

Mr. Jim Fera

Portion 54 and 61  
Mount Ousley Road, Mount Pleasant

GEOTECHNICAL INVESTIGATION FOR  
TWO PROPOSED HOUSE SITES

Report No. SC883/1-1 November 1993





## TABLE OF CONTENTS

|                                               | <u>PAGE</u> |
|-----------------------------------------------|-------------|
| 1.0 INTRODUCTION                              | 3           |
| 2.0 SCOPE OF INVESTIGATIONS                   | 3           |
| 3.0 SITE CONDITIONS                           | 4           |
| 3.1 Regional Setting                          | 4           |
| 3.2 Site Conditions of Northern Building Area | 6           |
| 3.3 Site Conditions of Southern Building Area | 7           |
| 4.0 DISCUSSION AND RECOMMENDATIONS            | 9           |
| 4.1 Northern Building Area                    | 9           |
| 4.2 Southern Building Area                    | 11          |
| 5.0 CONCLUSIONS                               | 13          |

APPENDIX A: Engineering Logs of Test Pits

DRAWING NO: SC893/1-1 Regional Site Plan

DRAWING NO: SC893/1-2 Site Plan of Northern Building Area

DRAWING NO: SC893/1-3 Site Plan of Southern Building Area

TABLE 1: Classification of Risk of Slope Instability

TABLE 2: Some Guidelines for Hillside Constructions

FIGURE 1: Illustrations of Good and Poor Hillside Practice

SC893/1-AB

22nd November 1993



## 1.0 INTRODUCTION

At the request of Mr. Anthony Fera and Mr. Jim Fera a geotechnical investigation has been carried out to assess the risk of slope instability for two proposed building areas within a 36 hectare (90 acre) property defined as Portions 54 and 61 in an area located west of Mount Ousley Road at Mount Pleasant. The investigation has been carried out in accordance with Coffey Partners International Proposal No. SCP510/1-AA dated 1st October 1993.

This report describes the investigations undertaken at the proposed building areas and provides an assessment on the risk of slope instability together with geotechnical constraints for development.

## 2.0 SCOPE OF INVESTIGATIONS

The scope of investigations involved field investigations as well as a review of published maps and aerial photographs pertaining to the site. The scope of investigations is listed below:

- surface mapping of slope features and rock exposures by a Senior Engineering Geologist from our firm on the 26th October 1993. The mapping utilised a 1:4000 scale orthophoto map prepared by the NSW Lands Department.
- excavation of nine test pits (numbered TP1 to TP9) using a mini tracked excavator. The test pits were logged by a Senior Engineering Geologist on the 26th October 1993. The engineering logs of the test pits are presented in Appendix A along with Explanation Sheets 1 and 2 defining the terms and symbols used.
- viewing aerial photographs of the area to assess for recent slope instability. Pairs of photographs from 1948, 1955, 1977 and 1986 were viewed stereoscopically.
- viewing regional geology and landslide maps of the area as produced by the NSW Geological Survey (scale 1:6330).
- discussions with the Mine Subsidence Board of NSW and the Department of Mineral Resources concerning the location of underground workings. Previous experience with other escarpment slopes in Wollongong has shown slope instability and cliffline failures can

SC893/1-AB

22nd November 1993



be attributed to underground coal mining and therefore a review of mine working plans was carried out.

### 3.0 SITE CONDITIONS

#### 3.1 Regional Setting

The property defined as portions 54 and 61 on the 1:25,000 scale topographic plan of Wollongong is located between the Illawarra Escarpment and Mount Ousley Road at Mount Pleasant. Based on discussions with the owner (Mr. Jim Fera) the property occupies about 36 hectares (90 acres) of which much of the land is rainforest or woodland covered. The lower portion of the site is used for grazing and sparse urban development.

The property occupies the upper slopes of the Illawarra Escarpment. Topographically the property contains areas with steep slopes which are typically forested and narrow to broad gently sloping benches which have been cleared historically for timber getting and farming.

Geologically the site is shown on the 1:6330 scale map of Fairy Meadow to be underlain by the interbedded sandstone, siltstone and claystone units of the upper members of the Narrabeen Group. Formations shown to occur on the property include the Newport Formation, Bulgo Sandstone, Stanwell Park Claystone and Scarborough Sandstone.

Cliffed exposures of the Scarborough Sandstone can be observed on the property some 50m upslope from Mount Ousley Road. The formations occurring near the building area are listed below:

| <u>Formation</u>                                                                     | <u>Reported Thickness</u> | <u>Assessed Elevation<br/>Range on Site (AHD)</u> | <u>Rock Type</u>                                      |
|--------------------------------------------------------------------------------------|---------------------------|---------------------------------------------------|-------------------------------------------------------|
| Scarborough Sandstone<br>(exposure 150m<br>downslope of proposed<br>building areas). | 24m                       | RL 220 to 240m                                    | Lithic and<br>quartz<br>Sandstone and<br>Conglomerate |

SC893/1-AB

22nd November 1993



5

|                                                                                                   |            |                 |                                                                              |
|---------------------------------------------------------------------------------------------------|------------|-----------------|------------------------------------------------------------------------------|
| <b>Stanwell Park Claystone</b><br>(Gently sloping and benched areas<br>containing building sites) | 0 to 37m   | RL 240m to 275m | Claystone and<br>quartz lithic<br>sandstone                                  |
| <b>Bulgo Sandstone</b><br>(steep sloping area above<br>building sites)                            | 90 to 130m | > RL 275m       | Quartz and<br>lithic<br>sandstone and<br>conglomerate<br>with minor<br>shale |

The geological units on the Fairy Meadow geology plan are shown on the 1:6330 scale slope stability map of Fairy Meadow (also prepared by the NSW Geological Survey) to have a slope stability classes characteristic of each geological unit. Above the building area, the steep slopes underlain by Bulgo Sandstone are classified as Class 5 of 6 (Topographically Unstable for development owing to steep slope and/or topographic position and nature of soil) while the more gently sloping area proposed for building and underlain by the Stanwell Park Claystone is classified as Class 3 of 6 (Less stable land, Most of land may be safely utilised although some areas are unstable).

The geology map shows the watercourse which flows eastward through the property and bisects the two proposed building areas is controlled by the Mt Pleasant Fault. Also shown on the geology map is a large area of talus covered slope which is shown to cover the Bulgo and Stanwell Park formations south of the fault.

A broad gently sloping and benched area located between 150m to 300m upslope of Mount Ousley Road has been extensively cleared for grazing and contains four homes, two of which are on the Fera property. These existing homes are 15 to 30 years old and are accessed by driveways leading from Mount Ousley Road. The same broad cleared area is proposed to contain the two house sites.

A review of coal mine plans as provided by the NSW Department of Mineral Resources shows the workings for the Old Mount Pleasant Mine and Balgownie Mine occur beneath the Escarpment and Mount Ousley Road areas and extend beneath Mr. Fera's property, stopping 200m north of the boundary. The Mount Keira Mine (to the south) is shown to extend northward to be about 500m south of the property boundary and 600m from the most southern of the proposed building areas.

SC893/1-AB

22nd November 1993



Two proposed building areas (each about 3000m<sup>2</sup> in area) have been identified by Mr. Fera within the 36 hectare property. These areas are defined in this report as the "northern and southern building areas". The two areas are about 100m apart separated by an incised watercourse as shown in Drawing No. SC893/1-1 and are described separately in Sections 3.2 and 3.3.

### 3.2 Site Conditions of Northern Building Area

#### Surface Observations

The northern building area is located on a narrow (20m to 30m wide) gently sloping bench at the northern end of the property located immediately upslope of one of the two existing residences. The bench is grass covered and slopes down to the east at about 10°. Drawing No. SC893/1-2 shows the bench to extend in a north-south direction about 100m. The downslope edge of the bench is defined by a sharp slope break to slopes of 25° to 35° for about 15m prior to flattening to more gentle slopes across the large bench area containing the existing residence.

Horizontal thin beds of coarse grained tuffaceous sandstone and silty sandstone are exposed in a farm track midway down the steep slope at the outer edge of the bench. This sandstone unit is likely to be within the upper part of the Stanwell Park Claystone formation and may represent a more resistant unit that has developed topographically as a scarp feature within the broad cleared area that is presumably underlain by the claystone/shale rock types.

The area above the bench is steep sloping at 28° and is thickly forested. A second bench (15m wide) is located about 70m upslope of the proposed building area. The forested 28° slope between the two benches contains large sandstone boulder exposures which may indeed be in situ beds. Trees on this forested slope are straight growing and the slope surface exhibits no evidence of recent instability. Above this second bench the ground slopes grade upwards steeply to the crest of the Illawarra Escarpment.

The northern end of the building area bench contains a small lobe of inferred shallow slide debris. This lobe is 20m wide and may represent the toe of a shallow earthflow (1m to 2m thick) which extends about 60m upslope on a 20° slope. Seepage was observed on the bench in this area due to a leaking water supply line.

SC893/1-AB

22nd November 1993



The southern end of the bench contains a filled embankment extending into the watercourse. This filling previously served as the northern abutment for a dam wall built during World War 2. The dam wall has been subsequently removed leaving a concrete causeway in the creek bed.

### Subsurface Conditions

Two test pits (TP1 and TP2) were excavated on the bench of the proposed northern building area. Both pits intersected talus material (ancient landslide debris) consisting of sandy clay with cobbles and boulders of sandstone. Test Pit TP1 intersected extremely to highly weathered sandstone beneath the talus material at 3.4m depth. This depth of talus cover is similar to the exposure 25m from TP1 in the farm track leading down from the bench and suggests a talus cover on the bench is 3m to 4m thick overlying weathered rock. No evidence of reactivation instability (ie slide planes) within the talus was observed within test pits TP1 and TP2.

In order to assess the risk of landsliding on the steep slope above the proposed building area and the longer term risk of slides moving onto the bench from above two test pits were excavated at distances 30m (TP4) and 70m (TP3) upslope. Test pit 4, located on a farm track, encountered 2.2m of talus material overlying weathered sandstone bedrock with no evidence of recent sliding. Test pit TP3, located on a narrow midslope bench intersected talus overlying weathered siltstone bedrock at 2.2m.

Groundwater inflows were not observed in the four test pits (TP1 to TP4).

