	1 1 1 1 1 1 1 1 1 1															22-11-90								
	A5	5								St														
		6																						
		— 7	End of hole : Tm (require	ed depth).					-						+									
																				-				
	Remerk	wat	er level: 4:2m; conde	ictivity : 15	ڪير ٥																			
				LANATION			OLDGIC		_						E 1	N G I		ERIN		EOL	DGY			
			ling (d:100mm) NMC: (d;:63mm)	Natural Mo Content	istuie	7	(see	tex:	1)			Drill	er:	В	Cos	c				ed:	F.	Whi	БРЧ	
	6qua.		section BWD	Bulk Wet Soil Partick Mineral comp Water leve			esmine	d l	by >	(RD		Plan	 ¢.;	Trie	fu.	5			Date Draw	i	F.	Whip		
			27.8.90 ————————————————————————————————————	Water level										22						oved		of	/.	

	FEAT	rure 🚠	ULVERSTONE EN Auger hole		в <i>6.</i>	EDLO	GΥ											080-0		141	TEM		1MG 354	70	
			Slope behind For	n Road														18	<u> </u>	DAT	_N.		441 10(Ta		
			No support used End of hole: 6.1n	n Creguire	d de	epth)) 	•••••										REDUCED	LEVE	COL			5	2 m	
penetration	METHOD OF ADVANCING HOLE	ELEVATION DEPTH	GEDLOGICAL DESCRIP soil type: plasticity or particle colour, secondary and minor	characteristics.	GEOLDGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	51	ng th	Penetrometer (KA) ?	density index	moisture condition	SPO (g/cm3)	BNO (9/cm3)	%	Sand % ====	%	Diguid Limit 10 2 0	nkage & =	Free Swell % =	irson Class	(A.A.)	99th efers (680)	NMC %	wafer
123		-	CLAY; medium to high pla dark brown; orgo CLAY; high plasticity		A						F fo Sf	M					T								
		1	brown; some medium sand and trace fine basall fragments & q	n to coarse e grave! –		94				125 to							-	9 45	17					21	
		colour change to light red- brown. CH 5t M >																							
	AS																\ \ \ \ \	29 9	24		6			47	4rg
		\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	colour change t brown with gre																						lineline
		5 -																							Tittiti
	End of hole: 6.1m (required depth).																						untuntunt		
	Remark	. Medi	ит gramed, angular gu	uartz sand	prese	ent. 1	hrougi	5	wh	o/e	pri	ofile													
AS	: QUON			PLANATION : Natural Mo		G	ratació (see	te.	x t	οι)						ΕN	GI		CTI	ON	EOL				
T :	thin 6qua	wall tub	e (d; :63mm) s section BWD	Content Soil Particl Mineral co	Densii le Den mpositi	ta					RD		Pla	nt	Tri	Cox efus 2.11				Date Drou		\mathcal{F}	Whi		
			<u>*</u>	Water lev date sho	el on								1			2.11				Shee	1	/,	of	1.	

		вс	RE	НО	LE	L	.0	G							DA	<i>7</i> .4	Poli	NT	NO	, 4	5/
FE LO	OJECT: LANDSLIDE INVESTIGATION - ATURE: Auger hole CATION: Frombergs property - N. Uh SING/HOLE COMPLETION . Open hole piezometer installe End of hole: 5.4m (refusa	versi	lone		àme	ter	PVC	Pi	be .) <u> </u>					LEVE	DA CO GRE	MUTEM MUTEM	4 8	AM6 + 33 : + 4 + HD(50.5 26 4 Tasm	ama
METHOD OF ADVANTURE DOLY	GEDLOGICAL DESCHIPTION Soil type: plasticity or particle characteristics, Colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	GLASSIFICATION (USC metric)	Peak (kR) Fre	, (i)	consistency density index		SPO (8/cm3)	(5)	%	Sand %	1 % /6	% 114	•	Swell %	rson Class	3	(080)	NMC %	wafer
AS	GILTY CLAY; high plasticity, dark brown Some fine to medium sand; organics Sandy CLAY; high plasticity, brown; sand-fine to medium some the to coarse growel (basalt frags), trace charcoal. colour change to yellow-brown; sand-fine to medium trace coarse. colour change to reddish yellow- brown colour change to yellow-brown	S ∂		мн			Fr Fo St	M													

12.6.88 to colour change to greenish brown 104 14 83 25 /6 5 increase in medium to coarse sand content - slightly weathered blue-grey basalt fragments. End of hole: 5.4m (refusal). Nillip ourface measured at 4.3m

. Water level; 4.90m ENGINEERING GEOLOGY SECTION METHOD OF ADVANCING HOLE EXPLANATION GEOLOGICAL SYMBOL AS : auger screwing (d: 100mm) Logged: R. Donaldson Date : 10 . 5 . 88 water level on Drawn: R. Donaldson Plant Triefus Approved: R Donaldoon Started : 10 5.88 Finished : 10.5.88 Sheet ...

colour change to mid brown

PROJECT : LANDSLIDE INVESTIGATION - FROMBERGS	0 10	BYETEM	AMG
	ÖF		433 <i>515</i>
LOCATION: Frombergs property - N. Ulverstone	ON-		5442665
CASING/HOLE COMPLETION	CED	DATUM	AHD(Tasmania)
. Open hole piezometer installed (50mm diameter PVC pipe) . End of hole: 7.5m (refusal — bedrock?)	EDUCE LEVEL	COLLAR	≈ 30m
4	ــــــــــــــــــــــــــــــــــــــ	TOVILLAGE	

Τ.	7	. 3	End of hole: 7.5 m (refus		1	1	T		ELD	7.55	75					LABO			TEEL	III AC	<u>U</u>			
METHOD OF ADMANCING HOLE		West tes	GEOLOGICAL DESCRIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC melric)	(44)	Į ĝ	Penetrometer (KB)	consistency density index	moisture canditian	SPO (9/cm²)	8WO (9/cm3)	%	Silf %	2 /2	imit %	ity Index	Linear Stransage 19 3	on Class	Brass	neters	NMC %	wafer
		,	Silty CLAY; high plasticity, dark brown, some fine to medium sand, true charcoal. Sandy CLAY, high plasticity, yellow-brown with green grey 4 red brown mottling. Sand - fine to medium; trace coarse sand to fine grarel.	A		мн				Fr Vs+ to H	М < PL													
		2 -	Same as above with some Sandy clay lensing developed.																					
AS																den								
		6 -	brown; some coarse sand to fine gravel - highly weathered																					
Remails	1	. Dlų	End of hele: 7.5m (refusal-bedrock? Downface measured at 5.2m)																				
thin	w	scre all tut e cros	OI ADVANCING HOLE EXPLANATION Wing (d: 100mm) NMC: Natural Mo e (d: 63mm) Content s section BWD: Bulk Wef	isture Densi	e Hy	(see			_				iller.		Co	x		SEG	00	N 99ed Ite ii.	: R	Dono 5 88 Donal		
tube	e	(70x7	Omm). SPD: Soil Partice 27.8.90 Water lev date sho	el on	_							Sta	urtea Vishea	7. i	11 - 5	98			. 44	prove	d: A	P. Dor	aldi	2671

BORFHOLF LOG

roc	ATION	Auger hole: Frombergs property - N. DLE COMPLETION Open hole prezometer instal End of hole: 88m (reguired	lled ((50m	n di	am	e ter	<i>f</i>	ve,	Þiþe	•)					LEVEL INATES	CO	MUT MAJJ MAJJ MAJJ MAJJ MAJJ	A.	433 44 HD(7a ≈ 2	269 sman
METHOD OF ADVANCING HOLE	NOTAVIAL WELEVATION	GEOLOGICAL DESCRIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	G E 0 L 0 G I CAL SYM B 0 L	SAMPLE NUMBER	CLASSIFICATION (USC METRIC)	Peak (kk) fus	Penetrometer (KB)			SPO (g/cm²)	BWO (9/cm3)	%	chenic	200	% //4	Diasticity Index 2	34	Emerson Class Na	Streeth (A)	eters (600)	NMC %
	,	Sandy SILT, low plasticity, grey-brown, some clay; organics. Sandy CLAY; high plasticity, yellow brown with green-grey mottling. Sand fine to medium, trace coarse. CLAY; high plasticity, mid grey with orange-brown mottling; some fine to medium sand.	A		ML			F VS t to H	M < PL M ≈ PL												The state of the s
Andrew Control of the	3	colour change to pockets of dark grey-brown.						St to VSt													
AS	¥ 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	Sandy CLAY; high plasticity, light brown; some fine to medium sand and trace coarse sand to fine gravel	S d		СН			F to St	M > P2												
	6	colour change to yellow brown																			
	7	colour change to mid brown						F													
Auger	. wate	D SUIFACE MEASURED AF 4.40 m er levels: 8.04m on 11.5.88 and 6.3 I ADVANCING HOLL ing (d:100mm) NMC: Natural Mol		GI	8 (See :								EN.	/GI		RIN		ord	OGY		
thin w	vall tube	(d;:63mm). Content section BWD: Bulk Wet I	Density Dens	^l y	•		ar n			Plant Start Finish	ed.	rie;	ius 5 8	38			Date Draw	i.!! n;.!	5 R Do	onald 88 viald	aon.

				LANDSLIDE INVESTIGATION Auger hole	N -	- FR	омв	E	96	<u>s</u>		•••••				••••			מנו	3	Y 8 T	ιM	1	4MG		
				frombergs property - N. C	1/vers	бпе				•••••									0.00			t.		433. 744.		
				LE COMPLETION				,,											0	١,	DATI	N_		ID(Ta		
			:	Open hole piezometer install End of hole 8.8m (required	led (50mm	dia	nei	er	م	rc.,	מנים	e)						DUCED	, ,	ou	AR				
		······		End of noie 0.8m (required	aej	>M).													H -	1:	MIT	TZV UND]:	2 2 9	M	
	5 NOV.	ELEVATION	DEPTH		205	HBER	*	V.	71	(4.2)	7.55	rs	_			ch	ABDE	11-4	1.	131	T		She.			
	METHOD OF ADVANCING HOLE	ELE			SEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC METric)	(%	Residual (M.A.)	her (k			(3/6,7)	(ew3/5)	%	% %	%	%	lodex.	rage		14	Bran.	eters	%	
	S A			GEDLOGICAL DESCRIPTION) GICAL	SAMP	(USC METIC)	(4%)	'a/ (×	trome	stency ly inda	ure		9			٠	T 1.m	city !	Sycar	Swell	8	(A.A.)	(666)		
	167,400			soil type: plasticity or particle characteristics, colour, secondary and minor components.	2504	"	CLA3	Peak	esido	Pene	consistency density index	moisture condition	500	8WO	Clay	Sand	Gravel	219010	Plasficity	Linear Shrinkage	Free	Emerson Class	ريا	,a'	NMC	wafer
, 		me	res -						4	_	\dashv				+	+	\forall	_	+	+	+	+	극	\exists	+	=
			-	a.												İ							-			=
																										=
Ц		_	8 -													4	\sqcup			4	1	1	_		_	
				colour change to dark brown	5 ,		СН					м													١	3
	AS		1	Clayey GRAVEL; fine grained in high plasticity clay matrix; blue-grey and	J		GC				F	> PL											1			7
		bitain; some fine to coarse sand - highly weathered basalf fragments															H			+	+	+	\dashv	-	-	
	brown; some fine to coarse sand - highly weathered basalf fragments End of hole; 8.8m (required depth).																								7	
																									-	
	Exer of none; a am (required depin).																i			-		-			4	
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	• • • • • • • • • • • • • • • • • • • •		. 00	ip surface measured at 4 40m afer levels: 8.04m on 11.5.88 and 6	37m -	n /2	5.80																			
-				ADVANCING HOLE EXPLANATION	-//7		0100104		MAG			1				E	VG1/	NE	E RI	NG	GEO	010	GΥ			
	augei	5	сгеи	ing (d: 100mm) NMC: Natural Mo	isture		(see					ļ						5	ξC	TIO						
				(d; :63mm). Content									Drill	er	B	ده)	?							onal	dso	١
:				section BWD : Bulk Wef													• • • • •							88		
	tube	(70	×70		Dens	sity						- 1	Plan											nala		
				27.8.90 Water leve	el on															14	prov	ed:	<u> </u>	Dona	woo)/(
	Water level on Slarted: 11.5.88 Finished: 11.5.88														1		2			2	- 1					

A5 T ST

PROJECT : LANDSLIDE INVESTIGATION - FROM & FOCA			
PROJECT: LANDSLIDE INVESTIGATION - FROMBERGS	00	BYBTEM	AMG
FEATURE : Huger hole	100		433540
LOCATION: Frombergs property - N. Ulverstone	OA	L.	
	0-	N	5442710
CASING/HOLE COMPLETION	8	DATUM	AHD (Tasmania)
. Open hole piezometer installed (50mm diameter PVC pipe)	VEL		
· End of hole: 5.2m (required depth).	0 4	COLLAR	
TAIL OF HOLE . SIZM CREGules GEBINS.	a L	DANIOND	≈ 23m

		End of hole: 5.2m (required	T	1	γ										يا ``		ועעו	ZAL	П.,	2	3 /n	·
METHOD OF ADVANCING HOLL	HLG50	GEOLOGICAL DESCHIPTION Sod type: plasticity or particle characteristics, colour, secondary and mimor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	Residual (M.) To a	Penetrometer (K.A.)	dex		SPO (g/cm²)	BNO (9/cm3)	1 1	rkenit	% /	1.6% 1.4	. 144	6 %	Emerson Class NR	She Street	r the refers	NMC %	wafer
	-	Sandy CLAY; high plasticity, brown; sand-medium to coarse, some fine gravel — extremely weathered basalt fragments and zeolites.			СН			м > Р2	S to F													
AS	2	no return. (well sorted sand ?)	S _d																			
															10.5.98							
		End of hole: 5:2m (required depth).		-																		
Remarks	MITHOD O	Levels: 4-80 on 11-5-88 and 4-7		G1	סנטטיכי				l				EN	VG1			G G	EOU	OGY			
thin w	iall tube	ing (d:100mm) NMC: Natural Mo (d:63mm) Content section BWD: Bulk Wet	Densn	iy	(see	tex ()					B					2099	:.i:	11:5	Dona!		

tube (70x70 mm).

