GENERAL NOTES

ALL WORK IS TO BE CARRIED OUT IN ACCORDANCE WITH THE QLD BUILDING ACT 1975-1998 & BUILDING REGULATIONS 2006 & SHALL COMPLY WITH AL LOCAL REGULATIONS & REQUIREMENTS

DO NOT SCALE

ALL LEVELS, DIMENSIONS ETC SHALL BE CHECKED AND VERIFIED BY THE BUILDER ON SITE BEFORE THE START OF CONSTRUCTION. FIGURED DIMENSIONS TO TAKE PREFERENCE OVER SCALED DRAWINGS. WHEN IN DOUBT ASK.

ALL WALL DIMENSIONS ARE TO STRUCTURAL COMPONENTS - NOT THE FACE OF LININGS / FINISHES

TOILET DOORS MUST OPEN OUTWARDS, SLIDE OR BE FITTED WITH LIFT OFF HINGES IF THE DISTANCE BETWEEN THE PAN AND NEAREST PART OF THE DOORWAY IS LESS THAN 1200mm

SITE DETAILS

SITE LEVELS AND FINISHED FLOOR LEVELS ARE TO BE VERIFIED BY THE BUILDING BEFORE STARTING ANY WORK ON SITE

SITE PLAN BOUNDARY CLEARANCES SHOWN ARE TO BE OUTSIDE OF FACES OF FASCIA OR BARGES

FOR LEVEL SITES FALL GROUND AWAY FROM BUILDINGS 50mm IN A MINIMUM DISTANCE OF 1m ON ALL SIDES

FOR SLOPED SITES DIVERT SURFACE WATER FROM UPHILL SIDE AWAY FROM BUILDINGS

DRAINAGE & STORMWATER

ALL STORMWATER DRAINAGE WORK TO BE IN ACCORDANCE WITH AS3500

DOWNPIPES ARE TO BE 100x75 OR 90mm DIA MIN UNLESS NOTED OR DETAILED ELSEWHERE

DISCHARGE RAIN WATER DOWNPIPES TO INTER-ALLOTMENT DRAINAGE SYSTEM IF AVAILABLE, KERB AND CHANNEL IF FALL PERMITS. ENSURE RAIN WATER IS DIRECTED AWAY FROM THE BUILDING.

FOR SEWERED SITES DISCHARGE WASTE WATER TO COUNCIL SEWER

THE LOCATION OF THE SEWER MAIN HAS BEEN SCALED FROM COUNCIL PLANS. WHERE THE SEWER LINE IS 2.0m OR LESS FROM THE BUILDING STRUCTURE IT IS THE RESPONSIBLY OF THE BUILDER TO PHYSICALLY LOCATE THE SEWER MAIN BEFORE STARTING ANY WORK.

FOR UNSEWERED SITES DISCHARGE WASTE TO WATER TO MINI TREATMENT SYSTEMS, SEPTIC TANK OR HOLDING TANKS AS SHOWN ON CONSULTANT PLANS

SLAB & FOOTINGS

CONCRETE WORK TO BE IN ACCORDANCE WITH AS 3600

ALL SLAB AND FOOTING DESIGN TO BE CARRIED OUT BY A LICENSED STRUCTURAL ENGINEER WHI IS A CURRENT RPEQ.

TERMITE PROTECTION

PROTECTION FROM TERMITES SHALL BE FROM A SYSTEM OR COMBINATION OF SYSTEMS IN ACCORDANCE WITH THE BCA/NCC AND AS 3660 AND INSTALLED BY AN APPROVED APPLICATOR. WRITTEN CONFIRMATION OF THE SYSTEM/S USED SHALL BE PROVIDED TO LOCAL GOV. AUTHORITY AND BUILDING SHALL ADVISE OWNER OF THEIR OBLIGATIONS AS APPLICABLE TO THE SYSTEMS USED

SHOULD THE CURRENT OWNER SELL THE PROPERTY, IT SHALL BE HIS/HER RESPONSIBILITY TO PROVIDE THE NEW OWNER WITH A COPY OF THE TERMITE PROTECTION RECORD.

TIMBER FRAMING

ALL TIMBER FRAMING TO BE IN ACCORDANCE WITH CURRENT AS 1684.3. PRE-FABRICATED TIMBER ROOF TRUSSES AND WALL FRAMING TO BE IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS AND DRAWINGS.

EXTERNAL TIMBER MEMBERS TO BE DURABLITY CLASS 1 OR 2 WITH SAPWOOD REMOVED OR PRESERVATIVE TREATED TO H3 UNLESS NOTED OTHERWISE. ALL PINE TO BE LOSP TREATED TO H3 LEVEL

WALL FRAMING, LINTELS ETC ARE TO BE IN ACCORDANCE WITH APPROVED FRAME MANUFACTURERS DETAILS AND ARE TO BE CERTIFIED FOR STRUCTURAL ADEQUACY BY THE MANUFACTURER FOR THE APPROPRIATE WIND CLASS.

ALL STRUCTURAL PLY IS TO BE IN ACCORDANCE WITH AS/NZ 2269 AND FIXED IN ACCORDANCE WITH MANUFACTURERS SPECS.

MASONRY

ALL MASONRY CONSTRUCTION IS TO BE IN ACCORDANCE WITH AS 3700

BATTENS

TIMBER ROOF BATTENS TO BE FIXED IN ACCORDANCE WITH AS 1684.2 OR AS 1684.3 (DEPENDING ON WIND SPEED) AND WPHS REQUIREMENTS

METAL ROOF BATTENS TO BE FIXED IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS AND WPHS REQUIREMENTS

ROOFING

METAL ROOFING TO BE IN ACCORDANCE WITH AS1562.1 AND FIXED TO MANUFACTURERS SPECIFICATIONS

STRUCTURAL STEEL

ALL STRUCTURAL STEEL MATERIALS, WORKMANSHIP, FABRICATION & ERECTION SHALL COMPLY WITH THE REQUIREMENTS OF AS 4100, AS 1538, AS 1554 AND ANY OTHER RELEVANT SPECIFICATION.

INSULATION

REFER TO ENERGY EFFICIENCY REPORT SUPPLIED BY OTHERS

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

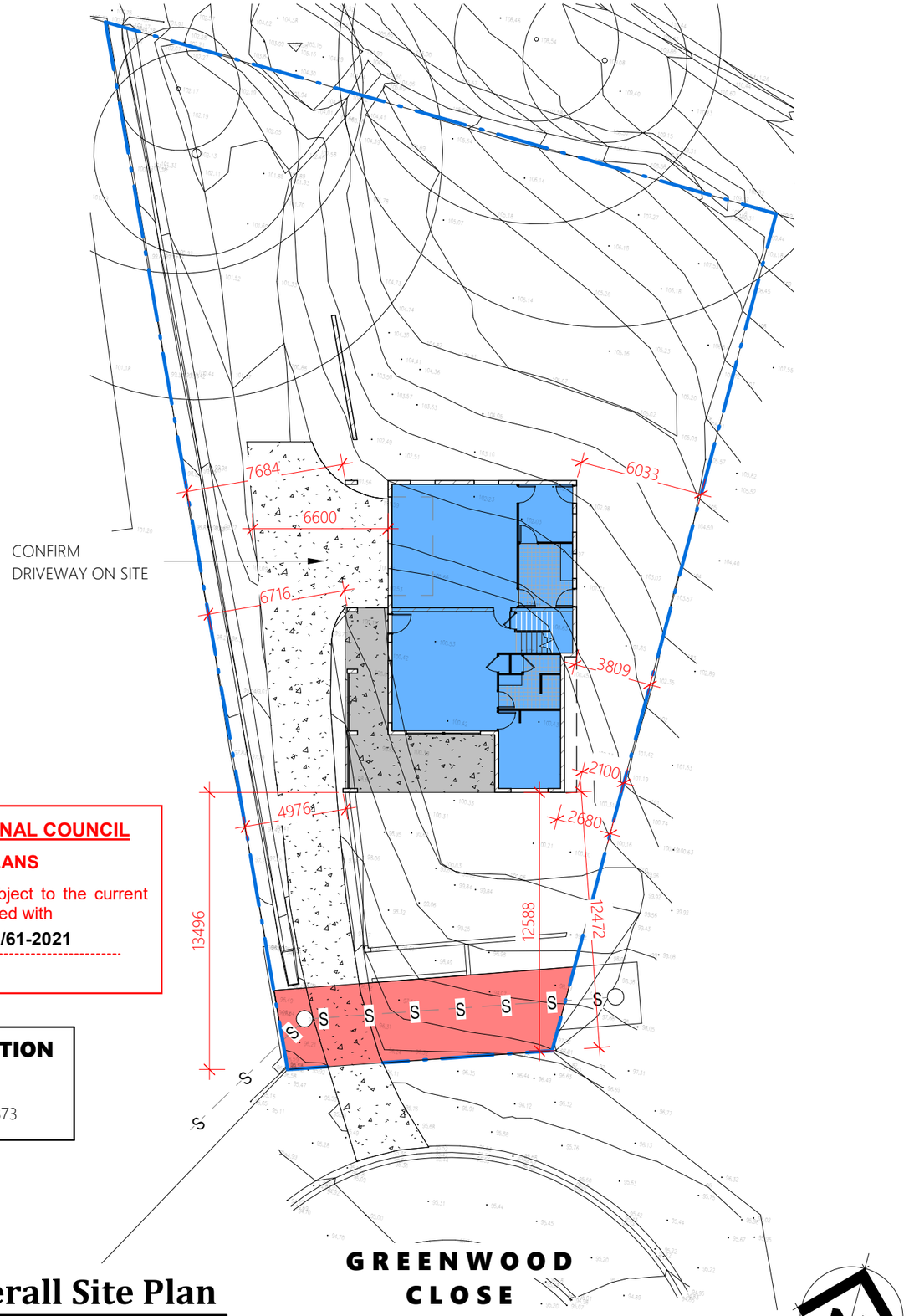
These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/61-2021

Dated: 21 December 2021

REAL PROPERTY DESCRIPTION

Lot Number:	1
Reg/Survery Plan Number:	SP 245 873



_Overall Site Plan

1 : 250

DO NOT SCALE DRAWING

ALL DIMENSION IN MILLIMETERS

REVISIONS

No:	Description:	Date:
A	FOR APPROVAL	14.01.2021
B	RETAINING WALL	29.11.2021

Builder:

BT BUILDERS QLD
DOMESTIC COMMERCIAL RENOVATIONS

ISSUED FOR

FOR APPROVAL

Project:

NEW DWELLING

Address:

17 GREENWOOD CLOSE

Drawing Title:

NOTES & SITE PLAN

dezignelements
BUILDING DESIGNERS

0407 271 336 **M**

info@dezignelements.com.au **E**

QBCC No: 1247120 BDAQ No: 0001677

Scale:	As indicated	Rev:	**B**
Date:	DEC 2020		
Drawn:	NJB		
Project No:	**20_028**	Drawing No:	**A-01**

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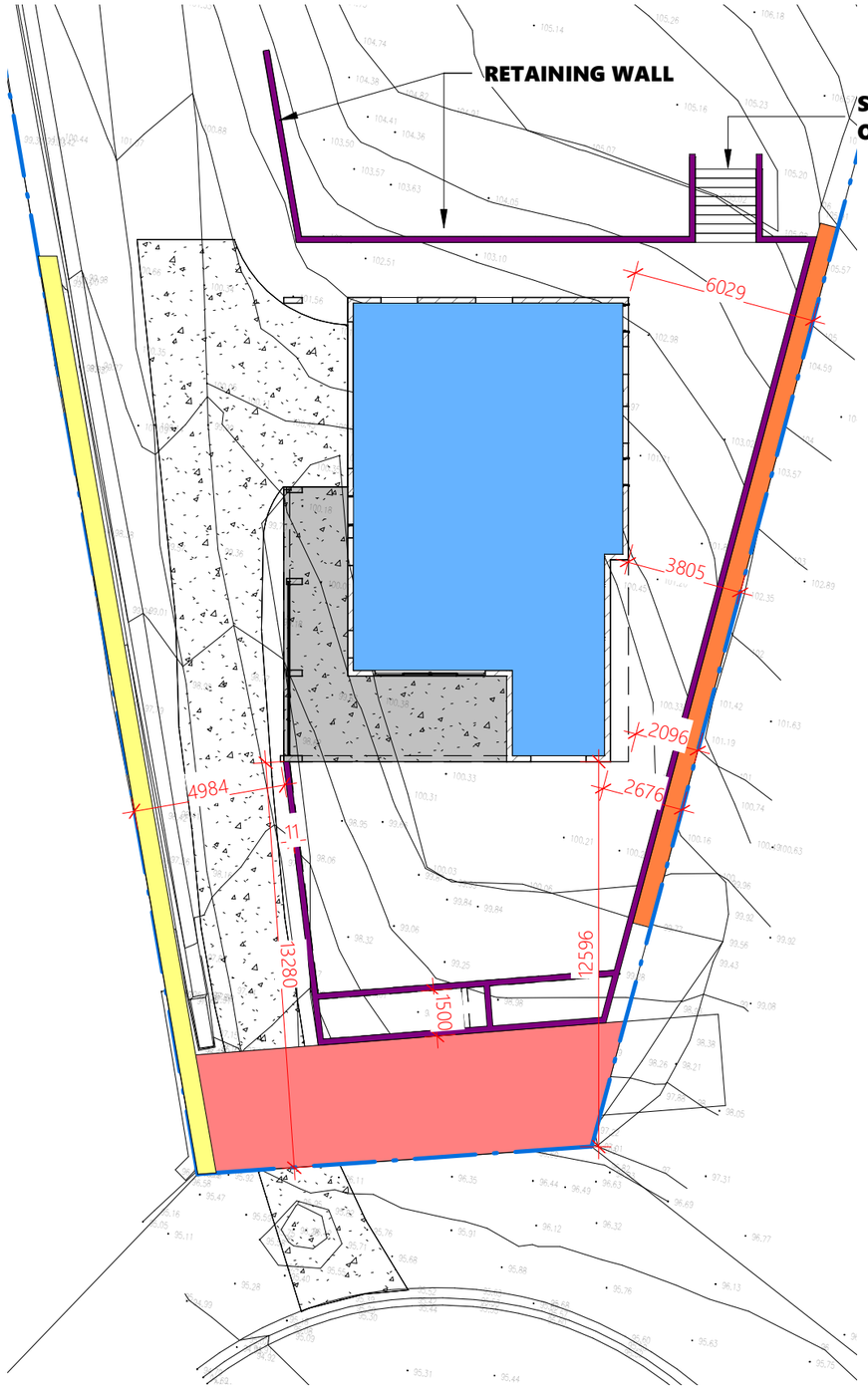

_Site Plan

1 : 200

RETAINING WALL - TYPE 1

BARLOW BLOCKS

RETAINING WALL - TYPE 2

RENDERED BLOCKS. BLOCK PIERS AND FENCE. CONFIRM ON SITE

RETAINING WALL - TYPE 3

SANDSTONE

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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Dated: 21 December 2021

DO NOT SCALE DRAWING

ALL DIMENSION IN MILLIMETERS

REVISIONS

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NEW DWELLING

Address:

17 GREENWOOD CLOSE

Drawing Title:

PART SITE PLAN

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Project No:	**20_028**	Drawing No:	**A-02**

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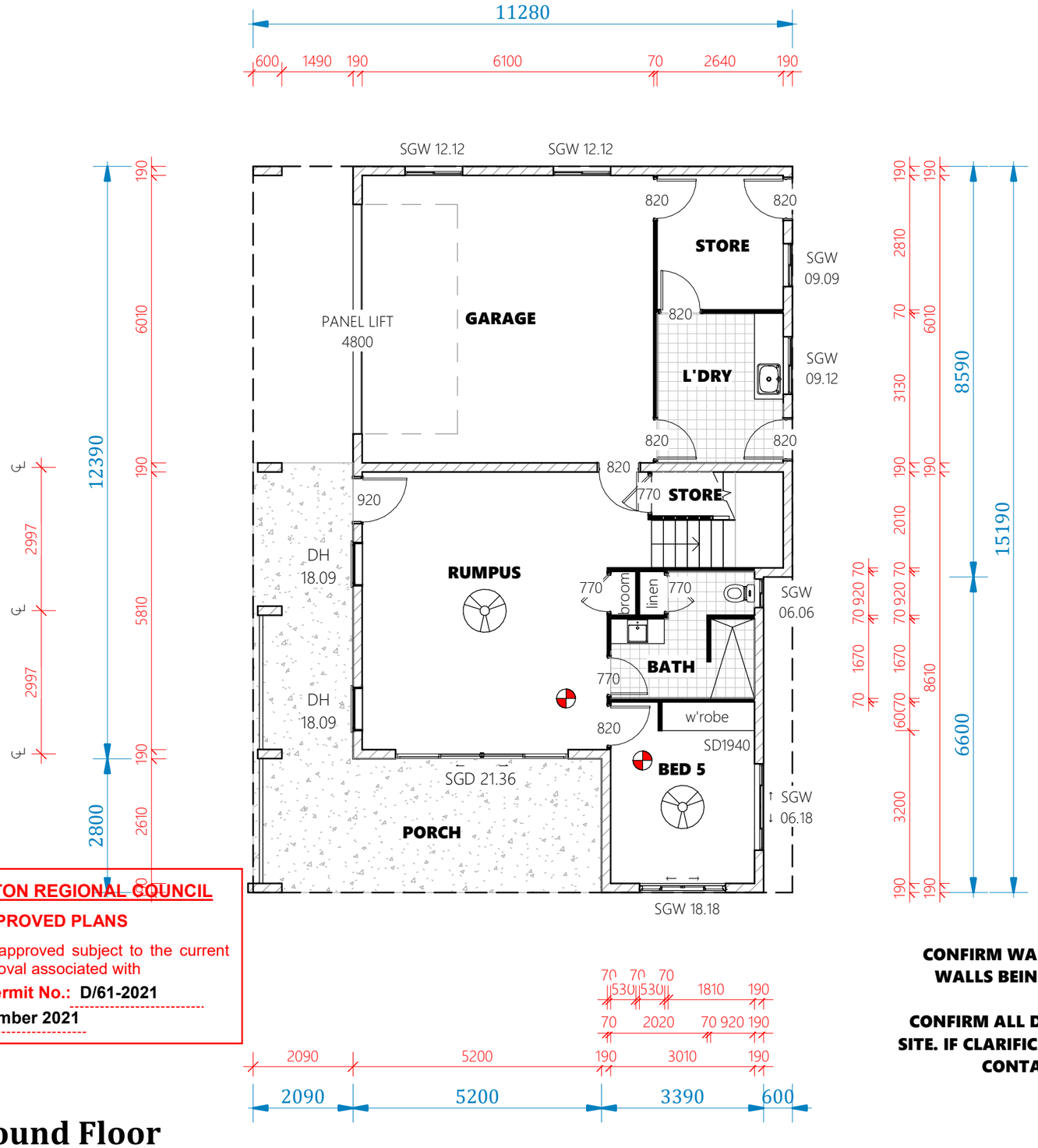
FLOOR AREA'S

GROUND:	121.07 m²
PORCH:	33.34 m²
UPPER:	144.68 m²
DECK:	21.14 m²
TOTAL:	**320.23 m²**



FLOOR PLAN LEGEND

- HARD WIRED SELF CONTAINED SMOKE ALARM.
- 1200 ø CEILING FAN WITH SPEED CONTROLLER.
- DP ○ 90mm ø PVC DOWN PIPE
- + HC HOSE COCK - T.B.C.