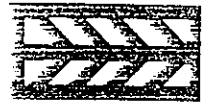
### 3.3 Site Conditions of Southern Building Area

#### Surface Observations

The proposed southern building area is located on the southern side of the major incised watercourse which runs diagonally through the property. The proposed building area occupies an area of about 3000m<sup>2</sup> and is situated at the slope break between the steep forested slope which rises some 100m to an escarpment plateau remnant and the gently sloping cleared pasture slopes. Drawing SC893/1-3 provides the layout of the southern building area. Groundslopes in the building area grade from about 5° in the upper portion of the cleared area steepening northward to 15° and 19° on the slopes leading down to the watercourse. Above the proposed building area the forested slope rises steeply at about 35° and has an overall slope of about 26° to the crest. Aerial

SC893/1-AB

22nd November 1993



photographs of this area from 1948 to 1986 revealed no instability on this steep slope above the proposed building area.

Drawing No. SC893/1-3 shows several slope breaks on the cleared pasture slopes below the upper bench area. These slope breaks (to angles of 14° and 19°) are arcuate shaped and may represent scarps of shallow landslides.

Large sandstone boulders to 4m diameter are exposed with the proposed building area. The area also contains several large established trees.

A small cutting 2.5m high excavated at the eastern end of the building area at the base of the steep forested slope exposes a thick bed of moderately weathered sandstone over a highly weathered cross bedded, coarse grained sandstone bed. The rock in the cutting is overlain by about 2m of talus material. Extremely weathered siltstone was exposed in a small second cutting located downslope of test pit TP8. A groundwater spring is evident on the contact between the steep slope and gently sloping pasture slope at the eastern end of the bench.

### Subsurface Conditions

Five test pits (TP5 to TP9) were excavated in the vicinity of the southern building area. Test pit TP5 was excavated at the rear of the 5° slope bench at the base of the steep forested slope. Pit TP5 intersected 1.5m of sandstone boulders within a topsoil matrix (recent scree material) above 1.4m of older talus with a sandy clay matrix which in turn overlies extremely weathered siltstone at 2.9m depth. The soil profile in pit TP5 is assessed to represent an area of boulders accumulation with boulders periodically rolling/sliding down the steep slope and collecting at the base of the slope.

To assess the subsurface conditions on the steeper cleared slopes where arcuate shaped slope features were observed, test pits TP6 and TP7 were excavated in a line downslope from TP5 at distances of 27m and 55m. Test pit TP6 encountered 2.1m of talus material (sandstone boulders in a sandy clay matrix) over residual soil and extremely weathered siltstone. A polished slide plane was observed at the soil/weathered rock contact at 2.1m depth. Significant groundwater inflow (say 1 litre/10 seconds) was observed within the talus material in TP6. Test pit TP7 located further downslope intersected 1.7m of talus overlying a 1.1m thick mottled clay layer of high plasticity. Within this clay layer were numerous polished planes indicating previous soil movements.



SC893/1-AB

22nd November 1993



Test pits TP8 and TP9 were excavated at the edge of the benched area above the slope breaks. Pit TP8 intersected 1.7m of very stiff sandy clay material of high plasticity overlying highly to extremely weathered mudstone (shale) at 2.2m depth. A polished slide plane was observed within the mottled clay layer at 1.6m depth. Test pit TP8 was free of groundwater. Test pit TP9 intersected a similar subsurface profile to TP8 with a highly weathered mudstone unit intersected at 2.5m depth. The overlying clay (1.9m thick) was of high plasticity, stiff consistency, mottled coloured and contained several slide planes at the base of the layer near the soil/rock contact. No groundwater inflow was observed in test pit TP9.

#### 4.0 DISCUSSIONS AND RECOMMENDATIONS

##### 4.1 Northern Building Area

The proposed northern building area has been investigated to assess the risk of slope instability above the building area and within downslope of the building area.

The steep forested slope above the proposed building area (located on the long narrow bench) was investigated by a review of maps/aerial photographs, a walk-over inspection and the excavation of pits TP3 and TP4. Both pits intersected 2.2m of talus material overlying in-situ weathered rock with no evidence of slope instability noted. The northern area of bench provides evidence of a shallow earthflow on the cleared steeper sloping area which has flowed down onto the bench.

Test pits on the bench revealed a deep talus soil cover say 3m to 4m thick over weathered rock with no evidence of reactivation.

On the basis of the site observation and historic data a preferred building envelope is recommended in the central portion of the long narrow bench. This area is about 15m by 30m. To assess the risk of instability for this designated building area the following site factors have been considered.

- Topographically located on a narrow (30m wide) bench at the base of a long steep forested slope and above a short steep scarp at the edge of the bench.
- Talus soil cover 3m to 4m thick.
- 10° ground slopes.



- Bedrock forming part of the Stanwell Park Claystone Formation.
- No evidence of recent slope instability above the building area or over the bench, other than at the northern end.
- No groundwater seepage observed.

On the basis of the above listed evidence, the recommended building envelope is assessed to have a **medium risk** of slope instability in accordance with the classification system in Table 1. Residential development within the envelope is recommended to incorporate the following geotechnical constraints:

1. House foundation to be taken down at least 0.5m into intact weathered rock. Should a brick or concrete residence to be proposed for the site a rigid pier wall reinforced concrete foundation system is recommended. For flexible timber or steel framed construction isolated footings to rock would be adequate.
2. No development to occur within 10m of the crest of the 35° scarp slope below the building envelop.
3. No significant earthworks are recommended for the building site and access road. Cut and fills should be restricted to a maximum height of 0.5m.
4. Roof water and pavement runoff should be piped to storage tanks or the watercourse.
5. A lined surface water catch drain is recommended at the rear of the building area to intercept runoff from the steep slope above.
6. The forest vegetation on the steep slope above the building area should be maintained. Vegetation retention is also recommended on the steep scarp below the building envelope.



7. On-site effluent disposal is not recommended on the narrow bench containing the designated building envelop. Disposal is recommended to occur on the gently sloping area (10° slope) located 40m northeast of the building envelop.
8. Development to follow good hillside practice as set out in Table 2 and Figure 1 attached.
9. Repair the leaking water supply line and divert it around the building envelop.

#### 4.2 Southern Building Area

The southern building area was proposed by the property owner (Mr. Jim Fera) to be located somewhere within the upper cleared pasture area investigated by test pits TP5 to TP9. In order to assess the risk of slope instability two issues must be addressed. Firstly, what is the risk of landslide activity from the escarpment above influencing the proposed building area and secondly, is the proposed building area itself influenced by slope instability. In relation to the first situation, a review has been made of historic mine subsidence records (to check if failures could occur as a consequence of mine subsidence) and aerial photographs. Both records suggesting no evidence for significant movement.

In relation to whether the building area itself could be influenced by instability the surface observation and test pitting program provide evidence that shallow slope instability (probably since forest clearance) has occurred on the sloping pasture slope which is assessed to be underlain by the Stanwell Park Claystone. No evidence of recent movement on the slope was observed in the aerial photos. However, the arcuate slope breaks to 15° to 19° slope angles and the polished slide planes throughout the clay layer in TP7 suggests historic movements have taken place on the steeper pasture slopes.

The slide planes observed in TP6, TP8 and TP9 suggest movement at the crest of the steeper pasture slopes (outer edge of upper bench) is occurring as a slow creep movement or an historic single movement which was a slope adjustment for movement downslope at TP7. The depth of the sliding is shallow (1.6m in TP8) and the established straight trees on the bench suggests, if creep movement is occurring, it is not influencing the trees growth which would have a root system within the slide affected area.

SC893/1-AB

22nd November 1993



12

On the basis that the test pits at the outer edge of the bench have intersected slide planes within the soil profile the cleared bench and lower slope is classified as **high risk** in accordance with the classification system in Table 1. Given this high risk of instability a section of the upper bench area is still considered possible for residential development provided the development incorporates engineering works to remediate the site and reduce the risk of instability. The test pitting provides guidance that the more suitable building area is located on the gently sloping upper bench area above test pit TP8 within the area shown on Drawing No. SC893/1-3. In this area the depth to weathered rock is assessed to be 2m to 3m.

Residential development in this area is recommended to incorporate the following geotechnical constraints:

1. The house should be constructed within the designated envelope with foundations taken 0.5m into the weathered rock. A deep pier wall foundation system is recommended for a rigid brick or concrete structure. For a flexible timber or steel structure isolated footings to rock would be adequate. As a part of the foundation preparation it is recommended that the slide affected soil be removed from the building area with the side and rear excavations supported by substantial engineer designed retaining walls. Based on the findings of TP8 the depth of excavation is anticipated to be about 1.6m though an inspection by a geotechnical engineer/geologist is recommended during the earthworks program.
2. Excavation outside the building area is not recommended other than small scale works for landscaping purposes.
3. No filling should be imported to the site. Any landscape filling obtained from the house excavation should not be disposed upslope or downslope of the building area. Excavation spoil should be transported to another area of the property.
3. A lined surface water catch drain is recommended above the building area to intersect surface waters from the steeply forested slope.
4. The spring water emerging at the eastern end of the bench should be directed into the catch drain constructed along the side of the existing bitumen sealed access road.



5. Roof water and pavement runoff should be controlled and piped to the watercourse or the roofwater collected in holding tanks for reuse..
6. On-site effluent disposal is recommended to be carried out no closer than 30m from the building area.
7. The access road to the building site is recommended to involve limited earthworks and extend along the gently sloping rear bench area from the existing bitumen access road.
8. Development to follow good hillside constructions practice as set out in Table 2 and Figure 1.

## 5.0 CONCLUSIONS

Two building envelopes have been provided for the site within broader building areas desired by the owner.

One building envelope has been recommended for a narrow benched area for the northern house site. This site is assessed to have a medium risk of slope instability and may be developed with a residential dwelling provided specific geotechnical constraints are adopted in the development to reduce the risk of instability.

A recommended building envelope has also been provided for the proposed southern house site. This designated envelope, like the immediate surrounding area exhibits evidence that creep sliding on a shallow slide plane has taken place in the past and thus the area is assessed to have a high risk of slope instability. Residential development is still considered possible within the building envelope provided the slide debris overlying the slide plane is removed and the specific geotechnical constraints implemented.



**TABLE 1**  
**CLASSIFICATION OF RISK OF SLOPE INSTABILITY**

### ASSESSMENT OF RISK

Natural hill slopes are formed by processes which reflect the site geology, environment and climate. These processes include downslope movement of the near surface soil and rocks: in geological time all slopes are unstable. The area of influence of these downslope movements may range from local to regional and are rarely related to property boundaries. The natural processes may be affected by human intervention in the form of construction and related activities.