SPD : Soil Particle Density

27.8.90 Water level on date shown.

Plant: Triefus Drown: R. Donaldson Started: 11. 5.88 Approved: R. Donaldson

Finished: 11.5.88

	PRO	JEC 1	Seutosana Vina Januar					•••••		••••••	•••••	•••••	•••••		•••••		문	S.	8 Y 8 7	TEM	<i>!</i>	MG	
	FEA.	TURE	Sewerage line trench Westland Drive - W. U.	lvers			•••••	•••••						•••••			CO-09D	4		I.		835	
			LE COMPLETION													••••	0:	= -		_N_		+47	
			THE COMPLETION														REDUCED		DAT		AHL	(ias	manio
			. Trench 0.9m deep.														35	إ	COLI	LAR UND ACL	≈	7 <i>m</i>	
		A TION DEPTH		T .	T	T	L		ELD :	7£ 57\$	\Box					BORA	ORY	TE	616				7
	METHOO OF ADVANCING HOLE	ELEVATION DEPT		GEOLOGICAL SYMBOL	83	NO!	Sh Stre		(88)		5			Ans)	!!!	-1-	×1 ~	9%	96		hear trengt sameh	,	2
penetration	PYANC	1	GEDLOGICAL DESCRIPTION	47 83	None	(FICATIO)	(4/4)	(g)		dex	100	(s/cm ³)	100	%	%		Index	nkage	//a	Cas	(*/k)		
pene	0000		soil type: plasticity or particle characteristics,	27907	SAMPLE NUMBER	CLASSIFICATION (USC METTIC)		toal (Penetrometer	density index moisture	5				0	's k	Plasticity	Linear Shrinkage	Swell	Emerson	કે હિ		je l
123	METH	metres	colour, secondary and minor components.	650	5.4	30	Peak (4R) =	Resid	20 8	i i	Spo	BWO	Cla	Silf	Sand	Gravel	Plas	Tibed	Free	Emo	3 8	NMC	water
İİ		_	Clayey SAND; fine to medium, dalk brown.	A		sc	П	T	Ť	. 4		T	T	П	T	Ť	T				Ī		Ī -
Ш		0.2	SAND; fine to medium, white; quartz rich			SP			1	4 م	1												-
Ш		0.4		1			\Box	7	45	1		7							Ī				1 =
	вн	1	dark brown; sand - fine	Q_m	*	~	55		- 1	S# N													-
		0.6	grained and occurring as lenses.		42	CH	,,,		i	to >		9		П		147	7 29	12	ľ	2		27] 3
		0.8	Sandy CLAY; medium plasticity, dark brown; sand - fine grained and occurring as lenses. Sub - horizontal peat layer (15m -m) thick 20cm from top boundary.			·	45	24	375	P	4				1								-
\prod							П	\top	\top		\top	1		П		T	П			T		T	_
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3 <i>H</i> :	back	thoe b				(see											SEC	TIO	N			-	
			-			•		,			Dri	//er									W		y
			* Mineral composition using X-ray differ	dete	rmineo	/															.9.9		
			using X-ray diffn	action.							Pla	nt	•••••								Wh	PPY	······
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,											Fin	ished.						31	eet.	/		/.	

					ВС	RE	НО	LE	:	LO	G							A7	A	POIA	17 A	/O ·	26
	рво	JECT	ULVERSTO	NE ENGINEE	RING	; G	EOLC	G									.[0	,,			A٨	1G	
	FEAT	TURE	Road cut	ting.													ORD	TES	8 Y 8 T	EM	428		2
	LOC	ATION	Opposite D	Marshalls resid	lence	, Kn	ghts	R	ad		W . C	Ilve	ish	ne			0.00	2		N.	544		
	CASI	NG/HO	LE COMPLETIO	N		•••••	•••••										CED	ایر	DATI	UM	AHD(Tasm	ania,
		••••••	Excavation	0.8m high.	•••••				•••••								REDUC		cou				
				U.OM Mys.															MIN	LIZA	2 /2	m	·
	HOLE	ELEYATION DEPTH			ğ		>	Voi She	FIE C		575		Ī.	H.	chanic nalpasi	41	Index 1	0110	96	₹ S.	hear rength	T	1
	METHOD OF ADMANCING HOLS	ELEK	a A t		SEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	51100				(s/cm3)	(s/cm3)		% %	\Box	% ×	1.1		3 /8/	ameter.	4	
	or AST		GEOLOGICA	DESCRIPTION	71016	. A.O	SIFIC	(k.R.)	3	Bucy	2 5	3	છ			,	Limit ita in	hrank	Swell	2 3	(88)	.	
	THOD .		soil type: plasticity colour, secondary	or particle characteristics, y and minor components.	0703	SAMP	(050	Peak	Residual (MPa)	consistency	Moisture	800	BWD	Clay	Sand	Gravel	Ligard La	Linear Shrinkage	free 5	Emerson	i ki	U	wafer
1	ME	metres						100	8	1	1_	,	B	9	3/07		1	1	4	3 0	100		
		0.2	C/AY. /aw	alasticila arou																			_
		3.2	CZAT; 10W	plasticity, grey		*	CL				м								-				-
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	JECT		ERIN	e e	FOL	OG	<u>.</u>										RO	S	171	TEM	T	AN	IG	
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WCWB	919		SYMBOL	жве	IFICATIO metric)	Shan		. 1			(s/cm3)	(8/cm3)	%	%	% 9	18	é	ge		C/433	Hyan	nefers		
YOF.		GEOLOGICAL DESCRIPTION		e w	11/18	(4.12)	<u>ર</u> ે	ower	inde	60 E	ુ	હ			1.		1 3	1.12	Swell		(k.R.)	(666)		
METHOD OF ADVANCING NOLE		soil type: plasticity or particle characteristics.	S E 0 LO GICA L	SAMPLE NOMBER	CLASSIFICATION (USC metric)	1	Residual (KPa)	Penetrometer	consistency density index	maisture	820	BWD	Clay	5111	Sand	Grave	Plasticitu	Tibeat ?	Free 5	Emerson		.	NMC	water
MET	metres	colour, secondary and minor components.	15	۵,	G	Peak	8	9	3-5	E 0	S	8	Ü	S	8	6	مَا مُ	1	F,	4	٠,٢	'a'	>	2
B	1	CLAY; high plasticity, red-				П																		=
_	-	brown with grey mottling.					1														. 1		49	1
7							1		s			/-52											57	1
	Ι, Ξ	The surface has a dry crac- ked crust (100-150 mm thick)		*		20/	5	- 1	10				70			,,		28						4
	. 1	under which the moisture		45	CH				F		2.29		79	"	4	1.5	7	20		1			62	1
	1	content is relatively high.					1	-		М														-
В	Gullying (up to Im deep) de- veloped in the material. 2 SANDY CLAY; medium to high plasticity, grey with brown mo- thing. Sand-fine to medium grained. Gullied with dry cracked crust. 3 SAND; fine to medium grained, weakly cemented, quartz rich. F 46 CH 40 CH 40 20 125 57 St ST D 10 D																						H	-
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	63mm)	BWD : Bulk Wef L										····							Date		2/	9.9	0	
ω, .	· · · · · · · · ·	SPD : Soil Particl									Plas	rt							Drau	n	$\mathcal{F}_{\cdot \cdot \cdot}$	Whif	py	
		* Mineral compositions with the world with the worl	ition c	tetermi	ned						Sta.	rted.							A ppr	oved		*****		
		using X-ray di	ffrach	m							Fini	shed.									1		1	

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DATA POINT Nº 58

BOREHOLE LOG

	FEA LOC	ATIO	N	ULVERSTON Surface — 5DA charc LE COMPLETION	grat h — N	Samp West C	e ERIN Dle Ulvers	fone	GE												LEVEL INATE	DA COI GRO	MITI MUT MUT MUT JAIL		4MG 128 144 HD(Ta	39. smar	65 nia)
2 penetration	METHOD OF ADVANCING HOLE	ELEVATION	д. ДЕРТН	GEOLOGICAL soil type: plasticity colour, socondary	or particle o	haracteristics,	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	(*A) 50	a/ (4.2)	- (kA)	consistency density index		SPO (3/cm3)	BWO (9/cm3)	36	Sand %	2 %	9/14	Plasticity Index 6	36	Emerson Class No	She sire family Co	etas (600) '6	NMC %	water
	Reman	40		CLAY,			75	43 [*]	CL											4-5	24 8		3			22	
A5	aug			ing (d: 100mm)		LANATIO : Natural N			(500									E	NG			TION					
	: 6qu		ross	(d; :63mm). section	BWD SPD ★ 27.8.90	Content : Bulk We : Soil Partie : Mineral : Water le date si	cle Dei compos evel on	ty sity tion	deter	mi	nea	l by	, XR	<i>ס</i> י	Plas Sta	it :						Dat Dro App	rove	J.	Why	<u></u>	

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			_	ULVERSTONE Surface - gi West Gawlei	ENGINE	= <i>ER</i>	NG	BA	 당소	263		u					ſ							
	PRO	DJEC	T	Surface - a	oh santi	6						•••••	•••••				••••	RD ES	#1	TEM	1	AM	••••	
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8	VCWG	1373				SYM BOL	NOMBER	47.0	Stren	17 6			(8/5003)	(3/cm3)	% %	1	% %	۱× (۱	.	1 1	Bran	neter	%	
penetration	ADYA			GEDLOGICAL DESC	HIPTION		\$	(FICATI)	(k/k)	Sae/a	ncy			9			Limit	19 10	Swell	C/455	(A.A.)	(680)		
9.	METHOD OF ADVANCING HOLE			soil type: plasticity or part	icle characteristics.	G E O LOGICAL	SAMPLE	CLASSIFICATION (USC metric)	3	Penetrometer	consistency density index	maisture	360	BWO	Silf	Sand	Gravel Liourd	Plasticity Inde	Free S	Emerson			NMC	water
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DATA POINT NO 60

BOREHOLE LOG

					ULVERSTONE ENGINEE Surface – grab Sample Beside South Road – Wes LE COMPLETION															LEDUCED CO.ORD	DA CO	ETEM E N TUM	. 4.		20 888:	5 nania)
penetration	2000	METHOD OF ADVANCING HOLE	Metro Metro	н тово	GEOLOGICAL DESCRIPTION soil type: plasticity or particle characteristics, colour, secondary and minor components.	GEOLOGICAL SYMBOL	SAMPLE NUMBER	CLASSIFICATION (USC metric)	(k/k) = 5	a/ (x/a)	Penetrometer (KR) 5	dex	ion.		છ	%	chen nelre	9 64	PATO NATIONAL	ify Index 6	TESTS 100 000	son Class	She	ar (600)	NMC %	wafer
	Ram				CLAY	<i>C</i> _₩	97*	CH												4-5	3	U			24	
	•••••	*****	METHO	00 01	ADVANCING HOLL * Mineral composition determined by XR.			ologic.).).			A . ://-					S	ERIN	ION					
					determined by XR.	D								Drille Plant Stark	ed		·····				Date Drau Appr	in	4. n	hippy	 	
											•		_	Finish	ed						Shee	<u> </u>	/	. 61	1.	