WINDOW / DOOR LEGEND

12.18	1200high x 1800 wide
XO	SLIDING / FIXED
SGW	SLIDING GLASS WINDOW
SGD	SLIDING GLASS DOOR
DH	DOUBLE HUNG
CMT	CASEMENT
CS	CAVITY SLIDER

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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Dated: 21 December 2021

CONFIRM WALL SETOUTS WITH BLOCK WALLS BEING BATTENED / SHEETED

CONFIRM ALL DIMENSIONS / HEIGHTS ON SITE. IF CLARIFICATION IS REQUIRED, PLEASE CONTACT THE DESIGNER

C B D A

ELEVATIONS

_Proposed Ground Floor

1 : 100

DO NOT SCALE DRAWING

ALL DIMENSION IN MILLIMETERS

REVISIONS

No:	Description:	Date:
A	FOR APPROVAL	14.01.2021
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Project:

NEW DWELLING

Address:

17 GREENWOOD CLOSE

Drawing Title:

GROUND FLOOR PLAN

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Drawn:	NJB		
Project No:	20_028	Drawing No:	A-03

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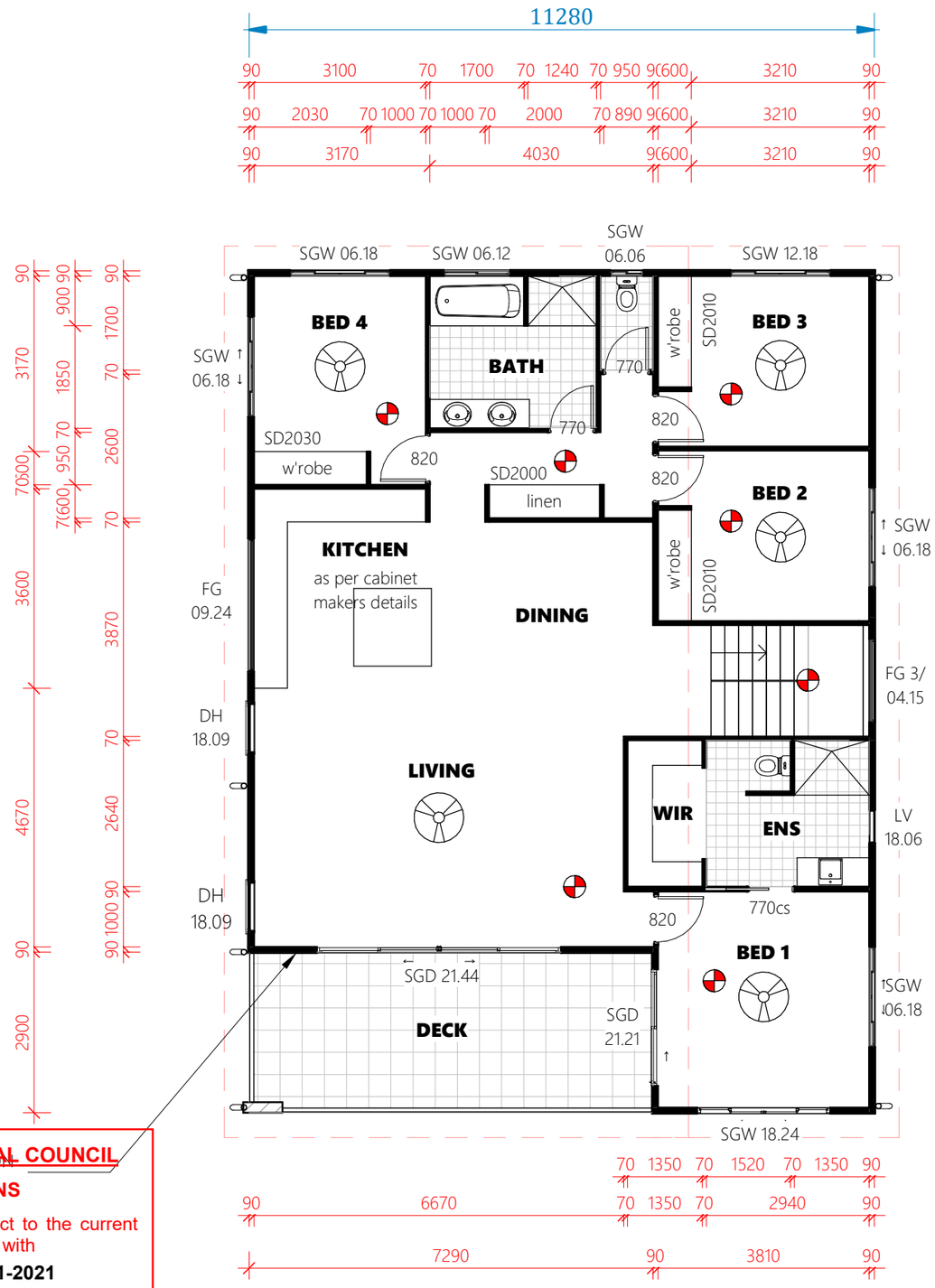
FLOOR AREA'S

GROUND:	121.07 m²
PORCH:	33.34 m²
UPPER:	144.68 m²
DECK:	21.14 m²
TOTAL:	**320.23 m²**



FLOOR PLAN LEGEND

- HARD WIRED SELF CONTAINED SMOKE ALARM.
- 1200 ø CEILING FAN WITH SPEED CONTROLLER.
- DP ○ 90mm ø PVC DOWN PIPE
- ┼ HC HOSE COCK - T.B.C.

WINDOW / DOOR LEGEND

12.18	1200high x 1800 wide
XO	SLIDING / FIXED
SGW	SLIDING GLASS WINDOW
SGD	SLIDING GLASS DOOR
DH	DOUBLE HUNG
CMT	CASEMENT
CS	CAVITY SLIDER

ROCKHAMPTON REGIONAL COUNCIL
~~CONTAINMENT CLASSIFICATION~~
TO DETERMINE STEP AT DOOR
APPROVED PLANS

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Development Permit No.: D/61-2021

Dated: 21 December 2021

CONFIRM WALL SETOUTS WITH BLOCK WALLS BEING BATTENED / SHEETED

CONFIRM ALL DIMENSIONS / HEIGHTS ON SITE. IF CLARIFICATION IS REQUIRED, PLEASE CONTACT THE DESIGNER

C
B D
A
ELEVATIONS

_Proposed Upper Floor

1 : 100

DO NOT SCALE DRAWING
ALL DIMENSION IN MILLIMETERS

REVISIONS

No:	Description:	Date:
A	FOR APPROVAL	14.01.2021
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FOR APPROVAL

Project:
NEW DWELLING

Address:
17 GREENWOOD CLOSE

Drawing Title:
UPPER FLOOR PLAN

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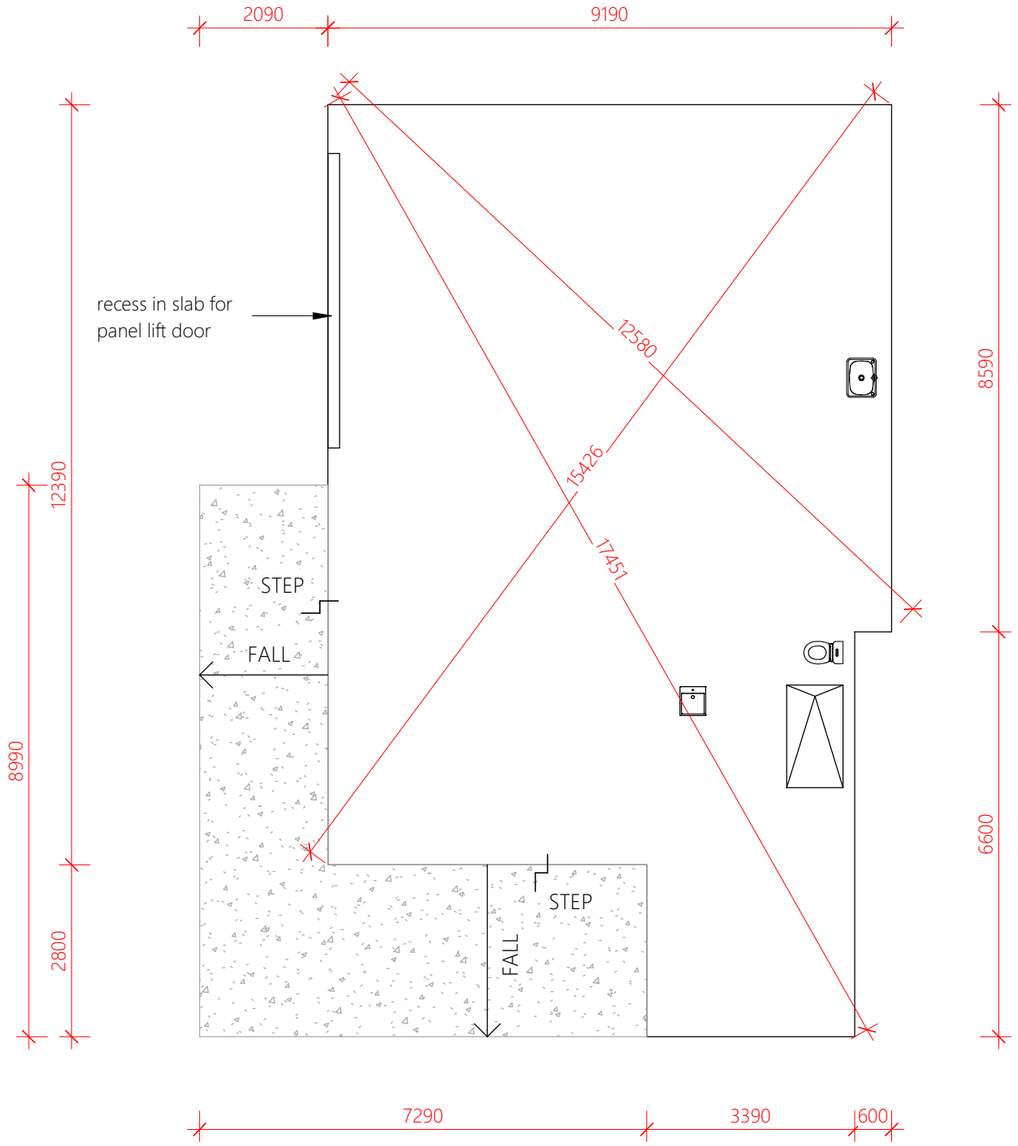

PLUMBING LEGEND

BSN	BASIN
BTH	BATH
DN	DOWN
DW	DISHWASHER
FW	FLOOR WASTE
FWG	FLOOR WASTE GULLY
HWU	HOT WATER UNIT
IC	INSPECTION CHAMBER
IO	INSPECTION OPENING
LT	LAUNDRY TUB
MH	MAN HOLE
ORG	OVER FLOW RELIEF GULLY
SHR	SHOWER
SK	SINK
VP	VENT PIPE
WC	WATER CLOSET
WM	WASHING MACHINE

DO NOT SCALE DRAWING

ALL DIMENSION IN MILLIMETERS

REVISIONS

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Project:
NEW DWELLING

Address:
17 GREENWOOD CLOSE

Drawing Title:
SLAB PLAN

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Project No:	20_028	Drawing No:	A-05

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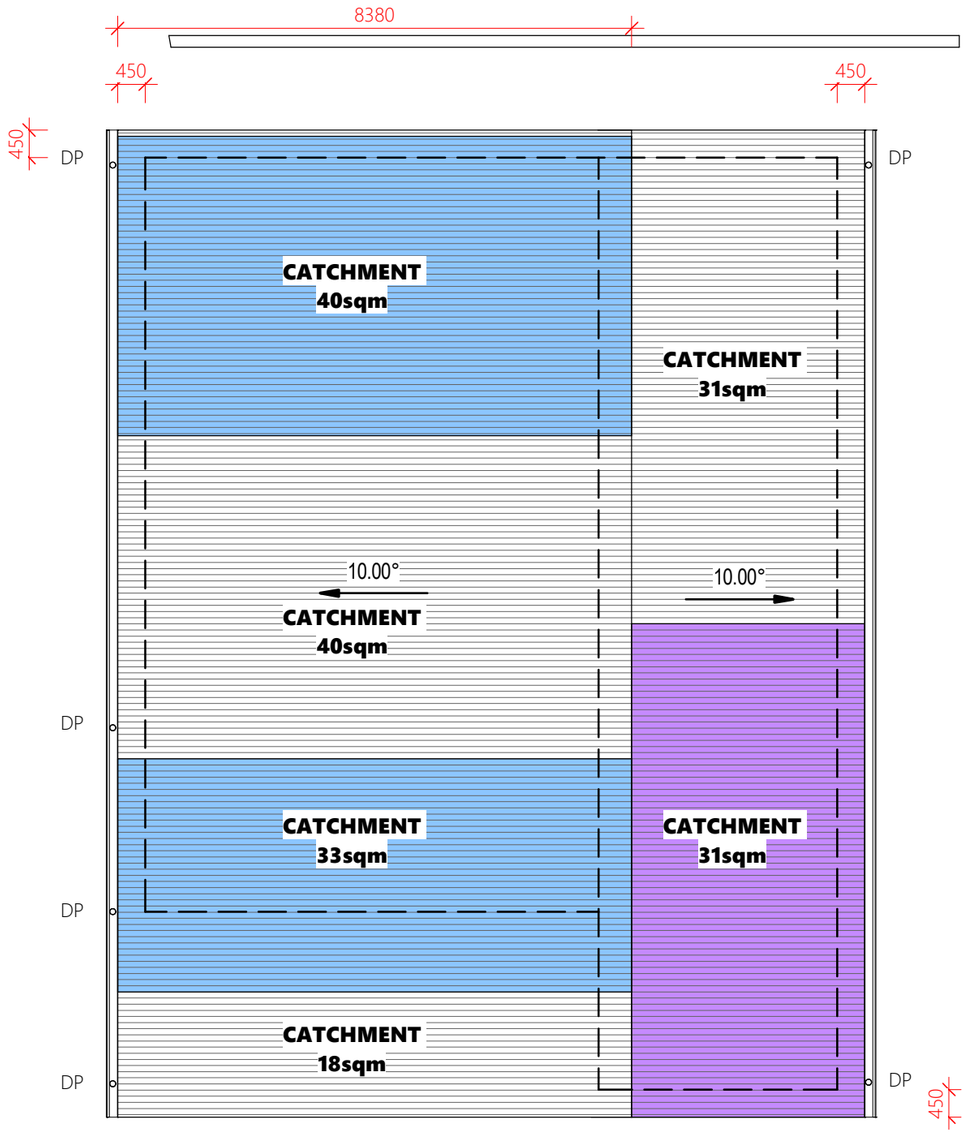
_Slab Plan

1 : 100



_Roof plan

1 : 100

ROCKHAMPTON REGIONAL COUNCIL

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Dated: 21 December 2021

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ALL DIMENSION IN MILLIMETERS

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Drawing Title:

ROOF PLAN

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20_028	**A-06**	

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Table 3.5.2.1 - RAINFALL DURATION INTENSITIES

Locality	5 minute duration rainfall intensity (mm/h) average recuurence interval, once in-	
	20 years	100 years
QLD Rockhampton	229	300

Table 3.5.2.2 - GUTTER AND DOWNPIPE SELECTION

Table a. Gutter sizes for various rainfall intensities and roof catchment area's per downpipe

Design Rainfall Intensity (mm/h) (as per Table 3.5.2.1)	Roof Catchment Area per Downpipe - m^2				
	30	40	50	60	70
	Size of gutter required to drain roof catchment area into one (1) downpipe (A, B, C, D, E and F defined in table b)				
255	A or C	A or D	B or E	E	F
275	A or C	A or D	B or E	F	F
325	A or C	B or E	F	F	F

Table b. Gutter size for various rainfall intensities

Gutter Type (As per Table a.)	Gutter Description	Minimum Cross Sectional Area mm^2
A	Medium rectangular gutter	6500
B	Large rectangular gutter	7900
C	115 mm D gutter	5200
D	125 mm D gutter	6300
E	150 mm D gutter	9000
F	Gutter must be designed in accordance with AS/NZS 3500.3 or Section 5 of AS/NZS 3500.5	

Table c. Downpipe selection

Downpipe Section	Gutter Sections - (as per table b)				
	A	B	C	D	E
75mm dia	Yes	Yes	Yes	Yes	No
100mm x 50mm	Yes	Yes	Yes	Yes	Yes
90mm dia	Yes	Yes	Yes	Yes	Yes
100mm x 75 mm	Yes	Yes	Yes	Yes	Yes
Legend:	Yes - downpipe is suitable for the eaves gutter selection; and No - downpipe is not suitable for the eaves gutter selection.				