A landslide (or landslide) is a downslope movement of a soil or rock mass as a result of shear failure at the boundaries of the moving mass. Soil creep, which is extremely slow and occurs without a well defined failure surface, is not included as a landslide.

It is not technically feasible to assess the stability of a particular site in absolute terms such as stable or unstable. However, the degree of risk of slope movement can be assessed by the recognition of surface features supplemented by limited information on the regional and local subsurface profile and with the benefit of experience gained in similar geological environments. The degree of risk is categorised below.

| RISK OF INSTABILITY | EXPLANATION                                                                                                                                                                 | IMPLICATIONS FOR DEVELOPMENT                                                                                                                                                                                             |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| VERY HIGH           | Evidence of active or past landslips or rockface failure, extensive instability may occur                                                                                   | Unsuitable for development unless major geotechnical work can satisfactorily improve the stability. Extensive geotechnical investigation necessary. Risk after development may be higher than usually accepted.          |
| HIGH                | Evidence of active soil creep or minor slips or rockface instability, significant instability may occur during and after extreme climatic conditions                        | Development restrictions and/or geotechnical works required. Geotechnical investigation necessary. Risk after development may be higher than usually accepted.                                                           |
| MEDIUM              | Evidence of possible soil creep or a steep soil covered slope, significant instability can be expected if the development does not have due regard for the site conditions. | Development restrictions may be required. Engineering practices suitable to hillside construction necessary. Geotechnical investigation may be needed. Risk after development generally no higher than usually accepted. |
| LOW                 | No evidence of instability observed; instability not expected unless major site changes occur.                                                                              | Good engineering practices suitable for hillside construction required. Risk after development normally acceptable.                                                                                                      |
| VERY LOW            | Typically shallow soil cover with flat to gently sloping topography.                                                                                                        | Good engineering practices should be followed.                                                                                                                                                                           |

Ref 1: GEOTECHNICAL RISKS ASSOCIATED WITH HILLSIDE DEVELOPMENT Australian Geomechanics News, Number 10, December, 1985.