PROJECT ULVERSTONE ENGINEERING GEOLOGY FEATURE Surface - grab sample LOCATION Reservoir site off Stubbs Road CASING/HOLE COMPLETION BOREHOLE LOG GEOLOGY ON INTIM AMG 1435030 N 5441690

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1 2	Denetration	METHOD OF ADVANCUS HOLE	HLD MELTES	GEDLOGICAL soil lypa: plasticity a	DESCRIPTION r particle characteristics, and minor components.	GEOLOGICAL SYMBOL	SAMPLE NOMBER	CLASSIFICATION	S110	Residual (*Pa) =	Penetrometer (KA)	consistency density index	moisture condition	SPD (g/cm³)	BWO (9/cm3)	%	Sand %	9 69	% // 6	0 00	Free Swell %	Emerson Class N2	3	\$ (600) 'd	NMC %	water
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penetration	METHOD OF ADVANCING HOLE	ELEVATION	д рерти	soil type	SEOLDGIC. : plaslici r, soconda	ily ar pə	rticla cl	həraclor		GEOLOGICAL SYMBOL	SAMPLE NOMBER	CLASSIFICATION	PICTUCAL TO	(x/2) /0/2/2/2/2/2/2/2/2/2/2/2/2/2/2/2/2/2/2/	3	consistency density index		SPD (8/cm²)	BNO (9/cm3)	² 6	5 % % % % % % % % % % % % % % % % % % %	2 %	# Timit %	ity Index 6	SATANKOge %	vell h	arson Class M	Shere Street Bran (By)	ng#	NMC %	water
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penetration	METHOD OF ADVANCATE MAY	ADYAN CING HOL	ELEVATION	DE			GEOL	LOGI	CAL	DE	SCH	II Ť TI	0 K				CRL SYMBOL		SAMPLE NUMBER	CLASSIFICATION	metric)	5	(x,2)		merer (km)	index			(8/cm²)	(3/cm3)	-	3°		**	% %	y Index 6	.0	Swell %	C/ass N2	Str	meke (650)	4*	%	•
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penetration	F AON			GEOLOGICAL DESCRIPTION	77.71	F NO	SIFICATI metric)		3	ome f	index	2 5	ુ	૭				11011	19 1	Swell	1 1	(k.R.)	(069)		
ă.	METHOD OF ADVANCING HOLE			soil type: plasticity or particle characteristics, colour, secondary and minor components.	GFOLOGICAL	SAMPLE NOMBER	CLASSIFICATION (USC metric)	Peak	Residual (xPa)	Penetrometer	consistency density index	moisture condition	800	BWO	Clay	#15	Gravel	Ligurd	Plasticity Index	Free	Emerson	١,٠		NMC	water
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DATA POINT Nº 65

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	PRO	JECT	ULVERST	ONE ENGINEER	RING	G	F010	67	,								ES	81			АМО	-	
	FEA	TURE	Surface	-grab sample ys: Road	·								·····				COOL		Ł		432		
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, E	METHOD OF ADVANCING HOLF	FLEVATION			SYMBOL	SAMPLE NOWBER	CLASSIFICATION (USC METRIC)	She	PIN C			(8/cm3)	(9/cm3)	7	96 9	% %	(1 J	\$ 80 20 20 20 20 20 20 20 20 20 20 20 20 20	Class Nº	Bran	rete!	%	
penetration	or ADI		georo	GICAL DESCRIPTION	G F O LO GICAL	ON 3%	SIFIC C Me	(4/4)	Post (KPA)	consistency density index	ion		૭		.	Limit	ity h	Swell		(k.k.)	(069)		ς.
	ЕТНОО			sticity or particle characteristics, Indary and minor components.	GEOLL	SAM	CL 455/ (05C	Peak	P. cot (KPa)	comsis	moisture candition	800	BWO	Sill S	Sand	Ligurd	Plasticity Index	Tree I	Emerson	١,٠	, Br	NMC	water
123	1 8	metres	CLAY		Tb _W	/02 [*]			1	+		2-37	9	2 7	7	91	51 /	<u>-</u>	6	ㅓ		45	
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Appendix 2
Summary of laboratory soil testing, data points 1 to 65

Data point	Sample	Depth (m)	USC classification	Geological n symbol	LL (%)	PL (%)	PI (%)	LS (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	MC (%)	EN (%)	Soil particle density	Bulk wet density	c' _r (kPa)	'r (°)
I	I	1.3-1.65	CH	Sd									54			1.77		22
	2	1.3–1.65 1.65–2.6	CH CH	Sd Sd	80	31	49	17					44	3	2.37		4	32
2	4	0.4–1.5	SP	Qm	00	31	77	17		6	94		77		2.37			
3	5	1.3–1.6	CH	Sd	115	29	86	24	70	16	14		47	1	2.26			
,	6	1.3–1.6	CH	Sd	113	27	00	27	70	10	17		44	'	2.20	1.80		
	7	1.7–1.9	CH	Sd	101	30	71	21					45	1			5	15
4	8	2.6-2.8	CH	Sd	108	32	76	24					49	6				
	9	4.5–4.8	CH	Ts	112	33	79	18					45	ı	2.36		2	8
	10	6.8–7.3	CH	Ts		2.4	25	1.4					2.4			1.40		
6	11 12	1.5–1.8 4.2–6.7	CH CH	Tbw Tbw	69	34	35	16					34	6		1.60		
7	14	1.6–2.8	CH	Cr	59	36	23	12					24	6				
•	15	4.3–4.6	CH	Cr	-								24	_		1.60		
8	16	0.4-1.3	SP	Qm						6	94							
	17	2.8–3.2	CH	PEw														
9	18	0.7–1.6	SP	Qm						4	96			_				
	19	4.8–7.0	CH	PEw									30	5				
10	20	0.6–1.3	CH	Qm	62	17	45	16					25	5	2.43			
П	21 22	1.0–2.0 5.1–5.4	CH CH	Sd Sd	87	36	51	20					38 56	6	2.57	1.74		
12	23	0.8–1.0	CH	Sd									41			1./4		
12	24	1.4–1.7	CH	Sd									50					
	25	1.8-2.0	CH	Sd									52					
	26	2.0-2.2	CH	Sd									52					
	27 28	2.2–2.5 3.8–4.1	CH CH	Sd Sd	148	43	105	29					53 60	6	2.50			
	29	5.1–5.5	CH	Sd	170	73	103	27					74	0	2.30	1.64		
13	30	2.6–2.9	CH	Sd	113	41	72	22					38	6				
	31	3.2–3.4	CH	Sd	105	43	62	17					39	3				
	32	3.4–3.65	CH	Sd	98	30	68	21					43	3	2.68		5	21
14	33	2.3–2.8	CH	Tbw	140	42	98	28	78	19	3		64	6	2.56		5	18
	34 35	1.8 -4 .3 6.9-7.2	CH CH	Tbw Tbw									66 82			1.56		
15	36	0.8–1.1	CH	Qa	105	24	81	21					32	5	2.53	1.50	4	18
13	37	2.1–2.9	CH	Qa Qa	103		0.	-1					32	3	2.55		•	10
16	38	0.2-1.3	CH	Sd	129	31	98	24					46	ı	2.31			
17	39	0.5-1.0	CH	Sd	168	39	129	25					63	3				
	40	1.0-1.25	CH	Sd	173	37		28	91	6	3		64	3	2.25		6	12
18	41	0.2-1.0	CH	Sd	135	32	103	26					51	3	2.50			
19	47	0.2-1.2	SP	Qm						19	71	10						
21	48	0.2-1.0	CH	Sd	64	35	29	16					27	6	2.69			
22	49	0.2-1.3	CH	Sd	85	27	38	20					39	2				
23	50	0.3-1.3	MH	Sd	54	31	23	14					26	6	2.71			
24	51	0-0.4	CL	PEw	43	26	17	9					15	6	2.65		2	15
25	52	0.4–2.8	CLI	PEr	7.	20	40	10						_				
25	53	0-0.2	CH	TBw	76	28	48	19					15	5				
26	54	0.3-1.3	CH	Sd	103	34	69	18					49	5	2.54	1.04		
27	55	1.0–1.3	CH	Qa	93	26		21	25	40			34	2	2.54	1.84		
28	56 57	0.75–1.1 5.8–6.3	CH CH	Sd Sd	49 67	18 26	41	12 13	35	48	17		24 25	5 5	2.61			
29	58	0.6–1.5	CH	Qm	136	27	109	28					43	5	2.38			
	59	5.5–7.0	CH	Qm	.50			_0					.5	,	2.50			
30	60	0.4-1.2	SP	Qm														
31	61	0.4–1.0	SP	Qa														
32	62	0.1-1.0	SM	Qa														
	63	5.0-7.0	SP	Qa														
33	64	0.4-1.0	SM	Qa	41	34	7	2					39					