Table 3.5.2.3 - OVERFLOW VOLUME

Table a. Overflow volume for continuous measure (L/s/m)

Design 5 mintue duration rainfall intensity (mm/h) from Table 3.5.2.1)	Ridge to Gutter Lenght (m)							
	2	4	6	8	10	12	14	16
275	0.15	0.31	0.46	0.61	0.76	0.92	1.1	1.2
300	0.17	0.33	0.50	0.67	0.83	1.0	1.2	1.3
325	0.18	0.36	0.54	0.72	0.90	1.1	1.3	1.4

Table b. Overflow volume for dedicated measure (L/s)

Design 5 mintue duration rainfall intensity (mm/h) from Table 3.5.2.1)	Roof Catchment Area (m^2)				
	30	40	50	60	70
275	2.3	3.1	3.8	4.6	5.3
300	2.5	3.3	4.2	5.0	5.8
325	2.7	3.6	4.5	5.4	6.3

Table 3.5.2.4 - ACCEPTABLE OVERFLOW MEASURES

A FRONT FACED SLOTTED GUTTER IS THE SELECTED OVERFLOW MEASURE AS IT PROVIDES 0.5 L/s/m.

0.67 L/s/m x 8.0m) WILL REMOVE UP TO 5.5 L/s) = 5.36L/s

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DO NOT SCALE DRAWING

ALL DIMENSION IN MILLIMETERS

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17 GREENWOOD CLOSE

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ROOF DETAILS

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Project No:	Drawing No:		
20_028	**A-07**		

_Elevation A

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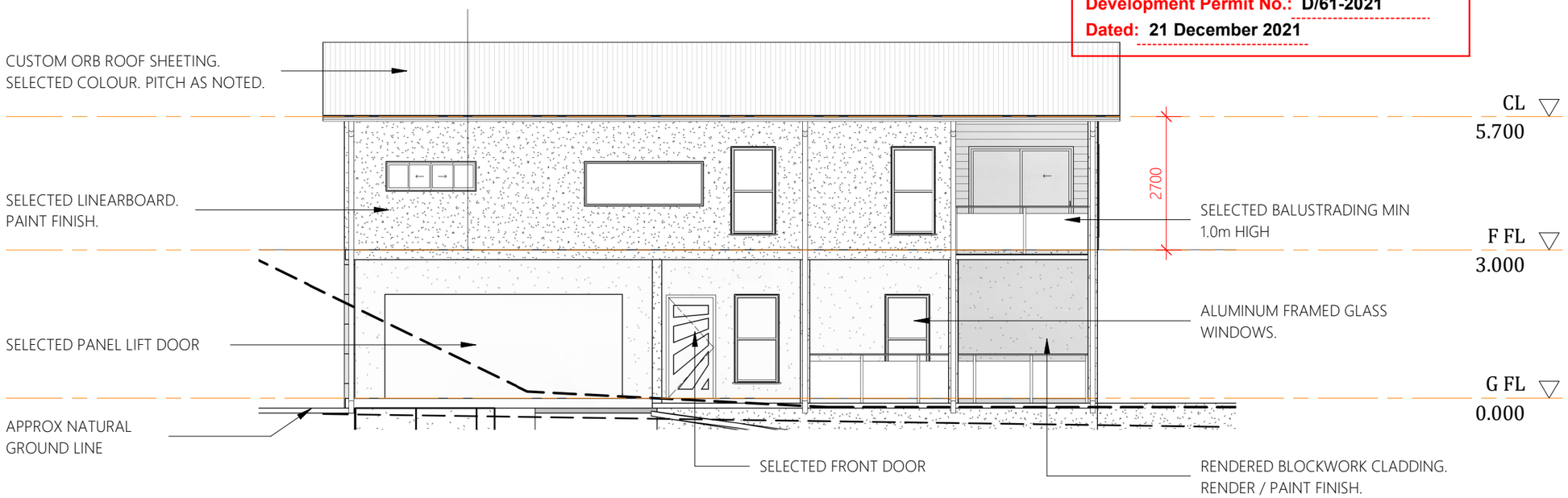

_Elevation B

1 : 100

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Drawing Title:

ELEVATIONS

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Project No:	Drawing No:
20_028	A-08

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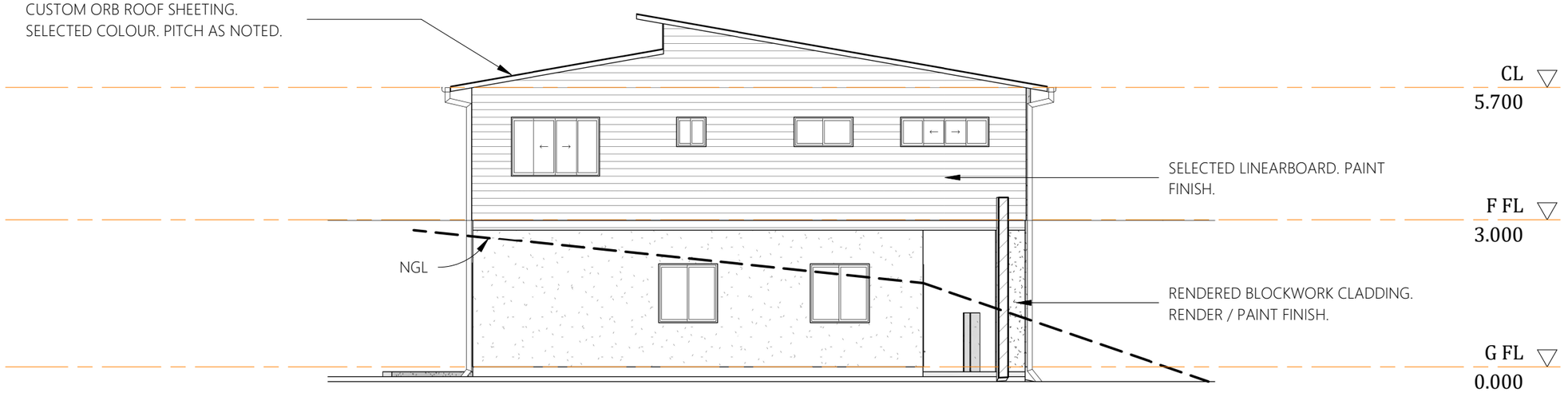

_Elevation C

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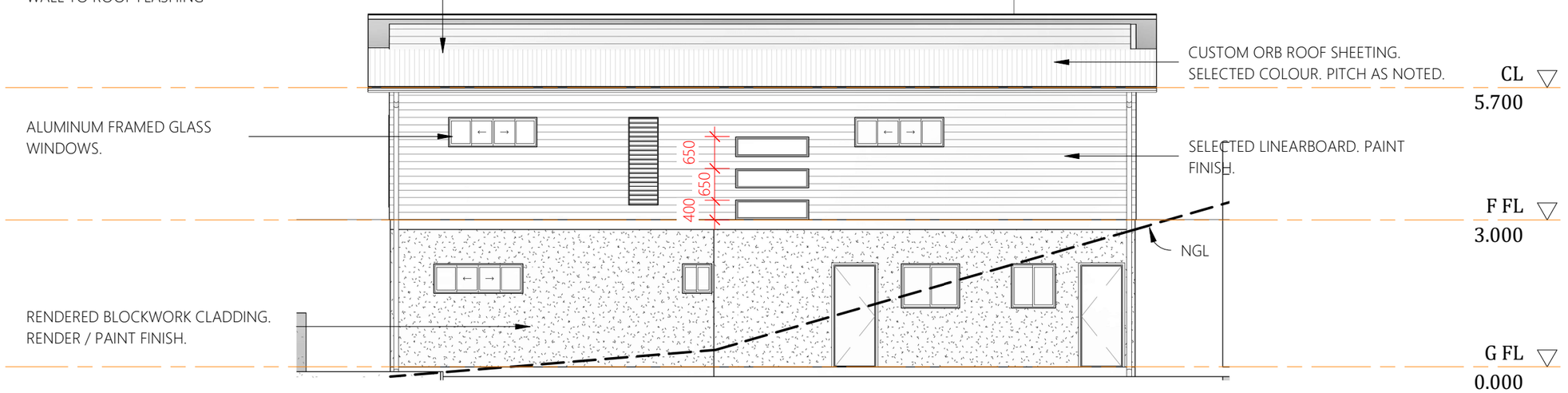

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1 : 100

DO NOT SCALE DRAWING

ALL DIMENSION IN MILLIMETERS

REVISIONS

No:	Description:	Date:
A	FOR APPROVAL	14.01.2021
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ELEVATIONS

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Scale:	1 : 100	Rev:
Date:	DEC 2020	**B**
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Project No:	Drawing No:
20_028	**A-09**

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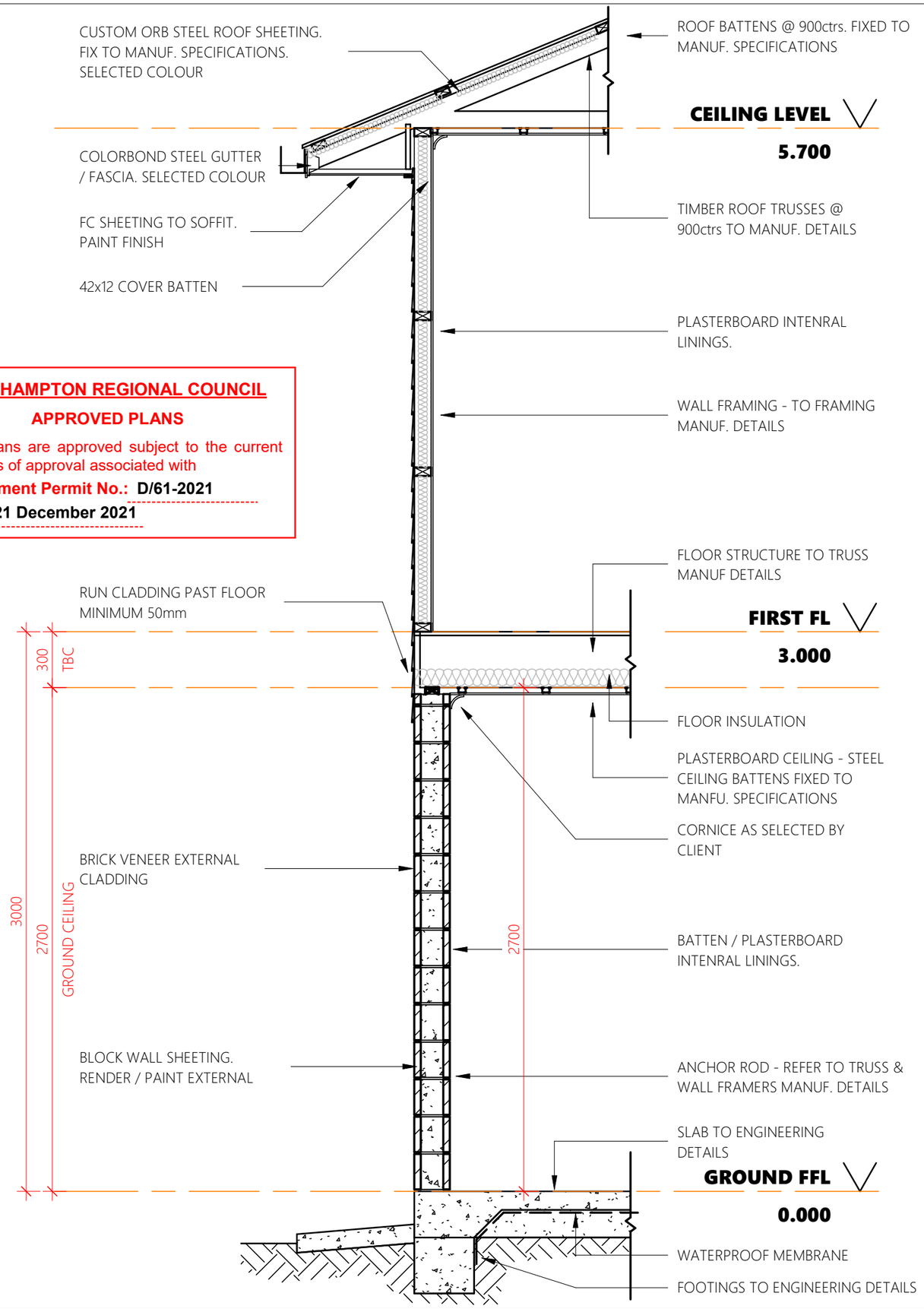

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APPROVED PLANS

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Development Permit No.: D/61-2021

Dated: 21 December 2021

Section Detail

1 : 25

DO NOT SCALE DRAWING

ALL DIMENSION IN MILLIMETERS

REVISIONS

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Address:

17 GREENWOOD CLOSE

Drawing Title:

SECTION DETAIL

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ALL DIMENSION IN MILLIMETERS

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17 GREENWOOD CLOSE

Drawing Title:

3D VIEWS

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J Rayner and A Russell Information Request Response Rehabilitation Plan

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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STEER
ENVIRONMENTAL CONSULTING

J Rayner and A Russell C/- Dileigh Consulting Engineers – Rehabilitation Plan - Information Request Response – Development Application D/124-2016 for operational works for stormwater, drainage works, earth works and access works – situated at 17 Greenwood Close, Frenchville QLD 4701 – Described as lot 1 on SP245873, Parish of Archer.

Applicant Name:	J Rayner and A Russell C/- Dileigh Consulting Engineers
DA #:	D/124-2016
Project #:	N/A
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Project: Development Application D/124-2016 for operational works for stormwater, drainage works, earth works and access works – situated at 17 Greenwood Close, Frenchville QLD 4701 – Described as lot 1 on SP245873, Parish of Archer.

Client: J Rayner and A Russell C/- Dileigh Consulting Engineers.

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Signed				

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1 Abbreviations

- DA - Development Application
- IR - Information Request
- RRC - Rockhampton Regional Council
- STEER EC - STEER Environmental Consulting

2 Introduction

2.1 Background

J Rayner and A Russell C/- Dileigh Consulting Engineers have submitted to Rockhampton Regional Council (RRC), Development Application (DA) D/124-2016 for operational works for stormwater, drainage works, earth works and access works – situated at 17 Greenwood Close, Frenchville QLD 4701 – Described as lot 1 on SP245873, Parish of Archer. J Rayner and A Russell have previously proceeded with initial development works on the land in question, in preparation for construction of a dwelling on the land.

RRC officers have undertaken a detailed assessment of the application, and on 22 August 2016 have provided J Rayner and A Russell with a written request for further information (IR).

This rehabilitation plan has been generated for the purpose of responding to and addressing the requirements for item 5.0 of the IR.

2.2 Information Request

Item 5.0 of the IR states (extracted directly from original RRC IR):

> Council officers have undertaken a detailed assessment of the development application and require you to provide further information to address the following issues:
>
> 5.0 Unauthorised earthworks has occurred on the adjoining Rockhampton Regional Council land (lot 1 RP618495), an environmental protection area, to the north of the site. Provide a rehabilitation plan for this area with reference to Planning Scheme policy SC6.9.6 – Rehabilitation Plans.

3 SC6.9.6 – Rehabilitation Plans

This rehabilitation plan has been developed in accordance with Rockhampton regional Council SC6.9.6 – Rehabilitation Plans.

SC6.9.6 – Rehabilitation Plans requires the following:

A rehabilitation plan must be prepared where rehabilitation of a site/s is undertaken. A rehabilitation plan must address the following:

1. Methodology — describe the process used to develop the plan. Include all field surveys, mapping data and literature used. Provide background information and describe the complexity of the project.
2. Environmental values — describe the key environmental values within and adjoining the rehabilitation area. Environmental values may include but not be limited to fauna or flora, vegetation communities, cultural heritage, geological, habitat, environmental corridors or biophysical values.
3. Ecosystem threats — describe the current and future threats to ecosystem and environmental values. Threats may include but not be limited to weed infestation, illegal access, erosion, grazing, inappropriate fire or hydrological regimes, inappropriate access, sedimentation or salinity.
4. Ecosystem condition — identify the condition of ecosystems within the rehabilitation area. The condition assessment will be used to determine management objectives and activities. The current condition should be accompanied by a series of photographs taken from established reference points.
5. Rehabilitation targets — determine appropriate and realistic rehabilitation targets based on assessment of ecosystem threats and condition.
6. Overall rehabilitation goals — provide an overarching statement of the desired outcome(s) for the rehabilitation plan.
7. Rehabilitation objectives — develop objectives to meet rehabilitation goals. The objectives will form the basis of the rehabilitation plan. Objectives can be used to set milestones and determine rehabilitation progression.
8. Rehabilitation activities — identify and describe all activities that are required to meet the objectives. It must be clear what activities will be undertaken during the project and how they will be implemented.
9. Performance criteria — performance criteria must be measurable, specific and relate directly to rehabilitation goals, objectives and activities. The performance criteria may include but not be limited to floristic and structural vegetation parameters, weed abundance, erosion, natural revegetation, recruitment, vegetation condition and fauna populations.
10. Management zones — for clarity it is important to identify management zones based on rehabilitation activities. Define which parts of the rehabilitation area will be retained, regenerated and revegetated. The management zones must be provided in a geographical information system spatial layer or a clearly annotated site map/aerial photograph.
11. Implementation schedule — determine an appropriate implementation schedule stating what activities will be undertaken during development and what activities need to be continued once transferred to Council. To improve the handover process to Council it is necessary to identify at what stage Council will need to continue with rehabilitation activities.
12. Monitoring and reporting — provide a monitoring and reporting schedule that will be implemented over the duration of the project. Work records of all activities including photos of the works must be submitted to Council quarterly for the duration of the project (includes the maintenance period).

4 Methodology

The methodology of the rehabilitation plan follows the steps identified below:

- Identification of rehabilitation site location and surrounding environment.
- Assessment of impact of unapproved earthworks.
- Identification of appropriate rehabilitation targets/goals/objectives to remedy impacts of unapproved earthworks.
- Development and implementation of rehabilitation activities. Surface treatment of rehabilitation area and replanting activities.
- Measurement and monitoring of performance criteria.
- Maintenance of rehabilitation area through to handover.
- Reporting of rehabilitation outcomes.

4.1 Site Location and Biodiversity Mapping

The location of the unauthorised earthworks is on the adjoining Rockhampton Regional Council land (Lot 1 RP618495) to Lot 1 SP245873 (owned by J Rayner and A Russell). The location of the unauthorised earthworks are represented in Figure 1.

Figure 1. Location of unauthorised earthworks on Lot 1 RP618495, adjacent to Lot 1 SP245873.