TABLE 2

## SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

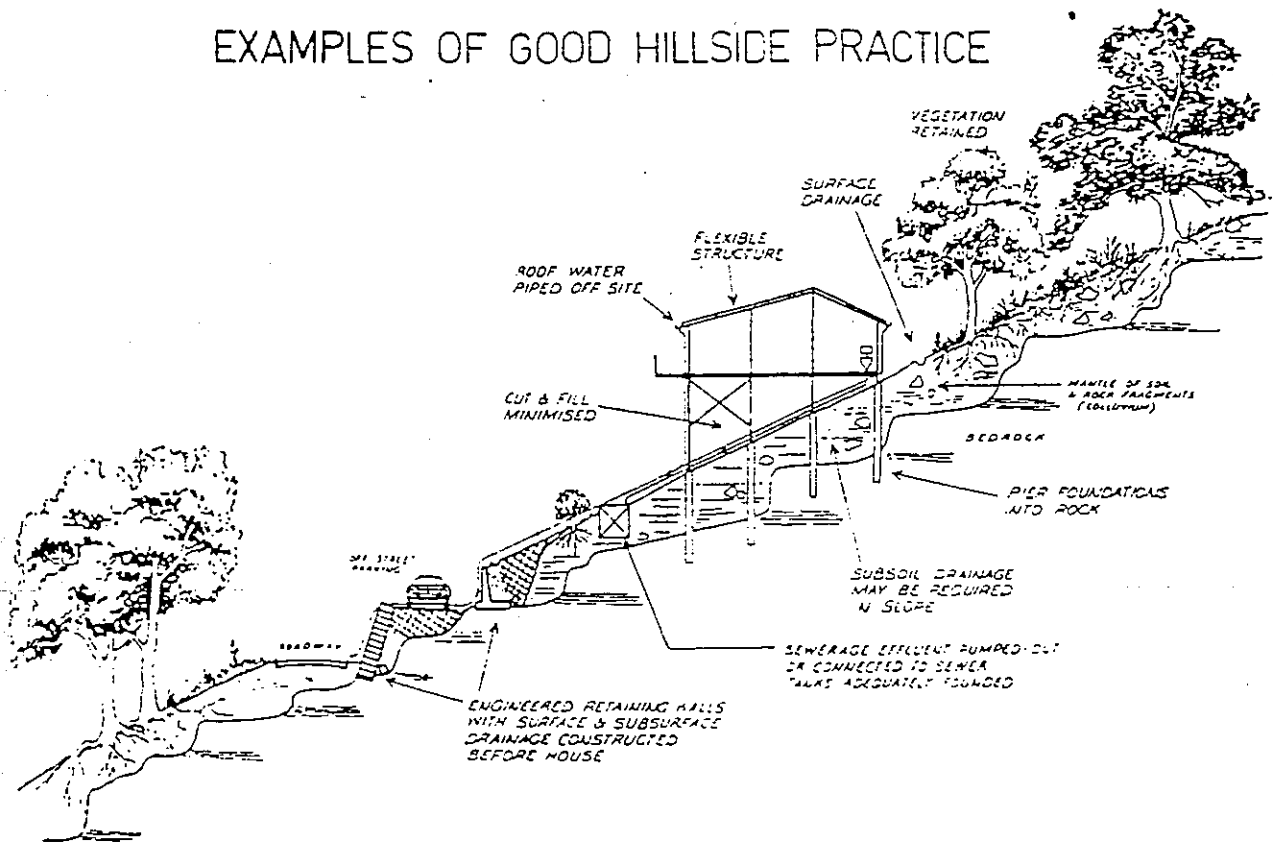
## GOOD ENGINEERING PRACTICE

## POOR ENGINEERING PRACTICE

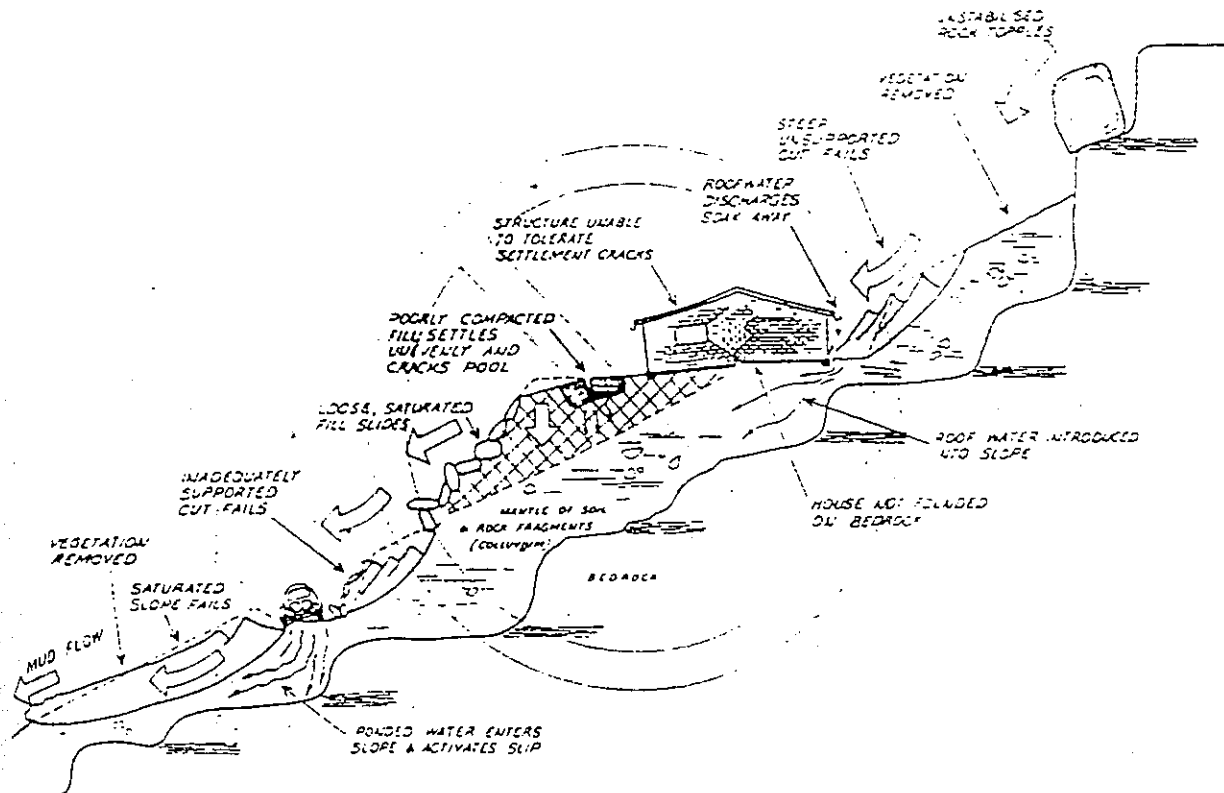
## ADVICE

|                                              |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                      |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GEOTECHNICAL ASSESSMENT                      | Obtain advice from a qualified, experienced geotechnical consultant at early stage of planning and before site works.                                                                                                                                                                                                                      | Prepare detailed plan and start site works before geotechnical advice.                                                                                                                               |
| PLANNING                                     |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                      |
| SITE PLANNING                                | Having obtained geotechnical advice, plan the development with the Risk of Instability and Implications for Development in mind.                                                                                                                                                                                                           | Plan development without regard for the Risk of Instability.                                                                                                                                         |
| DESIGN AND CONSTRUCTION                      |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                      |
| HOUSE DESIGN                                 | Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding.<br>Consider use of split levels.<br>Use decks for recreational areas where appropriate.                                                                                                                           | Floor plans which require extensive cutting and filling.<br>Movement intolerant structures.                                                                                                          |
| SITE CLEARING                                | Retain natural vegetation wherever practicable.                                                                                                                                                                                                                                                                                            | Indiscriminately clear the site.                                                                                                                                                                     |
| ACCESS & DRIVEWAYS                           | Satisfy requirements below for cuts, fills, retaining walls and drainage.<br>Council specifications for grades may need to be modified.<br>Driveways and parking areas may need to be fully supported on piers.                                                                                                                            | Excavate and fill for site access before geotechnical advice.                                                                                                                                        |
| EARTHWORKS                                   | Retain natural contours wherever possible.                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                      |
| CUTS                                         | Minimise depth.<br>Support with engineered retaining walls or batter to appropriate slope.<br>Provide drainage measures and erosion control.                                                                                                                                                                                               | Large scale cuts and benching.<br>Unsupported cuts.<br>Ignore drainage requirements.                                                                                                                 |
| FILLS                                        | Minimise height.<br>Strip vegetation and topsoil and key into natural slopes prior to filling.<br>Use and compact clean fill materials.<br>Batter to appropriate slope or support with engineered retaining wall.<br>Provide surface drainage and appropriate subsurface drainage.                                                         | Loose or poorly compacted fill.<br>Block natural drainage lines.<br>Fill over existing vegetation and topsoil.<br>Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill. |
| ROCK OUTCROPS & BOULDERS                     | Remove or stabilise boulders which may become unstable.<br>Support rock faces where necessary.                                                                                                                                                                                                                                             | Disturb or undercut detached blocks or boulders.                                                                                                                                                     |
| RETAINING WALLS                              | Engineer design to resist applied soil and water forces.<br>Found on rock where practicable.<br>Provide subsurface drainage within wall backfill and surface drainage on slope above.<br>Construct wall as soon as possible after cut/fill operation.                                                                                      | Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork.<br>Lack of subsurface drains and weepholes.                                                    |
| FOUNDATIONS                                  | Support on or within rock where practicable.<br>Use row of piers or strip foundations oriented up and down slope.<br>Design for lateral creep pressures.<br>Backfill foundation excavations to exclude ingress of surface water.                                                                                                           | Found on topsoil, loose fill, detached boulders or undercut cliffs.                                                                                                                                  |
| SWIMMING POOLS                               | Engineer designed.<br>Support on piers to rock where practicable.<br>Provide with under-drainage and gravity drain outlet where practicable.<br>Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.                                                         |                                                                                                                                                                                                      |
| DATA                                         |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                      |
| SURFACE                                      | Provide at top of cut and fill slopes.<br>Discharge to street drainage or natural water courses.<br>Provide generous falls to prevent blockage by siltation and incorporate silt traps.<br>Line to minimise infiltration and make flexible where possible.<br>Special structures to dissipate energy at changes of slope and/or direction. | Discharge at top of fills and cuts.<br>Allow water to pond on bench areas.                                                                                                                           |
| SUBSURFACE                                   | Provide filter around subsurface drain.<br>Provide drain behind retaining walls.<br>Use flexible pipelines with access for maintenance.<br>Prevent inflow of surface water.                                                                                                                                                                |                                                                                                                                                                                                      |
| SEPTIC & SULLAGE                             | Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some low risk areas.<br>Storage tanks should be water-tight and adequately founded.                                                                                                                                                               | Discharge sullage directly onto and into slopes.                                                                                                                                                     |
| EROSION CONTROL & LANDSCAPING                | Control erosion as this may lead to instability.<br>Revegetate cleared area.                                                                                                                                                                                                                                                               | Failure to observe earthworks and drainage recommendations when landscaping.                                                                                                                         |
| DRAWINGS AND SITE VISITS DURING CONSTRUCTION |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                      |
| DRAWINGS                                     | Building Application drawings should be viewed by geotechnical consultant.                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                      |
| SITE VISITS                                  | Site Visits by consultant may be appropriate during construction.                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                      |
| INSPECTION AND MAINTENANCE BY OWNER          |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                      |
| OWNER'S RESPONSIBILITY                       | Clean drainage systems; repair broken joints in drains and leaks in supply pipes.<br>Where structural distress is evident seek advice.<br>If seepage observed, determine cause or seek advice on consequences.                                                                                                                             |                                                                                                                                                                                                      |

## EXAMPLES OF GOOD HILLSIDE PRACTICE



## EXAMPLES OF POOR HILLSIDE PRACTICE



**FIGURE 1** Illustrations of Good and Poor Hillside Practice

This figure is an extract from *GEOTECHNICAL RISKS ASSOCIATED WITH HILLSIDE DEVELOPMENT* as presented in *Australian Geomechanics News*, Number 10, December, 1985, which discusses the matter more fully.





APPENDIX A

Engineering Logs of Test Pits



# descriptive terms soil and rock

## SOIL DESCRIPTIONS

Classification of Material based on Unified Classification System (refer SAA Site Investigation Code AS1726-1975 Add. No. 1 Table D1).

Moisture Condition based on appearance of soil

|              |                                                                                                                                                                     |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>dry</b>   | Looks and feels dry. Cohesive soils usually hard, powdery or friable, granular soils run freely through hands.                                                      |
| <b>moist</b> | Soil feels cool, darkened in colour. Cohesive soils usually weakened by moisture, granular soils tend to cohere, but one gets no free water on hands on remoulding. |
| <b>wet</b>   | Soil feels cool, darkened in colour. Cohesive soils weakened, granular soils tend to cohere, free water collects on hands when remoulding.                          |

Consistency based on unconfined compressive strength ( $Q_u$  generally estimated or measured by hand penetrometer)

| term      | very soft | soft | firm | stiff | very stiff | hard |
|-----------|-----------|------|------|-------|------------|------|
| $Q_u$ kPa |           | 25   | 50   | 100   | 200        | 400  |

If soil crumbles on test without meaningful result, it is described as friable

Density Index (generally estimated or based on penetrometer results)

| term                  | very loose | loose | medium dense | dense | very dense |
|-----------------------|------------|-------|--------------|-------|------------|
| density index $I_D$ % | 15         | 35    | 55           | 75    |            |

## ROCK DESCRIPTIONS

Weathering based on visual assessment

| term                 | criterion                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fresh                | Rock substance unaffected by weathering                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Slightly Weathered   | Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable. Strength properties are essentially those of the fresh rock substance.                                                                                                                                                                               |
| Moderately Weathered | Rock substance affected by weathering to the extent that staining extends throughout whole of the rock substance and the original colour of the fresh rock is no longer recognisable.                                                                                                                                                                                                                                                                                         |
| Highly Weathered     | Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and signs of chemical or physical decomposition of individual minerals are usually evident. Porosity and strength may be increased or decreased when compared to the fresh rock substance, usually as a result of the leaching or deposition of iron. The colour and strength of the original fresh rock substance is no longer recognisable. |
| Extremely Weathered  | Rock substance affected by weathering to the extent that the rock exhibits soil properties, i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.                                                                                                                                                                                                                             |

Strength based on point load strength index, corrected to 50 mm diameter ( $I_{s50}$ ) (refer S.R.M., Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1). (Generally estimated - x indicates test result).

| classification | extremely low | very low | low | medium | high | very high | extremely high |
|----------------|---------------|----------|-----|--------|------|-----------|----------------|
| $I_{s50}$ MPa  | 0.03          | 0.1      | 0.3 | 1      | 3    | 10        |                |

The unconfined compressive strength is typically about  $20 \times I_{s50}$  but the multiplier may range, for different rock types, from as low as 4 to as high as 30.

Defect Spacing

| classification | extremely close | very close | close | medium | wide | very wide | extremely wide |
|----------------|-----------------|------------|-------|--------|------|-----------|----------------|
| spacing m      | 0.03            | 0.1        | 0.3   | 1      | 3    | 10        |                |

Defect description uses terms contained on AS1726 table D2 to describe nature of defect (fault, joint, crushed zone, clay seam (etc.)) and character (roughness, extent, coating etc.).

# Graphic symbols soil and rock

## SOIL

|                                                                                   |                                            |                                                                                   |                        |
|-----------------------------------------------------------------------------------|--------------------------------------------|-----------------------------------------------------------------------------------|------------------------|
|  | Asphaltic Concrete or Hotmix               |  | Gravelly Clay (CL, CH) |
|  | Concrete                                   |  | Sandy Silt (ML)        |
|  | Topsoil                                    |  | Clayey Sand (SC)       |
|  | Fill                                       |  | Silty Sand (SM)        |
|  | Peat, Organic Clays and Silts (Pt, OL, OH) |  | Sand (SP, SW)          |
|  | Clay (CL, CH)                              |  | Clayey Gravel (GC)     |
|  | Silt (ML, MH)                              |  | Silty Gravel (GM)      |
|  | Sandy Clay (CL, CH)                        |  | Gravel (GP, GW)        |
|  | Silty Clay (CL, CH)                        |                                                                                   |                        |

## ROCK

|                                                                                     |                              |                                                                                     |                  |                                                                                       |           |
|-------------------------------------------------------------------------------------|------------------------------|-------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------------|-----------|
|  | Claystone (massive)          |  | Limestone        |  | Schist    |
|  | Siltstone (massive)          |  | Coal             |  | Gneiss    |
|  | Shale (laminated)            |  | Dolerite, Basalt |  | Quartzite |
|  | Sandstone (undifferentiated) |  | Tuff             |  | Talus     |
|  | Sandstone, fine grained      |  | Porphyry         |  | Alluvium  |
|  | Sandstone, coarse grained    |  | Granite          |                                                                                       |           |
|  | Conglomerate                 |  | Pegmatite        |                                                                                       |           |

## SEAMS

|                                                                                     |                                                 |
|-------------------------------------------------------------------------------------|-------------------------------------------------|
|  | Seam >0.1 m thick<br>(on a scale 1:50)          |
|  | Seam 0.01 m to 0.1 m thick<br>(on a scale 1:50) |

## INCLUSIONS (Special purposes only)

|                                                                                     |                |                                                                                     |                            |
|-------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------|----------------------------|
|  | Rock Fragments |  | Ironstone Gravel, Laterite |
|  | Swamp          |  | Shale Breccia in Sandstone |

## Water Level



Surfaces ————— Known Boundary ———— Probable Boundary ——— ? ——— ? Possible Boundary



pit no:

TP1

sheet 1 of 1

# neering log vation

office job no: Wollongong SC893/1

Jim Fera  
Proposed Residential Development  
Portion 54, Mount Ousley Road, Mount Pleasant  
Refer Drawing No. SC893/1-2, SC893/1-3

pit commenced: 20.10.93  
pit completed: 20.10.93  
logged by: CJP  
checked by: NSM

type and model: Mini excavator

R.L. surface: — m

dimensions: m long, m wide

datum:

| support | water | notes<br>samples,<br>tests, etc. | R.L. depth<br>metres | graphic log | classification<br>symbol | material<br>soil type: plasticity or particle characteristics<br>colour, secondary and minor components | moisture<br>condition | consistency,<br>density index | 100<br>kg<br>penetro-<br>meter | structure and<br>additional observations |
|---------|-------|----------------------------------|----------------------|-------------|--------------------------|---------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------|--------------------------------|------------------------------------------|
|         |       |                                  |                      |             |                          | Sandy CLAY, brown                                                                                       |                       |                               |                                | TOPSOIL                                  |
|         |       |                                  | 1.0                  |             | CL                       | Sandy CLAY, medium plasticity red brown with cobbles and boulders of sandstone                          | M                     | Fb                            |                                | TALUS                                    |
|         |       |                                  | 2.0                  |             |                          |                                                                                                         |                       |                               |                                |                                          |
|         |       |                                  | 3.0                  |             |                          |                                                                                                         |                       |                               |                                |                                          |
|         |       |                                  |                      |             | CH                       | Sandy CLAY high plasticity and sandstone, yellow brown                                                  |                       |                               |                                | EW/HW SANDSTONE                          |
|         |       |                                  |                      |             |                          | END TEST PIT TP1 AT 3.6m                                                                                |                       |                               |                                |                                          |

|                                                                                                                             |                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                            |                                                                                                                                                                            |                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>atural exposure<br/>isting excavation<br/>ckhoe bucket<br/>ildozor blade<br/>oper<br/>xavator<br/>and auger<br/>tube</p> | <p>support<br/>timbering N nil</p> <p>penetration 1 2 3</p> <p>no resistance ranging to refusal</p> <p>water</p> <p>10 Jan 78 water level on date shown</p> <p>water inflow</p> <p>water outflow</p> | <p>notes samples and tests</p> <p>U50 undisturbed sample 50mm diameter</p> <p>D disturbed sample</p> <p>N standard penetration tests:</p> <p>N* SPT + sample recovered</p> <p>Nc SPT with solid cone</p> <p>V vane shear</p> <p>P pressuremeter</p> <p>Bs bulk sample</p> <p>R refusal</p> | <p>classification symbols and soil description based on unified classification system</p> <p>moisture</p> <p>D dry</p> <p>M moist</p> <p>W wet</p> <p>Wp plastic limit</p> | <p>consistency/density index</p> <p>VS very soft</p> <p>S soft</p> <p>F firm</p> <p>St stiff</p> <p>VS<sub>t</sub> very stiff</p> <p>H hard</p> <p>Fb friable</p> <p>VL very loose</p> <p>L loose</p> <p>MD medium dense</p> <p>D dense</p> <p>VD very dense</p> |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



pit no:  
TP2  
sheet 1 of 1

# Engineering log excavation

office job no: Wollongong SC893/1

Client: Jim Fera  
Principal: Proposed Residential Development  
Project: Portion 54, Mount Ousley Road, Mount Pleasant  
Location: See Drawing SC893/1-2, SC893/1-3

pit commenced: 20.10.93  
pit completed: 20.10.93  
logged by: CJP  
checked by: NSM

Equipment type and model: Mini excavator

R.L. surface: — m

Excavation dimensions: m long, m wide

datum:

| penetration<br>1 2 3 | support<br>water | notes<br>samples,<br>tests, etc. | R.L. depth<br>metres | graphic log | classification<br>symbol | material<br>soil type: plasticity or particle characteristics,<br>colour, secondary and minor components | moisture<br>condition | consistency,<br>density index | 100 g hand<br>200 g penetrom-<br>eter<br>300 g<br>400 g | structure and<br>additional observations |
|----------------------|------------------|----------------------------------|----------------------|-------------|--------------------------|----------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------|---------------------------------------------------------|------------------------------------------|
|                      | NONE             |                                  | 1.0                  |             | GC                       | Sandy CLAY matrix and<br>COBBLES yellow brown and<br>red brown                                           | M                     | Fb                            |                                                         | TOPSOIL                                  |
|                      |                  |                                  | 2.0                  |             | CL                       | Sandy CLAY, medium plastici-<br>ty, red brown with cobbles<br>and boulders of sandstone                  |                       |                               |                                                         | TALUS                                    |
|                      |                  |                                  | 3.0                  |             |                          |                                                                                                          |                       |                               |                                                         |                                          |
|                      |                  |                                  |                      |             |                          | END TP2 AT 3.2m -<br><br>TERMINATION                                                                     |                       |                               |                                                         |                                          |

|                                                                                                                                                               |                                                                                                                                                    |                                                                                                                                                                                                                                                            |                                                                                                                                                                             |                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>key</b><br>N natural exposure<br>X existing excavation<br>BH Backhoe bucket<br>B bulldozer blade<br>R ripper<br>E excavator<br>HA hand auger<br>DT diatube | <b>support</b><br>timbering N nil<br><b>penetration</b> 1 2 3<br><br>water<br>10 Jan 78 water level on date shown<br>water inflow<br>water outflow | <b>notes</b> samples and tests<br>U50 undisturbed sample 50mm<br>diameter<br>D disturbed sample<br>N standard penetration tests:<br>N* SPT + sample recovered,<br>Nc SPT with solid cone<br>V vane shear<br>P pressuremeter<br>Bs bulk sample<br>R refusal | <b>classification symbols<br/>and soil description</b><br>based on unified<br>classification system<br><br><b>moisture</b><br>D dry<br>M moist<br>W wet<br>Wp plastic limit | <b>consistency/density index</b><br>VS very soft<br>S soft<br>F firm<br>St stiff<br>VSt very stiff<br>H hard<br>Fb friable<br>VL very loose<br>L loose<br>MD medium dense<br>D dense<br>VD very dense |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



# engineering log excavation

office job no: Wollongong SC893/1

client: Jim Fera  
 principal: Proposed Residential Development  
 project: Portion 54, Mount Ousley Road, Mount Pleasant  
 pit location: See Drawing No. SC893/1-2 , SC893/1-3

pit commenced: 20.10.93  
 pit completed: 20.10.93  
 logged by: CJP  
 checked by: NSM

equipment type and model: Mini Excavator  
 R.L. surface: — m  
 excavation dimensions: m long, m wide  
 datum:

| method | penetration<br>1 2 3 | support<br>water | notes<br>samples,<br>tests, etc. | depth<br>metres | graphic log | classification<br>symbol | material<br>soil type: plasticity or particle characteristics,<br>colour, secondary and minor components | moisture<br>condition | consistency,<br>density index | 100 hand<br>200 SPT<br>300 penetrometer<br>400 | structure and<br>additional observations |
|--------|----------------------|------------------|----------------------------------|-----------------|-------------|--------------------------|----------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------|------------------------------------------------|------------------------------------------|
|        |                      |                  |                                  | 1.0             |             | CL                       | Gravelly sandy CLAY, medium plasticity with sandstone cobbles and boulders, red brown                    | M                     | Fb                            |                                                | GRASS ROOTS<br><br>TALUS                 |
|        |                      |                  |                                  | 2.0             |             |                          | SILTSTONE, brown and light grey with CLAY medium plasticity horizontal bedding                           |                       |                               |                                                | EXTREMELY WEATHERED                      |
|        |                      |                  |                                  |                 |             |                          | END TEST PIT 2.5m DEPTH                                                                                  |                       |                               |                                                |                                          |

|                                                                                                                                                               |                                                                                                                                                      |                                                                                                                                                                                                                                                        |                                                                                                                                                                  |                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>key</b><br>N natural exposure<br>X existing excavation<br>BH Backhoe bucket<br>B bulldozer blade<br>R ripper<br>E excavator<br>HA hand auger<br>DT diatube | <b>support</b><br>T timbering N nil<br><b>penetration</b> 1 2 3<br><br>water<br>10 Jan 78 water level on date shown<br>water inflow<br>water outflow | <b>notes samples and tests</b><br>U50 undisturbed sample 50mm diameter<br>D disturbed sample<br>N standard penetration tests:<br>N* SPT + sample recovered<br>Nc SPT with solid cone<br>V vane shear<br>P pressuremeter<br>Bs bulk sample<br>R refusal | <b>classification symbols and soil description</b><br>based on unified classification system<br><b>moisture</b><br>D dry<br>M moist<br>W wet<br>Wp plastic limit | <b>consistency/density index</b><br>VS very soft<br>S soft<br>F firm<br>St stiff<br>VS+ very stiff<br>H hard<br>Fb friable<br>VL very loose<br>L loose<br>MD medium dense<br>D dense<br>VD very dense |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



pit no:  
 TP4  
 sheet 1 of 1

# Engineering log Excavation

office job no: Wollongong SC893/1

client: Jim Fera  
 principal: Proposed Residential Development  
 project: Portion 54, Mount Ousley Road, Mount Pleasant  
 pit location: See Drawing SC893/1-2 , SC893/1-3

pit commenced: 20.10.93  
 pit completed: 20.10.93  
 logged by: CJP  
 checked by: NSM

equipment type and model: Mini excavator

R.L. surface: — m

excavation dimensions: m long, m wide

datum:

| penetration<br>1 2 3 | support<br>water | notes<br>samples,<br>tests, etc. | depth<br>metres | graphic log | classification<br>symbol | material<br>soil type: plasticity or particle characteristics,<br>colour, secondary and minor components | moisture<br>condition | consistency,<br>density index | 100 kPa<br>penetro-<br>meter | structure and<br>additional observations |
|----------------------|------------------|----------------------------------|-----------------|-------------|--------------------------|----------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------|------------------------------|------------------------------------------|
|                      | NONE             |                                  | 1.0             |             | SC / Cl                  | Sandy CLAY, Clayey SAND low plasticity, red brown some boulders and cobbles of sandstone                 | M                     | Fb                            |                              | TALUS                                    |
|                      |                  |                                  | 2.0             |             |                          |                                                                                                          |                       |                               |                              |                                          |
|                      |                  |                                  | 2.5             |             |                          | SANDSTONE medium grained orange, light grey                                                              |                       | H                             |                              | EW/HW SANDSTONE                          |
|                      |                  |                                  | 3.0             |             |                          | END TP4 AT 2.6m—TERMINATED AT SLOW EXCAVATION                                                            |                       |                               |                              |                                          |

|                                                                                                                             |                                                                                                                                    |                                                                                                                                                                                                                                                 |                                                                                                                                                          |                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| natural exposure<br>existing excavation<br>Backhoe bucket<br>bulldozer blade<br>tipper<br>excavator<br>hand auger<br>datube | support<br>T timbering N nil<br>penetration 1 2 3<br>water<br>10 Jan 78 water level on date shown<br>water inflow<br>water outflow | notes samples and tests<br>U50 undisturbed sample 50mm diameter<br>D disturbed sample<br>N standard penetration tests:<br>N* SPT + sample recovered<br>Nc SPT with solid cone<br>V vane shear<br>P pressuremeter<br>Bs bulk sample<br>R refusal | classification symbols<br>and soil description<br>based on unified<br>classification system<br>moisture<br>D dry<br>M moist<br>W wet<br>Wp plastic limit | consistency/density index<br>VS very soft<br>S soft<br>F firm<br>St stiff<br>VSst very stiff<br>H hard<br>Fb friable<br>VL very loose<br>L loose<br>MD medium dense<br>D dense<br>VD very dense |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