Point Poin	——— Data	Sample	Depth	USC	Geological	LL	PL	PI	LS	Clay	Silt	Sand	Gravel	MC	EN	Soil	Bulk	c' _r	' _r
1																particle	wet		(°)
Fig. Section	34	65	0.3-1.0	CH	Tbw	94	38	56	19					51	6	2.44			
Second S																	1.75		
6		67	3.5–4.5	CH	Tbw	108	37	71	20					57	6				
Section Sect	35	68		CH						87	10	3		56		2.24	1.73	3	
71		69	1.4–2.4	CH	Sd	68	32	36	17					62	5			4	27
37	36														6				
15-36 CH		71	4.5–5.2	CH	Sd	78	45	33	13					53					
Section Sect	37	72		CH	Sd	92	35	57	21						6				
39		73	1.5–3.6	CH	Sd	101	37	64	21					54	6				
40	38	74	0.8-1.3	ML	Qm	36	17	19	5	21	28	50	I	17	I				
77	39	75	0.8-1.7	CH	Qa	63	22	41	15					26	5				
77	40	76	0.7-1.2	CH	Sd	110	32	78	21					48	2				
The color The		77	1.2–1.6			128	41								I	2.34		3	П
The color The	41	78	0.4 –1.0	CH	Tbw	104	39	65	18					41	6				
44 81 0.3-1.4 CH Tbw 98 29 69 25		79			Tbw	92		49							6	2.62		2	31
Record R		80	7.0–7.3	CH	Tbr	93	49	44	15					35			1.64		
S	44	81	0.3-1.4	CH	Tbw	98	29	69	25					46	6			4	30
45 84 1.0-1.2 CH Sd 99 38 61 22 47 50 5 2.60 4 29 46 87 5.0-7.0 CH Tbw? 134 45 89 26 62 5 47 88 0.4-1.0 SP Qm		82		CH	Tbr	80	39	41	18						6		1.76		
85		83		CH	Tbr	84	40	44	17					38	6				
86 3.0-3.5 CH Sd 105 36 69 21 50 5 2.60 4 29 46 87 5.0-7.0 CH Tbw? 134 45 89 26 62 5	45	84	1.0-1.2	CH	Sd														
46 87 5.0-7.0 CH Tbw? 134 45 89 26 62 5 47 88 0.4-1.0 SP Qm																			
47 88 0.4-1.0 SP Qm		86	3.0–3.5	CH	Sd	105	36	69	21					50	5	2.60		4	29_
89 1.0-1.6 SP Qm	46	87	5.0-7.0	CH	Tbw?	134	45	89	26					62	5				
48 90 0.3-1.3 CH Qa 69 19 49 16 33 5 2.61 49 91 0.2-0.8 SC 92 1.6-1.9 CH Ts 103 25 78 20 32 6 1.91 93 3.4-3.7 CH Sd 104 37 67 19 41 6 2.69 1.55 50 94 0.7-1.0 CH Sd 69 20 49 17 21 21 47 6 51 104 4.3-5.2 CH Sd 129 38 91 24 47 6 51 104 4.3-5.2 CH Sd 129 38 91 24 47 6 51 104 4.3-5.2 CH Sd 129 12 27 2 2.49 56 44 0-0.8 CL-ML Qa 27 20 7 4 19 2 2.51 57 45 0-2.0 CH Tbw 73 19 54 17	47	88	0.4-1.0	SP	Qm					- 1	3	95	1						
49 91 0.2-0.8 SC 92 1.6-1.9 CH Ts 103 25 78 20 32 6 1.91 93 3.4-3.7 CH Sd 104 37 67 19 41 6 2.69 1.55 50 94 0.7-1.0 CH Sd 69 20 49 17 21 95 3.2-3.6 CH Sd 129 38 91 24 47 6 51 104 4.3-5.2 CH Sd 129 38 91 24 17 6 55 42 0.3-0.9 CL-CH Qm 47 18 29 12 27 2 2.49 56 44 0-0.8 CL-ML Qa 27 20 7 4 19 2 2.51 57 45 0-2.0 CH Tbw 134 37 97 28 79 17 4 62 1 2.29 1.52 46 2.0-3.0 CH Tbw 73 19 54 17 38 15 47 31 1 2.50 1.77 58 43 Ts 45 21 24 8 22 3 59 96 CH Sd 94 39 55 20 36 6 2.64 60 97 CH Cw 65 20 45 13 24 6 61 98 CH Ts 89 34 55 16 28 6 103 CH Ts 92 35 57 16 28 6 20 99 CH PEw 74 27 47 14 Dry 6 2 15 63 100 CH Sd 46 23 23 10 19 5 64 101 CH Sd 46 23 23 10 19 5		89	1.0–1.6	SP	Qm					I	2	92	5						
92	48	90	0.3-1.3	CH	Qa	69	19	49	16					33	5	2.61			
93 3.4-3.7 CH Sd 104 37 67 19 41 6 2.69 1.55 50 94 0.7-1.0 CH Sd 69 20 49 17 21 95 3.2-3.6 CH Sd 129 38 91 24 47 6 51 104 4.3-5.2 CH Sd 129 12 27 2 2.49 56 42 0.3-0.9 CL-CH Qm 47 18 29 12 27 2 2.49 56 44 0-0.8 CL-ML Qa 27 20 7 4 19 2 2.51 57 45 0-2.0 CH Tbw 134 37 97 28 79 17 4 62 1 2.29 1.52 58 43 Ts 45 21 24 8 22 3 59 96 CH Sd 94 39 55 20 36 6	49	91	0.2-0.8	SC															
50 94 0.7-1.0 CH Sd 69 20 49 17 21 47 6 51 104 4.3-5.2 CH Sd 129 38 91 24 47 6 51 104 4.3-5.2 CH Sd 129 38 91 24 47 6 55 42 0.3-0.9 CL-CH Qm 47 18 29 12 27 2 2.49 56 44 0-0.8 CL-ML Qa 27 20 7 4 19 2 2.51 57 45 0-2.0 CH Tbw 134 37 97 28 79 17 4 62 1 2.29 1.52 46 2.0-3.0 CH Tbw 73 19 54 17 38 15 47 31 1 2.50 1.77 58 43 Ts 45 21 24 8 22 3 59 96 CH Sd 94 39 55 20 36 6 2.64 60 97 CH Cw 65 20 45 13 24 6 61 98 CH Ts 89 34 55 16 28 6 103 CH Ts 92 35 57 16 40 6 2.73 62 99 CH PEw 74 27 47 14 Dry 6 2 15 64 101 CH Sd 46 23 23 10 19 5		92		CH		103	25	78							6				
95 3.2-3.6 CH Sd 129 38 91 24 47 6 51 104 4.3-5.2 CH Sd		93	3.4–3.7	CH	Sd	104	37	67	19					41	6	2.69	1.55		
51 104 4.3–5.2 CH Sd I 4 16 55 42 0.3–0.9 CL-CH Qm 47 18 29 12 27 2 2.49 56 44 0–0.8 CL-ML Qa 27 20 7 4 19 2 2.51 57 45 0–2.0 CH Tbw 134 37 97 28 79 17 4 62 1 2.29 1.52 46 2.0–3.0 CH Tbw 73 19 54 17 38 15 47 31 1 2.50 1.77 58 43 Ts 45 21 24 8 22 3 59 96 CH Sd 94 39 55 20 36 6 2.64 60 97 CH Cw 65 20 45 13 24 6 61 98 CH Ts 89 34 55 16 28	50	94	0.7-1.0	CH	Sd	69	20	49						21					
55 42 0.3-0.9 CL-CH Qm 47 18 29 12 27 2 2.49 56 44 0-0.8 CL-ML Qa 27 20 7 4 19 2 2.51 57 45 0-2.0 CH Tbw 134 37 97 28 79 17 4 62 1 2.29 1.52 46 2.0-3.0 CH Tbw 73 19 54 17 38 15 47 31 1 2.50 1.77 58 43 Ts 45 21 24 8 22 3 59 96 CH Sd 94 39 55 20 36 6 2.64 60 97 CH Cw 65 20 45 13 24 6 61 98 CH Ts 92 35 57 16 40		95	3.2–3.6	CH	Sd	129	38	91	24					47	6				
56 44 0-0.8 CL-ML Qa 27 20 7 4 19 2 2.51 57 45 0-2.0 CH Tbw 134 37 97 28 79 17 4 62 1 2.29 1.52 46 2.0-3.0 CH Tbw 73 19 54 17 38 15 47 31 1 2.50 1.77 58 43 Ts 45 21 24 8 22 3 59 96 CH Sd 94 39 55 20 36 6 2.64 60 97 CH Cw 65 20 45 13 24 6 61 98 CH Ts 89 34 55 16 28 6 103 CH Ts 92 35 57 16 40 6 2.73	51	104	4.3-5.2	CH	Sd										I			4	16
57 45 0-2.0 CH Tbw 134 37 97 28 79 17 4 62 1 2.29 1.52 46 2.0-3.0 CH Tbw 73 19 54 17 38 15 47 31 1 2.50 1.77 58 43 Ts 45 21 24 8 22 3 59 96 CH Sd 94 39 55 20 36 6 2.64 60 97 CH Cw 65 20 45 13 24 6 61 98 CH Ts 89 34 55 16 28 6 103 CH Ts 92 35 57 16 40 6 2.73 62 99 CH PEw 74 27 47 14 Dry 6 2 15 63 100 CH Sd 46 23 23 10 19 5	55	42	0.3-0.9	CL-CH	Qm	47	18	29	12					27	2	2.49			
57 45 0-2.0 CH Tbw 134 37 97 28 79 17 4 62 1 2.29 1.52 46 2.0-3.0 CH Tbw 73 19 54 17 38 15 47 31 1 2.50 1.77 58 43 Ts 45 21 24 8 22 3 59 96 CH Sd 94 39 55 20 36 6 2.64 60 97 CH Cw 65 20 45 13 24 6 61 98 CH Ts 89 34 55 16 28 6 103 CH Ts 92 35 57 16 40 6 2.73 62 99 CH PEw 74 27 47 14 Dry 6 2 15 63 100 CH Sd 46 23 23 10 19 5	56	44	0-0.8	CL-ML	Qa	27	20	7	4					19	2	2.51			
46 2.0-3.0 CH Tbw 73 19 54 17 38 15 47 31 1 2.50 1.77 58 43 Ts 45 21 24 8 22 3 59 96 CH Sd 94 39 55 20 36 6 2.64 60 97 CH Cw 65 20 45 13 24 6 61 98 CH Ts 89 34 55 16 28 6 103 CH Ts 92 35 57 16 40 6 2.73 62 99 CH PEw 74 27 47 14 Dry 6 2 15 63 100 CH Sd 46 23 23 10 19 5 64 101 CH Sd 56 22 34	57	45	0-2.0		Thw	134		97		79	17	4		62	1		1.52		
59 96 CH Sd 94 39 55 20 36 6 2.64 60 97 CH Cw 65 20 45 13 24 6 61 98 CH Ts 89 34 55 16 28 6 103 CH Ts 92 35 57 16 40 6 2.73 62 99 CH PEw 74 27 47 14 Dry 6 2 15 63 100 CH Sd 46 23 23 10 19 5 64 101 CH Sd 56 22 34 13 18																			
60 97 CH Cw 65 20 45 13 24 6 61 98 CH Ts 89 34 55 16 28 6 103 CH Ts 92 35 57 16 40 6 2.73 62 99 CH PEw 74 27 47 14 Dry 6 2 15 63 100 CH Sd 46 23 23 10 19 5 64 101 CH Sd 56 22 34 13 18	58	43			Ts	45	21	24	8					22	3				
60 97 CH Cw 65 20 45 13 24 6 61 98 CH Ts 89 34 55 16 28 6 103 CH Ts 92 35 57 16 40 6 2.73 62 99 CH PEw 74 27 47 14 Dry 6 2 15 63 100 CH Sd 46 23 23 10 19 5 64 101 CH Sd 56 22 34 13 18	59	96		СН	Sd	94	39	55	20					36	6	2.64			
61 98 CH Ts 89 34 55 16 28 6 103 CH Ts 92 35 57 16 40 6 2.73 62 99 CH PEw 74 27 47 14 Dry 6 2 15 63 100 CH Sd 46 23 23 10 19 5 64 101 CH Sd 56 22 34 13 18																			
103 CH Ts 92 35 57 16 40 6 2.73 62 99 CH PEw 74 27 47 14 Dry 6 2 15 63 100 CH Sd 46 23 23 10 19 5 64 101 CH Sd 56 22 34 13 18																			
62 99 CH PEw 74 27 47 14 Dry 6 2 15 63 100 CH Sd 46 23 23 10 19 5 64 101 CH Sd 56 22 34 13 18	01															2.73			
63 100 CH Sd 46 23 23 10 19 5 64 101 CH Sd 56 22 34 13 18	42															2.75		2	15
64 I0I CH Sd 56 22 34 I3 I8																			13
		100													5				
65 102 CH Tbw 91 40 51 19 45 6 2.37	64	101		CH	Sd	56	22	34	13					18					
	65	102		СН	Tbw	91	40	51	19					45	6	2.37			

Notes:

Data point numbers 1-54 are auger holes; 55 trench; 56-57 existing excavations, 58-65 surface grab samples c'_r is residual cohesion in kilopascals, '_r is residual angle of friction in degrees Soil particle density and Bulk wet density are in g/cm^3

LL = liquid limit; PL = plastic limit; PI = plasticity index; LS = linear shrinkage

Geological symbols:

Qa = Alluvium; Qm = Coastal plain deposits; Sd = Slope deposit (transported soils)

Tbw = Residual soil — basalt parent rock; Tsi = Intra-basaltic sediments; Tbr = Basalt bedrock; Ts = Sub-basaltic sediments

Cw = Residual soil — Cambrian parent rock; Cr = Cambrian bedrock

PEw = Residual soil — Precambrian parent rock; PEr = Precambrian bedrock

 \emph{r} includes extremely weathered material (original rock fabric preserved)

Appendix 3

Details of data points 66 to 157

Site ID	Location	AMG (E)	AMG (N)	Reference	Dept Start	:h (m) End	Description	USC	Remarks
66	Clara Street, West Ulverstone	428970	5444340	UR74/3	0.00 1.20 3.00	1.20 3.00 3.40	red soil sandy clay weathered basalt, plastic layers yellow sand, wet		
67	Clara Street, West Ulverstone	429020	5444350	UR74/3	0.00 1.80 1.95	0.18 1.95 3.00	red soil grey claying sand red soil, sandstone		
68	Clara Street, West Ulverstone	429040	5444280	UR74/3	1.00 2.40	2.40 3.00	red soil, basalt boulders white quartz sand		
69	Clara Street, West Ulverstone	428950	5444450	UR74/3	1.00 1.20 1.35 1.50 1.65	1.20 1.35 1.50 1.65 3.30	red soil brown organic soil red soil grey plastic clay brown clay, shear surface		
70	Clara Street, West Ulverstone	428920	5444330	UR 74/3	0.00	3.00	red soil		
71	Clara Street, West Ulverstone	428890	5444480	UR 74/3	0.00 1.80 2.10	1.80 2.10 3.00	red soil grey plastic clay, sandy brown plastic clay, sheared		
72	Clara Street, West Ulverstone	428830	5444460	UR74/3	0.00 1.00	1.00 2.10	brown soil weathered basalt		
73	Clara Street, West Ulverstone	428820	5444500	UR74/3	0.00	3.00	brown soil, plastic, fissured, sheared		
74	Castra Road, Ulverstone	432120	5441460	U 1989	0.00 0.50 1.40 2.50	0.50 1.40 2.50 2.80	grey brown soil red brown clay, fissured red brown and grey clay, igneous texture red brown and grey clay, basalt		
75	Castra Road, Ulverstone	432110	5441410	U 1989	0.00 0.50 1.10	0.50 1.10 2.80	grey brown soil, fractured red clay, fissured grey brown and reddish clay, igneous texture		
76	Castra Road, Ulverstone	432130	5441410	U 1989	0.00 0.50 2.00	0.50 2.00 2.90	grey brown soil brown clay, fractured and fissured red brown clay, igneous texture		
77	Clayton	433200	5443290	U 1989	0.00 0.30 0.90 1.50	0.30 0.90 1.50 2.70	black sandy loam grey black sand, basalt or dolerite boulders brown clay, basalt or dolerite rock fawn grey clay, basalt or dolerite boulders		
78	Clayton	433220	5443430	U 1990	0.00 0.30 1.00	0.30 1.00 2.40	blue grey sand light grey sand brown grey sand, coarse, WT 1.4		
79	Clayton	433340	5443440	U 1990	0.00 0.30 1.40	0.30 1.40	brown loam brown clayey loam, basalt or dolerite boulders basalt or dolerite layer, very hard		
80	Clayton	433510	5443430	U 1990	0.00 0.40 1.50 2.00	0.40 1.50 2.00 3.00	grey sand, fine grained brown sand, some gravel grey, brown sand, coarser gravel grey brown sand, gravel, wet, WT 2.0		
81	Clayton	433510	5443430	U 1990	0.00 0.40 0.90 1.30 1.90	0.40 0.90 1.30 1.90 2.30	black loam, beach gravel brown sand, beach gravel light brown sand, beach gravel dark grey brown sand, beach gravel grey brown sand, beach gravel, wet, WT 2.1		
82	Clayton	433810	5443460	U 1989	0.00 0.30 0.50 0.80 1.60 2.80 3.00	0.30 0.50 0.80 1.60 2.80 3.00 3.50	grey brown sand, beach gravel black clayey sand grey clayey sand light grey clayey sand grey sand grey sand grey sand grey sand wet grey sand, some rounded gravel, WT 2.8		
83	Clayton	433970	5443430	U 1989	0.00 0.60 0.90 1.90	0.60 0.90 1.90 2.50	light grey sand brown clayey sand brown clay brown and black clay, some gravel, WT 2–2.4		
84	Clayton	434070	5443320	U 1989	0.00 1.00 2.00	1.00 2.00 2.50	light grey sand brown clayey sand black / green clay, some gravel, WT 1.8		