RRC states that the site of the unauthorised earthworks has been mapped as having matters of high and general local environmental significance. Following investigation and assessment of the subject site, STEER Environmental Consulting (STEER EC) is in agreement that the site is covered by an area mapped as having matters of high and local environmental significance. The location of the site in relation to biodiversity areas overlay map OM-3A is shown in Figures 1 and 2.

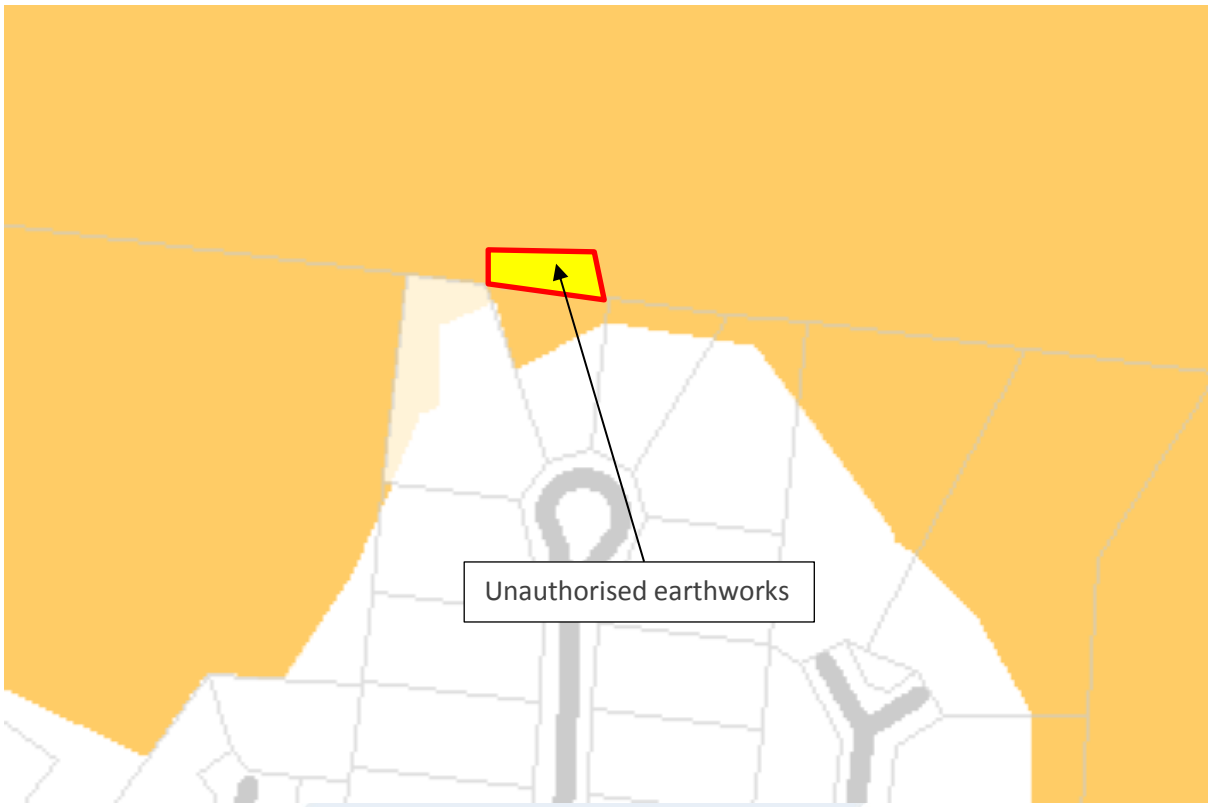


Figure 2. Location of unauthorised earthworks on Lot 1 RP618495, adjacent to Lot 1 SP245873. Large orange overlay indicates area mapped as having matters of state or local (high) environmental significance on biodiversity areas overlay map OM-3A.

5 Environmental Values

The key issue in this instance is presence of the area mapped as having matters of state or local (high) environmental significance. The rehabilitation area sits on the fringe of the area mapped as having matters of state or local (high) environmental significance, and as such serves an important role in providing a buffer between this are and other land uses. The key environmental values that are required to be protected are those values relating to:

- Existing remnant vegetation communities.
- Remnant ecosystems.
- Fauna and flora habitat.

The rehabilitation area should be managed to ensure these environmental values are protected and enhanced.

6 Ecosystem Threats

The primary current and future threats to the receiving environment adjacent to the rehabilitation area relate to:

- Degradation of ecosystem quality.
- Removal of naturally occurring native vegetation species.
- Invasion of non-native pest/weed species.

7 Ecosystem Condition - Level of Impact

The unauthorised earthworks have impacted upon an area of approximately 25m x 10m (250m^2), and the unauthorised earthworks are basically an unauthorised open stormwater diversion drain that is approximately 20m long (see Figure 3). It appears that the intent of the open drain structure was to divert overland stormwater flowing from the gradient above Lot 1 SP245873, into a nearby stormwater gully. The open stormwater diversion drain is basically constructed as a simple "V" cut across the gradient of the existing slope, and it is approximately 1-2m wide. There is no evidence of the drain being stabilised in any manner.

In addition to the actual drain, there has been associated impact on either side of the drain, with disturbance occurring out to approximately 1m from the drain

Disturbance to vegetation is difficult to accurately assess, as the area is on the fringe of the area having matters of high and local environmental significance. Naturally occurring remnant native vegetation has generally been thinned in this area, and invasive pest species such as *Lantana camarus* are also in abundance. It is likely that both native and pest species have been disturbed by the unapproved earthworks.

An investigation and vegetation survey of the immediate area around the unapproved earthworks identified that the drain has been placed in such a manner that some native species such as *Macrozamia miquelii (see Figure 3)* have been left undamaged immediately adjacent to the unapproved earthworks. Although it appears that vegetation may have been protected on purpose during the construction of the unapproved earthworks, this cannot be verified.

The impacts upon the receiving environment that will need to be managed by rehabilitation are as follows:

- Construction of an unstabilised drain of approximately 20m length.
- Removal of at least one mature naturally occurring native tree (appears that a maximum of 2 trees may have been removed).
- Removal of approximately 1-2 *Macrozamia miquelii shrubs.*
- Likely removal of 2-3 *Acacia* species.

Figure 3. Unauthorised earthworks on Lot 1 RP4444. Open drain structure. Note Macrozamia miquelii left undamaged at left of drain, and Lantana camara at bottom right of image.

8 Rehabilitation Goals and Objectives

Following assessment of the surrounding receiving environment and the level of impact within the rehabilitation, the following rehabilitation goals have been identified.

The rehabilitation plan should achieve the following goals, so that the rehabilitated area will be:

- Safe to humans and wildlife
- Non-polluting
- Stable
- Able to sustain and support the existing ecosystems identified in the area mapped as having matters of state or local (high) environmental significance.

Objectives for the rehabilitation plan are detailed:

- Ensure the rehabilitation area achieves a safe, stable landform/grade.
- Manage and mitigate sediment discharge from the rehabilitation area through surface treatment, vegetation planting, sediment controls/barriers.

- Successfully introduce native vegetation into the rehabilitation area that will protect and preserve the adjoining ecosystem.

9 Rehabilitation Activities

Rehabilitation activities for the proposed rehabilitation area are detailed in Table 1.

Table 1. Rehabilitation activities.

Rehabilitation Activity	Detail
Stabilisation of unauthorised drain.	The unauthorised drain should be either stabilised through "rock armouring" or similar treatment, or removed. This process must be conducted to appropriate engineering standards and the satisfaction of RRC. Care should be taken during this process to not cause further damage to remaining vegetation.
Installation of sediment control measures.	Sediment management/mitigation structures such as rubble traps and geotextile sediment barriers should be installed to capture liberated sediment from the rehabilitation area.
Pest/weed removal	Prior to introduction of the new rehabilitation vegetation, pest/weed removal and/or treatment should be undertaken. This should primarily focus on removal of *Lantana camara*.
Planting of tubestock seedlings.	3 x *Eucalyptus crebra* and 3 x *Acacia* species (seeded from nearby naturally occurring *Acacia*) and 3 x *Macrozamia miquelii (if reasonably available) should be replanted in the rehabilitation area in random placements, reasonably spaced from each other..*
Application of mulch.	Clean, weed free mulch sourced from native vegetation should be applied around each of the replanted plants. Exposed areas of earth in the rehabilitation should be treated with mulch.
Spreading of fallen timber.	The rehabilitation area contains a small pile of dead timber that may be from the removal of vegetation from the area (see Figure 4). This timber should be carefully spread randomly across the rehabilitation area. Care needs to be taken not to damage newly introduced plants or existing remaining vegetation during this process.
Ongoing management	Irrigation and pest/weed management should be undertaken on an ongoing basis until rehabilitation success criteria have been met.
Handover of rehabilitation area	Handover of rehabilitation area to RRC after 12 months, or upon achievement of success criteria.

Figure 4. Fallen timber pile in/adjoining rehabilitation area.

10 Performance Criteria

As this rehabilitation project is relatively small, performance criteria can be quite strict. Whereas a large scale rehabilitation project may have targets of approximately 80% survival rate for plantings, in this type small-scale project much tighter expectations can required, such as 100% survival rate. With this in mind, the following performance criteria have been placed on this rehabilitation area:

- 100% survival rate of plantings after 12 months.
- No evidence of erosion or sediment discharge from the rehabilitation area after 12 months.
- No evidence of *Lantana camara* in the rehabilitation area after 12 months.

11 Management Zones

Due to the very small physical area of this rehabilitation plan, no management zones are proposed.

12 Implementation Schedule

It is envisaged that the rehabilitation plan will be implemented within two weeks of acceptance by RRC. If success criteria are met, the rehabilitation plan will have a life of 12 months, at which time the rehabilitation area will be handed over to RRC. It is expected that ongoing management of the area at this time will only involve monitoring for erosion following significant storm events.

13 Monitoring and Reporting

Monitoring rehabilitation success is an essential part of any rehabilitation program. Monitoring will consist of a Land Survey and Vegetation Survey to be conducted every 3 months. Each of these are discussed below.

13.1 Land Survey

Rehabilitation areas will be inspected for erosion rills, erosion gullies and topsoil depth to determine their erosion rating (see Table 2). Three inspection locations will be determined for the rehabilitation area.

Table 2. Erosion rating system.

Erosion Rating	Average Depth of Rills	Topsoil Depth	General Observations
0	< 10cm	> 90% of original depth	Generally little erosion. The majority of rills are only <10 cm depth.
1	< 20cm	>70% of original depth	Minimal instances of sheet-wash and gully erosion.
2	< 50cm	>50% of original depth	Minimal-moderate erosion occurring but limited to localised areas.
3	> 50cm	>40% of original depth	Moderate erosion occurring.
4	Any > 80cm depth	>30% of original depth	Heavy erosion occurring.

A general inspection of the rehabilitation area for rills, gullies and washouts will be undertaken in addition to inspection locations. This can be accomplished by a walkover of the site. Where a washout is encountered, an estimate will be made of its area. If multiple washouts are encountered, an estimate of the percentage of the rehabilitation area disturbed by washouts will then be made (i.e. 5%). Surface inspection following significant rain events will also be undertaken in order to identify erosion events and allow for remedial action to be taken.

13.2 Vegetation Survey

The rehabilitation area will be surveyed as follows:

- Trees/shrubs identified to a species level, approximated for height, measured for diameter and counted for species abundance.

This information will be required to assess the Completion Criteria (see Appendix A). Any signs of adverse health conditions will be noted. Fauna use of the rehabilitation areas will also be noted. All vegetation surveys will be completed in accordance with the Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland (or appropriate similar reference documents).

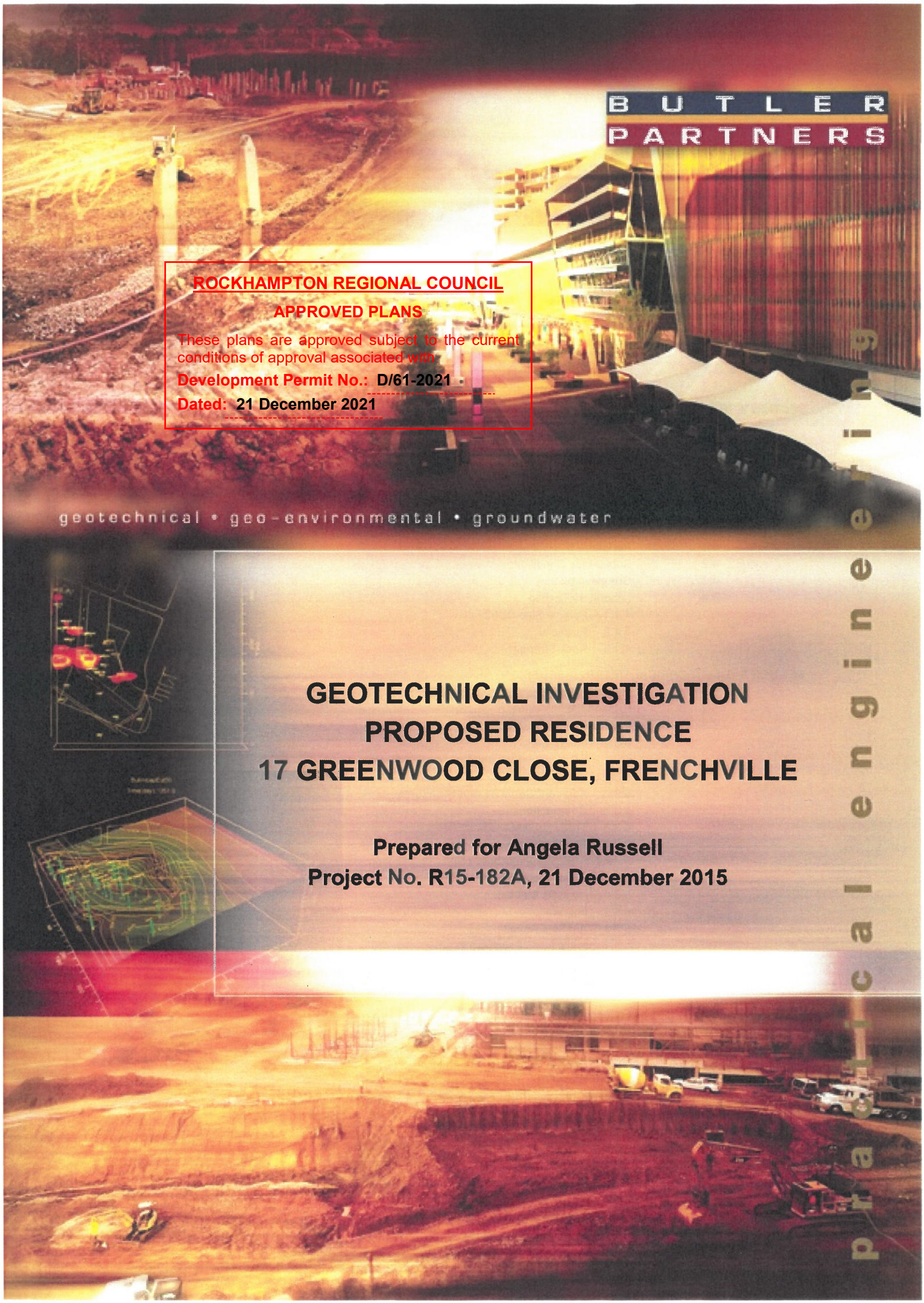
13.3 Reporting

Reporting of rehabilitation progress will be provided to RRC every 6 months during the life of the rehabilitation management plan. Therefore it is intended that reporting will consist of a 6-month report and then a final report at 12 months prior to handover to RRC.

13.4 Appendix A – Rehabilitation Success Criteria

Rehabilitation Goal	Mine Site Rehabilitation Objective	Rehabilitation Indicators	Rehabilitation Completion Criteria	Evidence of Compliance to be Supplied with Completion Criteria
Safe to humans and wildlife	Rehabilitation area floor remains safe for humans and animals now and in the future.	Erosion ratings are suitable for long term safety.	Erosion ratings (as adopted by the erosion rating system) are less than or equal to 2 (as defined in Table 2).	Evidenced in inspections of rehabilitation.
Non-Polluting	Erosion controlled to prevent sediment from entering waterways.	Erosion ratings represent sufficient soil stability to indicate a safe level of sediment loss.	Certification that erosion ratings represent sufficient soil stability to indicate a safe level of sediment loss.	Certification that erosion ratings represent sufficient soil stability to indicate a safe level of sediment loss.
Stable	Topsoil is stable and resistant to erosion.	Erosion rates.	Erosion rates measured or modelled using suitable modelling methods such as RUSLE and are no higher than 50% that of the surrounding environment.	Certification report comparing erosion losses (measured or modelled) from the rehabilitation site with surrounding environment.
		Erosion indicators such as rills, gullies and washouts are minimal.	Erosion ratings are less than or equal to 2.	Rehabilitation report or final rehabilitation report outlining erosion ratings on site.
	Functional erosion structures.	Erosion structures are fit for purpose.	Inspection and certification of erosion and water control structures such as rubble traps, geofabric fencing.	Certification from a suitably qualified person showing structures are fit for purpose.
	Vegetation cover.	Vegetation cover, percentage and type.	100% survival rate for replanted vegetation.	On ground rehabilitation inspection, outlined in final rehabilitation report.

Sustain and support existing ecosystems.	Vegetation is suitable for the land use.	Physical parameters of the soil.	Erosion ratings (as adopted by the erosion rating system) are less than or equal to 2 (as defined in Table 2)	On ground rehabilitation inspection, outlined in final rehabilitation report.
		Vegetation diversity.	Weed prevalence and occurrence is no greater than pre-rehabilitation	On ground rehabilitation inspection, outlined in final rehabilitation report.
			An appropriate shrub density.	On ground rehabilitation inspection, outlined in final rehabilitation report.


BUTLER
PARTNERS
ROCKHAMPTON REGIONAL COUNCIL
APPROVED PLANS
These plans are approved subject to the current conditions of approval associated with
Development Permit No.: D/61-2021
Dated: 21 December 2021
geotechnical • geo-environmental • groundwater
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENCE
17 GREENWOOD CLOSE, FRENCHVILLE
Prepared for Angela Russell
Project No. R15-182A, 21 December 2015
pavement engineering

Proposed Residence
17 Greenwood Close, Frenchville
Project No.: R15-182A
21 December 2015

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SECTION 1 - INTRODUCTION

1.1 Project

It is understood that it is proposed to construct a double storey residential dwelling at 17 Greenwood Close, Frenchville. Existing earthworks had already been completed on the allotment comprising significant cut and fill to construct two reasonably level building platforms.