# engineering log excavation



pit no:  
TP 5  
sheet 1 of 1

office job no: Wollongong SC893/1

client: Jim Fera  
principal: Proposed Residential Development  
project: Pottion 54, Mount Ousley Road, Mount Pleasant  
pit location: See Drawing SC893/1-2, SC893/1-3

pit commenced: 20.10.93  
pit completed: 20.10.93  
logged by: CJP  
checked by: NSM

equipment type and model: Mini Excavator

R.L. surface: — m

excavation dimensions: m long, m wide

datum:

| method | penetration | support | water | notes<br>samples,<br>tests, etc. | R.L. depth<br>metres | graphic log | classification<br>symbol | material<br>soil type: plasticity or particle characteristics,<br>colour, secondary and minor components                       | moisture<br>condition | consistency,<br>density index | 100 hand<br>200 kp penetrometer | structure and<br>additional observations                       |
|--------|-------------|---------|-------|----------------------------------|----------------------|-------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------|---------------------------------|----------------------------------------------------------------|
| 1 2 3  |             |         |       |                                  |                      |             |                          |                                                                                                                                |                       |                               |                                 |                                                                |
|        |             |         | NONE  |                                  | 1.0                  |             | GC                       | SANDSTONE BOULDERS and COBBLES in a sandy CLAY low plasticity brown to dark brown                                              |                       | Fb                            |                                 | TALUS MATERIAL & TOPSOIL<br>Roots common BOULDERS TO 0.7m DIA. |
|        |             |         |       |                                  | 2.0                  |             | GC                       | SANDSTONE BOULDERS and cobbles in a Sand CLAY matrix low plasticity brown to dark brown wit brown sandy CLAY and less boulders |                       | VSt / Fb                      |                                 | TALUS                                                          |
|        |             |         |       |                                  | 3.0                  |             |                          | SILTSTONE and CLAY high plasticity orange and light grey                                                                       |                       |                               |                                 | EW SILTSTONE                                                   |
|        |             |         |       |                                  |                      |             |                          | END TP5 AT 3.2m                                                                                                                |                       |                               |                                 |                                                                |

**key**  
N natural exposure  
X existing excavation  
BH Backhoe bucket  
B bulldozer blade  
R ripper  
E excavator  
HA hand auger  
DT diatube

**support**  
T timbering N nil  
**penetration** 1 2 3  
  
no resistance ranging to refusal  
**water**  
10 Jan 78 water level on date shown  
water inflow

**notes** samples and tests  
U50 undisturbed sample 50mm diameter  
D disturbed sample  
N standard penetration tests:  
N\* SPT + sample recovered  
Nc SPT with solid cone  
V vane shear  
P pressuremeter  
Bs bulk sample

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

**moisture**  
D dry  
M moist  
W wet  
Wp plastic limit

**consistency/density index**  
VS very soft  
S soft  
F firm  
St stiff  
VSt very stiff  
H hard  
Fb friable  
VL very loose  
L loose  
MD medium dense  
D dense  
VD vevr dense





pit no:  
 TP6  
 sheet 1 of 1

# engineering log excavation

office job no: Wollongong SC893/1

client: Jim Fera  
 principal: Proposed Residential Development  
 project: Portion 54, Mount Ousley Road, Mount Pleasant  
 pit location: See Drawing SC893/1-2, SC893/1-3

pit commenced: 20.10.93  
 pit completed: 20.10.93  
 logged by: CJP  
 checked by: NSM

equipment type and model: Mini excavator

R.L. surface: — m

excavation dimensions: m long, m wide

datum:

| method | penetration<br>1 2 3 | support<br>water | notes<br>samples,<br>tests, etc. | R.L. depth<br>metres | graphic log | classification<br>symbol | material<br>soil type: plasticity or particle characteristics,<br>colour, secondary and minor components | moisture<br>condition | consistency,<br>density index | 100 hand<br>kp penetrom-<br>eter<br>200<br>300<br>400 | structure and<br>additional observations                               |
|--------|----------------------|------------------|----------------------------------|----------------------|-------------|--------------------------|----------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------|-------------------------------------------------------|------------------------------------------------------------------------|
|        |                      |                  |                                  | 1.0                  |             | GC                       | BOULDERS of SANDSTONE with<br>SANDY CLAY matrix low<br>plasticity dark brown                             |                       | Fb                            |                                                       | TALUS                                                                  |
|        |                      |                  |                                  | 2.0                  |             |                          |                                                                                                          |                       |                               |                                                       |                                                                        |
|        |                      |                  |                                  | 3.0                  |             |                          | Sandy CLAY orange, yellow<br>and light grey with pieces<br>of highly weathered SILTST-<br>ONE            |                       | VSt<br>/                      |                                                       | Residual Soil<br>NEW SILTSTONE<br>Polished horizontal<br>plane at 2.1m |
|        |                      |                  |                                  |                      |             |                          | END TP6 AT 3.2m                                                                                          |                       |                               |                                                       | NOTE: Inflow guess-<br>ed at IL/10secs                                 |

## key

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

## support

timbering N nil  
 penetration 1 2 3  
 water  
 10 Jan 78 water level on date shown  
 water inflow  
 water outflow

notes samples and tests  
 U50 undisturbed sample 50mm  
 diameter  
 D disturbed sample  
 N standard penetration tests:  
 N\* SPT + sample recovered  
 Nc SPT with solid cone  
 V vane shear  
 P pressuremeter  
 Bs bulk sample  
 R refusal

## classification symbols and soil description based on unified classification system

moisture  
 D dry  
 M moist  
 W wet  
 Wp plastic limit

## consistency/density index

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



# engineering log excavation

office job no: Wollongong SC893/1

client: Jim Fera  
principal: Proposed Residential Development  
project: Portion 54, Mount Ousley Road, Mount Pleasant  
pit location: See Drawing SC893/1-2, SC893/1-3

pit commenced: 20.10.93  
pit completed: 20.10.93  
logged by: CJP  
checked by: NSM

equipment type and model:

R.L. surface: m

excavation dimensions:

m long,

m wide

datum:

| method | penetration | support | water | notes<br>samples,<br>tests, etc. | R.L. depth<br>metres | graphic log | classification<br>symbol | material<br>soil type: plasticity or particle characteristics,<br>colour, secondary and minor components          | moisture<br>condition | consistency,<br>density index | 100 hand<br>penetro-<br>meter | structure and<br>additional observations                        |
|--------|-------------|---------|-------|----------------------------------|----------------------|-------------|--------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------|-------------------------------|-----------------------------------------------------------------|
| 1 2 3  |             |         |       |                                  |                      |             |                          |                                                                                                                   |                       |                               |                               |                                                                 |
|        |             |         | NONE  |                                  |                      |             |                          | Sandy CLAY, low plasticity<br>dark brown                                                                          |                       |                               |                               | GRASS ROOTS<br>IN TOPSOIL                                       |
|        |             |         |       |                                  | 1.0                  |             | CL                       | Gravelly Sandy CLAY, medium<br>plasticity contains cobbles<br>and boulders of sandstone<br>grey, brown and orange |                       | Fb                            |                               | TALUS                                                           |
|        |             |         |       |                                  | 2.0                  |             | CH                       | CLAY high plasticity, mott-<br>light grey orange and yell-<br>ow brown                                            |                       | VSt                           |                               | x SLIDE DEBRIS<br>polished light grey<br>slide planes<br>common |
|        |             |         |       |                                  | 3.0                  |             |                          | END 2.8m LIMIT OF REACH                                                                                           |                       |                               |                               |                                                                 |

**key**  
N natural exposure  
X existing excavation  
BH Backhoe bucket  
B bulldozer blade  
R ripper  
E excavator  
HA hand auger  
DT diatube

**support**  
T timbering N nil  
**penetration** 1 2 3  
no resistance  
ranging to  
refusal  
**water**  
10 Jan 78 water level on date shown  
water inflow

**notes samples and tests**  
U50 undisturbed sample 50mm  
diameter  
D disturbed sample  
N standard penetration tests:  
N\* SPT + sample recovered  
Nc SPT with solid cone  
V vane shear  
P pressuremeter  
Bs bulk sample  
refusal

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

**moisture**  
D dry  
M moist  
W wet  
Wp plastic limit

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

# Engineering log excavation



pit no:  
 TP8  
 sheet 1 of 1

office job no: Wollongong SC893/1

client: Jim Fera  
 principal: Proposed Residential Development  
 project: Portion 54, Mount Ousley Road, Mount Pleasant  
 pit location: See Drawing SC893/1-2, SC893/1-3

pit commenced: 20.10.93  
 pit completed: 20.10.93  
 logged by: CJP  
 checked by: N.S.M

equipment type and model: Mini excavator  
 excavation dimensions: m long, m wide