Site ID	Location	AMG (E)	AMG (N)	Reference	Dept Start	th (m)	Description	USC	Remarks
85	Ulverstone.	. ,	5443410	U 1979	0.00	1.20	sand and rubble		
05	Civic Centre	730700	סודכדדכ	017/7	1.20	2.00	gritty sand, hard pan		
					2.00	3.00	dark yellow sand, WT 2.0		
86	Ulverstone,	430480	5443470	MR 1981	0.00	0.80	grey sand	SP	6 pits
	Civic Centre				0.80	2.00	dark brown sand, some cemented	SP-SM	
					2.00	2.40	sand, WT 2.0	SP	
87	Ulverstone,	430360	5442670	MR 1969	0.00	0.25	grey gravel, quartzite		
	High School				0.25	0.60	grey sand		
					0.60		sandy clay over weathered quartzite pebbles, WT 0.6		
		420270	F 4 42 72 2	MD 1040	0.00	0.05			
88	Ulverstone, High School	430370	5442720	MR 1969	0.00 0.25	0.25 0.30	grey gravel, quartzite black sandy loam		
	i ligii Scilooi				0.30	0.60	grey sand		
					0.60	2.10	dark grey to black clay, some gravel		
					2.10	2.40	black gravel in sand WT 2.0		
89	Lovett Street,	429800	5442490	DC 1990	0.00	0.25	grey topsoil		
	Ulverstone,				0.25	0.60	sandy loam		
	Fire Station				0.60 1.60	1.60 3.00	yellow grey clay, plastic grey sand, wet		
90	Lovett Street, Ulverstone,	429790	5442520	DC 1990	0.00 0.40	0.40 1.80	grey topsoil		
	Fire Station				1.80	2.70	grey clay, firm grey sand, wet		
<u> </u>		420020	F442FF0						
91	Lovett Street, Ulverstone,	429820	5442550		0.00 0.45	0.45 1.60	loaming topsoil grey?, softer with depth		
	Fire Station				1.60	2.80	grey sand, wet		
92	Lovett Street.	429770	5442550	DC 1990	0.00	0.35	grey topsoil		
,,	Ulverstone,	127770	3112330	DC 1770	0.35	1.50	grey clay, firm		
	Fire Station				1.50	2.70	grey wet sand		
93	Lovett Street,	429770	5442480	DC 1990	0.00	0.35	topsoil		
	Ulverstone,				0.35	1.70	grey yellow clay, firm		
	Fire Station				1.70	2.80	grey yellow sand, wet		
94	Short Street,	429550	5442640	MR 1982	0.00	0.43	black loaming sand	SP	6 pits
	Ulverstone				0.43	0.90	white sand		
					0.90 1.05	1.05 1.60	yellow orange sand yellow orange sand, some iron cemented		
					1.60	1.90	yellow sand		
95	East Ulverstone,	431990	5443520	MR 1979	0.00	0.20	grey broen sand	SP	3 pits
/5	Primary School	431770	3113320	111(17/7	0.20	0.60	brown silty sand, quartzite and basalt boulders	SM	5 pics
	,				0.60	1.10	brown gravelly clay (basalt boulders)	GC	
					1.10	1.70	orange brown highly weathered basalt (clayey)		
96	South Road,	427690	5443740	MR 1976	0.00	0.40	black green clay, sandy	CH	3 pits
	West Ulverstone,				0.40	1.40	blue grey clay, some coarse sand	CH	3 DH
	Drill Hole 2				1.40 3.50	3.50 6.00	brown grey clay, some rock fragments brown grey weathered	CH	
					6.00	13.00	brown and grey		
97	Leven River Bridge,	420020	5442680	MR 1976	0.00	1.50	water	SP	
7/	Ulverstone	720030	3442000	11K 1776	1.50	14.50	grey sand, black grey silty sand	ML	
					14.50	17.35	gravel with silty sand, some clay	GP	
97	Leven River Bridge,	428830	5442680	MR 1976	0.00	1.50	water		
	Ulverstone			•	1.50	2.50	gravel, fine grained	GP	
					2.50	12.00	grey sand, shell and fragments	SP-SC	
					12.00	16.65	grey black silt brown silty sand, pebbles and gravel	MH SC-GP	
					16.65	18.95		3C-GF	
98	Leven River Bridge,	428830	5442680	MR 1976	0.00	1.50	water	SD SC	
	Ulverstone				1.50 7.00	7.00 9.30	grey sand, some shells yellow sand, some clay seams	SP-SC SC	
					9.30	17.18	grey silt	MH	
					17.18	19.20	river shingles with silt and sand	GP	
_					17.18	29.60	orange brown clay with gravel, some sand	GP-SC	
99	Leven River Bridge,	428830	5544268		0.00	3.60	water		
	Ulverstone (Pier 3)				3.60	9.10	sand, fine gravel, silt yellow clay bands	SP-ML	
					9.10 17.10	17.10 18.55	grey silt fine grained, silty and sandy	ML-MH GP	
					18.55	22.64	river mined with sandy and clay fines	<u>.</u>	
					22.64	25.68	clay, friable, stiff, schist pebbles		
					25.68	27.40	pebbly clay		
					27.40 28.92	28.92 31.50	coarse gravel brown quartzite, hard		
					20.72	31.30	DI OWII QUAI CEICE, HAI U		

Site ID	Location	AMG (E)	AMG (N)	Reference	Depth Start	(m) End	Description	USC	Remarks
100	Leven River Bridge, Ulverstone (Pier 4)		5544268		0.00 3.85 8.80 16.05 18.25	3.85 8.80 16.05 18.25 27.10	water sand, fine gravel shells grey silt, shells shingle, some schist material yellow quartzite with laterite in top section	GP-SC MH GP	
101	Leven River Bridge, Ulverstone (Pier 5)	428830	5544268		0.00 3.80 10.00 17.20	3.80 10.00 17.20 50.00	water gravel, (water worm), silt sand, shells grey silt soft yellow quartzite bonds laterite material	GP-SC MH	
102	Leven River Bridge, Ulverstone A (W)	428750	5442750		0.0 6.38 15.50 18.20 20.18 21.10 23.20	6.38 15.50 18.20 20.18 21.10 23.20 26.20	brown sand, shells grey sand, some silt sand, pebbles, shells green clayey gravel green sand gravel green grey clayey sand grey sand with pebbles (volcanic, quartzite)	SP SP-GP GP GW	
103	Ulverstone Bypass, Masons Creek	429320	5442420	MR	0.00 1.50 4.00	1.50 4.00 6.50	clayey sand (clay sparse) clayey sand sandy clay/rock?		
104	Ulverstone Bypass, Masons Creek	429350	5442420	MR	0.00 0.15 4.30	0.15 4.30 6.50	sand sand, some clay sandy clay/rock?		
105	Ulverstone Bypass, Masons Creek	429370	5442430	MR	0.00 0.30 3.40 5.40	0.30 3.40 5.40 6.60	sand sand, some clay sandy clay sandy clay (wet)/rock?		
106	Ulverstone Bypass, Preston Road	429790	5442280	MR 1976	0.00 0.80 0.80 5.45	0.80 1.14 5.45 17.00	black and orange sand orange sandy clay yellow, grey, green sand black, grey brown, brown clay quartzite pebble at 10 m green, white black grey clay with quartzite fragm	SC CL SP-SC OL, CH ents	
107	Ulverstone Bypass, Preston Road	429790	5442280		0.00 6.00 8.40	6.00 8.40 12.60	black grey yellow sand and clayey sand, some gravel black grey silt some gravel organic green, brown black clay with pebbles quartzite, basalt	SC, CH OL CH	
		420750	F.440000		12.60	13.80	grey basalt cobbles, green brown tuff at end grey green phyllite		
108	Ulverstone Bypass, Preston Road	429/50	5442280		0.00 12.00	12.00 16.50	without sampling grey yellow phyllite with quartzite bands		
109	Ulverstone Bypass	430940	5441970		0.00 0.60 0.80	0.60 0.80 3.50	brown clayey gravel (basalt) grey clay gravel, rounded basalt fragments	CH CH	
110	Ulverstone Bypass	430940	5441970		0.00 0.40 1.20	0.40 1.20 1.50	brown clayey gravel (basalt) green grey clay some pebbles basalt slightly weathered	CL CH	
Ш	Ulverstone Bypass	430940	5441970		0.00 0.30 0.80	0.30 0.80 5.10	brown clayey gravel (basalt) yellow clay plastic brownish tuff, plastic	CL CH	
112	Ulverstone Bypass	430940	5441970		0.00 1.00 2.20 3.90 5.80	1.00 2.20 3.90 5.80 8.00	black, yellow clay plastic yellow clay plastic, some basalt fragments red brown grey pyroclastic rock yellow brown pyroclastic particles absent fragments	CL-CH CH	
113	Ulverstone Bypass	430940	5441970		0.00 0.40 0.80	0.40 0.80 4.30	black clay, rock fragments orange clay plastic pyroclastic	CL CH	
114	Ulverstone Bypass	430940	5441970		0.00 0.60 1.20	0.60 1.20 5.10	grey clay plastic brown clay plastic basalt, less weathered with depth, rippable	CL CL	
115	Ulverstone Bypass	430940	5441970		0.00 1.10	1.10 1.60	black clay plastic, rock fragments basalt, weathering decreases with depth, rippable	CL	
116	Ulverstone Bypass	430940	5441970		0.00 0.50 1.00	0.50 1.00 2.80	black clay plastic, some rock fragments brown clay, plastic basalt, weathering decreases with depth	CH CH	
117	Ulverstone Bypass	430940	5441970		0.00 0.50 1.60	0.50 1.60 3.20	black clay, plastic, pebbles orange clay plastic, rock fragments basalt variable weathering	CH CH	