1.2 Proposed Scope of Work

For the scope of the proposed development and the anticipated ground conditions, it was proposed that geotechnical investigation comprise the excavation and sampling of four test pits as well as inspection and mapping of observable features at the site.

Using the results of the fieldwork and laboratory testing outcomes, it was proposed that a slope stability assessment report be produced to provide geotechnical information on each of the following topics:

- subsurface conditions;
- slope stability assessment;
- earthworks and site preparation;
- site classification to AS2870;
- retaining wall pressures;
- temporary and permanent batter slopes;
- effect of footings on slope stability; and
- anticipated construction aspects.

1.3 Commission

Based on the proposed development, the anticipated subsurface conditions and the proposed scope of investigation work, a fee to undertake the geotechnical investigation was presented in a proposal of 1 October 2015. Butler Partners (Regional) Pty Ltd (Butler Partners) was subsequently commissioned by Angela Russell to carry out the geotechnical investigation as proposed.

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SECTION 2 - THE SITE

2.1 Site Description

The site is described as Lot 1 on SP245873, and is located at the end of Greenwood Close, with an existing residential development on the adjoining lot to the west and vacant land to the east. An existing boulder retaining wall approximately 1.0m to 1.5m high was observed in the adjacent allotment along the western boundary. At the time of the investigation, the site had recently (understood to be within the last six to nine months) undergone significant earthworks including excavation and filling to create two reasonably level platforms in the area of proposed development. Subsurface conditions exposed in the approximately 3m to 4m high cut faces comprise extremely to distinctly weathered siltstone.

The joints observed in the exposed cut were relatively closely spaced (20mm to 300mm) and were rough and irregular. The dip angle in the distinctly weathered siltstone was estimated to be approximately 70° to 80° in a south to south west direction, across the rock face. The slope batters generally comprise sparse grass cover, with the building platforms mostly clear of vegetation. At the time of the fieldwork, there was some evidence of movement/creep observed through tension cracking near the crest of the uncontrolled fill at the front of the allotment.

Ground surface levels generally fall in a south-westerly direction with the former 'natural' slope (pre-earthworks) estimated to be in the order of 15 to 17 degrees with an overall difference in elevation across the site of approximately 15m. Four general views of the site at the time of investigation are given in Photographs 1 to 4.

Photograph 1: View from lower platform toward the rear of the allotment

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Photograph 2: View of cut face behind the upper platform

Photograph 3: View of the fill batter from Greenwood Close

Photograph 4: View along western boundary toward Greenwood Close

2.2 Geology

Reference to the Geological Survey of Queensland's 1:100 000 geological series Rockhampton sheet indicates that the site is mapped as the Lakes Creek Formation of the Berserker Group (comprising siltstone and lithic sandstone).

SECTION 3 - FIELDWORK

3.1 Excavation and Sampling Methods

Four test pits (Test Pits 1 to 4) were excavated and sampled to between 1.8m and 2.8m depth, with a track mounted Hitachi hydraulic excavator (20-tonne) equipped with a 450mm bucket. Strata identification was based on the inspection of cuttings recovered from the bucket, supplemented by the inspection of the test pit side walls and disturbed samples.

Dynamic cone penetrometer (DCP) tests were carried out adjacent to each test pit. DCP tests at Test Pits 1, 3 and 4 refused on rock 'floaters' in the fill profile. On completion of excavation all test pits were backfilled with spoil and surface compacted.

3.2 Test Pit Locations and Supervision

Test pit locations were set out by measurement from existing site features and their locations are indicated approximately on the attached Drawing No. 1. The ground surface level at each test pit location was determined by interpolation from ground surface contours provided on Finch Surveying Consultants' Drawing No. 5440DTM dated 11 August 2015.

An experienced geotechnical engineer set out the test locations, logged the stratigraphy encountered in the test pits, directed the insitu sampling and testing program and supervised the fieldwork.

SECTION 4 - INVESTIGATION RESULTS

4.1 Reports

The subsurface conditions encountered in the test pits are given on Test Pit Report sheets included in Appendix A, using classification and descriptive terms defined in accompanying notes. Laboratory test report sheets are included in Appendix B.

4.2 Subsurface Conditions

For a description of the stratigraphy encountered in the test pits, the Test Pit Report sheets should be consulted. However, in broad summary, the subsurface conditions generally comprised sandy gravel fill varying in depths from 0.3m to 2.0m, underlain by 'natural' gravelly clay (in Test Pits 1 and 3), which in turn was underlain by low to high strength siltstone.

4.3 Groundwater

No free groundwater was encountered during test pit excavation, however it should be noted that groundwater levels can vary seasonally and with prevailing weather (and vegetation) conditions. If construction is to be undertaken at a significant time following this investigation and/or following significant 'wet' weather, it would be prudent to confirm groundwater levels prior to construction.

4.4 Laboratory Testing

Selected soil and rock samples recovered from the test pits were submitted to geotechnical testing laboratories for assessment of particle size distribution, plasticity and rock strength. The test results are summarised and discussed in the following sections.

4.4.1 Particle Size Distribution

Two selected samples of soil recovered from Test Pits 1 and 3 were tested for measurement of particle size distribution using wash sieve grading techniques and the reported results are summarised in Table 1.

Table 1: Summary of Reported Particle Size Distribution Test Results

Test Pit	Depth (m)	Sample Description	Sample Moisture Content (%)	Gravel Fraction[1] (%)	Sand Fraction[2] (%)	Silt and Clay Fraction[3] (%)
1	0.5 – 0.8	Sandy Gravel (Fill)	7.9	72	18	10
3	1.5 – 1.7	Gravelly Clay	17.6	30	14	56

[1] Particle size <60mm, >2mm; [2] Particle size (approximately) <2mm, >0.075mm; [3] Particle size (approximately) <0.075mm

4.4.2 Plasticity

Two samples of soil were tested for measurement of plasticity using Atterberg limit and linear shrinkage test methods. The reported test results are summarised in Table 2, together with the soil classification and indicate that the samples tested were medium plasticity.

Table 2: Summary of Reported Plasticity Test Results

Test Pit	Depth (m)	Sample Description	Sample Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Classification*
1	0.5 – 0.8	Sandy Gravel (Fill)	7.9	27	20	7	6.5	GC
3	1.5 – 1.7	Gravelly Clay	17.6	33	21	12	11.5	CI

* Australian Standard AS1726-1993, Geotechnical Site Investigation

4.4.3 Rock Strength

Selected rock samples, recovered from Test Pit 3, were tested for measurement of rock strength, using Point Load Test [Is(50)] methods and the test results are tabulated below and are also given on the relevant Test Pit Report sheets.

Table 3: Summary of Reported Rock Strength Test Results

Test Pit	Depth (m)	Sample Description	Point Load Strength ($I_s(50)$)	Rock Strength Category*
3	2.13 – 2.5	DW Siltstone	0.30	Low
			0.49	Medium
			0.75	Medium
			0.34	Medium
			2.1	High
			2.7	High

* Australian Standard AS1726-1993, *Geotechnical site investigations*

SECTION 5 - GEOTECHNICAL DESIGN DISCUSSION

5.1 Ground Model

The results of the investigation indicate that the subsurface conditions at the test pit locations comprised sandy gravel fill overlying gravelly clay (Test Pits 1 and 3), which in turn was underlain by low to high siltstone.

In these ground conditions geotechnical design will need to consider (at least) the following:

- subsurface conditions;
- condition of the existing fill;
- rock excavatability;
- slope stability;
- temporary cut batter stability;
- classification of the site in accordance with AS2870;
- retaining wall pressures;
- suitable foundation types;
- appropriate founding depths and bearing pressures;
- variations in footing founding depths and founding conditions across the site; and
- possible construction difficulties.

Discussion of geotechnical design parameters, as well as design and construction recommendations and suggestions are detailed in the following sections.

5.2 Existing Fill

It is not known whether the existing fill material encountered in the test pits was 'controlled' on placement (i.e. it is not known whether the fill was placed and uniformly compacted to an appropriate engineering specification). Supporting documentation should be obtained and checked to confirm that the fill has been placed in a controlled manner to a specification that is appropriate for the proposed development. If documentation does not exist (or the specification used for filling is not appropriate for the proposed development) then it is suggested that the existing fill be assumed to be uncontrolled.

If the fill cannot be shown to be controlled, then consideration should be given to the potential for adverse variation to exist in both the composition and degree of compaction of the fill. The presence of voids within uncontrolled fill as well as potential soft/loose zones or inclusions of deleterious materials and 'oversize' may lead to potentially significant future total and differential settlements, occurring possibly over relatively short distances and to areas of slope instability.

To minimise the risk of potentially adverse settlement or instability within the fill occurring, it is recommended that all uncontrolled fill be removed and replaced/recompacted with controlled fill of low reactivity 'keyed in' to the weathered rock.

5.3 Earthworks

5.3.1 Excavatability

5.3.1.1 Bulk and Confined Excavation

Based on the results of the fieldwork, excavation for building foundations would be expected to encounter some surface fill and soils, overlying weathered rock. The rock encountered in the test pits ranged from low to high strength, and it is considered possible that zones of 'stronger' and/or 'less jointed' rock may also exist within the proposed excavation depth.

Excavation of soil and extremely low to low strength rock should be readily achieved in bulk excavation using a large hydraulic excavator. Bulk excavation of medium to high strength rock will require relatively major use of 'rock breaker' equipment unless joint spacing is moderately close (less than 0.3m). In high strength (or stronger) rock (with relatively few discontinuities), rock breaker excavation methods only would be expected to be very slow and potentially severely damaging to equipment.

In confined (trench, footing, etc.) excavations in medium to high strength rock, heavy rock breaker equipment and slow excavation rates should be allowed for. Due to the inherent jointing and bedding planes contained in the rock, over break should be allowed for in pricing.

Consideration should be given in selecting suitable excavation methods/plant to the potential of encountering 'harder' rock below test pit location termination depths, and at 'shallower' depth intermediate to the test pit locations.

All confined excavations should be fully supported or battered/benched to a stable angle to ensure personnel safety.

5.3.2 Use of Cut for Fill

Organic soils, 'over-wet' soils, 'silts' and soils containing deleterious matter or oversize particles (>75mm size) should be excluded from use as structural fill.

The soils and low to medium strength rock should generally be suitable for re-use as 'controlled fill' provided that the excavated material is 'processed' so that it is well mixed and all 'oversize', organic/deleterious and any 'over wet' materials are excluded and expansive movement can be tolerated or designed for. All medium to high strength rock would be suitable for reuse as fill, but crushing and screening may be required to control particle size for 'hard' rock. The existing fill material encountered in the test pits appears suitable for reuse, but will require inspection and assessment for confirmation.

5.3.3 Adjacent Services and Structures

Care will be required to ensure that the effect of site earthworks does not impact adversely upon adjacent services and structures etc. (e.g. potential settlements induced by heavy rock breaking/blasting etc.). It is recommended that dilapidation surveys of adjacent structures and services etc. be undertaken prior to construction commencing on site where it is anticipated that rock breaking may be required.

5.3.4 Compaction

All fill required to support settlement sensitive structures/features should be 'controlled', placed in layers not greater than 250mm (loose thickness) and be uniformly compacted to a minimum dry density ratio of 98% (Standard compaction).

Reactive clay material should be avoided for use as fill, if possible. However if/where any reactive material is to be used as fill, it should be placed and maintained at a moisture content of not drier than Standard optimum moisture content in order to reduce potential shrink-swell movements. It should be noted that over-compacting reactive clay fill (particularly at a moisture content below optimum) should be avoided as potentially significant expansion could occur on 'wetting up'. Due allowance must be made in design and detailing for reactive fill movements if reactive fill is used.

To assist with achievement of adequate control of fill placement, 'Level 1' geotechnical supervision and testing as set out in Section 8 of AS3798 – 2007 *Guidelines on earthworks for commercial and residential developments* is recommended.

5.3.5 Traffickability

Traffickability for plant will be adversely affected by wet weather and trafficking 'wet' subgrade during and following wet weather would be expected to potentially result in disturbance to the subgrade, with consequent loss of subgrade strength. Consideration should be given to the placement of a coarse granular working platform to those areas where traffickability is critical, particularly the existing driveway access. The required layer thickness will depend on the type of plant proposed to traffic the site, however, a layer thickness of not less than 150mm is anticipated for 'light' equipment.

5.3.6 Site Drainage

During construction, the site should be graded such that water is readily shed and does not collect and pond indiscriminately over the site, otherwise softening of the exposed subgrade will occur.

5.4 Reactive Soil Movements and Site Classification

As the site is underlain in part by fill, the site would be classified as 'Class P' (problem site) in accordance with Australian Standard AS2870 - 2011 *Residential slabs and footings*. However, if the fill is 'controlled' and has been placed to an appropriate engineering specification, AS2870 allows the site to be reclassified based on the assessment of reactive ground surface movement.

The magnitude of potential reactive soil movements has been estimated using the following equation (from Australian Standard AS2870 - 2011 *Residential slabs and footings*), and parameters for the site selected based on recommendations in AS2870, results of the laboratory testing and published information:

$$y_s = \frac{1}{100}\sum_{n=1}^{N}\left(\alpha.I_{ss}.\overline{\Delta u}.h\right)_n$$

where y_s is the characteristic surface movement, in millimetres;
α is the lateral restraint factor;
I_{ss} is the shrink-swell index (taken as approximately 0.5% per pF to 1% per pF for the clayey gravel fill, based on the results of past experience and the laboratory test results);
$\overline{\Delta u}$ is the soil suction change averaged over the thickness of the layer under consideration (estimated as 1.2pF at the ground surface in Rockhampton, reducing linearly to zero at the maximum depth of suction change);
h is the thickness of layer under consideration, in millimetres; and
N is the number of soil/fill layers within the depth of suction change (H_s – taken as 2.3m in Rockhampton).

Characteristic surface movements for the ground conditions encountered in the test pits (assuming all surface fill is less than five years old and topsoil is removed) have been calculated to be between 30mm and 35mm using the parameters and method discussed above, assuming normal seasonal moisture/suction variations (i.e. no influence from trees etc.). Based on the magnitude of the calculated characteristic surface movement, the site would be reclassified as 'Class M' (Moderately Reactive); if all uncontrolled fill is removed.

If 'reactive' fill is used to fill the site, then the calculated characteristic surface movement values given above may increase significantly. It should be carefully noted that the calculated surface movement values given above do not include any allowance for 'abnormal' influences such as vegetation effects or poor drainage. It is strongly recommended that the estimated characteristic surface movement values given above be recalculated once site earthworks are completed.

It is considered that the following issues must be carefully considered in design:

- Where controlled fill is placed over a natural soil subgrade, higher characteristic movements than those nominated above could potentially occur (as AS2870 indicates that the ratio of lateral restrained to unrestrained movement will increase), particularly if fill reactivity is significantly greater than that of the existing site soils. If filling of the site is proposed, a revised site classification should be considered taking into account the actual reactivity, compaction and depth of fill used.

- Vegetation has the potential to significantly increase soil suction change magnitude and depth ($\overline{\Delta u}$ and Hs respectively in the equation above), which leads to a significant increase in potential reactive soil movements adjacent to existing (or proposed) tree locations. If trees are to be planted 'close' to the building in the future (or are to remain close to the building sites), consideration should be given to constructing root barriers around the trees, and footing design must allow for potentially (significantly) higher reactive soil movements than are nominated above. In addition, if trees and large shrubs are removed less than approximately one year (or longer in drought) from the time of building construction, then significantly greater characteristic surface movements than are nominated above could be expected.

- Abnormal subgrade moisture variations could potentially result in adverse, non-uniform reactive movements that are significantly greater than those nominated above for 'normal' seasonal moisture changes. The risk of 'abnormal' movement occurring could be reduced by ensuring over-watering of gardens, ponding water, broken/leaking pipes, planting trees/shrubs 'close' to buildings, etc. do not occur.

Good 'engineering practices' should be adopted in project design and detailing if control of reactive ground movement is desired. In particular, the following are recommended:

- trees/shrubs should not be planted or be allowed to remain closer than their mature height to movement sensitive features (unless significantly greater reactive movements than those estimated above are designed for);
- subgrade moisture should not be allowed to change during or following construction;
- site grades should be designed to readily shed water and prevent ponding around footings and other movement sensitive areas; and
- services should be designed to be flexible, to prevent any leakage and to rapidly remove any leakage should it occur.

5.5 ***Slope Stability Assessment***

There was no current observable evidence of instability in the cut areas and natural profile. It is considered that the existing fill may have been placed on sloping ground and not 'keyed in', which has led to tension cracking observed near the crest of the fill embankment. Without remediation it is anticipated that the fill embankment will continue to creep and potentially undergo failure during major rain events. As a result, it is recommended to either remove the existing fill and replace with suitable material as described in Section 5.3, or design and construct an engineered retaining wall system to retain the existing fill material and prevent further movement. In both cases, all aspects of building design and construction must be taken into consideration to ensure the stability of the site does not become compromised, particularly during wet weather events.

It should also be noted that all design and construction works must take into account the potential effects to neighbouring properties. An existing boulder retaining wall approximately 1.0m to 1.5m high was observed in the neighbouring property along the western boundary.

For a properly designed and constructed development at the site founded in the underlying weathered rock, the risk of instability occurring and affecting the development is considered to be **'moderate'** using the system described in the guidelines produced by the Australian Geomechanics Society. A slope stability analysis has been carried out to assess 'long term' stability of the fill embankment that currently exists at the site.

5.5.1 *Analysis Method*

Slope stability analysis has been undertaken using the commercially available geotechnical analysis software Slope/W, which uses limit equilibrium methods to assess the Factor of Safety (FOS) against slope instability. The analysis carried out has adopted the following:

- Slope geometry based on information determined from Finch Surveying Consultants Drawing No. 5440DTM.
- Subsurface profiles based on the results of the investigation.
- Mohr-Coulomb strength model for soils.

- 'Long term' analyses carried out using effective stress soil strength parameters.