R.L. surface: m  
 datum:

| method | penetration | support | water | notes<br>samples,<br>tests, etc. | R.L. depth<br>metres | graphic log | classification<br>symbol | material<br><br>soil type: plasticity or particle characteristics,<br>colour, secondary and minor components | moisture<br>condition | consistency,<br>density index | 100 mm hand<br>penetration<br>300 mm<br>400 | structure and<br>additional observations |
|--------|-------------|---------|-------|----------------------------------|----------------------|-------------|--------------------------|--------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------|---------------------------------------------|------------------------------------------|
| 1 2 3  |             |         |       |                                  |                      |             |                          |                                                                                                              |                       |                               |                                             |                                          |
|        |             |         |       |                                  |                      |             |                          | Silty SAND, dark brown                                                                                       |                       |                               |                                             | TOPSOIL                                  |
|        |             |         |       |                                  |                      |             |                          | Sandy CLAY, high plasticity<br>mottled orange light grey and<br>yellow brown some cobbles of<br>sandstone    |                       | VSt                           |                                             | SLIDE DEBRIS                             |
|        |             |         | NONE  |                                  | 2.0                  |             |                          | MUDSTONE laminated grey and<br>brown                                                                         |                       |                               |                                             | Slide plane at 1.6m                      |
|        |             |         |       |                                  | 3.0                  |             |                          | END TP8 AT 2.6m                                                                                              |                       |                               |                                             | EW/HW shale MW                           |

key  
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 X existing excavation  
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 B bulldozer blade  
 R ripper  
 E excavator  
 HA hand auger  
 DT diatube

support  
 T timbering N nil  
 penetration 1 2 3  
 no resistance  
 ranging to  
 refusal  
 water  
 10 Jan 78 water level on date shown  
 water inflow  
 water outflow

notes samples and tests  
 U50 undisturbed sample 50mm  
 diameter  
 D disturbed sample  
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 N\* SPT + sample recovered  
 Nc SPT with solid cone  
 V vane shear  
 P pressuremeter  
 Bs bulk sample  
 R refusal

classification symbols  
 and soil description  
 based on unified  
 classification system

moisture  
 D dry  
 M moist  
 W wet  
 Wp plastic limit

consistency/density index  
 VS very soft  
 S soft  
 F firm  
 St stiff  
 VSt very stiff  
 H hard  
 Fb friable  
 VL very loose  
 L loose  
 MD medium dense  
 D dense  
 VD very dense



pit no:  
TP9  
sheet 1 of 1

# engineering log excavation

office job no: Wollongong SC893/1

client: Jim Fera  
principal: Proposed Residential Development  
project: Portion 54, Mount Ousley Road, Mount Pleasant  
pit location: See Drawing SC893/1-2 , SC893/1-3

pit commenced: 20.10.93  
pit completed: 20.10.93  
logged by: CJP  
checked by: NSM

equipment type and model: Mini excavator

R.L. surface: — m

excavation dimensions: — m long, — m wide

datum:

| method | penetration | support | water | notes<br>samples,<br>tests, etc. | R.L. depth<br>metres | graphic log | classification<br>symbol | material<br>soil type: plasticity or particle characteristics,<br>colour, secondary and minor components      | moisture<br>condition | consistency,<br>density index | 100 hand<br>200 g penetrom<br>300 g<br>400 meter | structure and<br>additional observations |
|--------|-------------|---------|-------|----------------------------------|----------------------|-------------|--------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------|--------------------------------------------------|------------------------------------------|
|        |             |         |       |                                  |                      |             |                          | Silty SAND, dark brown some<br>sandstone boulders and cobbl-<br>es                                            |                       |                               |                                                  | TOPSOIL                                  |
|        |             |         |       |                                  | 1.0                  |             |                          | CLAY high plasticity mottled<br>light grey, orange and yell-<br>ow brown some sand and sand-<br>stone cobbles | M<br>><br>Wp          | St                            |                                                  | SLIDE DEBRIS                             |
|        |             |         |       |                                  | 2.0                  |             |                          |                                                                                                               |                       |                               |                                                  | Slide planes<br>near base                |
|        |             |         |       |                                  | 3.0                  |             |                          | MUDSTONE, grey and brown<br>laminated                                                                         |                       |                               |                                                  | HIGHLY WEATHERED<br>MUDSTONE             |
|        |             |         |       |                                  |                      |             |                          | END TP9 AT 3.7m                                                                                               |                       |                               |                                                  |                                          |

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

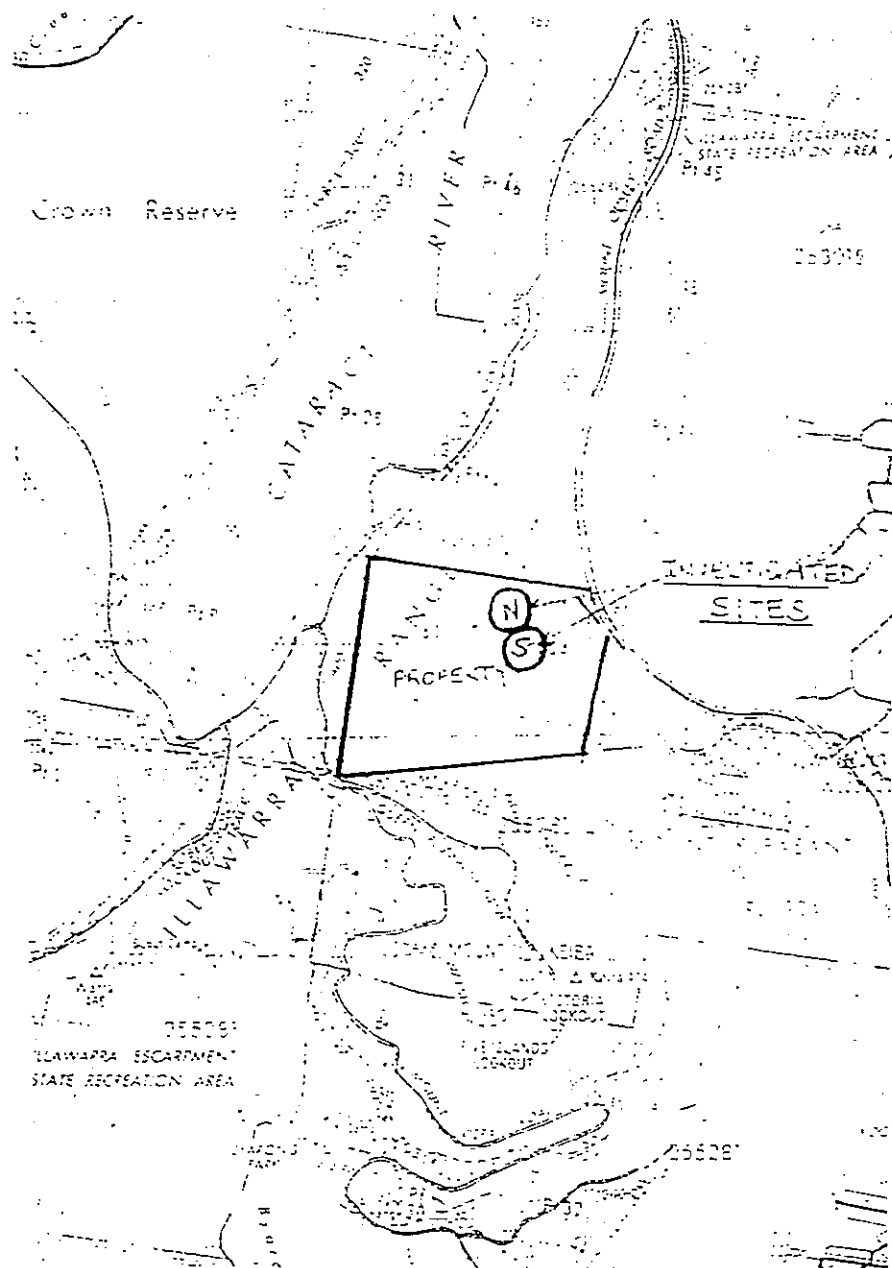
support  
T timbering N nil  
penetration 1 2 3  
no resistance  
ranging to  
refusal  
water  
10 Jan 78 water level on date shown  
water inflow  
water outflow

notes samples and tests  
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D disturbed sample  
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N\* SPT + sample recovered  
Nc SPT with solid cone  
V vane shear  
P pressuremeter  
Bs bulk sample  
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classification symbols  
and soil description  
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VSt very stiff  
H hard  
Fb friable  
VL very loose  
L loose  
MD medium dense  
D dense  
VD very dense



copied from Land Department Map

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424 (03) 492 319

|          |             |
|----------|-------------|
| drawn    | CJP         |
| approved | <i>aker</i> |
| date     | 23.11.93    |
| scale    | 1:25000     |