Site ID	Location	AMG (E)	AMG (N)	Reference	Depth Start	(m) End	Description	USC	Remarks
118	Ulverstone Bypass	430940	5441970		0.00 0.40 0.80	0.40 0.80 1.70	black clay, plastic, rock fragments orange yellow to brown clay, plastic basalt/variable weathering	CH CH	
119	Ulverstone Bypass, Castra Main Road	431990	5442290	MR 1977	0.00 0.45 0.90 1.23 6.00	0.45 0.90 1.23 6.00 15.50	topsoil orange yellow silty sand gravel, rounded pebbles orange yellow clay (weathered basalt) basalt variable weathered	CL GP CH	
		421000	F.4.42200		15.50	17.90 22.50	pyroclastic-agglomerate, tuff with sand and clay basalt, weathered at top		
120	Ulverstone Bypass, Castra Main Road	431990	5442290		0.00 0.30 1.23 2.50 15.58 15.85 17.30	0.30 1.23 2.50 15.58 15.85 17.30 20.27	topsoil red brown sandy clay grey brown gravel, clayey, quartz pebbles grey brown clay (weathered basalt) sandy clay, subangular quartz basalt and clay basalt, clay filled vesicles	CL GC CH	
121	Ulverstone Bypass, Castra Main Road	431990	5442290		0.00 0.30 1.60 2.00 4.78 14.20	0.30 1.60 2.00 4.78 14.20 19.13	topsoil brown clayey sand gravel (quartz) yellow clay, some gravel (basalt fragments) weathered basalt basalt completely weathered green brown basalt, blue grey with vesicles	CH GP	
122	Ulverstone Bypass, Forth Road Underpas		5442960		0.00 0.60 2.25	0.60 2.25 2.80	clayey gravel (basalt fragments) dark blue to black clay organic, plastic basalt deeply weathered	GC CH	
123	Ulverstone Bypass, Forth Road Underpas		5442960		0.00 1.00 2.50	1.00 2.50 3.70	clayey gravel (basalt fragments) blue green plastic clay. quartzite fragments at ba brown grey basalt, weathered	GC se	
124	Ulverstone Bypass Forth Road Underpas		5442960		0.00 0.90 1.60 2.90	0.90 1.60 2.90 3.60	clayey gravel (basalt fragments) dark blue to black clay, organic grey sand brown basalt, highly weathered		
125	Ulverstone Bypass Forth Road Underpas		5442960		0.00 1.30 2.60	1.30 2.60 3.80	clayey gravel (basalt fragments) grey silty sand brown-orange basalt, highly weathered		
126	Ulverstone Bypass Forth Road Underpa		5442960		0.00 0.60 1.00	0.60 1.00 2.40	brown clayey gravel (basalt fragments) blue grey clay, plastic brown grey silty clay, some sand and pebbles, medium plasticity	СН ОН-МН	
127	Ulverstone Bypass Forth Road Underpas		5442960		2.40 0.00 0.60	3.20 0.60 2.00	brown basalt, highly weathered clayey gravel (basalt fragments) dark grey-brown clay, occasional fragments basalt and quartzite plastic	GC CH	
128	Ulverstone Bypass Forth Road Underpas		544PQR0		2.00 0.00 1.00 2.20	3.00 1.00 2.20 3.60	grey brown basalt, moderately weathered clayey gravel (basalt fragments) silty sand, quartz boulders brown basalt, highly weathered	GC SP	
129	Ulverstone Bypass Forth Road Underpas		5442960		0.00 0.70 1.50 2.80	0.70 1.50 2.80 4.00	clayey gravel (basalt fragments) blue black clay, organic, plastic grey sand yellow brown basalt, highly weathered	GC OH SP	
130	Ulverstone Bypass Forth Interchange	432580	5442960		0.00 1.60 3.20	1.60 3.20 5.70	grey topsoil, brown to grey clayey sand brown green clay plastic clayey gravel, medium plasticity,	SC CH	
					5.70 11.30	11.30	basalt fragments (weathered basalt) brown yellow-green grey basalt weathering decreases with depth grey blue basalt, slightly weathered	GC	
131	Ulverstone Bypass, Forth Interchange	432580	5442960		0.00 0.15 2.00	0.15 2.00 4.40	grey sandy clay topsoil orange grey silty clay, low to medium plasticity brown grey gravelly clay (weathered basalt?)	CL	
132	Ulverstone Bypass	432580	5442960		0.00	0.15	medium plasticity yellow brown to blue grey basalt grey sandy clay topsoil	SC SS SS	
	Forth Interchange				0.15 2.00 2.90	2.00 2.90 6.00	orange grey clayey silt medium plasticity grey sand, some clay brown orange clayey silt medium plasticity (weathered basalt?)	SC-CL SP SC-CL	
					6.00 8.50	8.50 16.45	clayey silt with basalt fragments (highly weathered) brown to green grey basalt and/or pyroclastic be	GC edded?	

Site	Location	AMG	AMG	Reference	Deptl	n (m)	Description	USC	Remarks
ID		(E)	(N)		Start	End			
133	Ulverstone Bypass,	432580	5442960		0.00	0.20	grey sandy clay topsoil	SC	
	Forth Interchange	432580	5442960		0.20	1.60	grey silty clay medium to low plasticity	SC-CL	
					1.60	5.75	brown orange clay, basalt fragments increases	CLLCC	
					5.75	6.90	with depth (highly weathered basalt) green grey basalt/pyroclastic	CH-GC	
					6.90	10.97	blue grey basalt		
134	Bass Highway,	434470	5442900		0.00	0.45	loamy topsoil	SC-CL	
דכו	Claytons Rivulet	יייייי דייייי	3442700		0.45	1.90	red brown to brown clay (silty) friable	CL-CH	
	,				1.90	2.70	yellow brown to brown green sandy clay, friable	SC-CL	
135	Bass Highway,	434470	5442900		0.00	0.40	loamy topsoil friable	SC-CL	
133	Claytons Rivulet,	יייייי דייייי	3442700		0.40	1.75	brown clayey sand, silty, sandy clay,	3C-CL	
	,						friable-semi friable		
					1.75	2.75	blue grey sand (quartz)	SC	
136	Bass Highway,	434470	5442900		0.00	0.40	loamy topsoil	SC-CL	
	Claytons Rivulet				0.40	2.90	red brown silty and sandy clay friable	CL-CH	
137	Bass Highway,	436700	5442570		0.00	2.80	brown sandy gravel in sand	GP-GL	
137	Forth River	150700	3112370		2.80	7.45	greyish olive sand (quartz) some rock and	0. 02	
							shell fragments	SP	
					7.45	8.40	grey gravelly sand some wood	SP-GP	
					8.40	11.45	dark olive grey sandy silt (quartz and rock fragments), some shells increasing at base		
		45 :							
138	Bass Highway,	436610	5442570		0.00	10.15	light to medium grey sand, some silt, shells,	СМ	
	Forth River						wood fragments, occasional gravel fragments	SM	
139	Bass Highway,	436700	5442570		0.00	0.45	water	0.44	
	Forth River				0.45	3.20	grey sand (quartz) some pebbles	SW	
					3.20	6.87	cobbles and gravel, some clay and sand towards base	GP	
					6.87	7.32	grey brown clay, silty	CH	
140	Bass Highway,	424900	5442570		0.00	1.05	clayey gravel, silty clay		
140	Forth River	430000	3442370		0.00	1.03	(rounded quartzite fragments)	GC	
					1.05	1.20	light yellow sand, poorly graded	SP	
141	Bass Highway,	436840	5442570	MR 1983	0.00	0.80	sandy gravel (rounded quartzite fragments)		
171	Forth Bridge	130010	3112370	111(1703	0.00	0.00	in black and grey sand	GW	
					0.80	1.90	gravel (quartzite fragments becoming lower		
							with depth, sand	GP-GW	
142	Bass Highway,	436870	5442570		0.00	1.80	sandy gravel (rounded quartzite fragments) in		
	Forth Bridge						black light grey, orange brown sand	GW	
143	Bass Highway,	436910	5442570		0.00	0.05	silt, organic	OL	
	Forth Bridge				0.05	1.10	yellow grey sand (quartz)	SP	
					1.10	1.60	white to grey sandy gravel (quartzite fragments)	GW	
144	Bass Highway,	436910	5442570		0.00	0.05	dark brown silty clay, organic	OM	
	Forth Bridge				0.05	1.70	light brown to grey yellow sand (quartz)	SM-SP	
145	Bass Highway,	436980	5441250		0.00	0.45	dark grey to black sand (quartz) changing to grey	/ SP	
	Forth Bridge				0.45	1.90	gravel (quartzite fragments), roots to 0.9 m	GW	
146	Bass Highway,	436980	5442590		0.00	1.00	clayey gravel (rounded quartzite fragments)		
	Forth Bridge						in silty clay, organic	GC	
147	Bass Highway,	436980	5442590		0.00	0.80	clayey gravel (rounded quartzite fragments)		
/	Forth Bridge	.50700	3.12370		5.00	3.50	in silty clay, organic	GC	
148	Bass Highway,	437110	5442650		0.00	0.45	water		
5	Forth River Bridge	.5,110	3.12000		0.45	6.23	cobbles sand gravel rounded quartzite basalt		
	9-						fragments	GP	
					6.23	9.87	brown and grey basalt, vesicular		
					9.87	14.24	brown red grey tuff? Low specific gravity		
					14.24 14.82	14.82 15.27	brown sand, basalt pebbles gravel, quartzite fragments		
1.40	D 11: 1	4277116	F 4 40 4 5 0						
149	Bass Highway, Forth River Bridge	43/110	5442650		0.00 3.80	3.80 5.80	water dark green grey to white sand (quartz, rock		
	i oi ui kiver Bridge				3.00	3.60	and shell fragments)	SW-SP	
					5.80	8.00	gravel (quartz and schist fragments), some	U i	
							rounding, shells	GW-GP	
					8.00	8.20	sand	SW	
					8.20	10.50	gravel	GW-GP	
					10.50	12.50	sand with shingle layers (quartzite and schist	SP	
					12.50	13.00	fragments gravel (quartzite and schist fragments), rounded	ЭF	
							in silty gravel		
					13.00	15.20	yellow-brown clay some quartzite pebbles,		
					15.20	17.70	rounded	MH SP	
					13.20	16.70	white-grey sand, some pebble layers	or.	

Site	Location	AMG	AMG	Reference	Deptl	n (m)	Description	USC	Remarks
ID		(E)	(N)		Start	End			
150	Bass Highway,	437110	5442650		0.00	3.50	water		
	Forth River Bridge				3.50	5.75	sand, quartz and rock fragments, some pebble		
							layers	SW	
					5.75	7.95	gravel, subrounded quartzite, schist,		
							basalt fragments	GW	
					7.95	10.50	grey brown gravelly silt quartzite and rock		
							fragments	GM	
					10.50	14.80	red brown clay plastic quartzite pebbles at top		
							but mostly weathered basalt	CH	
					14.80	16.00	white gravel, quartzite fragments, sand	GW	
					16.00	16.45	white sand (quartz)	SP	
151	Bass Highway,	437110	5442650	MR 1982	0.00	3.80	silty sand and clay	MH-CL	
	Forth River Bridge			MR 1982	3.80	5.70	brown to grey sandy clay some gravel fragments		
	_						(quartzite basalt)	CL	
					5.70	8.00	gravel and shingle quartz and rock fragments	GP	
					8.00	12.81	red grey-yellow clay (entirely weathered basalt)	GC-CH	
					12.81	15.04	brown-red grey tuff?		
					15.04	15.40	gravelly sand (quartzite fragments)		
152-	Bass Highway,	437110	5442680		0.00	2.00	sand, silt, river gravel		
157	Forth River Bridge				3.70	12.54	gravel, silt and sandy clay		

All grid references are AGD66 datum

References:

UR Unpublished Report, Tasmania Department of Mines
U Ulverstone Municipal Council
MR Department of Main Roads
DC Department of Construction

USC Unified Soil Classification System

Appendix 4 Summary of X-ray diffraction results

Sample No.	3	5	7	8	9	Ш	14	19	20	21	28	30	32	33	36	38
Clay fraction (%) Serpentine Talc																
Stevensite											_					
Montmorillonite	20	35	20	5	40			10	50	80	5	15	20	45	15	85
Halloysite	75	60		80		65	45		50		90	80	65	45	75	15
Kaolinite	_	_			30		_	55			_	_				
Goethite	5	5		15		10	5			10	5	5	15	10	10	
Illite					30		45									
Quartz							5									
Hematite						10				10						
Mica								35								
Gibbsite						10										
Vermiculite						5										
Lepidocrocite																
Whole sample(%) Lepidocrocite																
Anatase																
Stevensite																
Montmorillonite	20	25	10	2	40			5	25		5		10	35	10	65
Halloysite	60	50	45	70		45	25		20	70	75	70	40	40	45	15
Kaolinite				. •	25			30		. •		. •				
Goethite	2	5	10	15		10	5	50		5	10	10	10	5	5	2
Illite	_		. •		25		25			•	. •	. •	. •			_
Quartz		10	25	5	10	25	45	45	55	10		5	15	2	35	2
Hematite						10	.5	15	55	10	5	•		5	33	-
Ilmenite		5	5	5		. •				5	5	2	15	2	5	5
Feldspar		5	5								•	2	10	_	2	10
Magnetite	5			5						5		10		10	-	2
Pyroxene	10													. •		-
Apatite	5															
Gibbsite	J					10										
Mica						10		20								
Vermiculite						2		20								
Talc						-										
Serpentine																
Chlorite																
	۲.5	۲.	C J	۲.	т.	Th	C	DF	0	۲.	CJ	CJ	C J	Th	0-	۲.
Geological symbol	Sd	Sd	Sd	Sd	Ts	Tbw	Cr	PEw	Qm	Sd	Sd	Sd	Sd	Tbw	Qa	Sd
Geological symbols	Qa Qm	Alluvii Coasta	ım al plain	deposi	ts											
	Sd	Slope	deposit	(trans	ported	l soils)										
	Tbw Tsi	Residu				ent rock										

Intra-basaltic sediments Tsi

Tbr Basalt bedrock

Sub-basaltic sediments

Cw Residual soil — Cambrian parent rock

Cr Cambrian bedrock

Residual soil — Precambrian parent rock

Precambrian bedrock

r includes extremely weathered material (original rock fabric preserved)