5.5.2 *Interpretation of Calculated Factor of Safety Values*

In the 'long term' it is typical to adopt a minimum calculated FOS in the range of 1.4 to 1.5, depending on the level of uncertainty in input parameters. Where detailed investigation has been carried out and applied loads are well defined, a FOS at the low end of the range could be considered, however, as the degree of uncertainty in parameters, geometry, applied loads, groundwater conditions and variability increases the acceptable FOS limit from slope stability analysis should increase.

5.5.3 *Analysis Results*

5.5.3.1 *Existing Fill*

For the analysis an automated search of potential circular failure surfaces was carried out to assess the failure surface with the lowest calculated FOS. The soil strength parameters and stratigraphy is presented in Figure 1, with results of the analysis is presented in Figure 2 and Figure 3 showing the failure surface with the lowest calculated FOS.

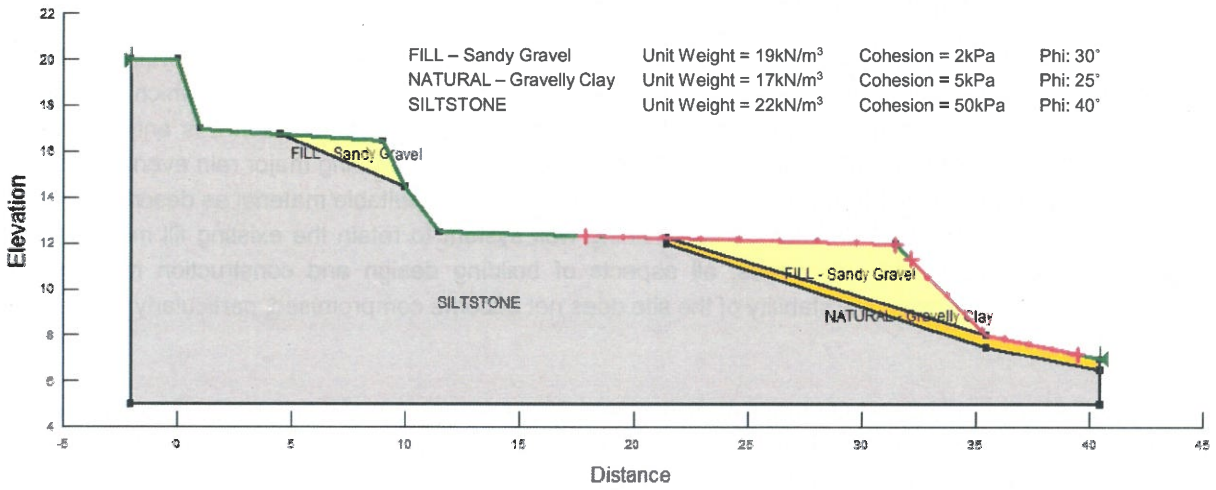

Figure 1: 'Long term' soil strength parameters and stratigraphy

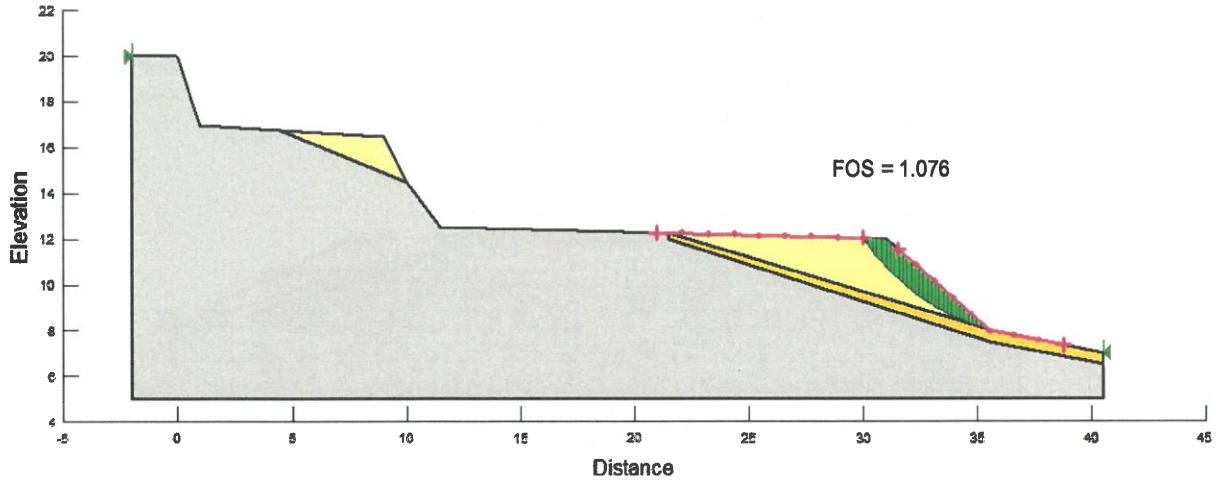

Figure 2: 'Long term' analysis for existing 'lower platform' fill profile

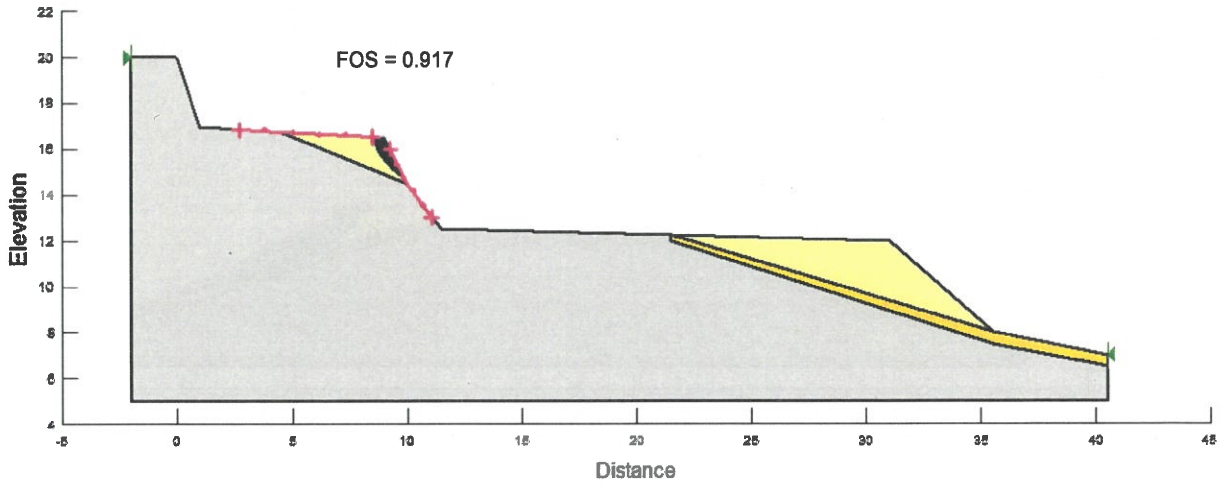

Figure 3: 'Long term' analysis for existing 'upper platform' fill profile

The results of the analysis discussed above indicate that, in its current state, the long term stability of the fill embankment is not acceptable and must either be removed and replaced as described in Section 5.3 or design and construct and engineered retaining wall to mitigate any further movement in the fill material.

5.5.3.2 Remediated Fill

An analysis was also performed to model the stability of the fill material if it was to be remediated and placed in a controlled manner under 'Level 1' supervision, as described in Section 5.3, and in accordance with the recommended maximum permanent slope recommendations in Table 4. The soil strength parameters and stratigraphy is presented in Figure 4, with results of the analysis is presented in Figure 5 and Figure 6 showing the failure surface with the lowest calculated FOS.

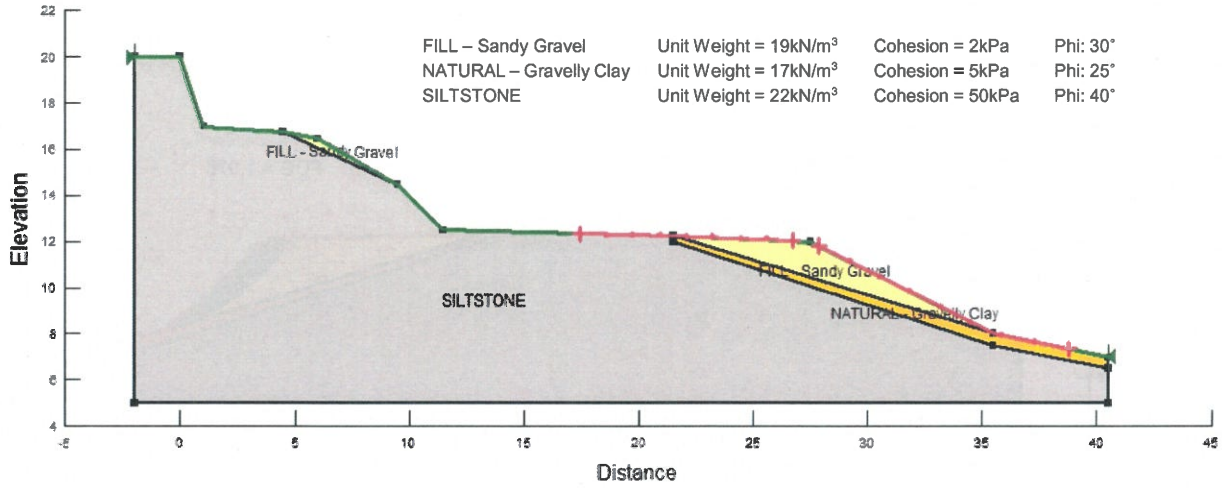

Figure 4: 'Long term' soil strength parameters and stratigraphy for 1V:2H controlled fill batter

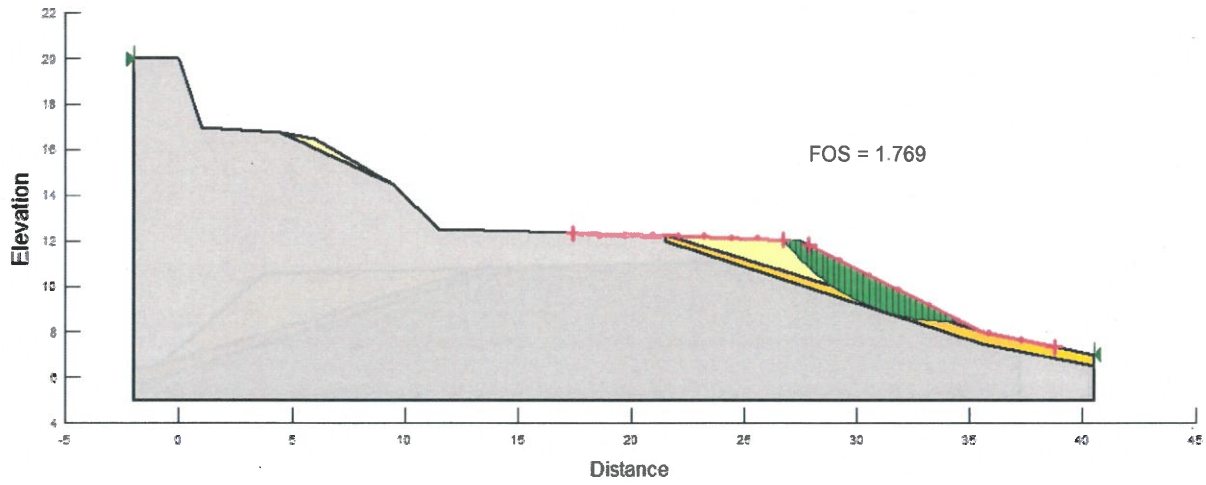

Figure 5: 'Long term' analysis for existing 'lower platform' for 1V:2H controlled fill batter profile

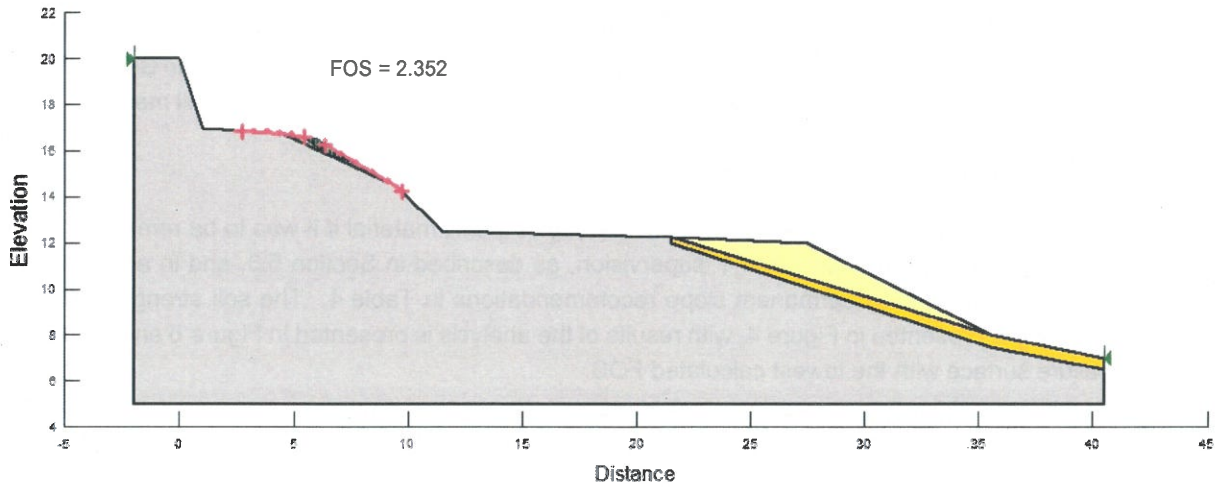

Figure 6: 'Long term' analysis for existing 'upper platform' for 1V:2H controlled fill batter profile

A long term FOS of 1.769 in the fill below the building would generally be expected to be acceptable.

5.6 Batter Slopes

If movement sensitive features/sections, etc. are not located 'close' to excavations, and geometry permits, battered slopes may be adopted. Provided slopes are protected from groundwater or surface water effects, the preliminary maximum cut slope angles given in the Table 4 may be used with a relatively low risk of instability for unsurcharged batters up to approximately 3m to 4m in height. Where batters exceed 4m in height mid-slope benches (not less than 3m wide) may be required and will require detailed stability assessment on a location by location basis. Detailed stability analysis prior to bulk earthworks design finalisation will be required to confirm stable batter slopes and detailed inspection by an experienced geotechnical engineer will be required at the time of construction to confirm the stability of batter faces and the need for any supplementary mechanical support.

Table 4: Preliminary Maximum Unsurcharged Cut Batter Slopes for 'Dry' Slopes 3-4m High

Material	Strength	Maximum Temporary Slope	Maximum Permanent Slope
Fill (Controlled – refer Section 5.3.4)[1]	-	1V:1H	1V:2H
Siltstone	low medium high	1V:1H[2] 1V:0.75H[2] 1V:0.5H[2]	1V:1.5H[2] 1V:1H[2] 1V:1H[2]

[1] Overfilled and cut back to design profile; [2] Subject to jointing

If insufficient space exists for the construction of cut batters at the maximum slopes given above, mechanical excavation support will be required in order to prevent excavation instability. At the batter angles nominated above there may be some localised slumping of batter slopes and it will be necessary to ensure that the faces are protected from any surface water or groundwater seepage effects.

5.7 Retaining Wall Pressures

Permanent retaining wall pressures can be obtained for drained, unsurcharged conditions, with horizontal and sloping backfill, using a triangular pressure distribution in conjunction with the parameters given in Table 5.

Table 5: Retaining Wall Design Parameters

Material	Strength	Total weight (t/m^3)	Horizontal Backfill		Sloping Backfill (1V:5H)	
			Lateral earth pressure coefficient			
			'Active' - k_a	'At Rest' - k_o	'Active' - k_a	'At Rest' - k_o
Sandy Gravel (Fill)	-	1.9	0.4	0.55	0.45	0.6
Siltstone	low medium high	2.3	0.35 0.3 0.2	0.5 0.4 0.3	0.4 0.35 0.25	0.55 0.45 0.35

Due allowance must also be included in the calculation of wall pressure for groundwater pressure, back-fill compaction, surcharge effects from adjacent structures and/or construction loading and the effects of sloping retained materials, reactive soil/fill pressures etc.

If a drainage system is installed behind retaining walls, it would still be prudent to allow for elevated water pressures as elevated groundwater levels may occur during or following prolonged 'wet' weather, or from blocked drainage etc. Drain design should incorporate free draining backfill and slotted pipe discharging into a sealed disposal system.

5.8 Foundations

Design of pad/strip footings or 'short' bored piles could be based on the maximum working bearing pressures nominated in Table 6.

Table 6: Working Bearing Pressure for Strip/Pad Footings and 'Short' Bored Piles

Material	Strength	Allowable Working Pressure (kPa)*
Controlled Fill - Level 1 (placed and compacted to Section 5.3.4)	-	100
Siltstone	extremely low	350
	very low	700
	low	1000
	medium	2500

* Not underlain by any 'softer' material

It is recommended that the above strengths be confirmed by an experienced geotechnical engineer prior to the casting of foundation elements. It should be carefully noted that the potential presence of 'strength inversions' in the rock will require careful consideration in foundation design and the selection of maximum bearing pressures/founding depths.

It is considered that local variations in rock strength could be expected to occur over the site and it is suggested that a 'flexible' approach be adopted to the foundation design, construction methodology and costing, so that footing sizes/founding depths can be readily adjusted as required during construction, without cost/time penalties being incurred. Use of mass concrete may be required to transfer foundation stresses to suitable founding strata.

It is recommended that in order to minimise potential differential footing performance that all footings be extended to found in similar stratigraphy (i.e footings for a particular structure should not found partly in fill and partly in weathered rock).

5.9 On-Ground Slab and Pavement Properties

5.9.1 Insitu Estimates of CBR

The correlation between DCP results and insitu CBR given by AUSTROADS[1], is reproduced in Figure 7 and can be used to estimate the CBR of proposed subgrade materials. Caution should be exercised with the interpretation of the DCP values as they are only relevant for the moisture conditions existing at the time of testing and 'false' interpreted CBR values can result from the presence of gravels etc. contained with otherwise 'clayey' soils.

[1] AUSTROADS' Publication No. AP-17/92 (1992) Pavement Design: A Guide to the Structural Design of Road Pavements – Figure 5.2.