MR. JIM FERA  
REGIONAL SITE PLAN



drawing no:  
SC893/1-1

job no. SC893/1

# LEGEND

REFER TO DRAWING NO  
SC893/1-3

 Recommended area in  
which to build

EXISTING  
FERA  
HOUSE

NORTH

GENTLE  
PASTURE  
SLOPE

PASTURE SLOPE

POSSIBLE  
SLIDE  
SCARP

EARTHFLOW  
DEBRIS

BENCH

BENCH

TPC

TP4

TP1

ENVELOPE

TP2

SLAB OF  
SANDSTONE  
ON  
LIFECAL

STEEP FORESTED  
SLOPE

SANDSTONE  
EXPOSED

TRAIL

WATERCOURSE

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Incorporated in NSW

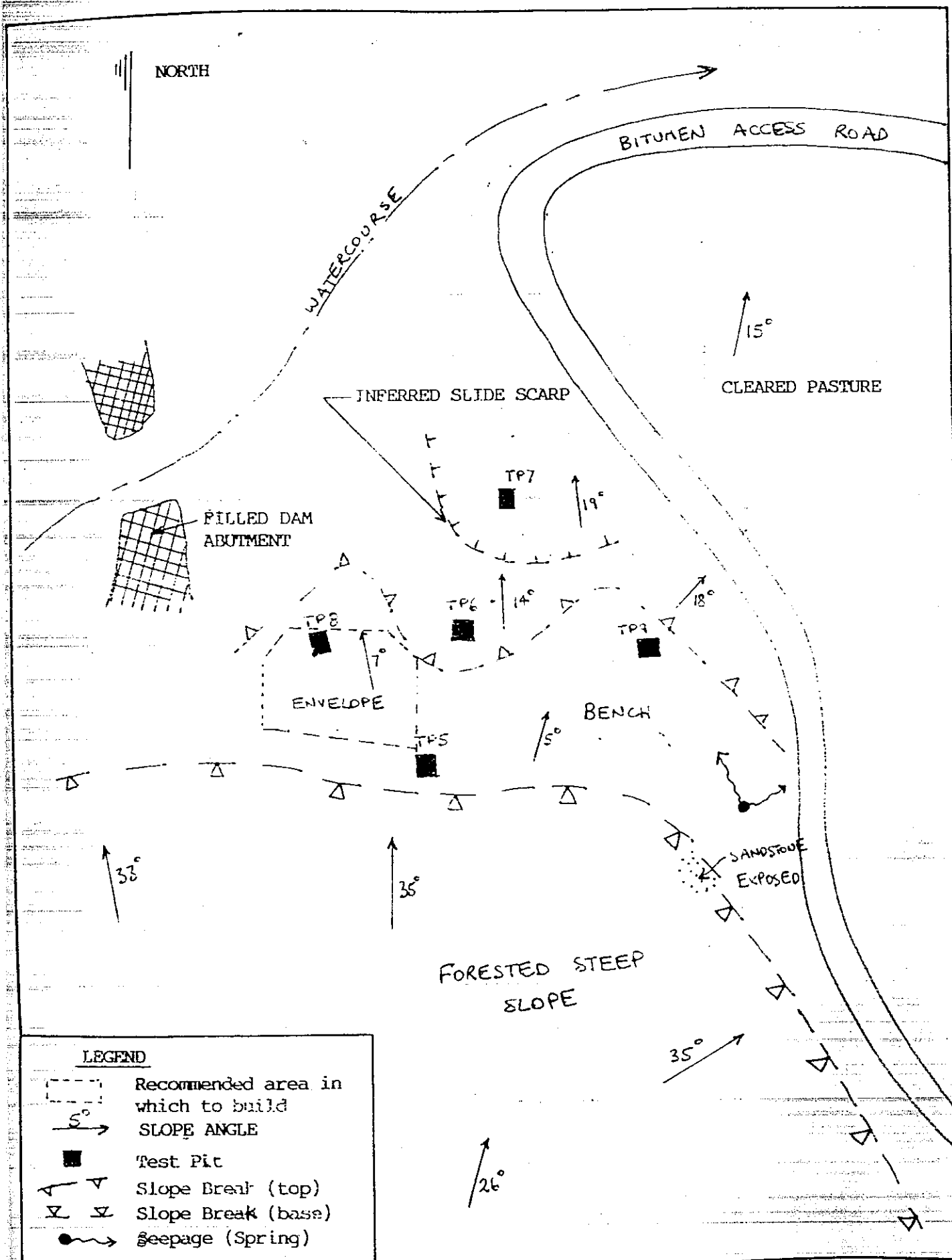
|          |               |
|----------|---------------|
| drawn    | CJP           |
| approved | <i>claker</i> |
| date     | 23.11.93      |
| scale    | 1: 1000       |

MR. JIM FERA  
SITE PLAN FOR NORTHERN BUILDING ENVELOPE



drawing no:  
SC893/1-2

job no: SC893/1



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Incorporated in NSW

|          |               |
|----------|---------------|
| drawn    | CJP           |
| approved | <i>Chaher</i> |
| date     | 23.11.93      |

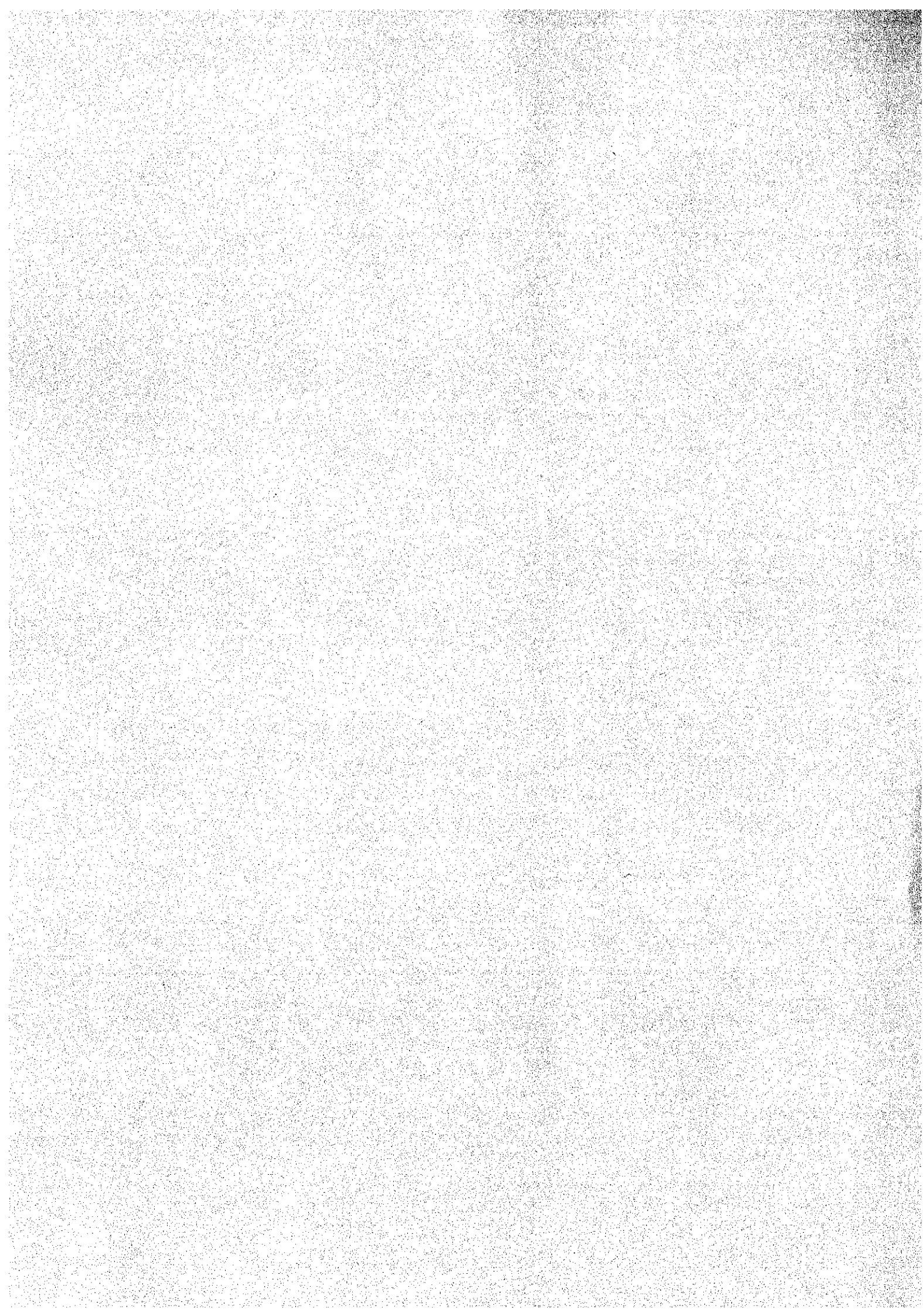
MR. JIM FERA  
SITE PLAN OF DESIGNATED SOUTHERN  
BUILDING ENVELOPE



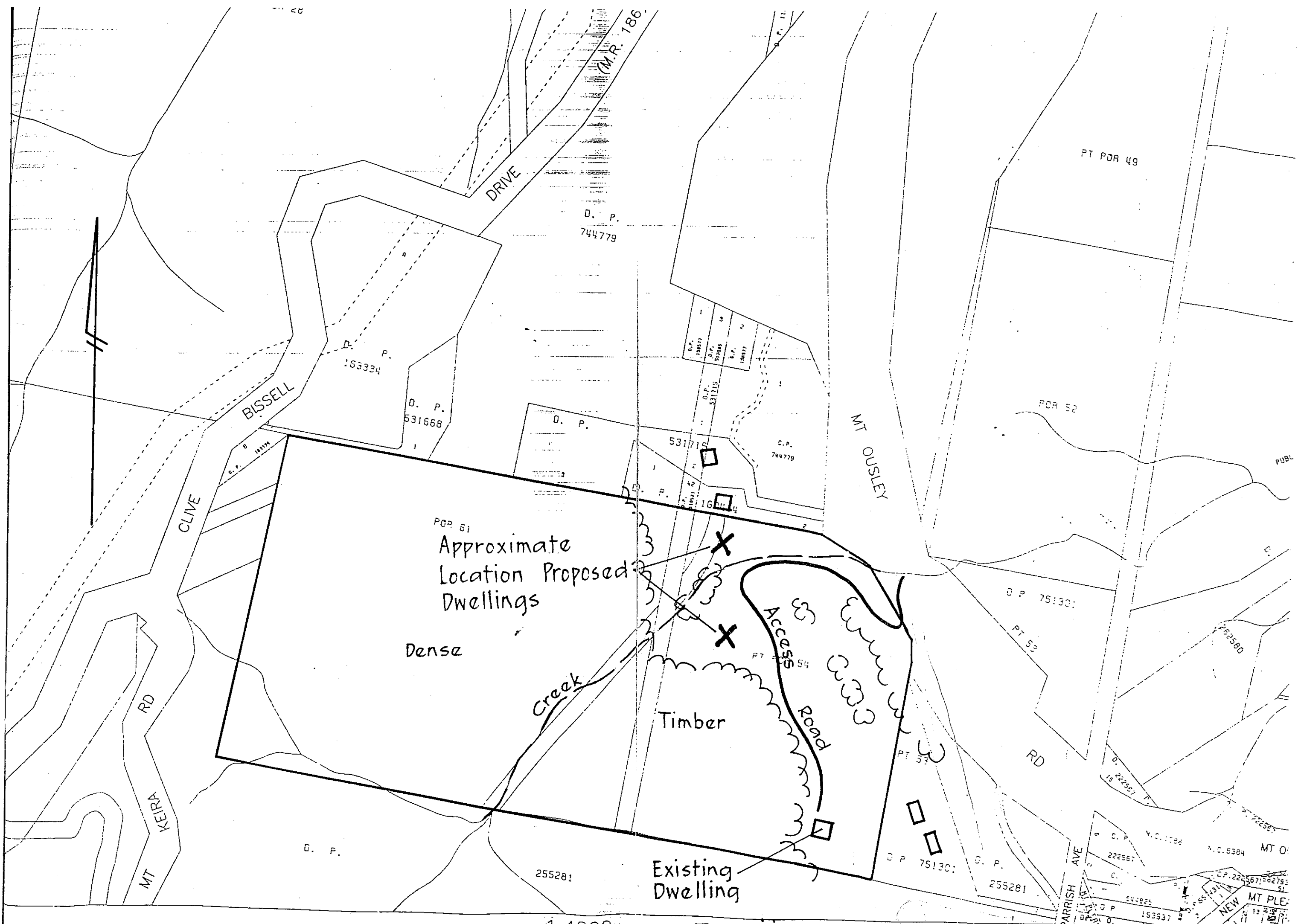
drawing no:

SC893/1-3

job no: SC893/1







1:4000

# EXISTING & PROPOSED DEVELOPMENTS