Sample No.	39	40	41	42	43	44	45	46	48	49	50	51	53	54	55	56
Clay fraction (%) Serpentine Talc																
Stevensite																55
Montmorillonite		85	85	40	40	20	50	50	75	55			90	85	70	
Halloysite		15	15	60			45	50		45	70		10	15		
Kaolinite					55	50	_				20	70			20	30
Goethite						10	5				30	10			5	10
Illite						10									5	
Quartz						10			15			-				
Hematite									15			5				
Mica Gibbsite									10			5				
Vermiculite									10			10				
Lepidocrocite												10				
Whole sample(%) Lepidocrocite Anatase																
Stevensite																15
Montmorillonite	65	75	65	15	20	5	40	20		40			65	45	50	13
Halloysite	15	15	15	20		•	40	20	35	30	35		00	10	50	
Kaolinite					30	10						25			10	10
Goethite	2		2			2	15	5	2		15	5		2	10	5
Illite						2									5	
Quartz	5	2	2	65	45	80		50	35		45	55			25	70
Hematite									15							
Ilmenite	5	5	5				5	2	5	2			2	10		
Feldspar	5	5	10					2	2	20			15	20	2	
Magnetite			2						2					15		
Pyroxene										10			20			
Apatite																
Gibbsite					2				2			2				
Mica					5							10				
Vermiculite												5				2
Talc																
Serpentine																
Chlorite																
Geological symbol	Sd	Sd	Sd	Qm	Ts	Qs	Tsi	Tsi	Sd	Sd	Qa	PEw	Tbw	Sd	Qa	Sd

Sample No.	57	58	65	67	68	69	70	72	73	74	75	76	77	78	79	80
Clay fraction (%)																
Serpentine												10	15			
Talc												5	5			
Stevensite																
Montmorillonite		60			40	45						80	75			
Halloysite		30	60	80	60	50	85	65	85		60				85	90
Kaolinite										25						
Goethite		5	10	20		5	10	5	15	5	10	5			15	10
Illite										70	15					
Quartz																
Hematite			20				5	20								
Mica																
Gibbsite			10					10			5					
Vermiculite											10					
Lepidocrocite		5														
Whole sample(%)																
Lepidocrocite		2														
Anatase																
Stevensite																
Montmorillonite		50			40	40						60	60	5		
Halloysite		20	55	65	55	40	80	55	70		25			70	75	85
, Kaolinite	15									5						
Goethite	5	5	10	15	2	2	10	5	15	2	5	10	5	10	15	5
Illite											5					
Quartz	50	25	5	2	2	2		10	2	75	50	2	2	2		
Hematite			25				5	20								
Ilmenite								2	5	2				2	2	5
Feldspar						5										
Magnetite				15		10	5	2	10				2	10	10	5
Pyroxene																
, Apatite																
Gibbsite			5	2				5		2	2					
Mica	30									15	10					
Vermiculite											2					
Talc												2	2			
Serpentine												20	30			
Chlorite												5				
Geological symbol	Sd	Qm	Tbw	Tbw	Sd	Sd	Sd	Sd	Sd	Qm	Qa	PEw	PEr	Tbw	Tbw	Tbr

Sample No.	82	86	87	90	92	93	95	96	97	98	99	100	102	103
Clay fraction (%)														
Serpentine														
Talc														
Stevensite														
Montmorillonite			35	35			10					5		
Halloysite	75	85	60	40		90	75	85		10			75	
Kaolinite										80		40		55
Goethite	10	5	5	15		10	15	15		10	5	5	5	40
Illite											95			
Quartz												10		
Hematite	5	10										10	10	
Mica												25		5
Gibbsite	10											5	10	
Vermiculite														
Lepidocrocite				10										
Whole sample(%)														
Lepidocrocite				5										
Anatase				3										
Stevensite														
Montmorillonite			30	15			5		10					
Halloysite	65	70	60	20	55	70	60	60					75	
Kaolinite		. •							25	70		20		45
Goethite	15	2	5	5		15	20	20	10	2	2	2	5	30
Illite		_		•					. •	_	50	_	•	
Quartz	10	10	2	45	40	15	10	5	45	20	45	45	2	20
Hematite	5	2	-			. •	. •	-				5	15	
Ilmenite	-	_	5	2	5	2	5	2		5		-		2
Feldspar			2	_	2	_	-	_		-				
Magnetite		15	_	2	_			10				5		
Pyroxene				_								-		
Apatite														
Gibbsite	5	2						2				2	5	
Mica	-	_		5				_	10	5		15	-	5
Vermiculite				-						-				
Talc														
Serpentine														
Chlorite														
Geological symbol	Tbi	Sd	Tbw	Qa	Tsi	Sd	Sd	Sd	Cw	Ts	PEw	Sd	Tbw	

APPENDIX 5 Details of water bores (data points 159 to 200)

Site ID	Location	AMG (E)	AMG (N)	Date drilled	DWS (m)	SWL (m)	TD (m)	Output (l/min)	Salinity (mg/l)	Driller's logs (m)
159	Turners Beach		5442070	26/06/1963			30.5			0–6.1 sand, 6.1–9.1 gravel, 9.1–12 clay 12.2–30.5 black schist
160	Turners Beach	435420	5442070	08/07/1963	11.6		13.7	7.6	13.3	0–7.6 sand, 7.6–9.8 sand and pebbles, 9.8–13.7 coarse gravel
161	Gawler	429700	5440820	21/02/1979	12.1–29	10.7	33.5	75.8		0-0.6 grey loam, 0.6-6.1 clay, 6.1-33.5 siltstone
162	Turners Beach	436110	5442380	17/04/1979			64			0–5.5 sand and gravel, 5.5–6.7 clay, 6.7–12.8 shingle, 12.8–51.8 sand and gravel 51.8–64 sand
163	Turners Beach	436110	5441920	27/04/1979	7.6–9.1	1.8	106.7	455		0–1.8 topsoil, 1.8–5.5 sand, 5.5–6.1 basalt, 6.1–18.3 shingle and gravel, 18.3–106.7 sand, clay and gravel
164	Turners Beach	435360	5442390	01/07/1963	10.7		12.5	22.7	320	0-0.46 sand, 4.6-12.5 gravel
165	Ulverstone	427290	5443410	09/03/1978	10.7	4.4	34.8	22.7		0-1.2 conglomerate, 1.2-7.9 clay, 7.9-34.8 hard mudstone
166	Ulverstone	4332950	5443050	15/09/1978	12.2–21.3	6.1	24.4	75.8		0-0.3 topsoil, 0.3-3.7 clay, 3.7-12.2 loose basalt, 12.2-21.3 sand and gravel, 21.3-24.4 quartzite
167	Turners Beach	435260	5442390	24/09/1965			13.1			0–0.6 sandy soil, 0.6–6.1 sand, 6.1–13.1 graphitic schist
168	Turners Beach	435310	5442390	27/09/1965	5.5		13.1	45.5	325	0-0.3 soil, 0.3-4.0 sand, 4.0-8.8 sand and rounded gravel, 8.8-13.1 graphitic schist
169	Turners Beach	435395	5442500	21/08/1979	6.1-9.8	4.6	9.8	34.1	9.8	0–6.1 sand, 6.1–9.8 gravel
170	Ulverstone	433140	5444620	14/02/1978	16.8–30.5		33.5	91		0-0.3 topsoil, 0.3-12.2 clay, 12.2-14.9 clay and boulders, 14.9-32 basalt, 32-33.5 schist
171	Turners Beach	435530	5441800	10/07/1963	11.6		13.7	19	320	0–4.6 sand, 4.6–8.2 sand, clay, some pebbles 8.2–11.6 clay. 11.6–12.2 coarse gravel, 12.2–13.7 fine gravel
172	Turners Beach	435810	5441790	15/10/1982	6.1–15.7	3.1	74.7	227		0–0.3 topsoil, 0.3–3.1 clay, 3.1–45.7 gravel and sand, 45.7–74.7 schist
173	Ulverstone	433190	5442160	16/02/1979			38.1			0–0.3 topsoil, 0.3–16.8 clay, 16.8–24.4 decomposed basalt, 24.4 –38.1 slate
174	Ulverstone	433080	5441920	17/02/1979			61			0-0.3 topsoil, 0.3-15.2 clay, 15.2-29 decomposed basalt, 29-61 slate
175	Ulverstone	428510	5443820	08/03/1978	6.1, 33.5	4.0	36.6	26.5		0–0.3 topsoil, 0.3–5.5 clay, 5.5–6.1 gravel, 6.1–33.5 soft quartzite, 33.5–38.1 quartzite
176	Ulverstone	430200	5442600	13/08/1979	2.1, 5.5		6.1	36.4		0-6.1 sand
178	Turners Beach	435450	5442390	23/09/1965	12.2		16.3	37.9	260	0-0.5 sandy clay, 0.5-0.8 sand, 0.8-9.1 sand and silt, 9.1-16.3 sand and rounded gravel
179	Ulverstone	427890	5444520	28/10/1982	13.7–27.4	12.2	61	37.9		0–0.3 topsoil, 0.3–12.2 clay, 12.2–27.4 basalt, 27.4–61 schist
180	Ulverstone	433510	5442640	16/02/1983	6.1, 27.4	3.1	54.9	60.6		0–0.3 topsoil, 0.3–12.2 brown clay, 12.2–27.4 basalt, clay, 27.4–53.4 basalt 53.4–54.9 quartz gravel
181	Ulverstone	433400	5442650	18/03/1983	6.1, 27.4		51.9	91		0-0.3 topsoil, 0.3-12.2 clay, 12.2-27.4 decomposed basalt, 27.4-47.3 basalt, 47.3-51.9 schist
182	Ulverstone	432890	5442780	18/02/1983	_		15.2			0-0.3 topsoil, 0.3-15.2 loose basalt
183	Ulverstone	432510	5442500	19/02/1983			9.1			0-0.3 topsoil, 0.3-9.1 loose basalt
184	Ulverstone	432310	5442440	19/02/1983	0.3–45.7		85.7	22.7		0–0.3 topsoil, 0.3–12.2 loose basalt, 12.2–18.3 clay, 18.3–70.8 basalt, 70.8–85.4 quartz gravel
185	Ulverstone	427280	5445210	13/05/1983	18.3–27.4	3.7	29.3	227		0-1.2 topsoil, 1.2-9.1 clay, 9.1-12.2 clay, shingle, 12.2-29.3 basalt

Site	Location	AMG	AMG	Date	DWS	SWL	TD	Output	Salinity	Driller's logs
ID_		(E)	(N)	Drilled	(m)	(m)	(m)	(l/min)	(mg/l)	(m)
186	West Gawler	427280	5441200	08/01/1984			71.4			0-0.3 topsoil, 0.3-1.2 clay, 1.2-36.6 basalt, 36.6-48.7 clay, 48.7-88.3 basalt, 88.3-91.4 quartzite
187	West Gawler	428700	5440860	10/04/1984	48.I	11.6	57.8	15.2		0–0.3 topsoil, 0.3–48.1 mudstone, 48.1–57.8 shale
188	Ulverstone	432610	5442640	12/11/1984	15.2, 27.4	9.1	30.4	30.3		0-0.6 topsoil, 0.6-9.1 clay, 9.1-15.2 loose basalt, 15.2-30.4 basalt
189	Ulverstone	432800	5442640	13/11/1984	9.1–30.4	6.1	32.9	91		0–0.6 topsoil, 0.6–10.7 clay, 10.7–18.3 decomposed basalt, 18.3–32.9 basalt
190	Ulverstone	432500	5442600	10/12/1984	21.3–27.4	12.2	27.4	37.9		0–0.3 topsoil, 0.3–21.3 clay, 21.3–27.4 decomposed rock
191	Ulverstone	427580	5444430	12/02/1985	61	30.5	67.I	19		0–0.3 topsoil, 0.3–6.1 clay, 6.1–67.1 mudstone
192	Ulverstone	426890	5444500	10/02/1988	25.9	9.1	30.4	45.5		0–0.3 topsoil, 0.3–7.0 soft mudstone, 7.0–30.4 mudstone
193	Ulverstone	429200	5442700	1986			72			
194	West Ulverstone	427990	5444830			0.45				
195	West Ulverstone	427080	5445200			12.97				
196	West Ulverstone	427500	5445350			11.3			630	
197	East Ulverstone	432970	5442800			0				
198	West Ulverstone	428090	5443790			6.4			105	
199	Castra Road	431970	5441430	01/12/1988	39.6	13.72	42.7	106	130	0–1.8 soil, clay, boulder, 1.8–15.2 clay 15.2–16.8 soft mudstone, 16.8–34.1 mudstone, 34.1–39.6 red and brown clay, 34.6–42.7 bluestone
200	Castra Road	432120	5441350	03/12/1988	21	4.51	27.4	114	350	0-3.1 white sand, 3.1-27.4 sandstone

Water bore localities have not all been field checked and may be only approximate in some cases. All grid references are AGD66 datum.