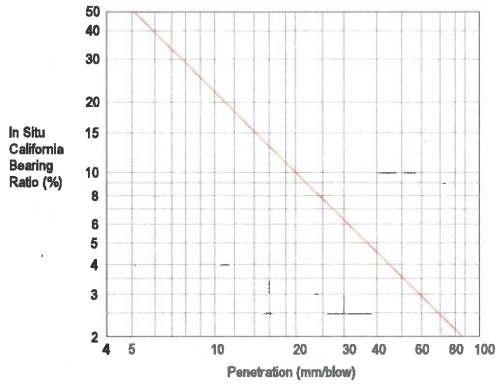

Figure 7: Correlation of DCP Results and Insitu CBR

5.9.2 Soaked Subgrade Properties

The design of on-ground slabs and pavements, cast over natural soil or controlled fill subgrade could be based on the 'soaked' parameters presented in Table 7, which are based on past experience and on the assumption that the subgrade is prepared in accordance with Section 5.3.

The subgrade design values will be significantly influenced by the properties of any compacted fill used.

Table 7: Subgrade Design Values

Subgrade Type	CBR (%)	Modulus of Subgrade Reaction* (kPa/mm)
Controlled Fill - Level 1 (placed and compacted to Section 5.3.4) Sandy Gravel	10 – 20	55 – 70
Gravelly Clay	3 – 5	20 – 30

* For transient loading only – sustained loads may cause consolidation settlement and appropriate design values must be determined by analysis

If reactive ground movement can occur, it is suggested that on-ground slabs be fully dowelled (and joints between slabs sealed to control differential movements and minimise under-slab moisture changes) and should be detailed to enable movement, independent of foundations, fixtures, etc.

BUTLER PARTNERS (REGIONAL) PTY LTD

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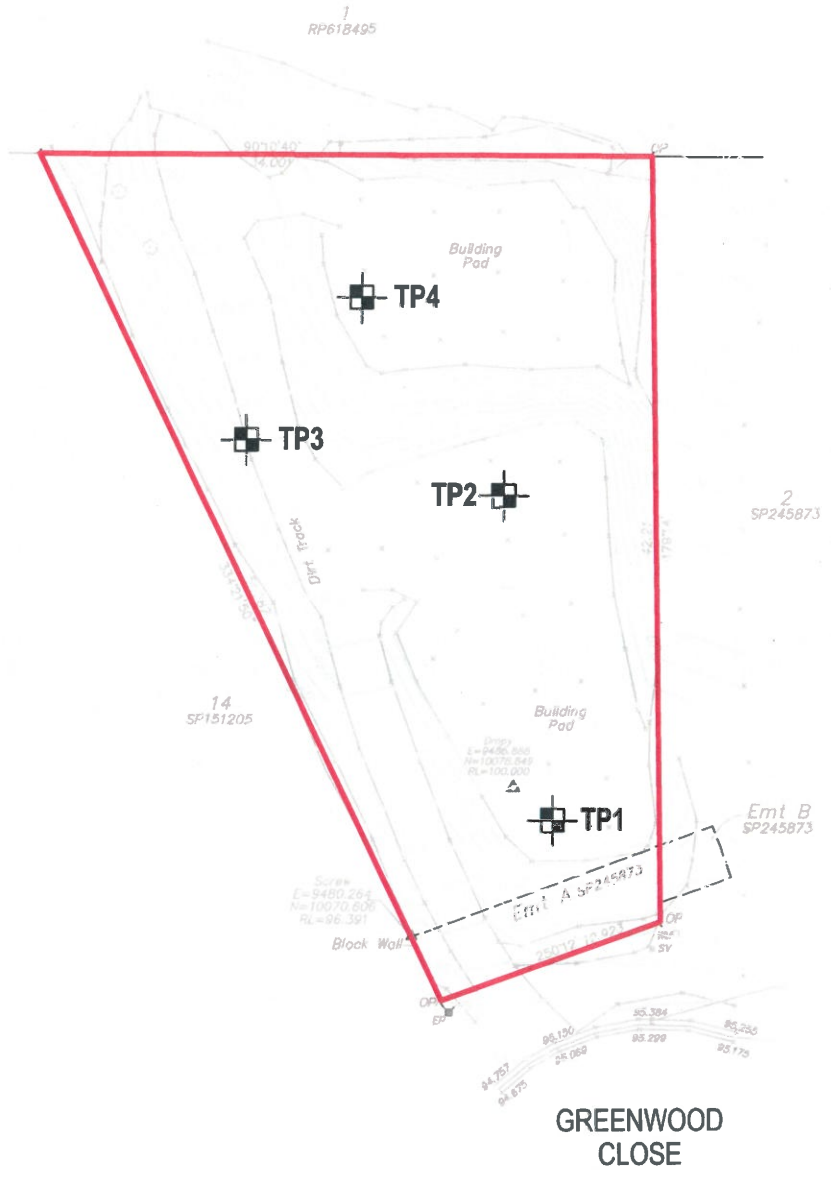
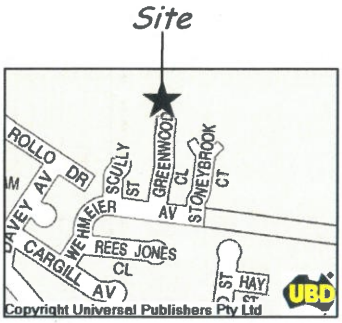




UBD Reference: Rockhampton Map 4 Grid H16
(ARC&T,v4.0) not to scale

PROPOSED RESIDENCE

17 GREENWOOD CLOSE, FRENCHVILLE

LOCALITY PLAN AND TEST PIT LOCATIONS

CLIENT: **Angela Russell**

SCALE AT A4:

0 5 10 15m

1:400

DATE:	DECEMBER 2015
DRAWN:	FD
APPROVED:	
PROJECT No:	R15-182A
DRAWING No: 1	REV: A

LEGEND

1 Test Pit

Site Boundary

Reference: Finch Surveying Consultants 'Plan of Contour Survey', Drawing No5440DTM, dated 11.08.2015.

Proposed Residence
17 Greenwood Close, Frenchville
Project No.: R15-182A
21 December 2015

APPENDIX A

TEST PIT REPORT SHEETS WITH EXPLANATORY NOTES

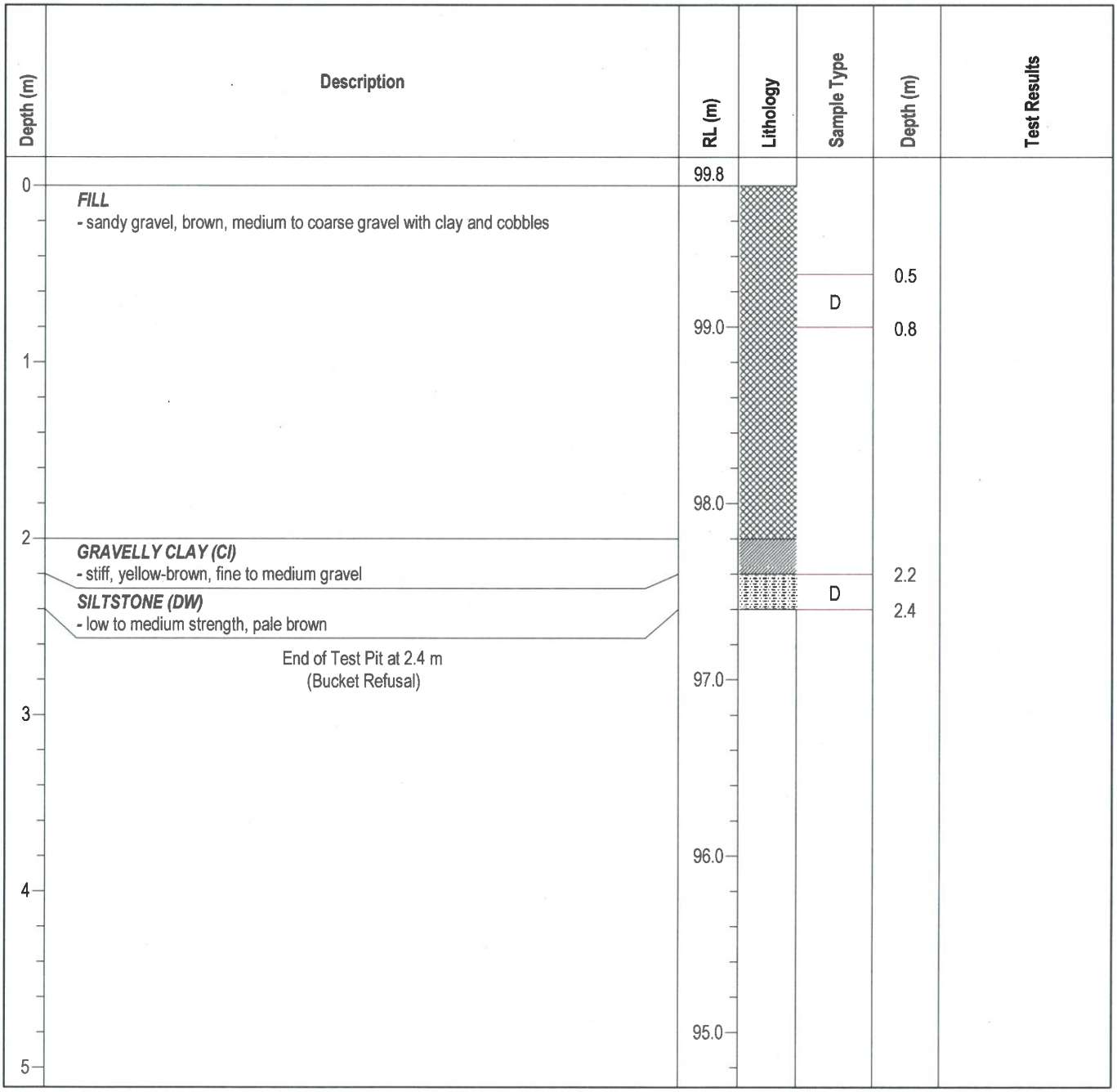
TEST PIT REPORT

BUTLER PARTNERS

Client: Angela Russell
Project: Proposed Residence
Location: 17 Greenwood Close, Frenchville
Project No: R15-182A

TEST PIT 1

Page No: 1 of 1
Date: 23 November 2015
Ground Surface Level: RL99.8m*



D	Disturbed Sample	E	Environmental Sample	pp	Pocket Penetrometer Test (kPa)
B	Bulk Sample	U	Undisturbed Tube (50mm diameter)	Is(50)	Point Load Test Result (MPa)
V	Vane Shear Strength (Uncorrected)kPa				

Rig: 20T Hitachi Excavator
Bucket Size: 450mm
Groundwater: No free groundwater encountered during test pitting
Remarks: * Ground surface levels interpolated from Finch Surveying Consultants Drawing No. 5440DTM, dated 11 August 2015

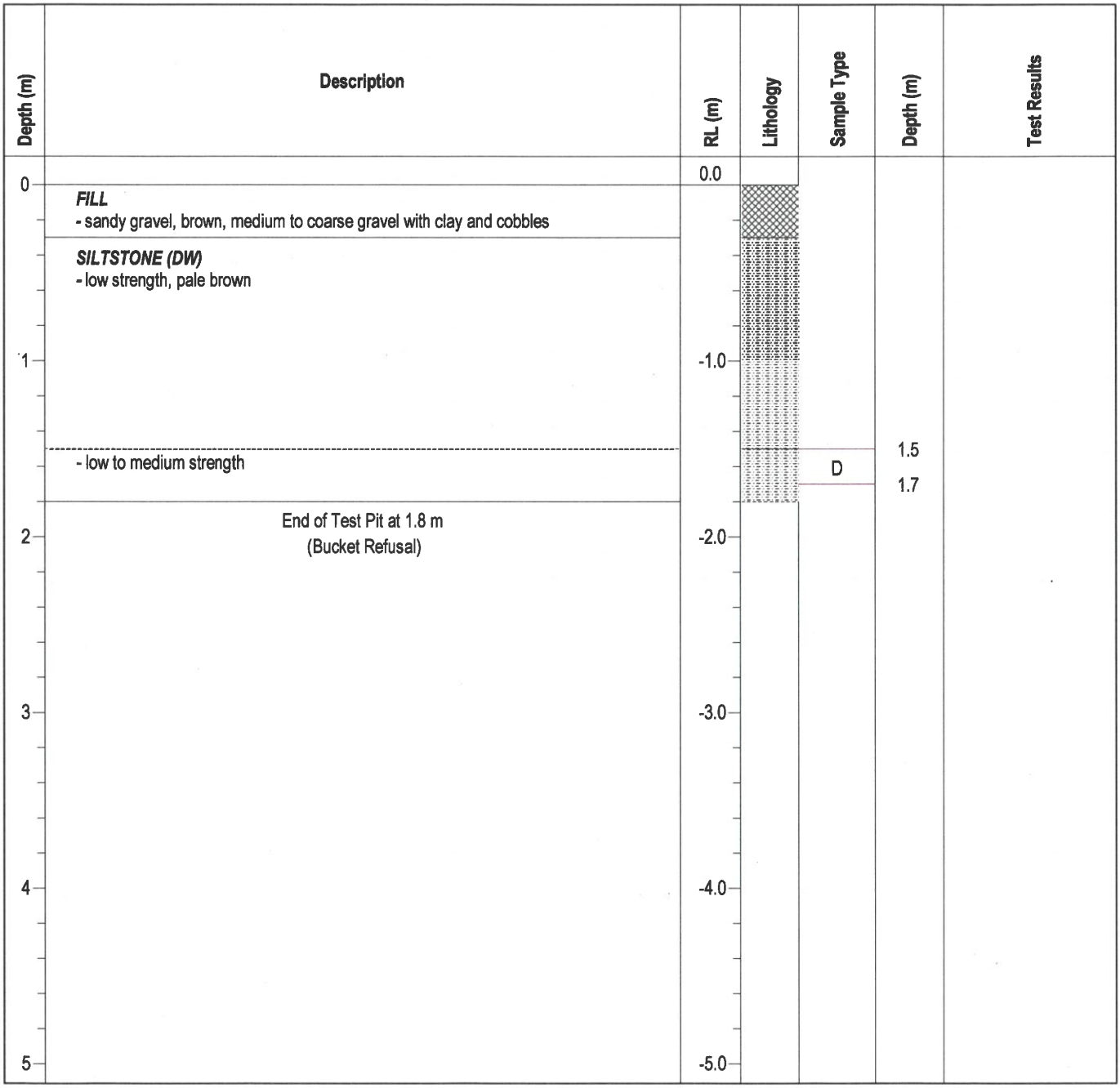
TEST PIT REPORT

BUTLER PARTNERS

Client: Angela Russell
Project: Proposed Residence
Location: 17 Greenwood Close, Frenchville
Project No: R15-182A

TEST PIT 2

Page No: 1 of 1
Date: 23 November 2015
Ground Surface Level: RL100.4m*



D	**Disturbed Sample**	**E**	**Environmental Sample**	**pp**	**Pocket Penetrometer Test (kPa)**
B	**Bulk Sample**	**U**	**Undisturbed Tube (50mm diameter)**	**Is(50)**	**Point Load Test Result (MPa)**
V	**Vane Shear Strength (Uncorrected)kPa**				

Rig: 20T Hitachi Excavator
Bucket Size: 450mm
Groundwater: No free groundwater encountered during test pitting
Remarks: * Ground surface levels interpolated from Finch Surveying Consultants Drawing No. 5440DTM, dated 11 August 2015

TEST PIT REPORT

BUTLER PARTNERS

Client: Angela Russell
Project: Proposed Residence
Location: 17 Greenwood Close, Frenchville
Project No: R15-182A

TEST PIT 3

Page No: 1 of 1
Date: 23 November 2015
Ground Surface Level: RL100.8m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0		100.8				
	FILL - sandy gravel, brown, medium to course gravel with clay and cobbles					
1		100.0				
	GRAVELLY CLAY (CI) - yellow-brown, fine to medium gravel			D	1.5 – 1.7	
	SILTSTONE (DW) - low to medium strength, pale brown mottled grey	99.0				
2	- some high strength bands			D	2.3 – 2.5	
	End of Test Pit at 2.8 m (Bucket Refusal)	98.0				
3						
		97.0				
4						
		96.0				
5						

D	**Disturbed Sample**	**E**	**Environmental Sample**	**pp**	**Pocket Penetrometer Test (kPa)**
B	**Bulk Sample**	**U**	**Undisturbed Tube (50mm diameter)**	**Is(50)**	**Point Load Test Result (MPa)**
V	**Vane Shear Strength (Uncorrected)kPa**				

Rig: 20T Hitachi Excavator
Bucket Size: 450mm
Groundwater: No free groundwater encountered during test pitting
Remarks: * Ground surface levels interpolated from Finch Surveying Consultants Drawing No. 5440DTM, dated 11 August 2015

TEST PIT REPORT

BUTLER PARTNERS

Client: Angela Russell
Project: Proposed Residence
Location: 17 Greenwood Close, Frenchville
Project No: R15-182A

TEST PIT 4

Page No: 1 of 1
Date: 23 November 2015
Ground Surface Level: RL104.6m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0		100.8				
	FILL - sandy gravel, red brown, medium to course gravel with clay and cobbles					
		100.0				
1				D	1.0	
					1.4	
	SILTSTONE (DW) - low to medium strength, pale brown	99.0				
2						
	- medium to high strength					
	End of Test Pit at 2.5 m (Bucket Refusal)	98.0				
3						
		97.0				
4						
		96.0				
5						

D	Disturbed Sample	E	Environmental Sample	pp	Pocket Penetrometer Test (kPa)
B	Bulk Sample	U	Undisturbed Tube (50mm diameter)	Is(50)	Point Load Test Result (MPa)
V	Vane Shear Strength (Uncorrected)kPa				

Rig: 20T Hitachi Excavator
Bucket Size: 450mm
Groundwater: No free groundwater encountered during test pitting
Remarks: * Ground surface levels interpolated from Finch Surveying Consultants Drawing No. 5440DTM, dated 11 August 2015

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DYNAMIC CONE PENETROMETER TEST REPORT SHEET

CLIENT:	Angela Russell	DATE:	3 December 2015
PROJECT:	Proposed Residence	PROJECT NO:	R15-182A
LOCATION:	17 Greenwood Close, Frenchville	REPORT NO:	R15-182A_DCP_R1512-59

DEPTH (m)	PENETRATION RESISTANCE – BLOWS/100mm TEST PIT NUMBER						
	1	2	3	4			
0.0 – 0.1	9	10	15	6			
0.1 – 0.2	7	22+	10	8			
0.2 – 0.3	9		9	22+			
0.3 – 0.4	22+		7				
0.4 – 0.5			22+				
0.5 – 0.6							
0.6 – 0.7							
0.7 – 0.8							
0.8 – 0.9							
0.9 – 1.0							
1.0 – 1.1							
1.1 – 1.2							
1.2 – 1.3							
1.3 – 1.4							
1.4 – 1.5							
1.5 – 1.6							
1.6 – 1.7							
1.7 – 1.8							
1.8 – 1.9							
1.9 – 2.0							
2.0 – 2.1							
2.1 – 2.2							
2.2 – 2.3							
2.3 – 2.4							
2.4 – 2.5							
2.5 – 2.6							
2.6 – 2.7							
2.7 – 2.8							
2.8 – 2.9							
2.9 – 3.0							

Test Method AS 1289.6.3.2

Authorised Signatory **Date 3/12/15**

Dwain Carolan

Accreditation No. 19665
Accredited for compliance with ISO/IEC 17025

Notes on Description and Classification of Soil

The methods of description and classification of soils used in this report are generally based on Australian Standard AS1726-1993 *Geotechnical Site Investigations*.

Soil description is based on an assessment of disturbed samples, as recovered from bores and excavations, or from undisturbed materials as seen in excavations and exposures or in undisturbed samples. Descriptions given on report sheets are an interpretation of the conditions encountered at the time of investigation.

In the case of cone or piezocone penetrometer tests, actual soil samples are not recovered and soil description is inferred based on published correlations, past experience and comparison with bore and/or test pit data (if available).

Soil classification is based on the particle size distribution of the soil and the plasticity of the portion of the material finer than 0.425mm. The description of particle size distribution and plasticity is based on the results of visual field estimation, laboratory testing or both. When assessed in the field, the properties of the soil are estimated; precise description will always require laboratory testing to define soil properties.

Where soil can be clearly identified as FILL this will be noted as the main soil type followed by a description of the composition of the fill (e.g. FILL – yellow-brown, fine to coarse grained gravelly clay fill with concrete rubble). If the soil is assessed as possibly being fill this will be noted as an additional observation.

Soils are generally described using the following sequence of terms. In certain instances, not all of the terms will be included in the soil description.

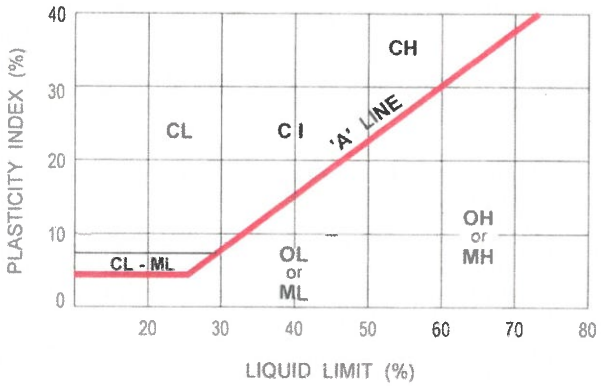
MAIN SOIL TYPE (CLASSIFICATION GROUP SYMBOL)
- strength/density, colour, structure/grain size, secondary and minor components, additional observations

Information on the definition of descriptive and classification terms follows.

SOIL TYPE and CLASSIFICATION GROUP SYMBOLS

	Major Divisions	Particle Size	Classification Group Symbol	Typical Names
COARSE GRAINED SOILS (more than half of material is larger than 0.075 mm)	BOULDERS	> 200mm		
	COBBLES	63 – 200mm		
	GRAVELS (more than half of coarse fraction is larger than 2.36mm)	Coarse: 20 – 63mm Medium: 6 – 20mm Fine: 2.36 – 6mm	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels.
			GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (more than half of coarse fraction is smaller than 2.36mm)	Coarse: 0.6 – 2.36mm Medium: 0.2 – 0.6mm Fine: 0.075 – 0.2mm	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands.
			SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (more than half of material is smaller than 0.075 mm)	SILTS & CLAYS (liquid limit <50%)		ML	Inorganic silts and very fine sands, silty/clayey fine sands or clayey silts with low plasticity.
			CL and CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS & CLAYS (liquid limit >50%)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils.
			CH	Inorganic clays of high plasticity.
			OH	Organic clays of medium to high plasticity, organic silts.
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

PLASTICITY CHART FOR CLASSIFICATION OF FINE GRAINED SOILS



(Reference: Australian Standard AS1726-1993 *Geotechnical site investigations*)

DESCRIPTIVE TERMS FOR MATERIAL PROPORTIONS

Coarse Grained Soils		Fine Grained Soils	
% Fines	Modifier	% Coarse	Modifier
< 5	Omit, or use 'trace'	< 15	Omit, or use trace.
5 – 12	Describe as 'with clay/silt' as applicable.	15 – 30	Describe as 'with sand/gravel' as applicable.
> 12	Prefix soil as 'silty/clayey' as applicable	> 30	Prefix soil as 'sandy/gravelly' as applicable.

STRENGTH TERMS – COHESIVE SOILS

Strength Term	Undrained Shear Strength	Field Guide to Strength
Very soft	< 12kPa	Exudes between the fingers when squeezed in hand.
Soft	12 – 25kPa	Can be moulded by light finger pressure.
Firm	25 – 50kPa	Can be moulded by strong finger pressure.
Stiff	50 – 100kPa	Cannot be moulded by fingers, can be indented by thumb.
Very stiff	100 – 200kPa	Can be indented by thumb nail.
Hard	> 200kPa	Can be indented with difficulty by thumb nail.

DENSITY TERMS – NON COHESIVE SOILS

Density Term	Density Index	SPT "N"	CPT Cone Resistance
Very loose	< 15%	0 – 5	0 – 2MPa
Loose	15 – 35%	5 – 10	2 – 5MPa
Medium dense	35 – 65%	10 – 30	5 – 15MPa
Dense	65 – 85%	30 – 50	15 – 25MPa
Very dense	> 85%	> 50	> 25MPa

COLOUR

The colour of a soil will generally be described in a 'moist' condition using simple colour terms (eg. black, grey, red, brown etc.) modified as necessary by "pale", "dark", "light" or "mottled". Borderline colours will be described as a combination of colours (eg. grey-brown).

EXAMPLE

e.g. CLAYEY SAND (SC) – medium dense, grey-brown, fine to medium grained with silt.

Indicates a medium dense, grey-brown, fine to medium grained clayey sand with silt.

Notes on Description and Classification of Rock

The methods of description and classification of rock used in this report are generally based on Australian Standard AS1726-1993 *Geotechnical site investigations.*

Rock description is based on an assessment of disturbed samples, as recovered from bores and excavations, or from undisturbed materials as seen in excavations and exposures, or in core samples. Descriptions given on report sheets are an interpretation of the conditions encountered at the time of investigation.

Notes outlining the method and terminology adopted for the description of rock defects are given below, however, detailed information on defects can generally only be determined where rock core is taken, or excavations or exposures allow detailed observation and measurement.

Rocks are generally described using the following sequence of terms. In certain instances not all of the terms will be included in the rock description.

ROCK TYPE (WEATHERING SYMBOL), strength, colour, grain size, defect frequency

Information on the definition of descriptive and classification terms follows.

ROCK TYPE

In general, simple rock names are used rather than precise geological classifications.

ROCK MATERIALS WEATHERING CLASSIFICATION

Term	Weathering Symbol	Definition
Residual soil	RS	Soil developed from extremely weathered rock; the mass structure and substance fabrics are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered	XW	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded in water.
Distinctly weathered *	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
- Highly weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock, usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
- Moderately weathered	MW	Rock substance affected by weathering to the extent that staining extends throughout the whole of the rock substance and the original colour of the fresh rock may be no longer recognisable.
Slightly weathered	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition or staining.

** Subdivision of this weathering grade into highly and moderately may be used where applicable.*

STRENGTH OF ROCK MATERIAL

Term	Symbol	Point Load Index I_s (50)	Field Guide To Strength
Extremely low	EL	<0.03MPa	Easily remoulded by hand to a material with soil properties.
Very low	VL	0.03 – 0.1MPa	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low	L	0.1 – 0.3MPa	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	M	0.3 – 1.0MPa	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	H	1.0 – 3.0MPa	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very high	VH	3.0 – 10.0MPa	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely high	EH	>10MPa	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Notes:
1. *These terms refer to the strength of the rock material and not to the strength of the rock mass which may be considerably weaker due to the effect of rock defects.*
2. *The field guide visual assessment for rock strength may be used for preliminary assessment or when point load testing is not available.*
3. *Anisotropy of rock may affect the field assessment of strength.*

COLOUR

The colour of a rock will generally be described in a 'moist' condition using simple colour terms (e.g. black, grey, red, brown, etc) modified as necessary by 'pale', 'dark', 'light' or 'mottled'. Borderline colours will be described as a combination of colours (e.g. grey-brown).

GRAIN SIZE

Descriptive Term	Particle Size Range
Coarse grained	0.6 – 2.0mm
Medium grained	0.2 – 0.6mm
Fine grained	0.06 – 0.2mm

DEFECT FREQUENCY

Where appropriate, a defect frequency may be recorded as part of the rock description and will be expressed as the number of natural (or interpreted natural) defects present in an equivalent one metre length of core; by use of the following defect frequency descriptive terms; or both. The descriptive terms refer to the spacing of all types of natural defects along which the rock is discontinuous and include, bedding plane partings, joints and other rock defects, but excludes known artificial fractures such as drilling breaks.

Defect Frequency	Description
Fragmented	Rock core is comprised primarily of fragments of length less than 20mm, and mostly of width less than the core diameter.
Highly Fractured	Core lengths are generally less than 20mm to 40mm with occasional fragments.
Fractured	Core lengths are mainly 30mm to 100mm with occasional shorter and longer sections.
Fractured to Slightly Fractured	Core lengths are mainly 100mm to 300mm with occasional shorter to longer sections.
Slightly Fractured	Core lengths are generally 300mm to 1,000mm with occasional longer sections and occasional sections of 100mm to 300mm.
Unbroken	The core does not contain any fractures.

EXAMPLE

e.g. SANDSTONE (XW) – low strength, pale brown, fine to coarse grained, slightly fractured.

ROCK DEFECT LOGGING

Defects are discontinuities in the rock mass and include joints, sheared zones, cleavages and bedding partings. The ability to observe and log defects will depend on the investigation methodology. Defects logged in core are described using the abbreviations noted in the following tables.

The *depth* noted in the description is measured in metres from the ground surface, the *defect angle* is measured in degrees from horizontal, and the defect *thickness* is measured normal to the plane of the defect and is in millimetres (unless otherwise noted).

Defects are generally described using the following sequence of terms:

Depth, Defect Type, Defect Angle (dip), Surface Roughness, Infill, Thickness

DEFECT TYPE

B	– Bedding
J	– Joint
S	– Shear Zone
C	– Crushed Zone

SURFACE ROUGHNESS

i	- rough or irregular, stepped
ii	- smooth, stepped
iii	- slickensided, stepped
iv	- rough or irregular, undulating
v	- smooth, undulating
vi	- slickensided, undulating
vii	- rough or irregular, planar
viii	- smooth planar
ix	- slickensided, planar

INFILL

Infill refers to secondary minerals or other materials formed on the surface of the defect and some common descriptions are given in the following table together with their abbreviations.

Ls	- limonite staining
Fe	- iron staining
Cl	- clay
Mn	- manganese staining
Qtz	- quartz
Ca	- calcite
Clean	- no visible infill

EXAMPLE

3.59m, J, 90, vii, Ls, 1mm

indicates a joint at 3.59m depth that is at 90° to horizontal (i.e. vertical), is rough or irregular and planar, limonite stained and 1mm thick.

Proposed Residence
17 Greenwood Close, Frenchville
Project No.: R15-182A
21 December 2015

APPENDIX B

LABORATORY TEST REPORT SHEETS

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BUTLER PARTNERS

Rockhampton Laboratory
3/197 Kent Street
Rockhampton Queensland 4700
Telephone : 61 (07) 4927 1400
Accreditation No. 19665

Accredited for compliance with ISO/IEC 17025

Certified System Quality ISO 9001

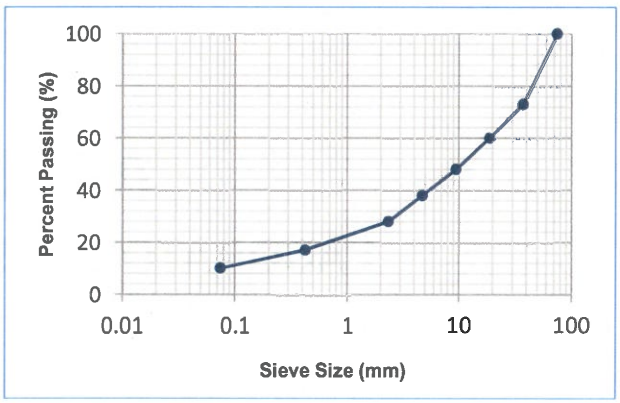
MATERIAL TEST REPORT

Client:	Angela Russell	Tested by:	DC	Date:	3/12/2015
Project:	Proposed Residence	Checked by:	DC	Date:	4/12/2015
Location:	17 Greenwood Close, Frenchville	**Report No.:**	**R15-182A_MAT_R1511-582**		
Project No:	R15-182A				

Sample No.:	R1511-582
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Date Sampled:	25/11/2015
Sampled by:	JB
Test Pit:	1
Depth (m):	0.5-0.8
Mositure Content (%):	7.9
Sample Description:	Sandy Gravel

Particle Size Distribution - AS1289.3.6.1, AS1289.2.1.1

	PERCENT PASSING		
AS SIEVE SIZE (mm)	MINIMUM LIMIT	RESULT	MAXIMUM LIMIT
75	-	100	-
37.5	-	73	-
19	-	60	-
9.5	-	48	-
4.75	-	38	-
2.36	-	28	-
0.425	-	17	-
0.075	-	10	-



Atterberg Limit - AS1289.2.1.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1

Sample Requirements	MINIMUM LIMIT	RESULT	MAXIMUM LIMIT
Liquid Limit (%)	-	27	-
Plastic Limit (%)	-	20	-
Plasticity Index (%)	-	7	-
Linear Shrinkage (%)	-	6.5	-

0.075mm / 0.425mm	-		-
Plasticity Index x 0.425mm rate	-		-
Linear Shrinkage x 0.425mm rate	-		-
Shrinkage defects	-	None	-

Comments:

Authorised Signatory

Dwain Carolan

Date 7/12/15

Rockhampton Laboratory
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Rockhampton Queensland 4700
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Accreditation No. 19665

Accredited for compliance with ISO/IEC 17025

Quality ISO 9001

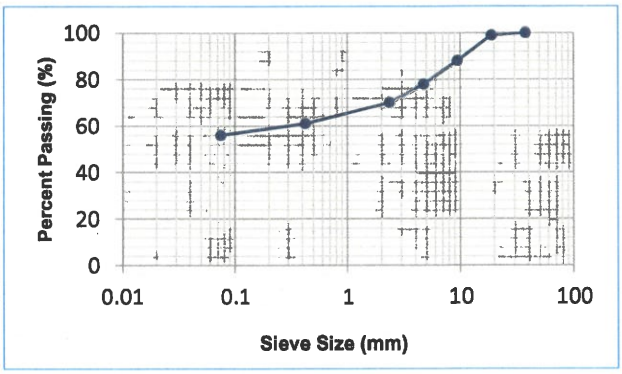
MATERIAL TEST REPORT

Client:	Angela Russell	Tested by:	DC	Date:	3/12/2015
Project:	Proposed Residence	Checked by:	DC	Date:	4/12/2015
Location:	17 Greenwood Close, Frenchville	**Report No.:**	**R15-182A_MAT_R1511-583**		
Project No:	R15-182A				

Sample No.:	R1511-583
Sampling Method:	AS1289.1.2.1 Cl.6.5.3
Date Sampled:	25/11/2015
Sampled by:	JB
Test Pit:	3
Depth (m):	1.5-1.7
Mositure Content (%):	17.6
Sample Description:	Gravelly Clay

Particle Size Distribution - AS1289.3.6.1, AS1289.2.1.1

	PERCENT PASSING		
AS SIEVE SIZE (mm)	MINIMUM LIMIT	RESULT	MAXIMUM LIMIT
37.5	-	**100**	-
19	-	**99**	-
9.5	-	**88**	-
4.75	-	**78**	-
2.36	-	**70**	-
0.425	-	**61**	-
0.075	-	**56**	-



Atterberg Limit - AS1289.2.1.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.3.1, AS1289.3.4.1

Sample Requirements	MINIMUM LIMIT	RESULT	MAXIMUM LIMIT
Liquid Limit (%)	-	**33**	-
Plastic Limit (%)	-	**21**	-
Plasticity Index (%)	-	**12**	-
Linear Shrinkage (%)	-	**11.5**	-
0.075mm / 0.425mm	-		-
Plasticity Index x 0.425mm rate	-		-
Linear Shrinkage x 0.425mm rate	-		-
Shrinkage defects	-	**None**	-

Comments:

Authorised Signatory

Dwain Carolan **Date** 7/12/15

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POINT LOAD STRENGTH INDEX TEST REPORT

Test Method: AS4133.4.1 AS1726

Client:	Angela Russell	**Report No.:**	**R15-182A_PL_R1511-585**
Project:	Proposed Residential Development	**Tested by:**	CM/DN
Location:	17 Greenwood Close	**Date:**	27/11/2015
	Frenchville	**Checked by:**	CM/DN
Project No:	R15-182A	**Date:**	27/11/2015

Test Pit	Depth (m)	Test Type	Sample Description	Point Load Strength [$I_s(50)$] (Mpa)	Rock Strength Category*
3	2.13-2.5	Irregular	DW Siltsone	0.30	Low
3	2.13-2.5	Irregular	DW Siltsone	0.49	Medium
3	2.13-2.5	Irregular	DW Siltsone	0.75	Medium
3	2.13-2.5	Irregular	DW Siltsone	0.34	Medium
3	2.13-2.5	Irregular	DW Siltsone	2.1	High
3	2.13-2.5	Irregular	DW Siltsone	2.7	High

*Australian Standard AS1726-1993 *Geotechnical site investigation*