DWS Depth water struck
SWL Standing water level
TD Total depth of hole

APPENDIX 6

Log of diamond drill hole, Ulverstone

Hole drilled: December 1990

Location: Von Bibras Road, AMG reference 430 400 mE, 5 441 500 mN (data point 158)

From (m)	To (m)	Recovery (m)	Description
0	1.1	0.98	Red brown clay (thin zone at beginning with roots).
1.1	1.7	0.56	Light brown and red mottled clay, sandy texture (igneous).
.7	2.5	0.53	As above.
2.5	4.0	1.1	Reddish brown clay, igneous texture becoming firmer.
4.0	5.5	0.70	As above, some remnant jointing, black lining on joints.
5.5	7.0	1.40	Light brown to pink clay, sandy texture (igneous), jointing visible.
7.0	8.5	1.57	As above except for 0.1 m of unweathered basalt at 0.43 m from start of run.
3.5	10.0	0.94	Pinkish clay, igneous texture, one 40 mm piece of unweathered basalt.
10.0	11.5	1.43	0.4 m of above (pinkish clay), 0.1 m grey clay with igneous texture, 0.35 m brown clay with igneous texture and white speckles, followed by grey weathered basalt.
11.5	13	1.04	Grey and brown clay, igneous texture.
13	14.5	1.48	Light grey brown clayey material (weathered basalt), zones with white spots (vesicle fillings).
14.5	16.0	1.48	As above.
16.0	17.5	1.34	As above, some zones with cream-coloured seams (weathered secondary mineral?) and networks.
17.5	19.0	1.46	As above with cream coloured seams and networks.
19.0	20.5	1.65	As above with some darker grey zones, large weathered vesicle fillings in centre of run.
20.5	22.0	1.5	Slightly darker grey brown weathered basalt (clay with igneous texture), 60 mm section of unweathered basalt at 21.2 m.
22.0	23.5	1.45	Light grey-brown deeply weathered basalt, joints becoming visible (clay with igneous texture), one 60 mm zone of unweathered basalt in the middle of run.
23.5	25.0	1.14	Dark grey very weathered basalt, weathered vesicle fillings, some unfilled vesicles.
25.0	26.5	1.42	Dark grey very weathered basalt, some zones are less weathered, white vesicle fillings.
26.5	28.0	1.42	Mid to dark grey weathered basalt zones of fine-grained greenish material at beginning of run, possible thin sedimentary layer at 27.5 m.
28.0	29.5	1.52	First half of run mid grey and brown tuff, breccia or basalt with xenoliths. Final half is dark gre to black weathered basalt with white vesicle fillings and occasional white seams.
29.5	31.0	1.44	Dark grey to black basalt, slightly weathered, vesicles common in some zones (up to 10 mm across).
31.0	32.5	1.60	As above, less vesicles, final 0.15 m light grey green sediments (fine).
32.5	34.0	1.52	0.88 m light grey fine-grained sediments (or tuff?) followed by light grey to brown deeply weathered basalt or tuff/breccia, zones of vesicles.
34.0	35.5	1.48	Brown to grey basalt, deeply weathered for first 0.6 m (zones with vesicles) followed by grey basalt, little weathering, some vesicles.
35.5	37.0	1.48	Dark grey to black massive basalt, little weathering, occasional vesicles, 3–4 joints, weathered zeolite on joint surfaces.
37.0	38.5	1.5	As above (basalt), 4–5 joints.
38.5	40.0	1.36	As above, thick white seams on joints.
40.0	41.5	1.52	Dark grey vesicular basalt, more weathered than above, vesicles mainly open some filled, 0.18 m of brown weathered basalt in middle of run.
41.5	43.0	1.31	Dark grey vesicular basalt, weathered vesicles partially filled, brown weathered zone in middle of run.
13.0	44.5	1.55	Dark grey to black basalt, slightly weathered, occasional vesicles (filled), 8-10 joints.
14.5	46.0	1.28	As above, less vesicles, 6–8 joints.
46.0	47.5	1.26	Brown and grey more weathered basalt, some vesicles (filled).
47.5	49.0	1.52	Brown weathered basalt, some fine-grained brown zones (sediments for weathered zeolite?) i a deeply weathered section.

From	То	Recovery	Description
(m)	(m)	(m)	
49.0	50.5	1.55	Brown weathered basalt with vesicles (filled and weathered).
50.5	52.0	1.50	Dark grey, less weathered basalt (brown as above for first 50 mm at beginning), variable concentration of vesicles.
52.0	53.5	1.50	Dark grey to black massive basalt, minor weathering on joints, occasional filled vesicles.
53.5	55.0	1. 4 8	As above, 3–4 joints.
55.0	56.5	1.55	As above, 2–3 joints.
56.5	58.0	1.54	As above, 2–3 joints.
58.0	59.5	1.46	As above, few vesicles.
59.5	61.0	1.63	As above, few vesicles.
61.0	62.5	1.50	As above for first part, final 0.45 m is more weathered and vesicular, a few joints.
62.5	64.0	1.50	Dark grey to black slightly weathered basalt, vesicular, zone of zeolite across core at 63.8 m.
64.0	65.5	1.50	Dark grey to black weathered basalt, vesicles becoming less common.
65.5	67.0	1.48	As above, few vesicles, slightly weathered basalt.
67.0	68.5	1.50	As above, final half has filled vesicles (white), basalt slightly to moderately weathered.
68.5	70.0	1.52	Variably weathered basalt with vesicles, less weathered at end.
70.0	71.5	1.55	Slightly weathered basalt, occasional vesicles, fractured in parts.
71.5	73.0	1.55	Dark grey-black basalt, fractured, 40 mm weathered basalt at end.
73.0	74.5	1.45	Fractured basalt, occasional unfilled vesicle
74.5	76.0	1.48	As above, less fractures.
76.0	77.5	1.48	Fractured basalt, dark grey to black, occasional unfilled vesicles.
77.5	79.0	1.43	As above, less fractured.
79.0	80.5	1.49	As above for first part, final 0.66 m is vesicular, weathered and fractured basalt.
80.5	82.0	1.45	0.8 m vesicular and weathered basalt, becomes less weathered but still slight to moderate weathering in the basalt (dark grey black, filled vesicles common at end).
82.0	83.5	1.4?	Dark grey-black vesicular weathered basalt, white vesicle fillings.
83.5	85.0	1.45	Dark grey-black basalt, slight to moderate weathering, vesicles variable in concentration, some filled, some unfilled.
85.0	86.5	1.40	First 20–30 mm scoriaceous basalt, then light brown grey gravelly zone for 20–30 mm followed by 80–100 mm of sandy material then becoming finer grained (light brown and grey mudstone/siltstone).
86.5	88.0	1.5?	Light brown-grey sediments, broken 0.55 m fine-grained followed by sandy and silty sediments. Final material may be tuff?
0.88			END OF HOLE

Vesicle infill at 42 m was determined as chabazite (by XRD)

Palynology of clay sample at 87 m indicates a probable middle Eocene age

Whole sample XRD at 87 m gave 45% kaolinite, 30% quartz, 15% montmorillonite, 10% mica and 2% gibbsite

APPENDIX 7

Palynology report — Ulverstone diamond drill hole. Sample 87 m depth (Palynology Number P1045)

by S. M. Forsyth

The microflora contains several species that begin their ranges within the Malvacipollis diversus Zone. These include Ischyosporites gremius, Meaupreaidites elegansiformis, Proteacidites pachypolus, Kuylisporites waterbolkii and Foveotriletes balteus. According to Partridge (1973) the last three species first appear in the Bass Basin in the Upper Malvacipollis diversus Zone. Santalumidites cainozoicus appears first within the Upper M. diversus Zone and Nothofagidites asperus within the overlying Proteacidites asperopolus Zone.

Species which appear first in the Nothofagidites asperus Zone are not common but include Polycingulatisporites simplex or Quintinia-type pollen, Foveotriletes palaequetrus, Rugulatisporites trophus and probably Matonisporites ornamentalis. Nothofagidites falcatus may be present.

An upper age limit is suggested by the common occurrence of Stereisporites (Tripunctisporis) sp., which in the Bass Basin ceased to be common above the Middle Nothofagidites asperus Zone but extends into the Proteacidites tuberculatus Zone. Ischyosporites gremius and Proteacidites pachypolus do not range above the Nothofagidites asperus Zone and Santalumidites cainozoicus does not range into the Upper N. asperus Zone. Within the Bass Basin Rugulatisporites trophus similarly does not range into the Upper N. asperus Zone and Polycingulatisporites esobalteus terminates within the Middle N. asperus Zone.

No quantitative work has been carried out but qualitatively the microflora appear to post-date the reversal of the *Haloragacidites harrisii/Nothofagidites* spp. ratio, which occurs at or below the boundary between *Proteacidites asperopolus* Zone and the *Nothofagidites asperus* Zone.

Assuming no facies effects, the microflora appear to be of younger aspect than those of the Tamar region.

In the Tamar the undifferentiated Upper M. diversus Zone-Proteacidites asperopolus Zone contains abundant dinoflagellates, more common to abundant Proteacidites pachypolus occurrences and probably lacks Santalumidites cainozoicus. The Ulverstone microflora is of older aspect than Nothofagidites asperus Zone occurrences reported from the Longford Basin (Matthews, 1983), which lack P. pachypolus and probable Upper N. asperus Zone microfloras from the lower part of the largely volcanic sequence of the Hellyer region (Brown and Forsyth, 1984; Baillie, 1987a, b, c; Baillie and Green, 1988, 1990) and Corinna-Lower Pieman area (Morgan, 1987). Proteacidites pachypolus is a component of Nothofagidites asperus Zone microfloras west of Ross (Forsyth, 1989a) and near Avoca.

Overall the microflora can best be correlated with an interval close to the Proteacidites asperopolus Zone/Nothofagidites asperus Zone boundary. An interval within the N. asperus Zone is indicated but the rarity of N. asperus Zone indicators and absence of others suggest that the interval is very

certainly older than Upper *N. asperus* Zone. Following Partridge (1976), the microflora is of Eocene, most probably Middle Eocene age.

The strata at 87 m depth in the Ulverstone bore are significantly older than sub-basalt strata near Sheffield (Forsyth, 1989b), the Wesley Vale Sand (Cromer, 1980) and some strata interbedded? with basalt along the line of the new Howth–Penguin highway. Morgan (letter 23 February 1987) noted that lower *N. asperus* Zone strata underlay the Thirlstane Basalt in Olivers bore. Strata underlying basalt near Selbourne is probably older than that at Ulverstone.

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APPENDIX 8

The petrology of some basalt samples, Ulverstone diamond drill hole

by R. S. Bottrill

Two rock samples from the Ulverstone diamond-drill hole were submitted by W. L. Matthews for mineralogical examination.

Sample — 21.3 m

In hand specimen this sample is rather massive, dark grey and fine grained, a typical basalt. Some amygdular-type patches of clay minerals are present, and fine white spots probably represent feldspars.

In thin section the sample is basaltic in composition, with a hypocrystalline (i.e. semi-glassy) texture. The coarsest phase is olivine (\sim 15%), as euhedral to subhedral phenocrysts to 0.5 mm, partly altered to 'iddingsite'. The groundmass is largely fine plagioclase (\sim 25%; \sim An_{40–50}), as non-orientated laths. Interstitial to these minerals are very fine grained pyroxenes (titaniferous augite; euhedral–anhedral; \sim 25%), olivine (anhedral; \sim 5%), glass (dark brown; \sim 25%) and opaque minerals (magnetite?; dendritic; \sim 5%) in an intersertal to intergranular texture.

A few vesicles are present, now filled with clay minerals. Alteration is abundant, ~5–10%, mostly of olivine, but also of the groundmass (excluding plagioclase).

Sample — 74.5m

In hand specimen this sample is rather massive, black and fine grained, another typical basalt. It appears relatively fresh but some patches of clay minerals are present, and olivine phenocrysts to a few millimetres are also present.

In thin section the sample is basaltic in composition, with a holocrystalline (i.e. fully crystalline) texture. The coarsest phase is olivine (\sim 10%), as euhedral to subhedral phenocrysts to \sim 2 mm, partly altered to 'iddingsite'. The groundmass is largely composed of fine plagioclase (\sim 65%; \sim An_{40–50}), as flow-lineated laths. Interstitial to these minerals are very fine grained pyroxenes (titaniferous augite; euhedral–anhedral; \sim 20%), olivine (anhedral; \sim 3%), and opaques (magnetite?; dendritic, \sim 5%) in an intergranular texture.

No vesicles were observed. Alteration is abundant, ~5–10%, mostly of olivine, but also of the groundmass (excluding plagioclase).

Discussion

The two basalt samples are probably similar in bulk composition and co-genetic, but differ in texture. The sample from 21.3 m probably formed nearer the top of a flow, cooling rather rapidly, while the sample from 74.5 m appears to have cooled more slowly, crystallising fully.